NATIONAL REPORT

Close-up on the bio-economy

LABOUR MARKET INTELLIGENCE

BioTalent™ Canada

Igniting the bio-economy's brainpower

BioTalent Canada

BioTalent Canada supports the people behind life-changing science. Trusted as the go-to source for labour market intelligence, we guide bio-economy stakeholders with evidence-based data and industry-driven standards. We are focused on igniting the industry's brainpower, bridging the gap between job-ready talent and employers, and ensuring the long-term agility, resiliency and sustainability of one of Canada's most vital sectors.

Recently named one of the 50 Best Workplaces in Canada with 10–50 employees and awarded a Great Place to Work® Certification 2021, BioTalent Canada practices the same industry standards it recommends to its stakeholders. These distinctions were awarded to BioTalent Canada following a thorough and independent analysis conducted by Great Place to Work®.

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About this report

BioTalent Canada's 2021 series of labour market intelligence (LMI) reports, *Close-up on the bio-economy*, aims to provide the perspective bio-economy organizations need to find, recruit, train and retain talented teams based on real, meaningful understanding of the labour market.

Building on the last national full LMI study conducted in 2013,[1] this new national report gives a much-needed update on the complex, multi-dimensional bio-economy, the companies within it, and the skills and talent they require. Its insights are based on surveys, stakeholder roundtables and interviews, an environmental scan and extensive data analysis.

What's new in 2021

Close-up on the bio-economy draws on methods and research questions not included in BioTalent Canada's previous LMI studies, including:

- **Bio-economy labour market outlooks** based on econometric models that estimate hiring requirements in combination with talent supply estimates
- **Supply projections** for domestic and international student graduates, internationally educated professionals, demographic shifts, and more
- **Larger sample sizes** for more reliable data
- **An enhanced definition of the bio-economy** derived from standardized classification systems and focused on bio-economy occupations within the highest quality data sets

This new series also includes projections and findings specific to the impacts of **COVID-19**. The primary employer survey closed in March 2020, providing a pre-pandemic baseline to compare against additional perspective gathered throughout 2020 and 2021. This has provided the opportunity to rapidly assess the consequences of the pandemic for the bio-economy labour market and include economic recovery impacts in forecast models.

1 *Sequencing the Data*, 2013. A previous LMI report, *Splicing the Data*, was published in 2008.

Other reports in the series

The *Close-up on the bio-economy* LMI series is published as part of BioTalent Canada's mission to provide bio-economy stakeholders with valuable, evidence-based labour market intelligence and job-ready human resources.

It also includes:

- A **Demand and Supply Outlook**
- **Regional spotlights** (Atlantic Canada, Quebec, Ontario, Prairies, Western Canada)
- **Metro hub spotlights** (Greater Montreal, Greater Toronto Area, Metro Vancouver)
- Research briefs on topics such as bio-economy education and work-integrated learning

Visit biotalent.ca/LMIStudy to download these and other LMI reports, briefs and articles.

Research partners

The following researchers contributed to the development of this research and report:

- DPM Research Inc.
- Prism Economics & Analysis Inc.
- EKOS Research Associates Inc.
- Ipsos

Message from the President and CEO

The evidence predicts the demand for talent in all sectors of Canada's bio-economy will far exceed the supply of available brainpower by as soon as 2024. And if that happens, progress will slow, growth will stall. By 2029, 65,000 additional workers will be needed.

Industries like bio-manufacturing, which Canadians already rely on, will have to grow dramatically if Canada is to regain its capacity to produce vaccines domestically. This is even more concerning with the research indicating Canada is ALREADY in a severe skills deficit when it comes to bio-manufacturing.

Some of the most well-educated people on Earth live here. We welcome hundreds of thousands of skilled immigrants annually. All this means some of the best and brightest call Canada home. Where are they working? Why is the bio-economy struggling to attract and retain talent?

This Labour Market Intelligence report dives deep into these issues. We're an evidence-based industry and this is the most in-depth study BioTalent Canada has ever produced. Our rigorous methodology makes this report the go-to-source for national bio-economy skills data. The recommendations herein—if adopted—will ramp up recruitment and retention.

The youth is the future. While cliché, nowhere is this truer than in the bio-economy. And skilled youth is in high demand in every industry. We must find ways to increase awareness of bio-economy career opportunities. Introducing students to industry earlier and through work-integrated learning programs is an opportunity to capitalize on access to talent before competing industries have the chance.

Internationally educated professionals need clearer pathways to bio-economy employment. The untapped potential of this deep talent pool is key. Canada is built on immigration. So the bio-economy must be, too.

Finally, we need to upskill and reskill people from other readily available talent pools. There are ways to train professionals from other industries to transition to the bio-economy, seamlessly. Finding the salespeople, marketers, HR specialists and administrators we need is a key strategy. If we are to fill the gaps, we must look also to non-scientists.

The opportunities for bio-economy workplaces to become more diverse are plentiful. The number of women that work in the bio-economy is disproportionate to the number of women that graduate from STEM programs. How come? Add to this the under-representation of newcomers, Canadians with disabilities, and indigenous Canadians and the consequences of failing to widen the recruitment net grow even more dire. Diversity and inclusion measures are no longer optional—they are critical if we are to find the talent we need.

But there is a lot of good news related to the future of Canada's bio-economy, as well. This report uncovered the biggest challenges facing the industry. Science knows challenges are nothing more than opportunities in disguise. We know where the gaps are, but more importantly, we know how to close them.

Our thanks to the organizations, individuals and associations who gave so generously of their time and expertise to make this, and the host of related reports released as part of a series, possible.

Rob Henderson,
President and CEO, BioTalent Canada

Executive summary

Canada's bio-economy is likely to require **65,000 additional workers by 2029**. Companies will be challenged to fill positions due to a highly competitive labour market, relatively low awareness of bio-economy careers and, in many cases, an ongoing lack of HR capacity or capital to attract and retain candidates. Bio-manufacturing capacity will be a particularly urgent area of need, both in the bio-health sub-sector and more broadly.

A sector of small, R&D-focused companies

The bio-economy is defined as the economic activity associated with the invention, development, production and use of primarily bio-based products, bio-based production processes and/or biotechnology-based intellectual property. The **roughly 12,000 organizations** in Canada's bio-economy collectively **employed some 200,000 people** in 2019.

The overwhelming **majority of bio-economy companies are small or medium-sized businesses**: 83% report fewer than 50 employees, and 55% generate annual total gross revenues of less than $1 million — figures that have held steady since BioTalent Canada's first LMI study in 2008. Just 30% have a dedicated HR department.

The bio-economy is rooted in research and development (R&D), with 69% of companies engaged in some form of R&D activities.

More than half (54%) of the sector is made up of primarily bio-health companies, but **many companies are involved in multiple bio-economy sub-sectors**. The relative proportions of bio-health, bio-industrial and agri-bio sub-sectors have all grown slightly since BioTalent Canada's 2013 national LMI study.

The bio-economy workforce covers a wide range of occupations, with R&D and manufacturing together accounting for nearly half of all jobs. The distribution of employees across sub-sectors and regions mirrors the distribution of companies, with bio-health accounting for the largest proportion, and Alberta, British Columbia, Ontario and Quebec home to the most jobs and firms.

Bio-health makes up more than half of the bio-economy.

Demand will outpace supply

The bio-economy is **expected to grow modestly between 2021 and 2029**. Current estimates indicate there will not be enough workers to meet the labour need of 65,000 additional workers by the end of the decade, with significant pressure starting within the next three years and job-opening-to-candidate ratios reaching 4:1 in some cases.

Most new hires will be required by the bio-health sub-sector, with a significant number also needed in bio-industrial and agri-bio. Bio-energy is expected to contract and not return to pre-pandemic employment levels by the end of the forecast period.

Shifting demographics play a key role in the anticipated shortages as the population aged 55 and older grows and the youth share of the population shrinks below the threshold needed to replace retirees. Internationally educated professionals (IEPs) and recent immigrants could help fill the gap but currently make up only a small percentage of the bio-economy workforce.

Some of the most severe shortages are expected in bio-manufacturing and processing. Forecasts suggest employers will be able to fill only 25% of job openings in these areas between now and 2029. The shortage is expected to intensify as Canada seeks to expand its manufacturing sector due to the glaring lack of capacity highlighted by COVID-19.

Employers may be able to fill only 25% of bio-manufacturing and processing job openings by 2029.

While labour shortages are expected for all bio-economy job functions throughout the forecast period, three areas stand out as likely to experience persistent, severe shortages until 2029 and beyond:

- Manufacturing and production jobs
- Distribution and logistics jobs
- Management, finance and administration jobs

Mixed strategies needed to address the shortfall

While some shortages may be mitigated by more active recruitment of new graduates in relevant fields, additional strategies will be required, such as recruiting skilled immigrants and looking beyond traditional pools. Candidates will need a wide variety and mix of skills, specializations and educational credentials, and many employers will find it difficult to find candidates who fulfill every qualification they're seeking. In some cases, it will be necessary to hire promising candidates with most of the qualifications they need and provide their own training to produce the exact, highly tailored skill sets for specific positions. The sector's traditional reliance on post-secondary graduates is a liability, as university degree completions are expected to decline throughout the forecast period. **More international students are needed** to make up for the decrease in Canadian learners, with incentives for them to stay beyond graduation.

Greater outreach to students in bio-economy-relevant programs such as life sciences and agriculture may be another way to grow the talent pool. In 2018, 42% of graduates from undergraduate programs in physical and life sciences and technologies, and 32% of agriculture, natural resources and conservation graduates from undergraduate programs work in jobs "not at all related" to their studies. **Raising awareness of bio-economy careers** among these groups and promoting greater mobility could enable more graduates to find work more closely related to their studies while mitigating some of the anticipated labour shortages.

The bio-economy has a tremendous **opportunity to seek talent from under-represented groups**. Women make up an average of roughly one-third (34%) of bio-economy workers overall. Other equity-seeking groups have less representation: visible minorities make up an average of 20% of the bio-economy workforce, IEPs 17% and recent immigrants 9%. Indigenous workers and workers with disabilities make up an average of just 1% of the bio-economy workforce each.

The bio-economy has a tremendous opportunity to seek talent from under-represented groups.

As many **employers also report that candidates lack soft skills** such as problem-solving, collaboration and the business development skills that support commercialization, **work-integrated learning (WIL) may be a further important lever** for strengthening the talent supply. Currently, WIL participation varies widely across fields and levels of study.

Recommendations

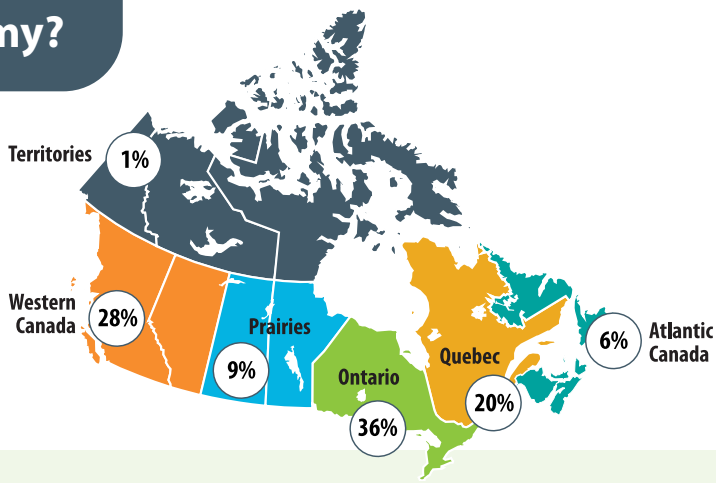
To address the labour needs of the bio-economy to 2029, based on the findings of this LMI study, BioTalent Canada recommends the following:

1. **Create anchor companies** to help develop a stronger ecosystem of bio-economy companies and talent
2. **Support work-integrated learning** by incorporating it into more programs
3. **Diversify recruitment** and human resources practices to reach a broader and more diverse talent pool
4. **Create a wage subsidy program for immigrants** to reduce the perceived risk of hiring immigrants.
5. **Create pathways for international students and IEPs** to integrate international talent into the labour market
6. **Support reskilling initiatives** to expand the talent pool beyond traditional fields of education and work experience
7. **Foster bio-economy mobility** to expand the talent pools for companies not located near educational hubs
8. **Strengthen human resource offerings** to compete for talent more effectively against other sectors
9. **Improve succession planning** to reduce the need to hire externally
10. **Raise awareness of bio-economy career opportunities** to increase the talent supply

Who makes up the bio-economy?

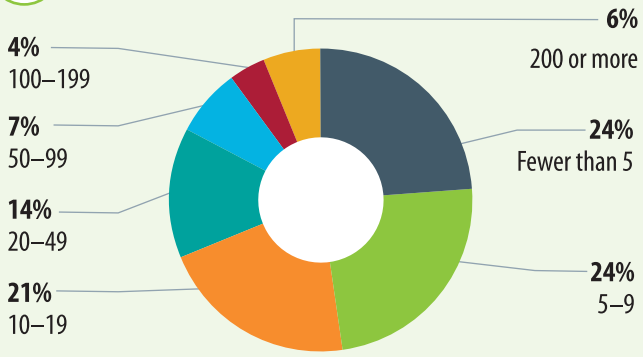
THE COMPANIES

~**12,000** bio-economy organizations Canada-wide*

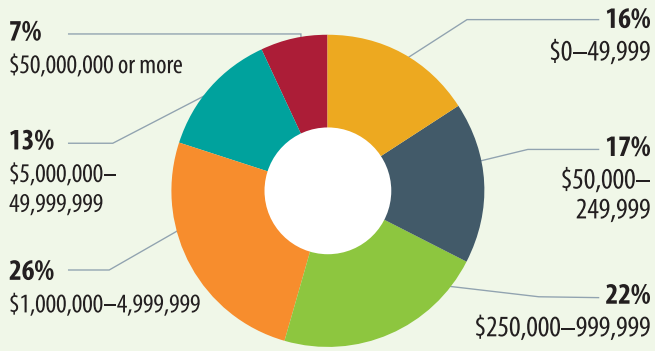


Most are small to medium-sized

Number of employees

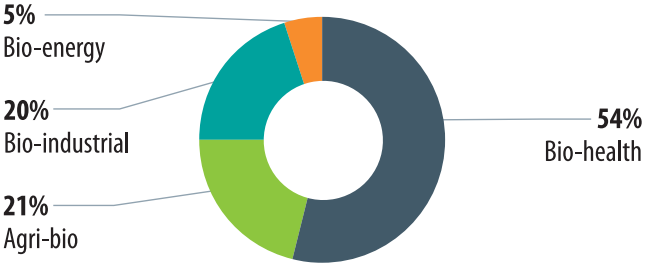


Annual total gross revenue



Bio-health dominates, but 53% of companies span multiple sub-sectors

Primary sub-sectors



Primary and secondary sub-sectors

Bio-health **56%**

Agri-bio **35%**

Bio-industrial **21%**

Bio-energy **11%**

69% engage in research and development

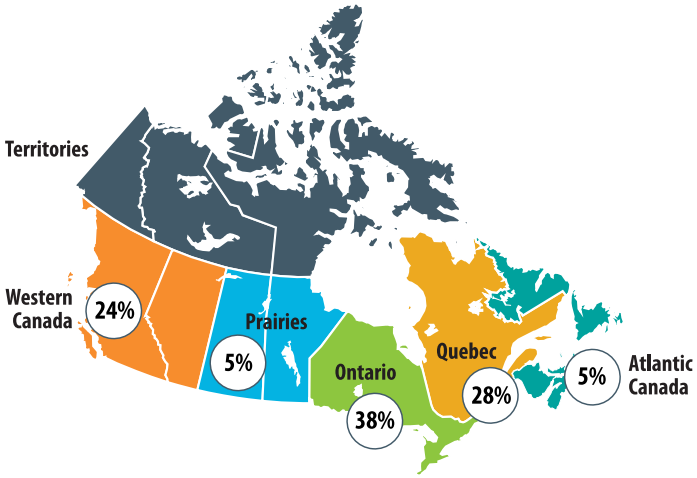
41% cite research and development as primary or secondary business activity

70% have no formal human resources department

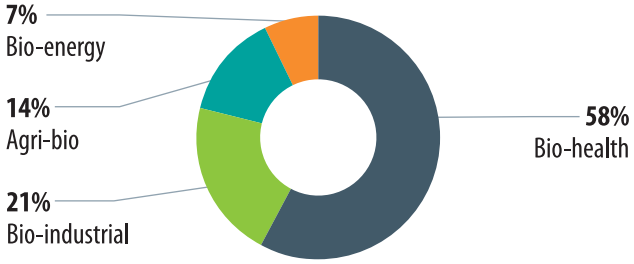
* *Western Canada includes Alberta and British Columbia. The Prairies include Manitoba and Saskatchewan. Atlantic Canada includes New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.*

THE PEOPLE

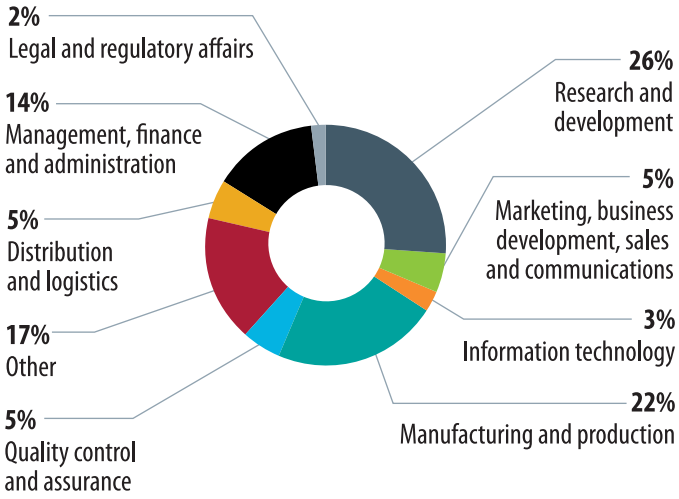
~200,000
bio-economy workers*



Most work in bio-health



Job functions cover a wide range



The sector has an opportunity to improve diversity

- Women: **34%**
- Indigenous people: **1%**
- People with disabilities: **1%**
- Internationally educated professionals: **17%**
- Recent immigrants†: **9%**
- Visible minorities: **20%**

* *Western Canada includes Alberta and British Columbia. The Prairies include Manitoba and Saskatchewan. Atlantic Canada includes New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.*

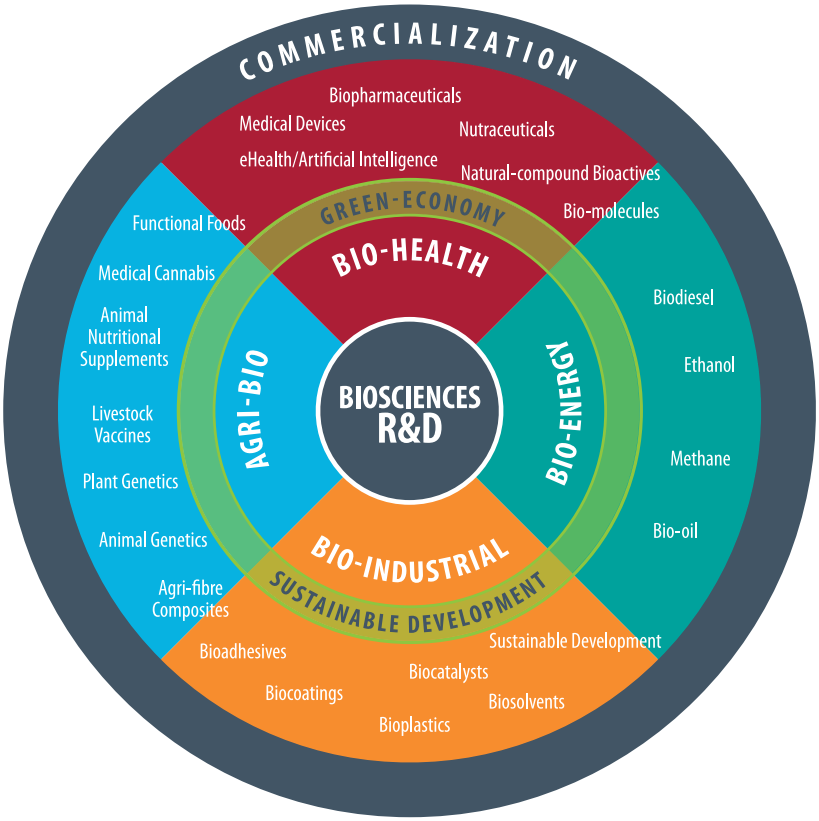
† *Recent immigrants are those who have been in Canada less than five years.*

DEFINING THE BIO-ECONOMY

The bio-economy today

The bio-economy is defined as the economic activity associated with the invention, development, production and use of primarily bio-based products, bio-based production processes and/or biotechnology-based intellectual property. It includes the use of resources from agriculture, forestry, fisheries/aquaculture, organic waste and aquatic biomass.

The field is multidisciplinary in that it cuts across the bio-health, bio-energy, bio-agriculture (agri-bio) and bio-industrial (chemicals and materials) sub-sectors. These four are all rooted in their own foundations of research and development and all have products, processes or intellectual property that are involved in the "green" or sustainable development economy as well, to a greater or lesser extent. The bio-economy sub-sectors share a common objective: the commercialization of resultant bio-products, processes and/or intellectual property.



The **bio-health** sub-sector encompasses the invention, development, manufacturing, commercialization and use of products that improve therapeutics, diagnostics, prevention and health administration, as well as the development and production of nutraceuticals and applications of medical cannabis. Research and development activities contribute to the development of new products, bio-based technologies and intellectual property related to the production of bio-health products and technologies.

The **bio-energy** sub-sector encompasses the invention, development, production, commercialization and use of renewable fuels through the conversion of organic material into heat or power. Research and development activities contribute to the development of new products, bio-based technologies and intellectual property related to the production of bio-energy.

The **bio-industrial** sub-sector encompasses the invention, development, manufacturing, commercialization and use of goods for industrial use, such as bio-chemicals and bio-materials, through the conversion of organic material. Research and development activities contribute to the development of new products, bio-based technologies and intellectual property related to the production of bio-industrial products. Among others, the development and production of biocatalysts are an integral part of this sub-sector.

The **agri-bio** sub-sector encompasses the invention, development, production, commercialization and use of new or modified products resulting from the manipulation, modification or alteration of the natural features of plants and crops, animals and/or other food sources. Research and development activities contribute to the development of new products, bio-based technologies and intellectual property that support improved quality, yield and efficiency in the agricultural sector and food production.

Companies in the bio-economy are found across the country, and in this report are grouped as:

- Western Canada (Alberta and British Columbia)
- The Prairies (Manitoba and Saskatchewan)
- Ontario
- Quebec
- Atlantic Canada (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island)
- Territories

A cross-cutting endeavour

Touching on so many different sectors makes the bio-economy a critical — if not always visible — contributor to Canada's economy as a whole. In 2019, the broader sectors that include the bio-economy contributed more than $640 billion to the country's gross domestic product (GDP). While the COVID-19 pandemic caused an estimated 6% economic contraction in 2020, with especially noticeable effects in the manufacturing sector, forecasts anticipate a rebound, with GDP stabilizing at pre-pandemic growth levels of around 1.7% by 2025. This is good news for the bio-economy in general, although some related sectors such as agriculture will grow more slowly in the coming decade, potentially affecting bio-economy growth overall.

Rooted in R&D

To gain a current-state picture of the bio-economy, BioTalent Canada commissioned a survey of employers in 2020. Among the findings was that research and development (R&D) plays a fundamental role in the bio-economy, underpinning all sub-sectors and often serving as the entry point for workers. **More than two-thirds (69%) of bio-economy employers surveyed by in 2020 said they engaged in R&D activities**, with 41% naming it their primary or secondary business activity.

That R&D orientation drives continual redefinition of the bio-economy as innovations span or merge sub-sectors and sometimes even create new sub-sectors. Such evolution is critical to the health of the bio-economy, ensuring it can continue to meet the ever-shifting needs of Canadians. Yet the heavy focus on R&D also imposes constraints.

R&D tends to be early-stage work carried out by small firms or research organizations far removed from commercialization, manufacturing and scale-up, which are needed to achieve a globally competitive bio-economy. Often, Canadian innovations and the talent that developed them are acquired by large foreign companies. To combat this, in 2018 the Health and Biosciences Economic Strategy Table called for an increase in last-stage funding to support domestic growth and development of large anchor firms that can compete globally.

"...anchor firms attract, recruit and develop talented managers who often become entrepreneurs of spinoff biotech start-ups. They also acquire small and mid-sized [companies]... building their own capacity while providing a strong source of funding for the domestic innovation ecosystem."

– Canada's Economic Strategy Tables: Health and Biosciences Report

Low awareness of career opportunities

A survey of various groups from the general Canadian population, including post-secondary students and graduates in science, technology, engineering and mathematics (STEM) fields, revealed mostly low to moderate awareness of bio-economy concepts and occupations. **This makes it hard for bio-economy organizations to compete for talent with those in other STEM-related industries.** Yet once survey respondents were told about bio-economy occupations, they indicated interest. This points to a need for greater outreach and communication so that prospective workers understand the connections between STEM fields and the bio-economy. These kinds of activities should be directed to groups such as high school students who are starting to make career-related decisions.

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Canada

INDUSTRY VIEWPOINT

Montréal InVivo

Putting bio-economy careers on the map

Serving some 600 local life sciences and health technologies organizations in the Greater Montreal area, Montréal InVivo has a unique perspective on the human resources challenges facing firms in its region — which include helping young professionals develop the in-demand skills and forging professional pathways into the life sciences field.

Company profile: Montréal InVivo

Location: Montreal

Employees: 8

Bio-economy sub-sectors: All

Montreal InVivo is the economic development agency for life sciences and health technologies in Greater Montreal, supporting an ecosystem that employs roughly 41,000 people and includes private companies, research organizations and government agencies. Montréal InVivo's mandate is to create an environment where all its members can grow and succeed.

Q: Can you paint a picture of Montreal's life sciences ecosystem today?

FRANK BÉRAUD, CEO: It's a big, diverse field that covers everything from biotechnologies and pharmaceuticals to health artificial intelligence (AI), research and manufacturing. All together, the 450 companies in our cluster contribute almost 80 percent of Quebec's life sciences' GDP.

Q: What are the biggest HR challenges for the ecosystem as a whole?

FB: Competition for scarce talent in niche areas. There's a lot of demand for people with experience in big data and AI, for example, and we compete with other industries for the same individuals.

CLAUDIE NOËL, DIRECTOR OF SKILLS AND TALENT DEVELOPMENT: We also need to build more pathways for new professionals into life sciences. There's no single route into the field and no central location where people can post or look for jobs. And there are so many opportunities besides working in the lab: finance, marketing, business development, project management, legal... We want people, especially young graduates, to know about the full range.

Q: How important is that youth cohort, the next generation?

CN: Essential. And really, we need them to develop in-demand skills before companies start asking for them. You can't fill 200 positions overnight.

FB: We also need to improve employee retention in the ecosystem overall. So workers stay here and we benefit from their experience. People need to know it's possible to build a career in life sciences and health technologies in Quebec.

Q: How do you do that? How do you get young workers with the right skills into the field, and how do you keep them in the province?

FB: We've developed a short training program called Continuum that helps people create hybrid professional profiles, blending their backgrounds in life sciences with expertise in other areas such as bioinformatics or data science. This kind of program could be applied to any number of career paths, from business development to biomanufacturing. If you look at our own organization, most of us have degrees in life sciences but we work in project management, communications or entrepreneurship.

CN: Continuum will help young and experienced professionals develop adjacent or niche skills in big data and AI applied to human health. We know that the more fluent people can be in new areas in high demand, the more likely they'll be to stay in the industry. The first cohort has just gone through and is now integrated into various companies for an immersive training period.

"People need to know it's possible to build a career in life sciences in Quebec."

Q: How broad is your talent pool?

FB: We want it to be as broad as possible. There's been a push to attract and retain international students. We did a few professional "speed dating" events that connected international students to local employers who had open positions or internships and it was a big hit. We're also targeting the local talent pool help them connect with local employers. The career fair we created to help them connect during the EFFERVESCENCE 2021 event was a big success. It shows that there's a need for a specialized platform where companies and candidates can find each other.

CN: We also have a partnership with the City of Montreal that provides financial support for women in life sciences to study entrepreneurship. The idea is that if we encourage more women to become entrepreneurs, we can increase that number of women in leadership positions. Women make up less than 15% of board members in the industry.

Q: You said earlier you want to make sure workers are aware of the full range of opportunities the ecosystem has to offer. How do you do that?

CN: We are currently working with Pharmabio Development on a platform that lists the types of skills the biotech companies are looking for, and the jobs in the sector that exist outside the wet lab. We can use that as a hook to attract more people into the sector. But we definitely do need to continue promoting the various pathways into life sciences.

Who makes up the bio-economy?

The bio-economy in Canada contains some 12,000 organizations, which collectively employed nearly 200,000 people in 2019 in a wide range of functions and include commercial businesses as well as hospital and university research institutions. Most are small companies concentrated in Ontario and Western Canada, with the majority focused on bio-health and nearly half engaged in some form of R&D.

Employers in profile

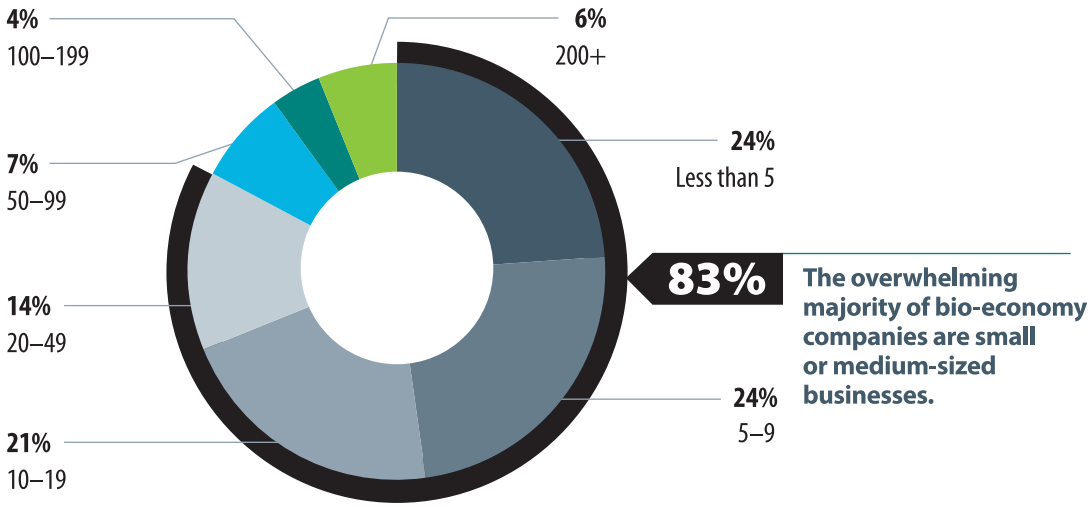
Small and medium-sized companies dominate the sector. Of the organizations surveyed, **more than three-quarters (83%) had fewer than 50 employees**, and nearly a quarter (24%) had fewer than five. Just 10% had 100 or more employees. Very few of these companies (just 30%) have their own formal human resources departments.

These numbers have not changed significantly since BioTalent Canada's first LMI study in 2008, pointing to a continuing need to provide supports that will enable companies to grow into mid-sized and, ultimately, large anchor companies.

Revenue figures and distributions for bio-economy businesses have remained more or less consistent since BioTalent Canada's first LMI study in 2008. In 2020, **more than half of the companies (55%) reported annual total gross revenues of less than $1 million**. A few of the largest players (7%) reported total gross revenues of $50 million or more.

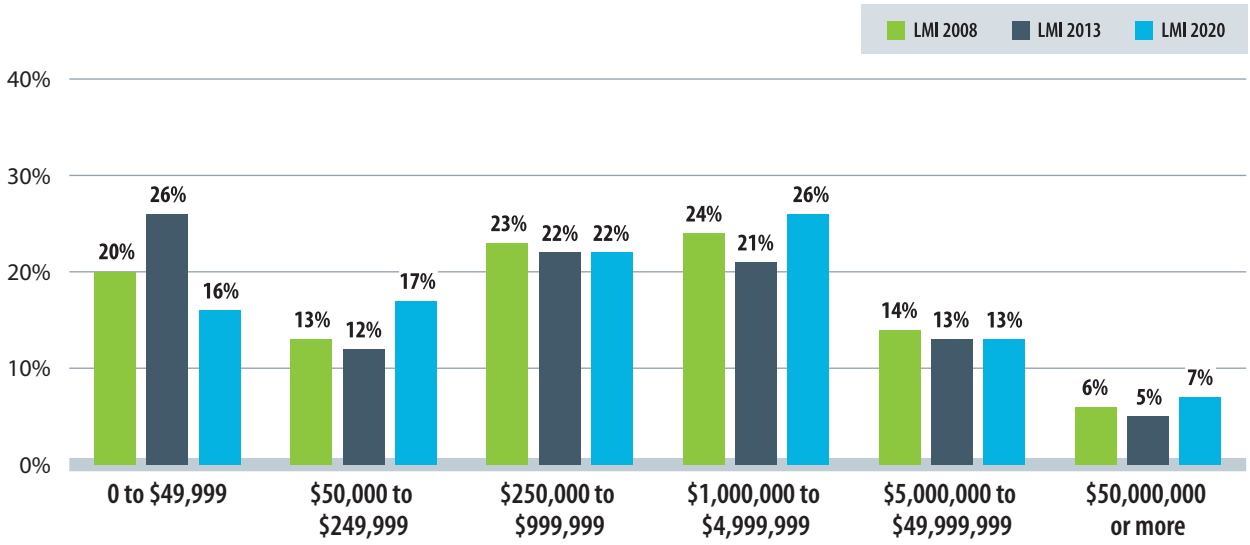
FIGURE 1. Bio-economy companies by total number of employees

Number of employees (all contract types) include full-time, part-time, contract, and all other employees (including coop and interns) in Canada.



Source: BioTalent Canada Survey of Employers (2020)

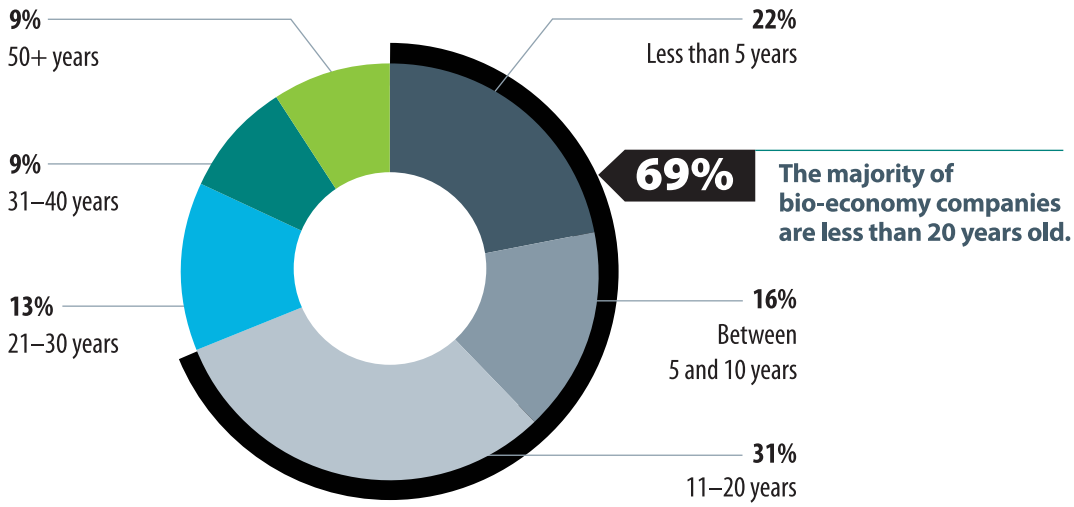
FIGURE 2. Companies by annual total gross revenue (comparative)



Sources: BioTalent Canada Survey of Employers (2020) and Sequencing the Data (2013).

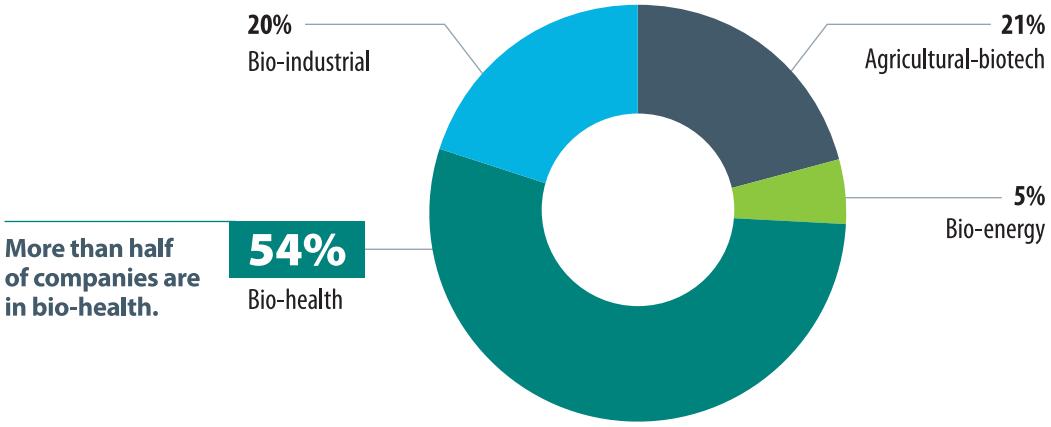
Note: The proportions for 2008 have been adjusted to remove the % of "no response" at 16%. For the 2013 data categories, the "pre-revenue" and "less than $49,000" responses have been combined into the "0 to $49,999" category in this graph for comparability purposes.

FIGURE 3. Bio-economy companies by age



Source: BioTalent Canada Survey of Employers (2020)

FIGURE 4. Companies by primary sub-sector



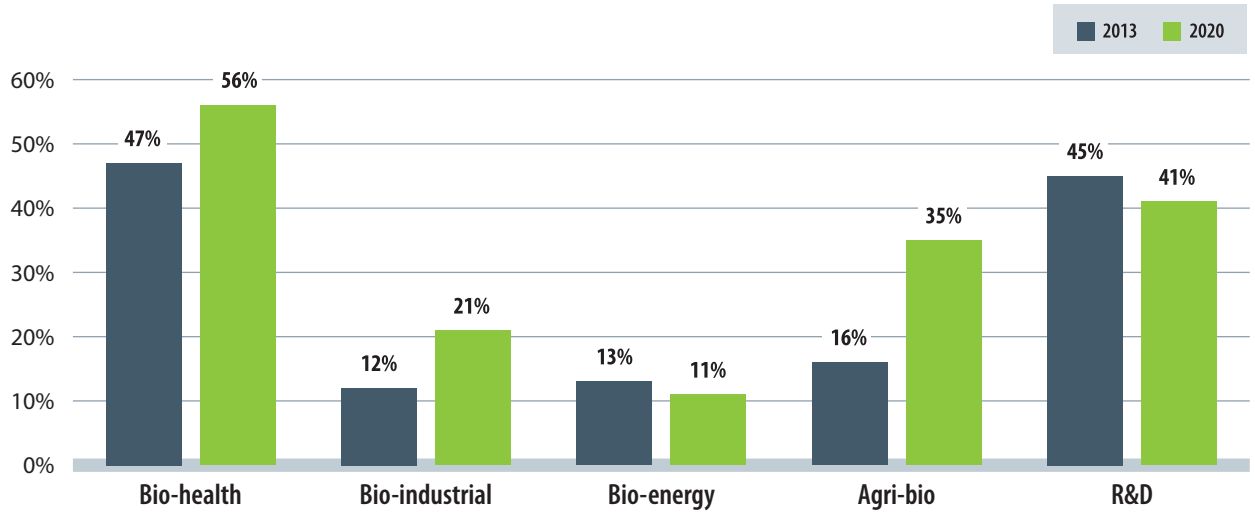
Source: BioTalent Canada Survey of Employers (2020)

More than two-thirds (69%) of survey respondents said their companies have been in business for 20 years or less. Nearly a quarter (22%) were established within the past five years. Even with those high proportions of relatively young firms, the average age of bio-economy firms is increasing overall, with the proportion of companies older than 25 years up 8 percentage points since 2013. This is a good sign for the sector, as **companies are remaining in business longer**, a key element of expanding the sector.

Of the four primary sub-sectors, bio-health is by far the largest, accounting for more than half (54%) of all companies in the bio-economy.

This distribution does not tell the whole story, however, as **more than half (53%) of companies' work is interdisciplinary** — spanning more than one sub-sector. When activities in a secondary sub-sector are taken into account, the proportion of companies involved with bio-energy more than doubles to 11% and the proportion involved with agri-bio rises to 35%. This represents a significant shift from 2013, when just 16% of companies reported primary or secondary activity in agri-bio. Bio-health and bio-industrial activities have also increased since 2013.

FIGURE 5. Companies by primary and secondary sub-sectors – shifts since 2013

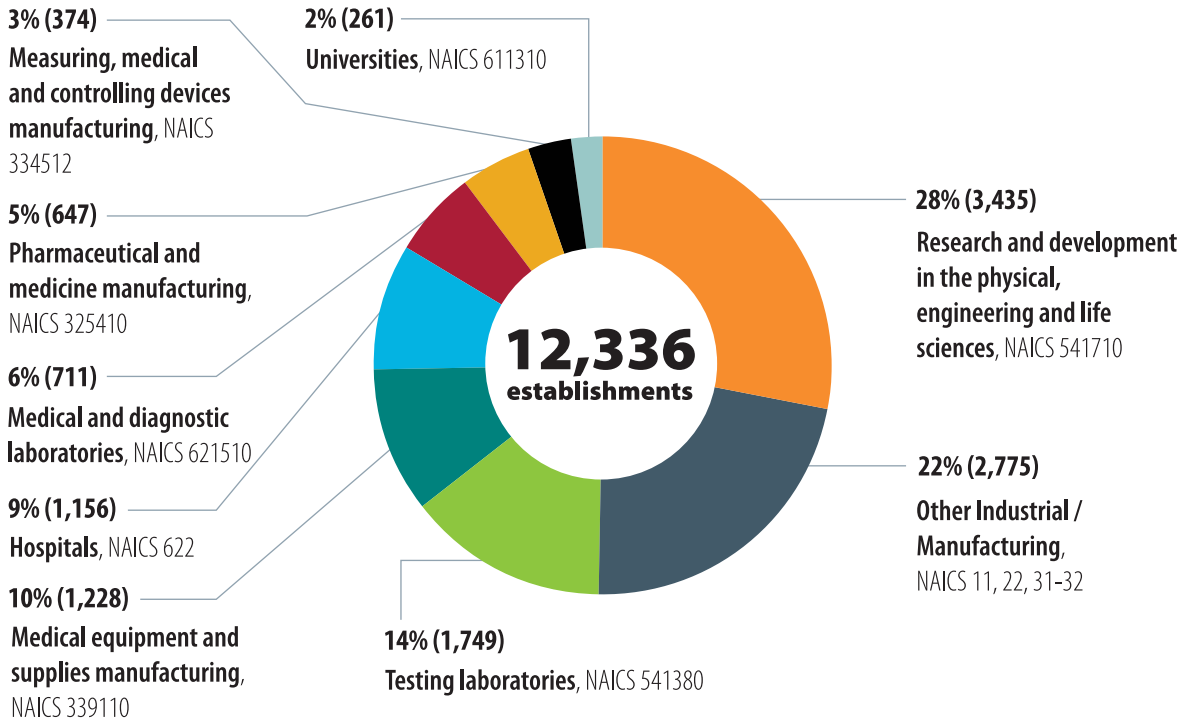


Sources: BioTalent Canada Survey of Employers (2020) and Sequencing the Data (2013).

The distribution of companies' primary and secondary sub-sectors is starting to shift.

The North American Industry Classification System (NAICS) gives a different view of the bio-economy and its areas of focus. NAICS 541710 refers to physical, engineering and life sciences R&D — which makes up more than a quarter (28%) of bio-economy establishments. The next largest segment is other industrial/manufacturing (NAICS 11, 22, 31–33), at 23%.

FIGURE 6. Bio-economy establishments by NAICS industrial sector

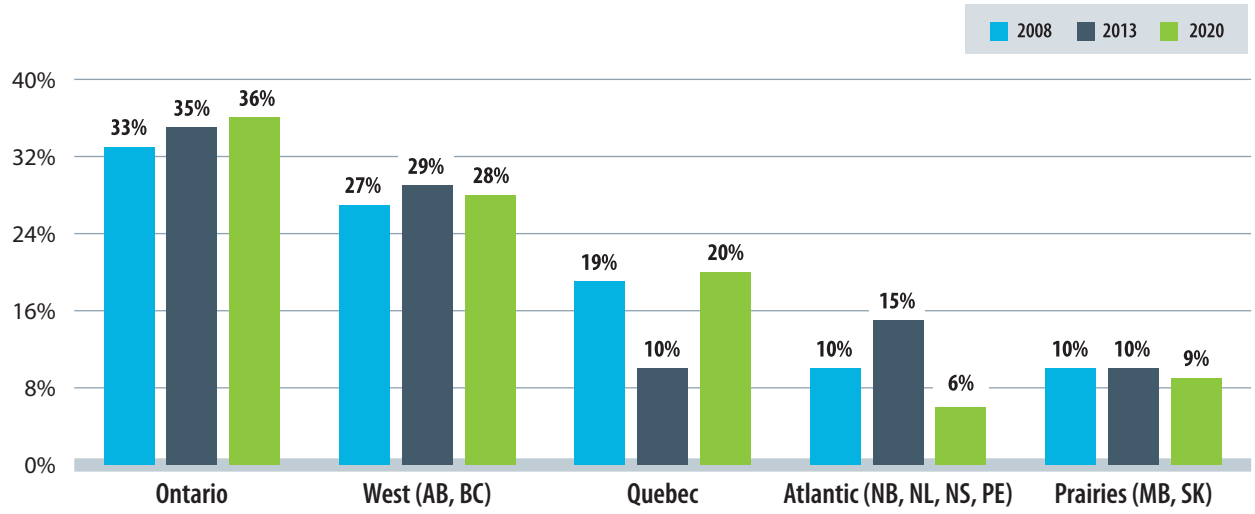


Source: BioTalent Canada Modeling and Projections (2020)

Note: Percentages may not add up to 100% due to rounding.

The distribution of bio-economy activity across the country has also remained fairly consistent since 2008. Today, nearly two-thirds of Canadian bio-economy companies (64%) are located in Ontario, Alberta and British Columbia.

FIGURE 7. Companies by region



Source: BioTalent Canada Survey of Employers (2020) and Sequencing the Data (2013).

Note: The proportions for 2013 have been adjusted to remove the % of "no response" at 10.7%). The differences in trend for the Quebec and Atlantic regions for the 2013 period are challenging to interpret. Given the similarities between 2008 and 2020, the 2013 data may be an artifact of the survey sampling and response rates for that survey period.

The bio-economy remains largely concentrated in Ontario, Western Canada and Quebec.

Workers in profile

The bio-economy workforce covers a wide range of occupations in a variety of industries. Table 1 shows the top 10 by NAICS code and estimated employment.

TABLE 1. Bio-economy employment estimates by industry, 2019

Industry	Bio-economy employment	Share of total bio-economy employment
Pharmaceutical and medicine manufacturing (NAICS 3254)	30,850	15%
Hospitals (NAICS 6220)	29,040	15%
R&D in physical, engineering and life sciences (NAICS 514710)	28,990	15%
Medical equipment and supplies manufacturing (NAICS 339110)	19,990	10%
Testing laboratories (NAICS 541380)	18,890	9%
Universities (NAICS 6113)	12,580	6%
Soap, cleaning compound and toilet preparation manufacturing (NAICS 3256)	11,480	6%
Measuring, medical and controlling device manufacturing (NAICS 334512)	6,610	3%
Animal food manufacturing (NAICS 3111)	5,010	3%
Aquaculture (NAICS 1125)	4,340	2%
Other	31,490	16%
Total	**199,270**	**100%**

Source: BioTalent Canada Modeling and Projections (2020)

Most of these jobs can be classified into the following categories:

- **Research and development:** Jobs related to innovation and introducing new intellectual property, processes, products and services
  Examples: research directors, scientists, laboratory technicians, trial coordinators
- **Manufacturing (production):** Jobs that involve processing materials into finished products
  Examples: engineers, technicians
- **Distribution:** Jobs that involve moving goods from manufacturers to points of sale
  Examples: logistics managers, distribution coordinators, material handlers
- **General management, finance and administration:** Jobs related to managing a company, department or unit
  Examples: executives, budget analysts, administrative assistants, human resources specialists
- **Legal and regulatory:** Jobs centred on providing legal services or overseeing regulatory compliance requirements
  Examples: lawyers, patent agents, compliance specialists
- **Quality control and quality assurance:** Jobs that focus on the quality management of processes or products
  Examples: quality control analysts, quality assurance auditors, quality control technicians
- **Marketing, business development, sales and communications:** Jobs that involve promoting and raising awareness of organizations and their products, selling products, and pursuing business opportunities
  Examples: sales managers, customer service representatives, marketing specialists, social media strategists
- **Information technology:** Jobs that involve installing, maintaining and monitoring computers and associated networks and systems
  Examples: data analysts, software and web developers, programmers, IT support specialists

R&D and manufacturing account for nearly half of bio-economy jobs overall (26% and 22%, respectively), followed by "other" (jobs that don't fit into the categories described above) at 17%. The "other" category is particularly prevalent in the bio-health sub-sector, second only to R&D.

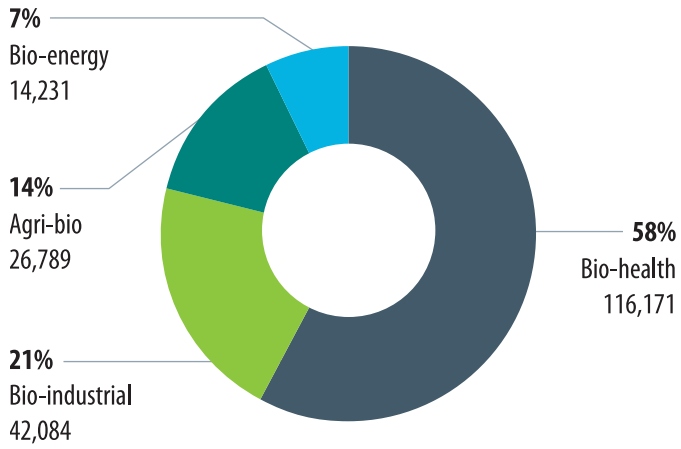
Employment in the bio-economy is highly concentrated in bio-health. More than half (58%) of all employees work in this sub-sector, with a further quarter (21%) in the bio-industrial sub-sector.

TABLE 2. Employment by job category and sub-sector

Job category	Total	Agri-bio	Bio-energy	Bio-health	Bio-industrial
Research and development	**26%**	24%	27%	30%	19%
Manufacturing (production)	**22%**	32%	36%	13%	38%
Management, finance and administration	**14%**	19%	15%	13%	13%
Distribution	**5%**	6%	5%	5%	6%
Quality control and quality assurance	**5%**	5%	4%	5%	5%
Marketing, business development, sales and communications	**5%**	7%	3%	5%	4%
Legal and regulatory affairs	**2%**	2%	2%	2%	1%
Information technology	**3%**	2%	2%	4%	2%
Other	**17%**	4%	7%	23%	13%

Source: BioTalent Canada Modeling and Projections (2020)

FIGURE 8. Bio-economy employment estimates by sub-sector



Source: BioTalent Canada Modeling and Projections (2020)

The regional distribution of bio-economy jobs mirrors that of bio-economy companies, with the largest concentrations in Ontario, Western Canada and Quebec. Distribution is fairly consistent across sub-sectors with the exception of agri-bio, which includes aquaculture businesses and has a noticeably higher number of jobs in the Atlantic and western coastal regions.

TABLE 3. Employment by region and sub-sector, 2019

Region[2]	Total	Agri-bio	Bio-energy	Bio-health	Bio-industrial
Atlantic	**5%**	13%	4%	5%	4%
Quebec	**28%**	20%	27%	28%	32%
Ontario	**38%**	27%	33%	41%	38%
Prairies	**5%**	6%	8%	5%	3%
West	**24%**	33%	28%	22%	23%
Territories	**<1%**	<1%	<1%	1%	<1%

Source: BioTalent Canada Modeling and Projections (2020)

Read our regional and metro hub reports for deeper perspective on the bio-economy labour market across Canada.

Equity and diversity in the workforce

Women account for an average of roughly one-third (34%) of bio-economy workers overall and even more in agri-biotech and bio-health (37% and 40%, respectively). Other groups have less representation, with visible minorities making up an average of 20% of the bio-economy workforce, internationally educated professionals (IEPs) 17% and recent immigrants (those who have been in Canada less than five years) less than 10%. Indigenous workers and workers with disabilities remain at just 1% of the bio-economy workforce each.

This is generally lower representation than in the overall Canadian labour force, where women make up 47.5% of workers,[3] people with disabilities 10%[4] and Indigenous people 3.5%.[5] Visible minorities account for 22% of the overall Canadian workforce, which is nearly identical to the bio-economy,[6] and recent immigrants are better represented in the bio-economy than in the overall labour force, where they make up just 4% of workers.[7] These findings suggest there may be under-represented populations that could be important sources of new talent for the bio-economy going forward.

2 *Western Canada includes Alberta and British Columbia. The Prairies include Manitoba and Saskatchewan. Atlantic Canada includes New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.*

3 *Statistics Canada (2021). Table: 14-10-0335-02.*

4 *Statistics Canada. Table 14-10-0359-01 Labour force characteristics by Indigenous group and educational attainment (x 1,000).*

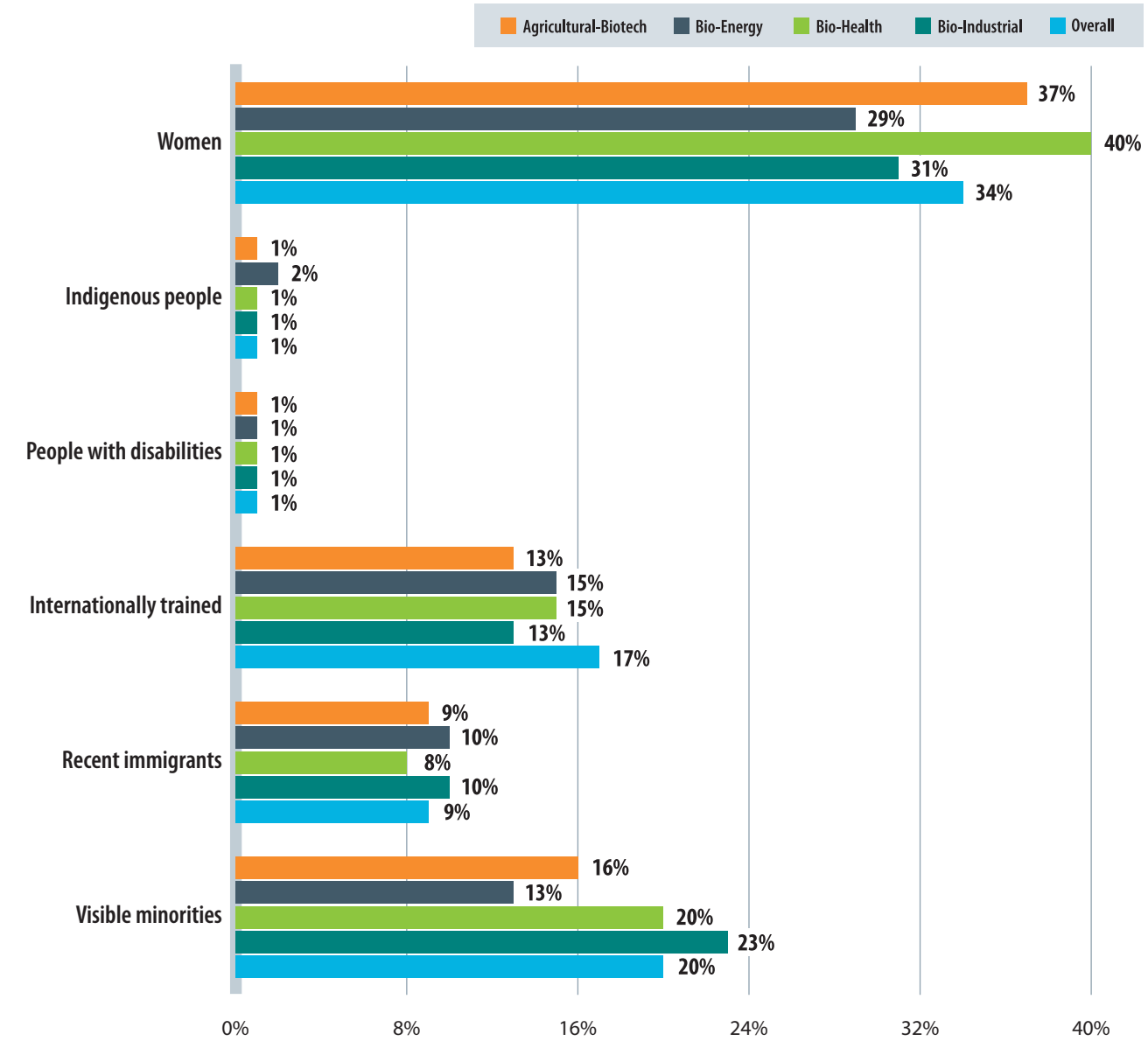
5 *Statistics Canada. Table 13-10-0347-01 Labour force status for adults with and without disabilities.*

6 *Statistics Canada (2021). Data Tables 2016 Census.*

7 *Statistics Canada (2021). Table: 14-10-0083-01.*

Focusing on under-represented groups could open up new pools of talent.

FIGURE 9. Average proportions of workers by equity-seeking group status



Source: BioTalent Canada Survey of Employers (2020)

Farmers Edge

Pivoting to digital HR in a pandemic

When the COVID-19 pandemic hit, the HR team at Farmers Edge barely missed a beat — embracing remote recruitment and retention to broaden its pool of candidates. A switch to digital HR practices is helping the company find the highly skilled people it needs to grow and develop a common corporate culture to energize its diverse international workforce.

Company profile: Farmers Edge

Location: Winnipeg

Employees: 500

Bio-economy sub-sector: Agri-bio

A digital agriculture company at the forefront of innovation and clean tech, Farmers Edge provides analytical solutions and technical support to help farmers increase yields, boost soil health, streamline operations, implement climate-friendly practices and measure results.

Q: What were your HR goals before the pandemic hit, and how did the lockdowns affect them?

COLLEEN COATES, VICE-PRESIDENT OF PEOPLE AND CULTURE: Our goal is to lead the next agricultural revolution. We were expanding our workforce at the outset of the pandemic, building our multinational team to create smart farms — capitalizing on the strong growth in digital agronomy, new insurance partnerships and carbon credit sales. Obviously, the lockdowns required us to shift our tactics.

Q: What did you do about it?

CC: We switched to virtual interviews and remote hiring. We brought on people who'd never set foot in our offices and shipped equipment to them. It's opened more opportunities: we can recruit from anywhere, and candidates aren't limited to looking for jobs only in Winnipeg, for example, or having to travel to the middle of Alberta to attend a career fair. As things evolve, we'll be switching to more remote recruitment and hiring.

Q: With those options and that flexibility, do you still face HR challenges?

CC: Oh, sure. We need to attract people into really unique roles that require particular skillsets: agri-meteorologists, for example, or people with specialized skills in agronomy and technology. We operate in a highly fluid, fast-paced environment that isn't suitable for everybody. We want people who are trailblazers: thinkers and doers passionate about reinventing customer experience, creating disruptive technologies, and open to learning and adapting as we go. That talent can be hard to find.

"We want people who are trailblazers — who are open to learning and adapting as we go."

Q: So the challenge is to find the 'sweet spot' of technical skills, soft skills and personal culture, is that right?

CC: Right. We're building a diverse workforce — people with different backgrounds, opinions and ideas who can bring new perspectives and passion for what they do best. We have people in six countries from a variety of cultures; we need to align their personal and professional values, create a motivating environment and work together toward a common goal. Also, in a tight talent market, employee retention is critical. Our development of succession plans helps with that.

Q: Do you have digital strategies to nurture culture and drive retention?

CC: Our CEO leads a series of virtual Town Halls that bring teams together, provide important updates, celebrate achievements, give team members an opportunity to present ideas, voice opinions, ask questions and discuss what they can do to help the company succeed. We follow those with a survey to see how we can continue to improve. We also implemented a "Disruption Box" that lets team members submit ideas, suggestions and questions digitally.

We're always looking for different ways to engage with our team members and communicate effectively with everyone: How do younger employees want to hear from us? Does the tech team want internal chats or face-to-face conversations? We need to continually work on our retention strategies, building a fully engaged workforce, facilitating skills growth, and at the same time capturing the changing nature of work.

Q: How critical is solving the talent challenges to your ongoing success?

CC: Our talent will drive our results. The pandemic quickened our pace for growth. We're positioning ourselves to disrupt the industry and get people thinking differently. We need to make sure we're prepared for that future.

Labour market outlook

Given the state of the bio-economy today, what will the sector need in terms of labour to the end of the present decade? Estimates suggest the answer is an additional 65,000 workers by 2029.[8] Based on anticipated conditions, labour supply will not be sufficient to meet that demand. In many sub-sectors, there will be two job openings for every candidate by 2022. By the end of the decade that could grow to a 4:1 gap in some cases.

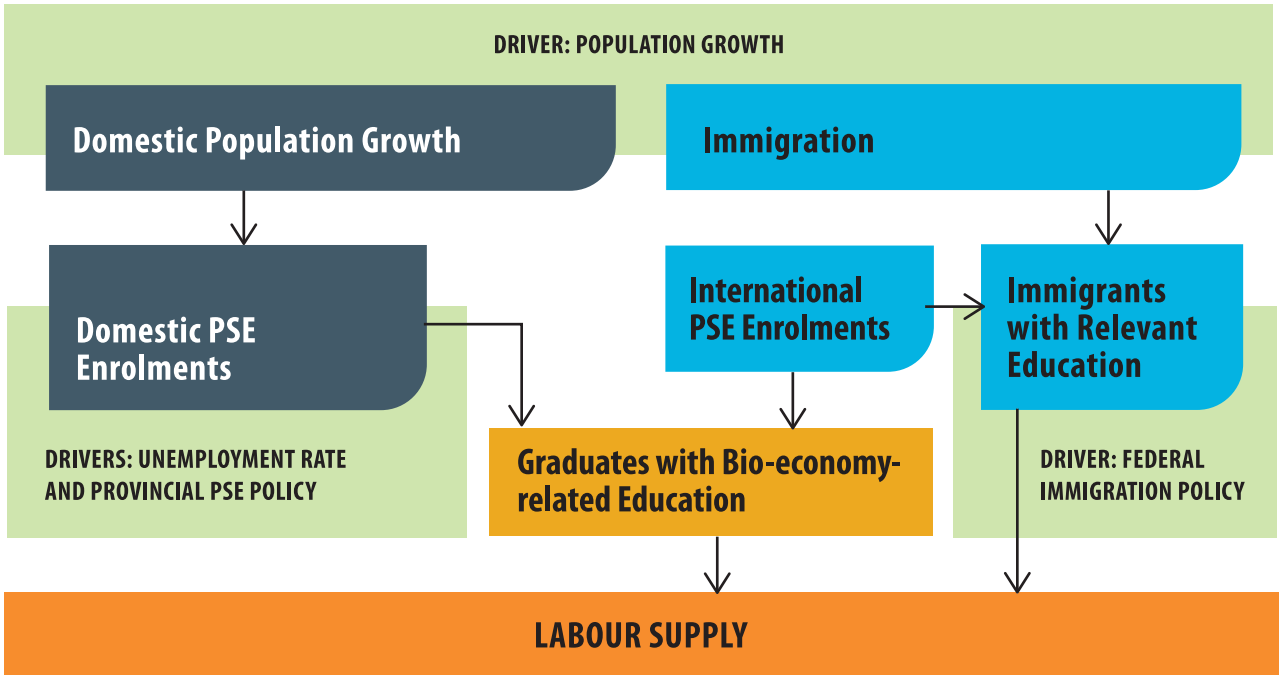
Employment in the bio-economy is expected to grow by around 1.5% between 2021 and 2024,[9] reaching 214,000 workers. After 2024, the growth rate is expected to slow, but employment will continue to grow by around 1.0% from 2025 to 2029. By the end of the decade, the sector will employ more than 233,000 people.

Read our demand and supply report for more detail on bio-economy labour needs in Canada.

8 *Note that, while this report focuses primarily on private sector employers, all forecasts and modelling include actual and potential workers from the public, education and private sectors.*

9 *This study considered three time periods for its economic forecasts: immediate (to explore pandemic-related changes between 2019 and 2020), short term (2021 to 2024) and medium/longer term (2025 to 2029).*

FIGURE 10. Labour supply drivers in the bio-economy



Because the bio-economy requires highly skilled — and often highly specialized — labour, the sector is currently dependent on post-secondary education for nearly all its talent. Prospective workers may be Canadian graduates of post-secondary institutions, international students who become immigrants after they graduate, or recent immigrants with relevant education credentials. Given the bio-economy's adjacency to other sectors of the economy, an additional source of labour supply could be re-skilling un- or under-employed workers in relevant industries such as traditional manufacturing.

Youth (those under 25 years old)[10] have historically been critical to the labour supply as they represent future enrolments in educational programs and the next generations of skilled workers. Yet the youth share of the population in Canada has been declining steadily since 2000 and will likely continue to do so, falling from 33% in 2000 to 26% by 2029. The number of individuals aged 55 years and older continues to rise and is expected to reach 34% by 2029.

Even though overall the core working-age population (anyone between 25 and 54 years old) should hold at around 40% to 2029, the combined trend of fewer youth and more people aging above 55 is concerning because a strong supply of youth is needed to age into the workforce and replace older workers.

In many sub-sectors of the bio-economy, there will be two job openings for every candidate by 2022.[11]

10 The definition of "youth" varies depending on the source. While BioTalent Canada defines "youth" as under 30, the source data for this report defines youth as under 25.

11 For a full break-down of sub-sectors and the number of job openings forecasted, see BioTalent Canada's Close-up on the bio economy: A demand and supply outlook

This makes immigration key to meeting labour demand. Currently, only 9% of bio-economy workers are recent immigrants and 17% are IEPs, suggesting an opportunity to expand recruitment from these populations. While numbers of immigrants to Canada with degrees declined in 2020 due to COVID-19, it is expected to rise again and reach 111,500 by 2029. Around 39,000 of these immigrants are expected to have bio-economy related degrees, representing a pool of highly skilled talent that can help fill the projected labour shortages. Experience shows that public policy can support this: between 2010 and 2014, government policy changes led to a 40% increase in immigrants with post-secondary education as well as previous study and work permits.

Between 2010 and 2014, government policy changes led to a 40% increase in immigrants with post-secondary education as well as previous study and work permits.

Employment demand and skills requirements

While employment in the bio-economy is expected to grow over the forecast period, the individual sub-sectors will experience their own patterns of expansion and contraction.

TABLE 4. Employment outlooks by sub-sector

Year	Overall	Bio-health	Bio-industrial	Agri-bio	Bio-energy
% change 2019 to 2020	**+4.3%**	+6.8%	+4.3%	(-1.6%)	(-4.7%)
Employment 2020	▲ **208,000**	▲ 124,000	▲ 44,000	▼ 26,000	▼ 13,500
Employment 2024	▲ **214,000**	▲ 126,000	▲ 45,000	▲ 29,000	▲ 14,000
Employment 2029	▲ **223,000**	▲ 131,000	▲ 47,500	▲ 30,000	▼ 13,500

Source: BioTalent Canada Modeling and Projections (2020)

Bio-health

Bio-health grew faster than any other sub-sector in 2020, largely due to increased pharmaceutical and medicine manufacturing. Employment was up by 6.8% — reaching 124,000 jobs — and is expected to remain above pre-pandemic levels throughout the forecast period, even with a slight contraction (1.1%) in 2021. The bio-health sub-sector is expected to employ approximately 126,000 workers by 2024 and more than 131,000 workers by 2029.

Bio-industrial

Employment in the bio-industrial sub-sector grew by 4.3% to 44,000 workers in 2020, primarily to support increased demand for personal care and cleaning products. As the economy recovers from the pandemic, employment levels in this sub-sector are expected to return to normal levels and then grow to around 47,500 workers by 2029.

Agri-bio

Agri-bio employment fell by 1.6% to 26,000 workers in 2020, largely due to contractions in the aquaculture industry caused by reduced demand for seafood from restaurants and cruise ships. Relatively low growth for the sub-sector is predicted during the forecast period, with total employment surpassing 30,000 by 2029.

Bio-energy

Bio-energy employment fell by 4.7% to 13,500 workers in 2020, the largest contraction of any bio-economy sub-sector. This was due to employment losses in oilseed processing, temporary plant closures and restricted operating capacity, as well as reduced profits associated with some facilities' shifting to hand sanitizer production. The sub-sector is expected to make a partial recovery but will see low employment growth for a few years, followed by a slight decline for the rest of the forecast period. Employment in the sub-sector is expected to peak at 14,000 by 2024 before falling back below 13,500 by 2029.

The bio-manufacturing gap

COVID-19 highlighted a significant gap in the Canadian bio-economy: bio-manufacturing and processing capacity. Canada was initially unable to produce sufficient personal protective equipment (PPE) to meet its needs and had no domestic capacity to develop and manufacture vaccines. Commitments have been made to build facilities to remedy this, but those facilities will require skilled people to operate them — a supply of talent does not currently exist.

Estimates suggest Canada will need an additional 16,140 bio-manufacturing workers by 2029 (5,160 in bio-health manufacturing alone), even without taking into account expansion growth due to recently announced investments. Only 25% of those positions will be fillable by predicted supply during this time period.

To fill the shortages, the bio-economy will need to develop new strategies, such as training workers from other sectors and more actively recruiting from outside traditional labour pools, including people from demographic groups under-represented in the bio-economy such as Indigenous persons, newcomers to Canada and persons with disabilities.

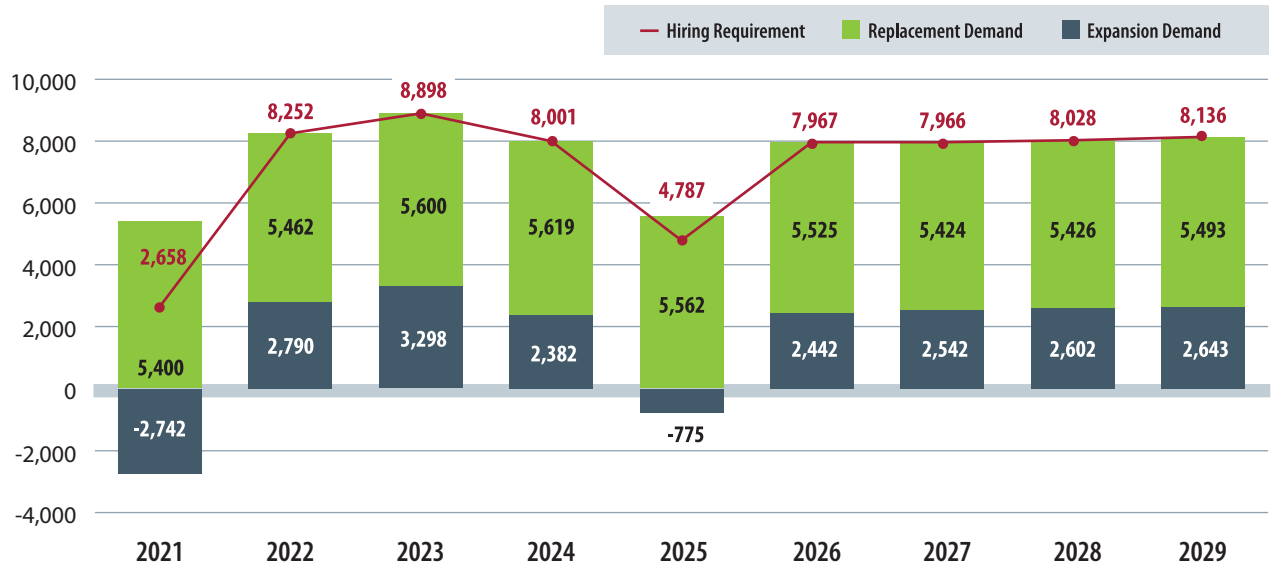
Expansion and replacement

Most of the requirement for 65,000 additional workers across the bio-economy between 2021 and 2029 will be to replace retirees or individuals leaving the workforce for other reasons — in other words, to fill *replacement demand*. Yet a portion will also be needed to fill new jobs as their industries grow *(expansion demand)*.

While replacement demand is expected to remain relatively stable across the forecast period, expansion demand is expected to fluctuate slightly. Expansion is weakest in 2021, as the bio-economy contracts back to pre-pandemic levels. A second slight dip is expected in 2025 as the economic recovery results in higher interest rates that will likely lead to reduced investment in the bio-economy.

Manufacturing and R&D roles are among the top three areas where employers need to hire in all four sub-sectors, and it is crucial to fill both — R&D will stall if there are not enough workers to produce their developments.

FIGURE 11. Hiring requirement outlook by demand type



Source: BioTalent Canada Modeling and Projections (2020)

Manufacturing and R&D roles are among the top three areas where employers need to hire in all four sub-sectors.

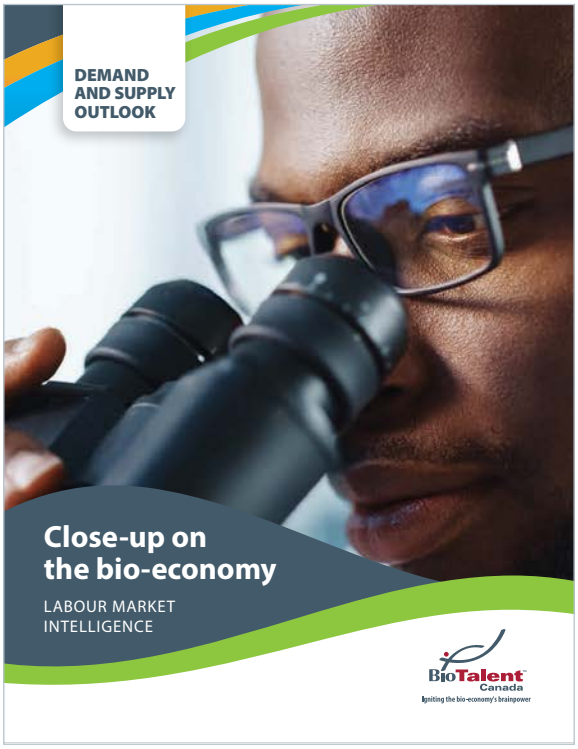
TABLE 5. 2029 hiring requirements by sub-sector

Sub-sector	Workers needed	Demand type	Key roles
Bio-health	36,000	Mostly replacement	▸ R&D (25%) ▸ Management, finance and administration (16%) ▸ Manufacturing (14%)
Bio-industrial	14,500	Mostly replacement	▸ Manufacturing (40%) ▸ R&D (15%) ▸ Management, finance and administration (15%)
Agri-bio	11,000	Nearly half expansion until 2023	▸ Manufacturing (35%) ▸ Management, finance and administration (23%) ▸ R&D (15%)
Bio-energy	3,300	Virtually all replacement	▸ Manufacturing (39%) ▸ R&D (19%)

Source: BioTalent Canada Modeling and Projections (2020)

All four sub-sectors will be competing for highly skilled workers amongst themselves and with companies in other STEM sectors. The battle will be especially intense over candidates with technical credentials such as degrees in chemical engineering, biotechnology, medicine, biology and life sciences. Some bio-economy firms may also find themselves up against players in the farming or utility sectors; manufacturers; or organizations in education, scientific and technical services, hospitals and other medical sectors. Competition for workers such as those in human resources, marketing, logistics and similar non-technical fields will be widespread and cover all segments of the broader economy. Companies without formal HR departments may find themselves at a disadvantage in this competition for talent.

Anticipated employment demand can be combined with expected supply to model where labour needs will be most acute throughout the forecast period. All sub-sectors have reported experiencing some hiring challenges, and the outlook suggests these will continue and likely worsen through to 2029.



Top HR challenges

Bio-economy employers rank HR among their top five obstacles to company development. More than half (56%) report management-level skills and labour shortages (up from 43% in 2013), while 61% report skills and labour shortages in research and technical areas — up 24 percentage points from 2013. These issues are likely made more difficult by the lack of dedicated human resources staff in most bio-economy companies — just 30% have a formal human resources department.

Main issues

40%
Lack of qualified candidates with required specialized skill sets or experience

36%
Insufficient capital or resources to pay competitive wages to attract and retain qualified candidates

30%
Lack of qualified candidates with practical/non-academic skills

16%
Loss of candidates and employees to large, well-known organizations

13%
Lack of applicants

What are the skills gaps?

- **Soft skills:** The most critical skills gaps among candidates and new employers are problem-solving, collaboration and communication.
- **Business skills:** Companies looking to grow and commercialize innovations from R&D want more employees to have stronger business development knowledge and skills.
- **Technical skills:** These present some gaps — among both new graduates and established employees who fail to keep up with relevant technology or knowledge advancement.

How are companies recruiting?

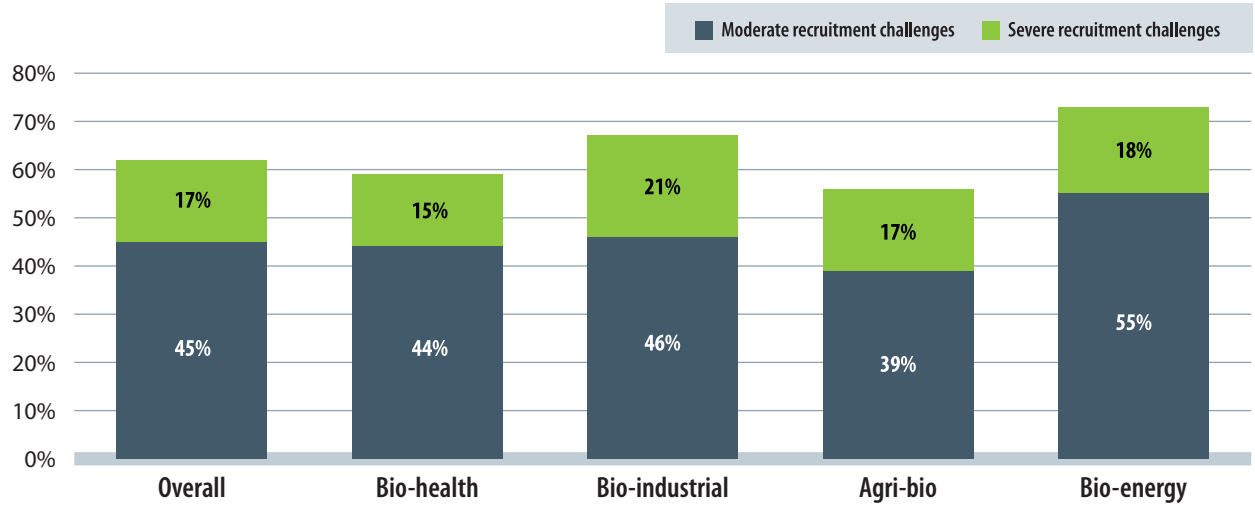
Most bio-economy employers rely on personal contacts and employee referrals (74%) and job banks or other online resources (67%). These approaches have been among the top strategies since 2008, along with company websites (whose use dropped from 62% in 2013 to 41% in 2020) and job fairs (whose use went from 80% in 2008 to just 8% in 2020). While no direct causal connection can be determined, it is possible that reliance on personal contact and referrals may be contributing to the limited diversity in the bio-economy.

Overall, **62% of surveyed companies reported some or significant challenges recruiting and retaining qualified staff**. Larger firms seem to experience these difficulties more acutely: 72% of firms with annual revenues of $50 million or more report recruiting and retention issues compared to 54% of those with revenues of less than $50 million.

Companies have particular difficulty hiring for mid-level positions due partly to the lack of mid-sized companies in the bio-economy and partly because it's difficult for small and medium-sized businesses to offer incentives that make it worthwhile for workers at "safe" jobs in large companies to join their teams instead. Senior-level and C-suite talent are also often hard to recruit and retain, with many top candidates leaving Canada for better-paying jobs in the United States or Europe, and others starting their own companies.

The lack of mid-sized companies in the bio-economy makes it especially difficult to hire for mid-level positions.

FIGURE 12. Recruitment challenges by sub-sector



Source: BioTalent Canada Survey of Employers (2020)

Recruitment is becoming harder for more companies throughout the bio-economy.

Overall labour market ratings by job category are calculated by comparing hiring requirements in each forecast year to the number of expected new bio-economy workforce entrants in the same year.

A three-tiered rating scale shows the severity of the hiring challenges:

Level 1

Labour supply is **greater than 75%** of labour demand.
Low to moderate labour shortages are expected.

Level 2

Labour supply is **between 25% and 75%** of labour demand.
Moderate to serious labour shortages are expected.

Level 3

Labour supply is **less than 25%** of labour demand.
Serious to severe labour shortages are expected.

TABLE 6. National bio-economy labour market ratings outlook by job function

Job function	2021	2022	2023	2024	2025	2026	2027	2028	2029
Manufacturing and production	3	3	3	3	3	3	3	3	3
Distribution and logistics	3	3	3	3	3	3	3	3	3
Management, finance and administration	2	3	3	3	2	3	3	3	3
Quality control and assurance	1	2	3	2	2	2	3	3	3
Marketing, business development and sales	2	2	2	2	2	2	2	2	2
Legal and regulatory affairs	2	2	2	2	1	2	2	2	2
Research and development	1	2	2	2	1	2	2	2	2
Information technology	1	2	2	2	1	2	2	2	2
Other	1	2	2	2	2	2	2	2	2
Overall	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**

Source: BioTalent Canada Modeling and Projections (2020)

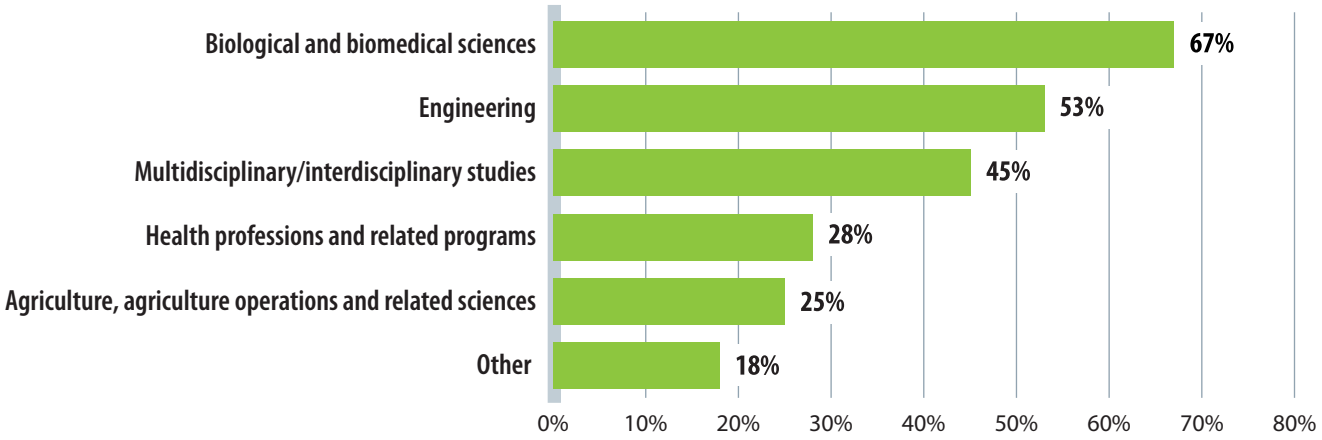
Table 6 shows that **manufacturing and production; management, finance and administration; and distribution and logistics are expected to face the most serious labour shortages throughout the forecast period**. This is true across all sub-sectors and presents a major hurdle to the bio-economy's expansion. It is notable as well that management, finance and administration are also "hot spots" in the forecast, as this means bio-economy companies will have to become "employers of choice" to compete with other sectors for generalized, non-scientific talent.

These ratings take into account the shares of new workforce entrants who have chosen occupations in the bio-economy in the past and assumes that a similar share will choose occupations in the bio-economy during the forecast period. Given that assumption, some of the shortages could be mitigated by more active recruitment efforts among new graduates from relevant fields. These efforts will not be enough to fully address the shortages, however, and additional strategies, such as recruiting skilled immigrants and looking beyond traditional pools to attract candidates with a wider variety of backgrounds, will be required.

Education and the talent supply

The wide range of jobs in the bio-economy means employers also seek a wide range of skills, disciplines and levels of education. Biological and biomedical sciences are at the top of the list: approximately two-thirds of bio-economy employers recruit mainly from these fields. Around half also look for workers with engineering qualifications and multi- or interdisciplinary backgrounds, indicating the need for staff with specialized technical skills who also understand the broader business context. Reflecting this, a number of post-secondary institutions have started to offer programs that combine STEM fields with business, commerce or regulatory components.

FIGURE 13. Top fields of study for employers



Source: BioTalent Canada Survey of Employers (2020)

Most jobs in the bio-economy require at least a university undergraduate degree. In the 2020 survey of bio-economy employers, roughly two-thirds said they require an undergraduate degree for positions in IT (71%), management, finance and administration (69%), and legal and regulatory affairs (64%). In some functional areas, post-graduate education is often also essential — including R&D (required by 63% of employers) and legal and regulatory affairs (40%).[12] Even for functional areas that rely less on advanced scientific education, many employers still require post-secondary education. In manufacturing and production, 23% of employers look for candidates with an undergraduate degree, 12% seek out those with a post-graduate degree, 38% expect a college or trade school diploma, and 34% hire for roles that require no more than a high school diploma.

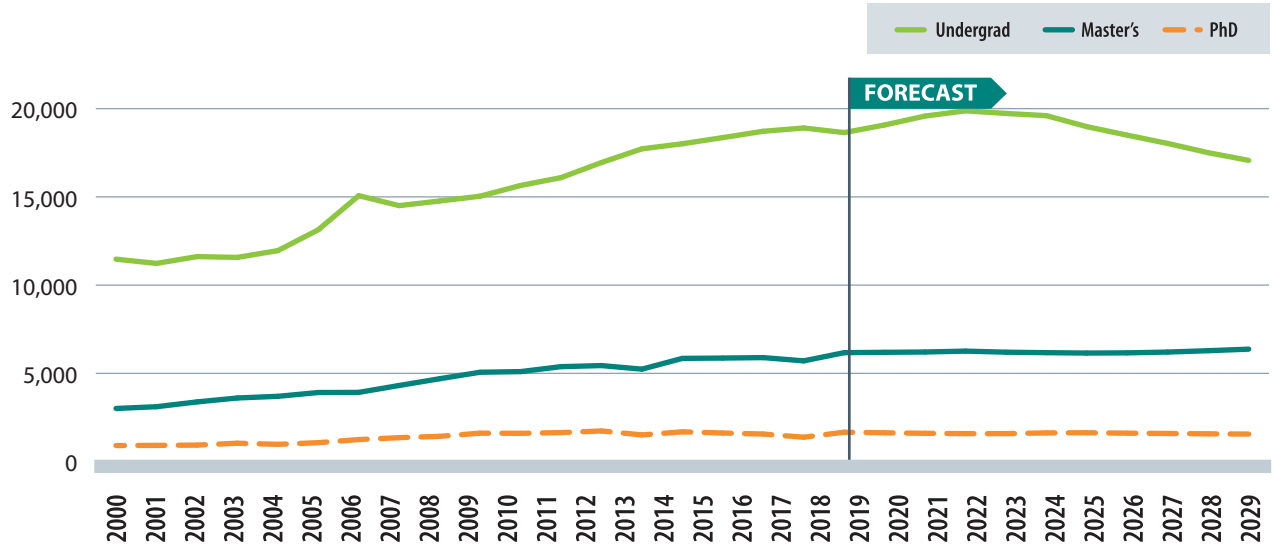
For roles in distribution and logistics, 45% of employers look for candidates with an undergraduate degree, 6% seek out those with a post graduate degree, 55% expect a college or trade school diploma, and 31% hire for roles that require no more than a high school diploma.

Despite the decline in the post-secondary-aged (20–24 years old) segment of the population, enrolment in post-secondary education increased by 28% from the 2008–2009 academic year to 2018–2019, rising from 1.35 million students to 1.72 million. This is due in part to a larger proportion of international students.

12 Note that employers could choose more than one answer, as different roles within the same functional area might require different levels of education.

Yet as the post-secondary-aged population declines, domestic post-secondary enrolment is expected to decline as well, and will only be partly offset by increasing international enrolment. As a result, **the number of university undergraduate degree completions by domestic students is expected to decline by around 14%** between 2022 and 2029, while post-graduate degree completions by domestic students (master's and PhDs) remain fairly stable.

FIGURE 14. Domestic degree completions by study level



Source: BioTalent Canada Modeling and Projections (2020)

In 2016–2017, nearly 200,000 students were enrolled in university programs specifically related to the bio-economy. In 2018–2019, more than 156,000 students were enrolled in college-level STEM and health programs.[13]

International students make up a large and growing share of those enrolments, climbing from 7% to 11% at the university level between 2012 and 2017 and marking an even higher share of PhD enrolments (39% in the 2016–2017 academic year). Between 2014 and 2019, international college-level STEM-H (science, technology, engineering, math and health) enrolments more than doubled to 23%.

While exact numbers are not yet known, it is estimated the COVID-19 pandemic resulted in 65,000 fewer international students enrolled at Canadian post-secondary institutions for the 2019–2020 and 2020–2021 school years. This drop of 20–30% may have a negative impact on research activities in STEM labs, as graduate students — including significant numbers of international students — often play key roles in these activities.

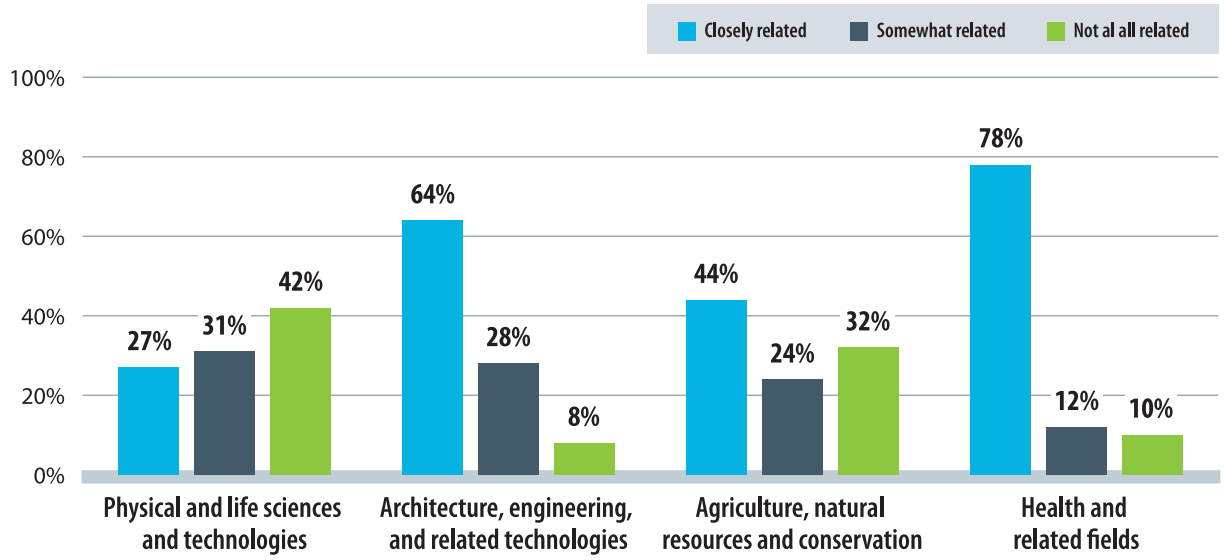
A high number of graduates of bio-economy-related university programs (particularly undergraduate programs) report that their work, three years after graduation, is only "somewhat" or "not at all" related to their field of study. While 78% of graduates in health and related fields say their work is "closely" related to their fields of study, just 44% of those in agriculture, natural resources and conservation say the same — and only 27% in physical and life sciences and technologies.

13 *Excluding those in Quebec, which are offered by Cégep as three-year technical diplomas and cannot be distinguished from two-year diplomas leading to university programs. For this reason, Quebec has been excluded from this analysis.*

Master's graduates report slightly higher levels of employment relatedness, but there are still significant numbers whose jobs are not closely related to their fields.

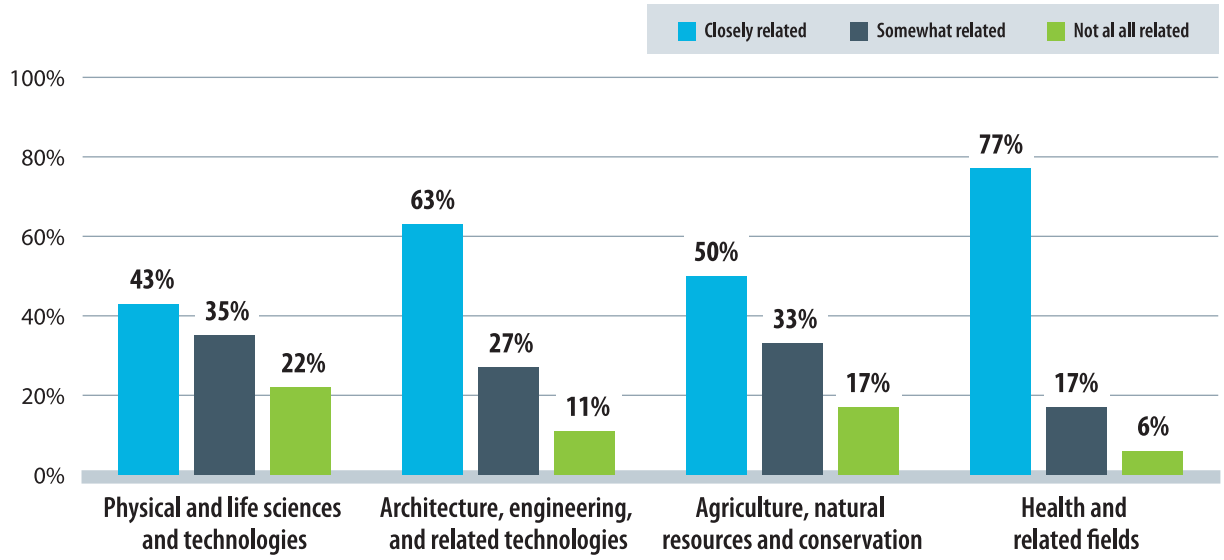
FIGURE 15. Relatedness of current jobs to fields of study three years post-graduation

a) Undergraduate degrees



Source: National Graduate Survey (2018)

b) Master's degrees



Source: National Graduate Survey (2018)

Women in post-secondary education

The percentage of women enrolled in all fields of post-secondary education remains high, at 55% in 2018–2019, with women making up at least half of enrolment in short-cycle tertiary education, undergraduate degrees and master's programs. While they make up only 49% of doctoral or equivalent programs, that has increased by two percentage points since 2008–2009. The numbers are similar in bio-economy-related university programs. Women's enrolment in college-level STEM and health programs has also remained stable at around 50%.

Many graduates from university programs relevant to the bio-economy say their current work is not closely related to their fields of study.

One reason graduates may not find work closely related to their studies is that **90% stay and work in the region where they studied** — with the exception of the Atlantic region, where that number drops to 70%. This is primarily because of higher salaries available elsewhere and the perceived lack of career opportunities in Atlantic Canada. The situation is compounded by the fact that recruitment to Atlantic Canada from other regions often emphasizes lifestyle factors such as smaller communities that are well-suited to raising families, while younger workers tend to prioritize greater urbanization.

While limited graduate mobility benefits companies located near education clusters, it may make jobs harder to come by for candidates and at the same time presents hiring challenges for companies with few post-secondary institutions nearby.

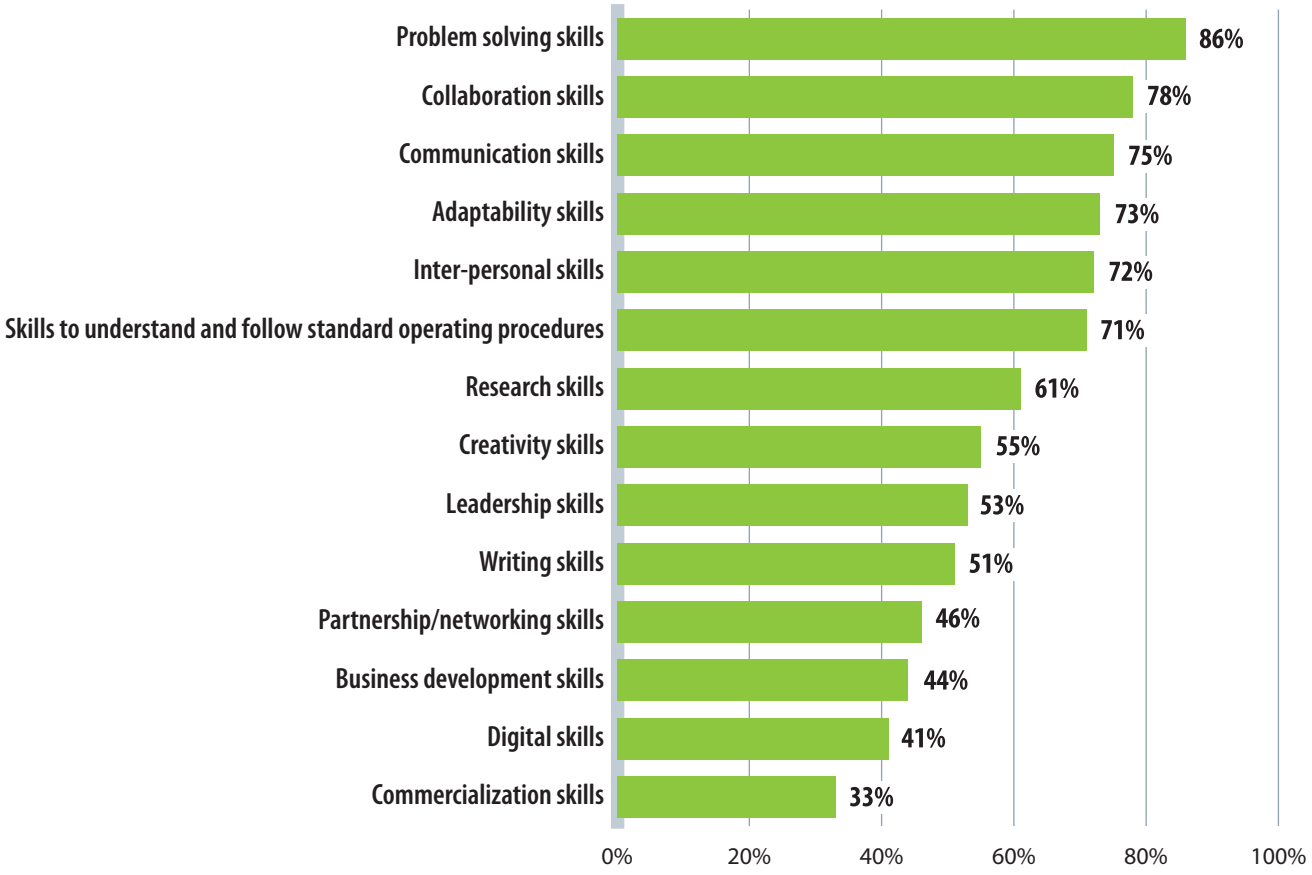
What skills are needed

Another key issue in meeting the labour demands of the bio-economy is the nature of the education itself. Graduates from Canadian post-secondary institutions arrive to the workforce with solid foundational technical and scientific knowledge and skills, but many employers surveyed report insufficient "soft skills". Chief among these is problem-solving, rated as very important by 86% of bio-economy employers. Around three-quarters of employers also stressed the importance of collaboration, communication, adaptability and inter-personal skills, as well as skills to follow and understand standard operating procedures (SOPs).

Finding the right skills match is also often difficult due to the nature of the jobs employers are trying to fill. Many are leading-edge roles with no standard or expected skill set, or by the need in small companies for employees to take on multiple roles and so bring a wider range of skills. As a result, **candidates who have *all* required skills are extremely rare** — to the point that they are often referred to as "unicorns" — and finding them can be nearly impossible. Rather than invest time and effort in searching for "unicorns", which will be elusive, employers may prefer to develop their own by hiring candidates who are strong in some of the desired skills and training them in the others.

Targeted training programs that address the specific skills cited by many employers may be extremely useful for this purpose. Work-integrated learning (WIL) — including co-ops, work placements, internships and clinical placements — can also be an effective way to develop some of the key skills students, recent graduates and other new hires may not already have.

FIGURE 16. Skills rated very important by employers



Source: BioTalent Canada Survey of Employers (2020)

WIL as a skills gateway

Students who participate in WIL gain real-world experience that isn't necessarily possible to simulate in an academic setting, giving them a better understanding of their industry and the skills required to work in it. Student satisfaction with WIL is usually high, and most students who participate in WIL report that it helped them find a job.[14]

That said, the percentage of students who participate in WIL varies widely among fields and levels of study. While 84% of university undergraduate students in health and related fields have participated in a work placement, only 18% of PhD students in the same fields have done so at their level. Approximately one-quarter (27%) of students in physical and life sciences and technologies report participating in WIL.[15] Costs are often cited as a barrier, along with work permits and regulations for international students.

Employers and educators in roundtable sessions and interviews acknowledged the value of WIL. Employers who take part in WIL programs gain the opportunity to train emerging talent in the specific skills they require and build connections that may give them an edge in the competition for labour when students graduate and enter the market. WIL opportunities that bridge multiple regions may also help mitigate the mobility challenges noted above by creating connections between students and regions other than those where they studied.

While the COVID-19 pandemic did cause some disruption in WIL, post-secondary institution interviewees say placement levels have been bouncing back since the spring and summer of 2020, and most post-secondary institutions believe students' skills acquisition has not been adversely affected. Programs with mandatory co-op requirements have dealt with the dip in placement availability by allowing students to defer their co-op terms or finish programs without co-op credits. In certain cases, the pandemic may have even increased interest in WIL opportunities: interviewees say some students have expressed a preference for education streams that will lead to employment rather than further study or unclear employment options.

Approximately one-quarter (27%) of students in physical and life sciences and technologies report participating in WIL.

14 *Statistics Canada, NGS 2018.*

15 *Statistics Canada, NGS 2018.*

COVID-19 impacts

COVID-19 has had a wide range of impacts on business and society, yet overall bio-economy companies seem to have weathered the storm.

Business volumes

~ ⅓

of companies said their business levels were **unchanged** in fall 2020 and winter 2021

> ⅓

said their business levels were **higher than usual** in fall 2020 and winter 2021

~ ¼

said their business levels were **lower than usual** in fall 2020 and winter 2021

Revenue – same or increased

70%

expected their **revenues to stay the same or increase** in the next six months in fall 2020

80%

said the same in winter 2021

Investments – same or increased

81%

expected **their capital investments to stay the same or increase** in the next six months in fall 2020

78%

said the same in winter 2021

Top pandemic-related challenges

- Lockdowns/restrictions imposed by government **(42%)**
- Increased mental health concerns among staff **(30%)**
- Management of employee communications **(27%)**
- Returning to office/workplace **(25%)**
- Implementation of new health and safety practices **(25%)**
- Providing remote IT support to employees **(24%)**

Future hiring plans

Most companies were either already hiring or planning to hire before the end of 2021, and many others plan to maintain current staffing levels. Some will be hiring to recoup lost ground due to pandemic-related layoffs and slowdowns, while others are simply continuing their planned growth and replacement hiring.

40%

of companies **planned to maintain current staff levels**

31%

were hiring by the end of 2021

23%

planned to start hiring by the end of 2021

1%

planned to reduce staff levels

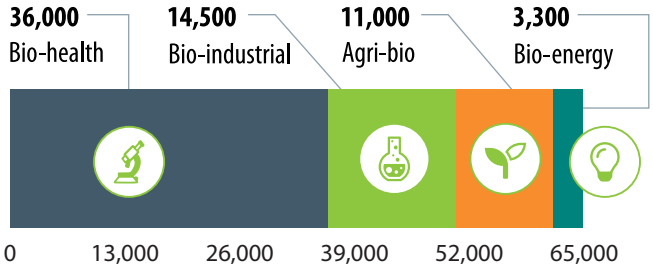
6%

didn't know

Demand and supply in the bio-economy

DEMAND

65,000 more workers
needed by 2029



Employees will need a broad range of technical, business and soft skills

Skills rated very important by employers

- Problem-solving **86%**
- Collaboration **78%**
- Communication **75%**
- Adaptability **73%**
- Inter-personal **72%**
- Understanding and following SOPs **71%**
- Research **61%**
- Creativity **55%**
- Leadership **53%**
- Writing **51%**
- Partnership/networking **46%**
- Business development **44%**
- Digital **41%**
- Commercialization **33%**

Some roles will be especially hard to fill to 2029

- **Manufacturing and production**
- **Distribution and logistics**
- **Management, finance and administration**

Employers struggle to find and win talent

- **Lack of qualified candidates with specialized skills or experience (40%)**
- **Lack of capital to pay competitive wages to attract and retain qualified candidates (36%)**

SUPPLY

Most candidates need a university undergraduate degree or higher

Level of education required during recruitment by company functional area

College diploma or trade school

Distribution and logistics
55%

Manufacturing and production
38%

University post-graduate degree

Research and development
63%

University undergraduate degree

Information technology
71%

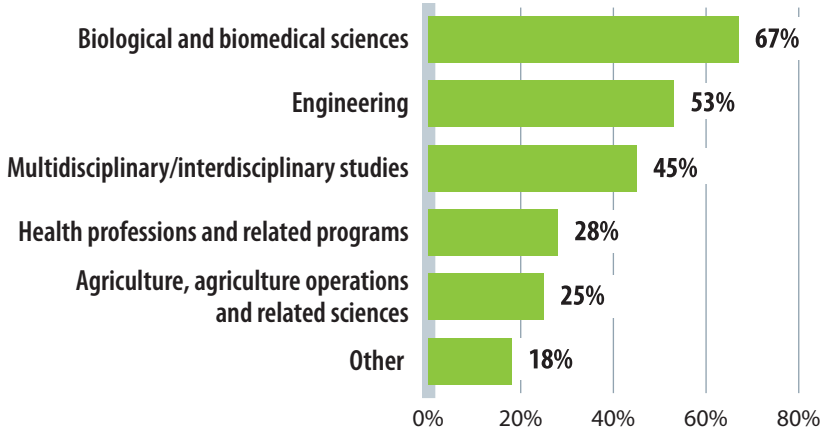
Management, finance and administration
69%

Legal and regulatory affairs
64%

Marketing, business development and sales
57%

Quality control and assurance
50%

Employers hire from many fields of study



90%

of graduates stay and find work in the regions where they studied*

The student population is becoming more international

The post-secondary-aged segment of the Canadian population is declining

Undergraduate degree completions by domestic students are expected to decline by 14% between 2021 and 2029

The international student population in undergraduate bio-economy-related programs rose from 7% of enrolments in 2012 to 11% in 2017

** With the exception of Atlantic Canada, where this number drops to 70%.*

Mediphage Bioceuticals

Seeking the skills to scale

Mediphage Bioceuticals' made-in-Canada gene therapy platform could revolutionize medical treatments. But with commercialization skills hard to come by in Canada, the Toronto-based company is weighing the question of whether or not to move some operations to the U.S.

Company profile: Mediphage Bioceuticals

Location: Toronto

Employees: 15

Bio-economy sub-sectors: Bio-health

Background: Mediphage Bioceuticals is a bio-health start-up founded in 2016 as a spin-off from the University of Waterloo. Its non-viral DNA therapy delivery platform for a more personalized and calibrated approach to treating disease is not possible using a viral delivery method.

Q: What's the unique promise of Mediphage Bioceuticals' gene therapy platform?

ALVARO AMORROTU, CEO: *T*he research we're building on provides a way to deliver DNA therapies without a virus-based carrier. That makes it possible to administer treatments with less risk of triggering patients' immune systems. That could open up new treatment possibilities that are currently unavailable.

Q: What do you need most to reach your growth objectives?

AA: Talent. We're looking to add six or seven people over the next year, and we expect to grow to 30 to 32 people over the next two years.

LEE BOWMAN, COO: The challenge is that there's a worldwide shortage. The biotech industry is booming, and gene therapy is a relatively new field within it. Canadian universities produce a lot of high-quality and capable researchers, but not necessarily with the related business skills, and we'll eventually need to pursue regulatory approval and continue advancing our platform.

AA: We're also looking for some specialized skill sets — process development, for example. There are a few contract development manufacturing organizations (CDMOs) in Canada that we can tap into, but they're expensive. Developing a manufacturing process internally would be more cost-effective, but that would put us in competition with the CDMOs for the same people.

"Canadian universities produce a lot of high-quality and capable researchers, but not necessarily with the related business skills we'll eventually need to pursue regulatory approval and continue advancing our platform."

Q: Where do you look for people currently?

LB: We recruit heavily from Canadian universities. Many of our R&D staff are either recent graduates, students on internships or have come to us through the internship placement agency, Mitacs. For our leadership however, we've had to look farther abroad and use our personal networks. For example, Alvaro is based in Boston. Now we're weighing the question operationally, too: do we need to move some of our operations to the U.S.? It's cumbersome to divide people among locations, and we'd rather not do it. But we can see a day when we may need to hire 10 more people, and we're not certain the necessary talent we need is here in Canada.

Q: What impact did COVID-19 have on your operations?

LB: The shutdowns were tough for everyone. They slowed our hiring and growth and limited what we could do in our facilities, which postponed some of the results we're gathering. But in a way it helped us, too. We began work on a COVID-19 vaccine using our platform, which allowed us to access funds we couldn't have otherwise. DNA vaccines are now a key application of our platform, and the data coming from this work continues to complement our work advancing other applications and expanding our portfolio.

Q: From an HR perspective, how will you approach your next phase of growth?

AA: We would prefer to stay in Canada. We want to help the ecosystem develop further. Maybe we'll branch into the U.S. for process development. Further down the road, and from a clinical and regulatory point of view, it would be easier to recruit a Chief Medical Officer with the right skills, experience and networks there, too. It's the biggest market, and we'll need people who've worked with the Food and Drug Administration (FDA) to run clinical trials and drive the approvals process.

LB: We know and understand how passionate the people in our ecosystem are, and they want to see it grow. We don't want to see more of what happened with Providence Therapeutics: they were positioned to advance on a made-in-Canada COVID vaccine but now they're leaving the country.[16] It would be a shame to see more of that.

16 *COVID-19 vaccine maker Providence says it's leaving Canada after calls for more federal support go unanswered, CBC News, April 30, 2021.*

Implications and recommendations

As this 2021 LMI report has shown, the bio-economy will require tens of thousands of workers by 2029, largely to replace those exiting the workforce, with a smaller proportion needed to fill new roles. Companies will be challenged to fill positions due to a highly competitive labour market, relatively low awareness of bio-economy careers and, in many cases, an ongoing lack of HR capacity or capital to attract and retain candidates.

Many companies will also struggle to find well-rounded talent with soft skills, with the business knowledge to complement technical skills, and those with the precise mix of qualifications required for highly specialized or multifaceted positions ("unicorns").

At the same time, bio-economy firms will face the longer-term consequences of COVID-19. Employee mental health, for instance, is a concern for many organizations, yet with 70% of employers lacking dedicated human resources departments, few have adequate resources to address it. Without appropriate supports, there could be long-term effects on productivity, burnout rates and retention.

Hiring for manufacturing and processing, especially in the bio-health and bio-industrial sub-sectors, will be a particular challenge, as the bio-economy faces massive labour shortages in these areas until at least 2029. With anticipated expansion of pharmaceutical development and manufacturing and PPE manufacturing as a result of COVID-19, such shortages are expected to become even more severe. Canada will not be able to develop domestic capacity in these areas unless something is done to significantly expand the labour pool.

Several actions could be taken to address these needs and ensure the bio-economy continues to be a vibrant, sustainable driver of Canada's economy:

1. Create anchor companies

A strong network of large, well-known anchor companies (recommended by the Health and Biosciences Economic Strategy Table) will help raise awareness of bio-economy careers, attract top talent, offer avenues for career advancement and enable companies to achieve full commercialization within Canada. These firms would make it possible for more companies and innovations to stay in Canada, offering alternatives to foreign investments or acquisitions. That would support the growth and development of smaller companies, giving them access to a broader and deeper talent pool and more investment capital for a self-sustaining, domestic start-up, growth, acquisition and spin-off cycle.

2. Support work-integrated learning

Specific credentials are often only one piece of what makes someone a highly qualified candidate. Practical skills not necessarily learned in the context of a degree program can also be critical. Incorporating WIL into post-secondary education can help build those skills, improve retention and promote graduate mobility, among other benefits — yet today a significant proportion of students do not participate in WIL programs, particularly at post-graduate levels. As costs are often cited as a barrier, along with work permits and regulations for international students, additional support for and promotion of WIL programs, including non-school-affiliated programs such as apprenticeships, could increase participation and strengthen the sector as a whole. BioTalent Canada's Student Work Placement Program could play a key role in developing additional WIL capacity and has placed more than 5,000 students since its inception — many of whom were hired on permanently after the placement was complete.

3. Diversify recruitment and human resources practices

Workforce diversity has been abundantly proven to deliver business benefits including improved financial results and enhanced innovation, yet representation of visible minorities, recent immigrants and IEPs remains low in the bio-economy, and numbers of Indigenous workers and workers with disabilities are even lower. This may be partly because most companies tend to hire through personal connections and employee referrals, limiting the scope of their networks. If companies are serious about diversity and inclusion — and solving their labour shortages — they must expand their recruitment streams and adopt new, more inclusive HR practices and methodologies. Some companies may benefit from a turnkey HR solution that would help them reach a larger talent pool by taking diversity and the latest HR practices into account for recruitment.

4. Create a wage subsidy program for immigrants

Immigrants remain under-represented in the bio-economy labour market. Wage subsidies have proven effective at increasing representation of other under-represented groups and so could be effective in this case as well. Wage subsidy programs such as BioTalent Canada's BioReady Paid Internship program can help reduce perceived risk and encourage bio-economy companies to take advantage of the skills, knowledge and fresh insights immigrants bring.

5. Create pathways for international students and internationally educated professionals

Based on Canada's forecasted population growth, domestic talent will not be enough to fill anticipated labour demands. That makes it critical to ensure international students and IEPs can be integrated seamlessly into Canada's talent pool and labour market. This requires removing policy barriers that inhibit immigration as well as issues around skills and credential recognition and more. That includes making WIL programs more open and easily accessible to international students. The Government of Canada took action in winter and spring 2021 on these fronts by opening up new pathways to permanent residency for international students and extending work permits for international students.

6. Support additional skills development and reskilling initiatives

Many jobs in the bio-economy, including in the most in-demand areas such as manufacturing and management, do not necessarily require advanced STEM or health backgrounds, and skills from other sectors are often transferrable to these jobs. Reskilling, training and entry-level certification programs would enable the bio-economy to recruit from other industries, helping to alleviate some of the most severe labour shortages. Targeted training programs, such as BioTalent Canada's Essential Skills Fundamentals, can also help ensure new employees can quickly gain the skills required by employers. These strategies can also help employers develop promising candidates into ideal employees with tailored training in the exact skill mix required for specific positions. Post-secondary institutions might develop innovative programs and approaches to address the sector's skills gaps: technical programs emphasizing job-readiness and professional development; soft skill programs; programs to meet region-specific needs; and additional support via non-credit courses.

7. Foster bio-economy mobility

The tendency of bio-economy graduates to remain in the regions where they studied presents serious hiring challenges for companies not located near post-secondary institutions. More research is needed to understand what keeps graduates from looking further afield, and initiatives to incentivize greater mobility, such as wage subsidies and inter-provincial WIL opportunities, should be considered.

8. Strengthen human resource offerings

To compete for talent — especially industry-agnostic talent — bio-economy companies must ensure their human resource offerings are current and compelling. While salaries are a key element of this, even companies with limited resources can improve their offerings with alternative benefits such as healthcare savings accounts, professional development opportunities, wellness days, volunteer days, mentoring, coaching, flexible hours and more.

9. Improve succession planning

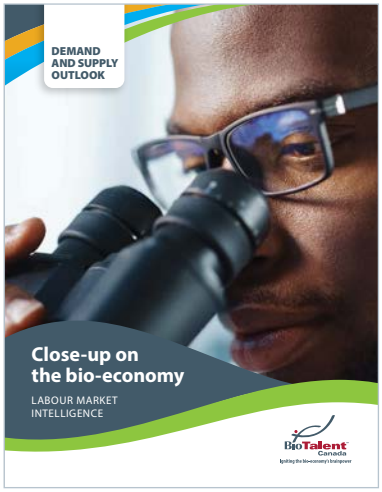
Mid-level and senior positions can be some of the most difficult to hire for, and the period while an external hire learns about a company can be challenging for everyone — and could even put retention at risk. Implementing robust succession planning strategies ensures vital knowledge can be passed down and critical roles can be filled quickly when key staff members retire or leave the company. These strategies could include mentorship programs or formal knowledge transfer processes for retirees to pass on their expertise as they gradually transition out of the workforce. Having a clear understanding of potential career progression based on a standardized system such as BioTalent Canada's National Occupational Standards can also help attract and retain talent at all levels.

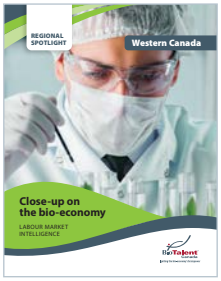
10. Raise awareness of bio-economy career opportunities

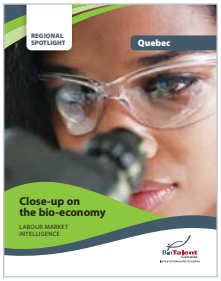
Surveys have shown that the general Canadian population, including post-secondary students and graduates of STEM programs, have low to moderate awareness of the bio-economy or occupations in it. This affects the sector's ability to compete for talent. Outreach is needed so prospective workers understand the connections between STEM and other fields and the bio-economy. Employers should connect with students as early as possible — including those in high school who are just starting to make career-related decisions and those in non-STEM fields of study — through career fairs and networking events. Enhanced partnerships between industry and academia can also serve as pipelines to employment for graduates.

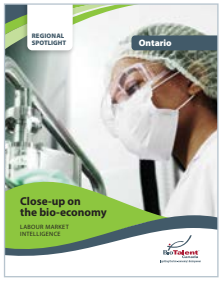
For more information on the labour market conditions and outlook for the bio-economy, see the additional reports in our *Close-up on the bio-economy* LMI series at biotalent.ca/LMIStudy.

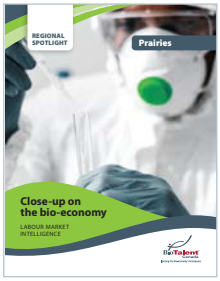
- A **Demand and Supply Outlook**
- **Regional spotlights** (Western Canada, Prairies, Ontario, Quebec, Atlantic Canada)
- **Metro hub spotlights** (Greater Montreal, Greater Toronto Area, Metro Vancouver)

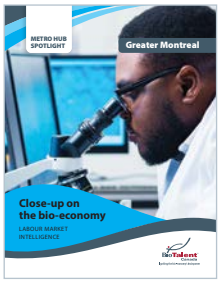


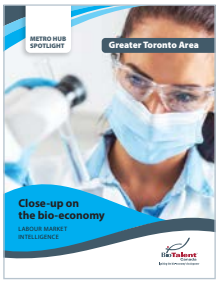


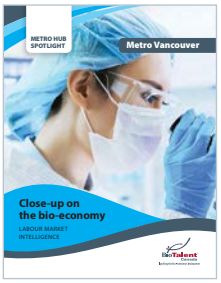












A ready mechanism

BioTalent Canada is prepared to support employers that lack the internal human resource capacity for talent recruitment, retention and development. BioTalent Canada has delivered numerous successful programs that have contributed to the growth of Canada's bio-economy labour market and to building a stronger, more sustainable sector. These include:

- Wage subsidy programs, including the Student Work Placement Program, Science and Technology Internship Program – Green Jobs, Science Horizons Youth Internship Program, Career Starter Program and BioReady™ Paid Internship Program
- Job matching platforms, including the bio-economy-specific job board, The PetriDish™
- Programs for internationally educated professionals, including the BioSkills Recognition Program and BioReady™ designation
- Skills courses, including the Essential and Technical Skills Fundamentals courses
- National Occupational Standards, a set of profiles documenting the skills, education and credentials required for specific bio-economy roles, to help employers recruit and retain the right talent, even with limited in-house human resource capacity

Methodology

This labour market study involved both quantitative and qualitative data collection, and included both primary and secondary sources.

The following outlines the primary methods used for this study:

- **Survey of bio-economy companies**, conducted between January and April 2020, with 573 bio-economy employers. The margin of error for a total sample of n=573 is +/- 4.1%, nineteen times out of twenty
- **Career perceptions survey**, conducted online between December 2020 and January 2021, with 1,531 Canadians from specific sub-groups
- **Stakeholder roundtables**, conducted as a series of three facilitated discussions in November and December 2019, with a cross-section of 119 bio-economy stakeholders
- **Stakeholder interviews**, conducted to collect qualitative data from 138 bio-economy stakeholders from various regions, sub-sectors and organizations
- **Job postings analysis**, analyzing occupational information from 10,826 bio-economy job postings collected between September 2019 and September 2020 from various public job boards and corporate websites
- **Environmental scan**, compiling and reviewing reports and articles on key issues related to the labour market and the bio-economy
- **Analysis of labour and industry data**, compiling and analyzing various databases from Statistics Canada and other agencies
- **Labour market forecasting and projections**, developing national, regional and hub-level models for forecasting hiring requirements, talent supply and future labour market outlooks for the bio-economy

It should be noted that, while most surveys and interviews focused on private sector organizations, forecasting and modelling included workers and potential workers from public, private and education sectors.

Identifying bio-economy occupations

Because the bio-economy is so diverse and touches so many sectors, it can be difficult to isolate and organize specific bio-economy occupations. For this study, the following process was undertaken to develop occupational groupings according to functions, key roles and common job titles:

1. Compiling findings from an initial environmental scan and web search to identify general occupations associated with the bio-economy.
2. Conducting a focused, in-depth literature and web search using search terms from BioTalent Canada's previous work in this area combined with the results of the first step, adapted to capture information specific to each sub-sector, area and function.
3. Conducting a final refined search to identify any missing occupations as highlighted in the job posting analysis.

The main challenge with this approach is that the results of most searches were specific to individual jobs rather than occupations, and details about areas and sub-sectors were not always available. As well, the bio-health sub-sector tended to use different definitions, terminology, job titles and credentials than the other three sub-sectors. For this reason, bio-health was analyzed separately.

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