JULY | 2019

CLEAN BIOTECH INDUSTRIES

Across the Prairie Provinces

Prairie Biosciences Canada

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* Clean Biotech is abbreviated **CBT** throughout this report

1.0 Executive Summary

Clean Biotechnology (CBT) uses environmentally friendly alternatives to conventional products. CBT applies the science of biotechnology for creating and producing alternative energy, developing a range of sustainable biomaterials/industrial products, and bioremediation.

Industrial products are everyday items, ranging from auto body parts to fabrics and specialty papers. Products fall into the following categories:

1) **BIOFUELS AND BIOENERGY**

2) **BIOFIBRES AND BIOMATERIALS**

3) **BIOCHEMICALS**

CBT transforms microorganisms, plants, and their components into new products. Work within this area includes fuel made from algae and landfill water, agricultural growth enhancers extracted from seaweed, and cellulose-based chemicals. Examples of recent large CBT activities throughout the prairies include the development of a large pea processing facility in Manitoba (for proteins), award winning advancements in wastewater treatment for livestock production in Alberta, and advancements in grain data and analytics in Saskatchewan.

revenue

(noun)

rev-e-nue

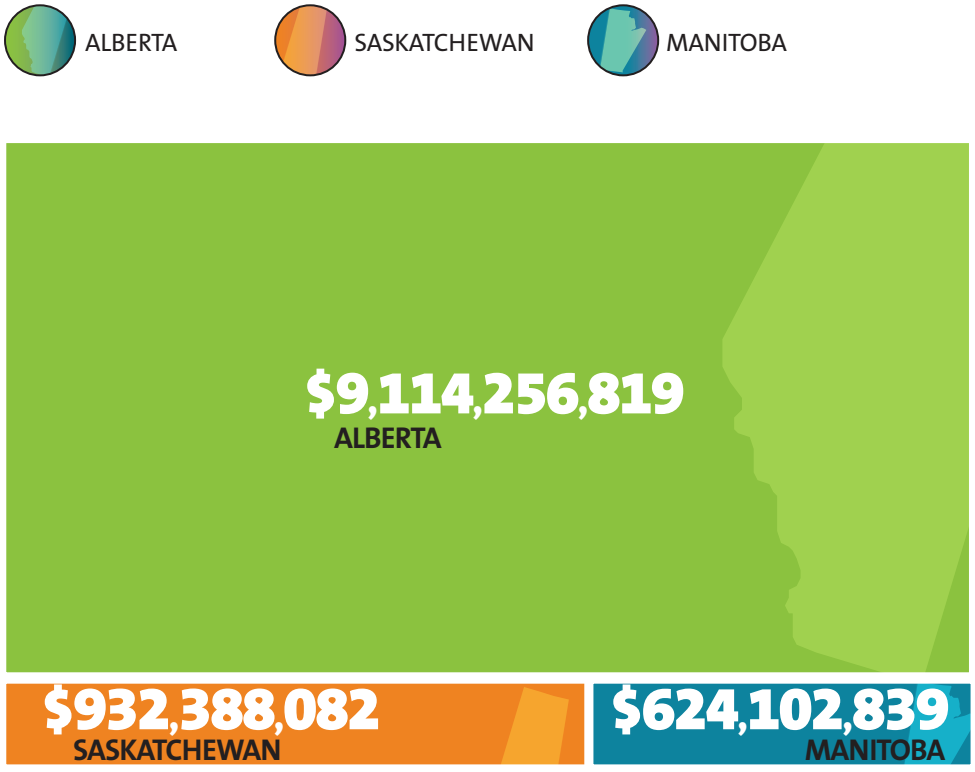
Definition of revenue

income, especially when of a company or organization and of a substantial nature.

Synonym income, takings, receipts, proceeds, earnings.

This report focuses on the CBT industry, with specific focus on Manitoba, Saskatchewan, and Alberta.

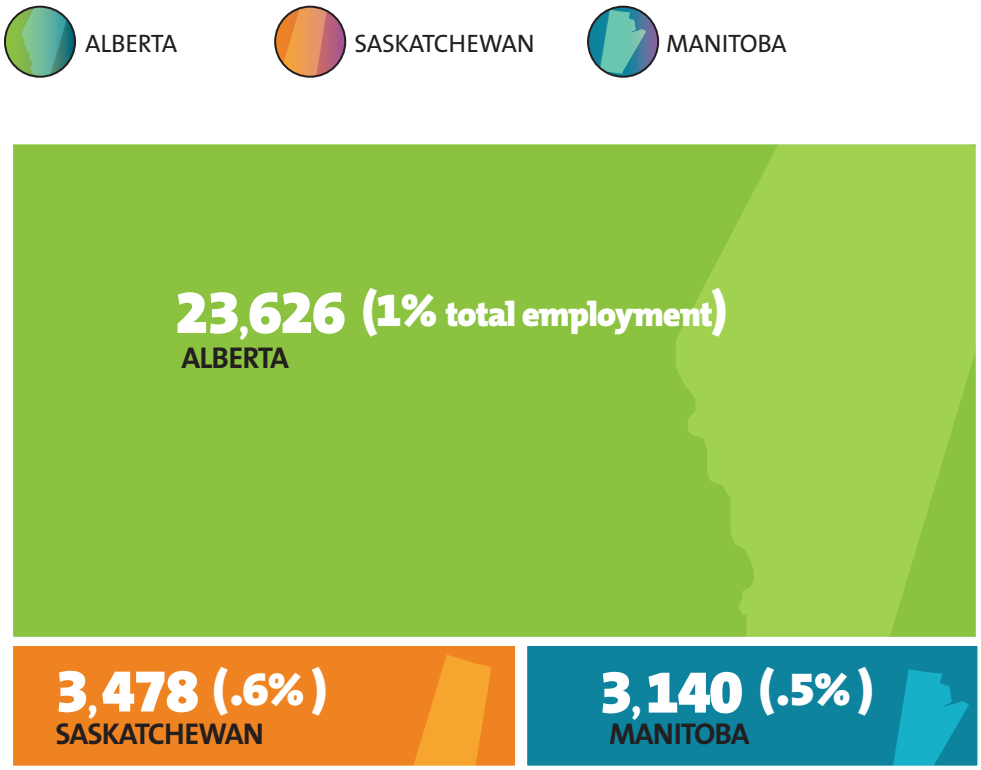
TOTAL INDUSTRY SALES/REVENUE 2017



1.0 Executive Summary

Total Industry Sales/Revenue in 2017 across the Prairie Provinces is estimated at $10,670,747,740. Despite a smaller population, Saskatchewan's CBT sector generates more sales/revenue than Manitoba. Alberta has many more companies relative to the other provinces. Despite the fact that Alberta companies have on average, lower revenues, (section 6) the volume of companies create greater contributions to the GDP and total revenue in the west.

TOTAL INDUSTRY EMPLOYMENT 2017 (as a percentage of total direct GDP)



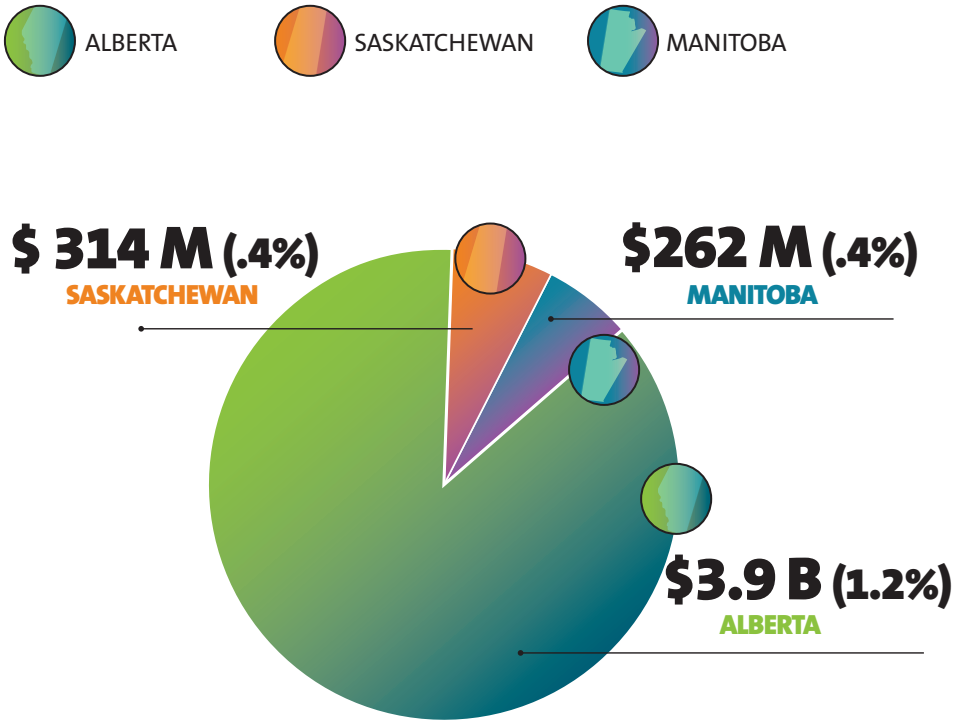
Total Industry Employment in 2017 across the **Prairie Provinces is estimated at 30,244**.

gdp
(noun)

je·de·pe
Definition of gdp
short for gross domestic product.

Each Province's CBT Industry contributes significantly to its provincial economy with Alberta's being the largest.

WITHIN PROVINCE DIRECT GDP CONTRIBUTION (as a percentage of total direct GDP)



1.0 Executive Summary

GDP Definitions:

DIRECT GDP

The market value of final goods and services produced by the industry less the value of intermediate inputs required to produce the final goods and services.

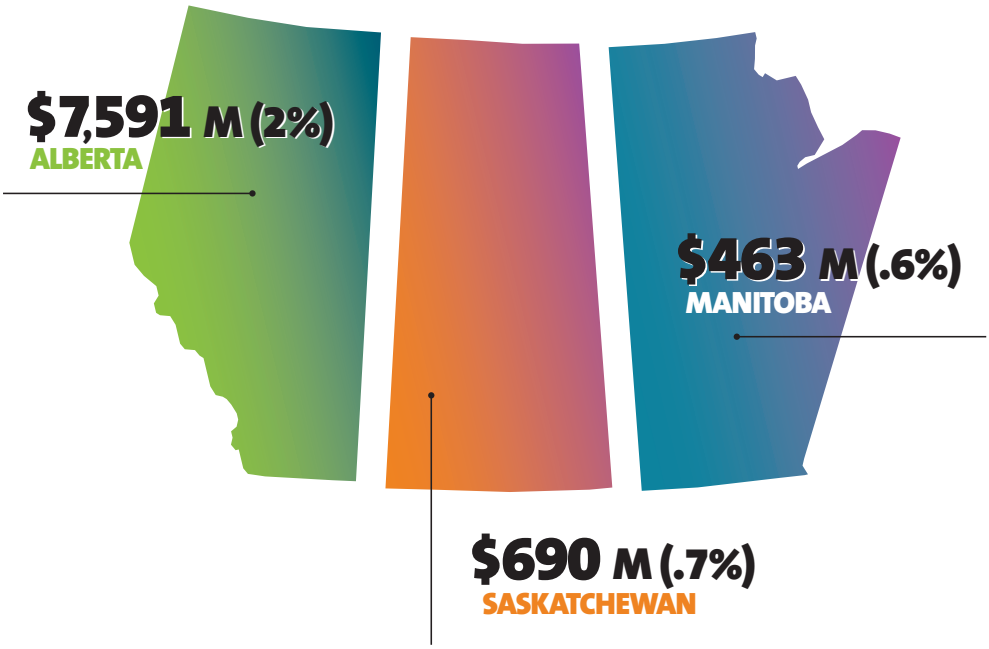
INDIRECT GDP

The GDP contribution resulting from the inputs supplied required to produce final goods and services. These inputs are supplied by other businesses in the economy through a supply chain network.

INDUCED GDP (wage effect)

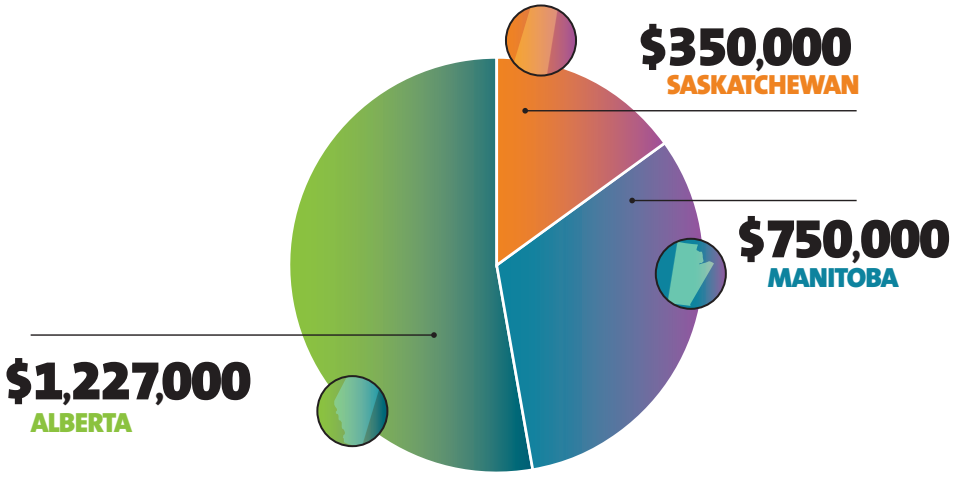
The expansion in economic activity caused by direct and indirect GDP which generates disposable income that individuals and households spend in the economy.

WITHIN PROVINCE TOTAL GDP CONTRIBUTION (as a percentage of total GDP)



Capital Raised

AVERAGE CAPITAL RAISED 2017



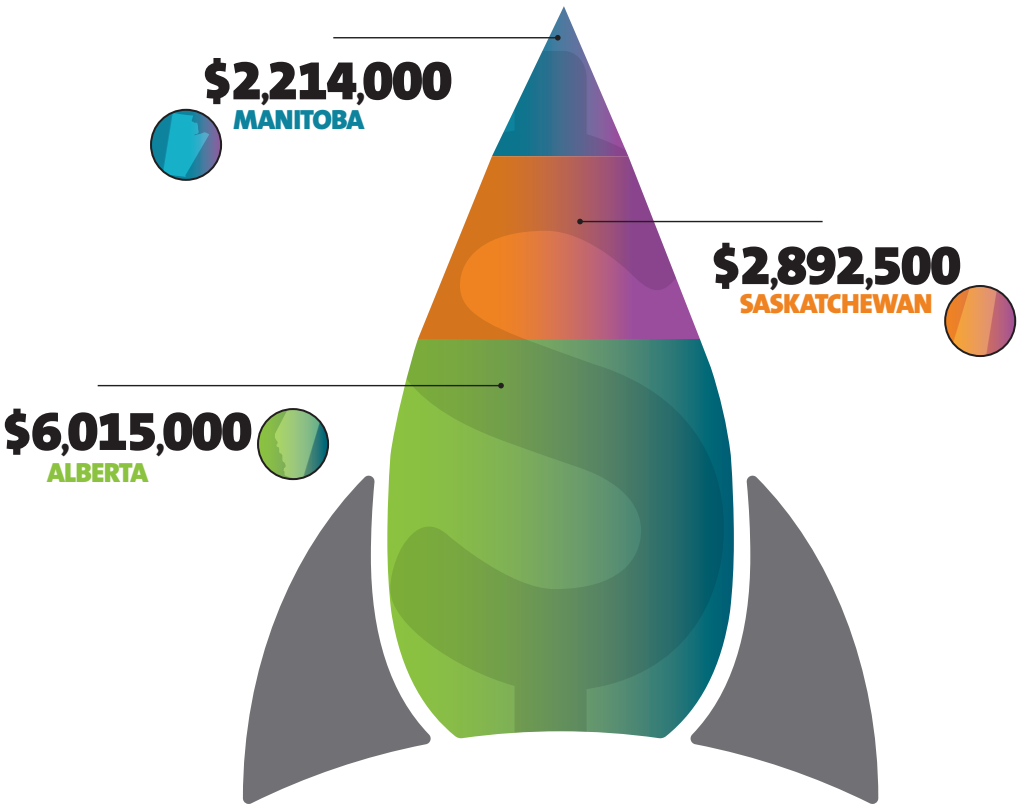
Alberta companies tend to raise the most capital followed by Manitoba and Saskatchewan respectively based on the average capital raised. Total capital raised in the industry as a whole is unknown, but total actual capital raised by the survey sample is as follows:

PROVINCE	TOTAL CAPITAL RAISED	SAMPLE SIZE
Manitoba	$8,250,000	11
Saskatchewan	$4,550,000	13
Alberta	$26,991,250	22

1.0 Executive Summary

Research and Development

TOTAL R&D INVESTMENT IN 2017



Alberta companies tend to conduct the most R&D followed by Saskatchewan and Manitoba respectively. Based on the respondents the average R&D invested by the survey sample is as follows:

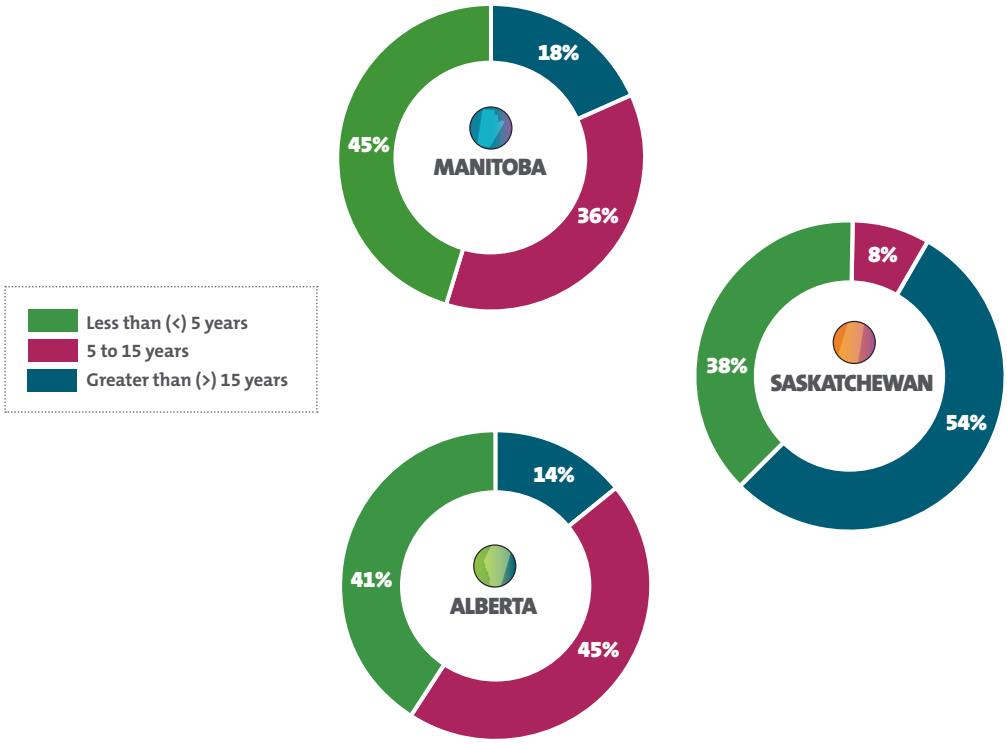
PROVINCE	AVERAGE R&D INVESTED	SAMPLE SIZE
Manitoba	$201,313	11
Saskatchewan	$222,500	13
Alberta	$273,460	22

Summary Findings

2.0 Business Age and Lifecycle

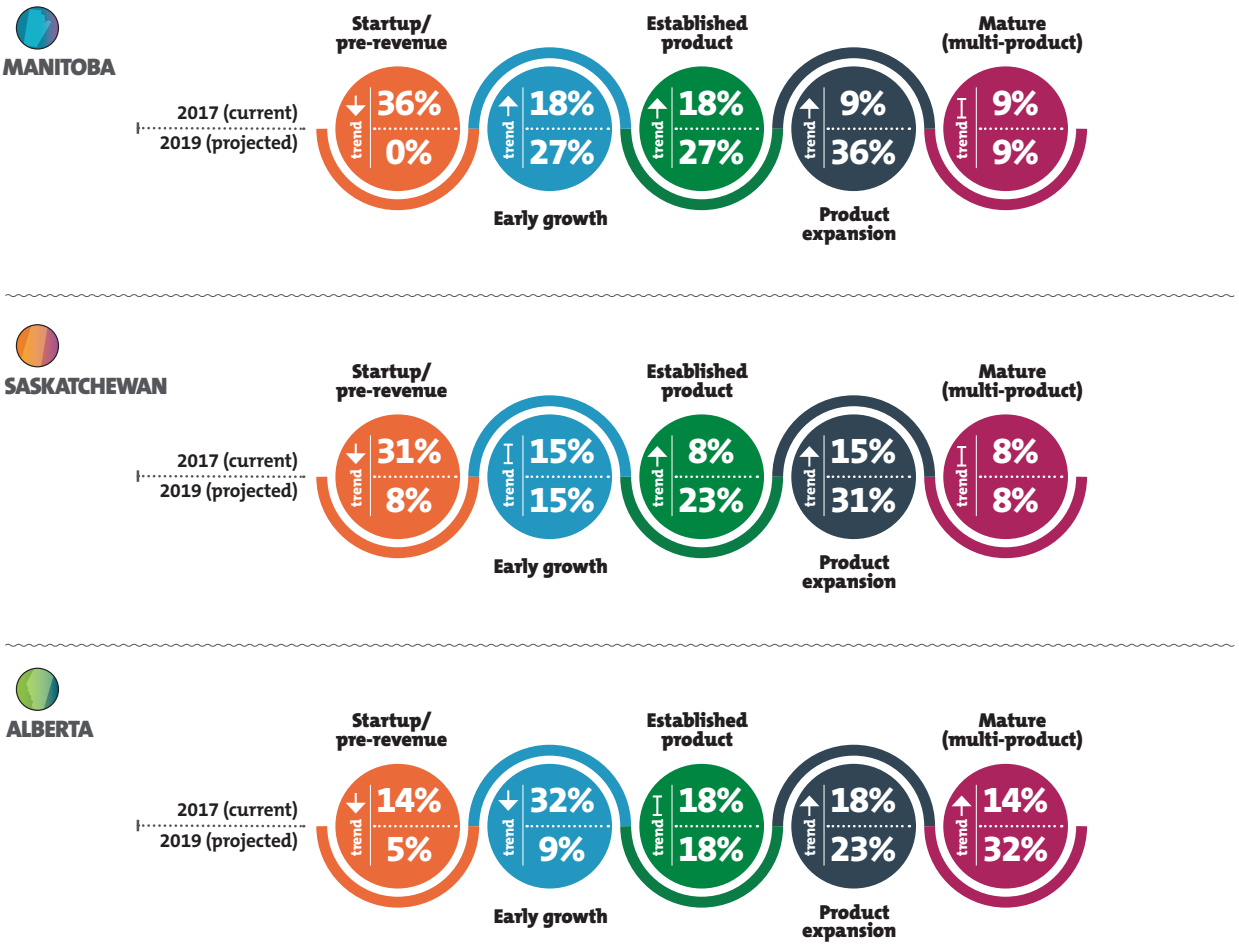
Saskatchewan companies are significantly older than the other provinces with 54% reporting being greater than 15 years of age. Manitoba reported the greatest proportion of start-ups (less than 5 years), with Alberta reporting the greatest proportion of 5 to 15 years (45%). The higher percentage of start-ups may contribute to the lower revenue in Manitoba.

BUSINESS AGE



Companies were asked to indicate their current business stage, and, their anticipated business stage in two years (2019). In line with the business age results, 36% of Manitoba companies reported being start-up/pre-revenue with zero companies expecting to remain in this category in 2019. The majority of companies in Manitoba expect to be in either early growth, established product, or product expansion in two years. Alberta companies are highly optimistic with 14% reporting as currently mature and 32% expecting maturity in just two years. Both Manitoba and Saskatchewan report the same proportions for current and anticipated maturity with 9% and 8% respectively. The results suggest that industry growth in Alberta may be quicker than in the other Prairie Provinces and that maturity may be difficult to reach in Saskatchewan given that 54% of companies are greater than 15 years old with only 8% currently at the maturity stage.

BUSINESS STAGE - 2017 & 2019



2.0 Business Age and Lifecycle

2.1 Future Growth Strategies

Survey respondents were asked to indicate future growth strategies that their company intends to pursue. Across the provinces, companies intend on developing new products, services and processes, expanding market share, and securing government funding to expand business with 92% of Saskatchewan companies reporting that they will be developing new products, services and processes.

FUTURE GROWTH STRATEGIES	MANITOBA	SASKATCHEWAN	ALBERTA
Developing new products, services and processes	**73%**	**92%**	**77%**
Expanding your market share	**73%**	**54%**	**73%**
Securing government funding to expand business	**45%**	**62%**	**77%**
Licensing and re-selling of technology	36%	31%	45%
Securing bank financing to expand business	36%	31%	32%
Continuing operations without a major change	36%	0%	32%
Acquiring one or more companies	9%	23%	14%
Merging with one or more companies	9%	15%	18%
Selling to another company	0%	8%	23%

2.2 Challenges Facing Businesses

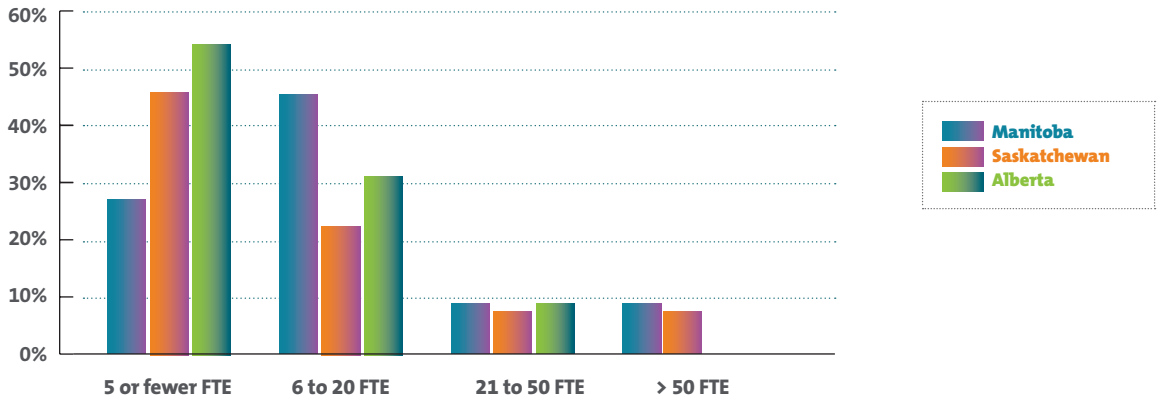
Managing the regulatory process and attracting a strategic partner for the purposes of investment, new technology, R&D are the greatest challenges facing companies. A very similar pattern holds for all businesses facing challenges across the prairies. However, accessing Canadian markets is reported as a significant challenge in Alberta with 77% reporting as either a major or minor challenge. This is contrary to Manitoba and Saskatchewan with only 45% and 46% reporting this as a challenge respectively. The same pattern holds for maintaining a Canadian presence with 54% of Alberta companies reporting as either a major or minor challenge compared to 39% and 36% in Manitoba and Saskatchewan respectively. These Canadian related challenges reported by Alberta are contrary to the results from 5.0 Location of Sales which demonstrates that Alberta sells proportionally more to the rest of Canada than the other provinces. However, this could imply that Manitoba and Saskatchewan aren't attempting sales to the rest of Canada.

PROVINCE	CHALLENGES	MAJOR OBSTACLE	MINOR OBSTACLE
Manitoba	Attracting a strategic partner for the purposes of investment, new technology, R&D	18%	45%
Saskatchewan		54%	31%
Alberta		32%	36%
Manitoba	Managing the regulatory process	27%	36%
Saskatchewan		27%	36%
Alberta		27%	36%
Manitoba	Accessing Canadian markets	0%	45%
Saskatchewan		0%	46%
Alberta		32%	45%
Manitoba	Attracting a technology licensing partner	0%	36%
Saskatchewan		8%	31%
Alberta		5%	27%
Manitoba	Maintaining IP protection	9%	27%
Saskatchewan		0%	46%
Alberta		18%	36%
Manitoba	Maintaining a Canadian presence	0%	36%
Saskatchewan		8%	31%
Alberta		18%	36%

3.0 Company Size

COMPANY SIZE - EMPLOYMENT

55% of Alberta CBT companies have 5 or fewer FTEs followed by Saskatchewan (46%). Manitoba (27%) has fewer small companies. However, if you look at the companies with fewer than 20 FTE, the three regions have similar numbers; 72% of Manitoba companies have 1 to 20 FTEs, followed by Alberta (82%) and Saskatchewan (76%). No Alberta company reported as having greater than 50 FTEs with Manitoba and Saskatchewan at 9% and 8% respectively. These results suggest that Manitoba CBT companies are relatively larger in terms of employment per company than the other Prairie Provinces despite the high proportion of young, start-up/pre-revenue companies.



4.0 Location of Sales

Companies were asked to report the destination of their sales. Total sample revenue was as follows:

PROVINCE	TOTAL SAMPLE REVENUE
Manitoba	$40,574,997
Saskatchewan	$29,874,998
Alberta	$15,224,996

Virtually all of Manitoba and Alberta sales are within their own province, while only 25% of Saskatchewan sales are within Saskatchewan. Sales from Saskatchewan are primarily to the United States with some shipment to Europe and Asia. This is consistent with 38% of Saskatchewan companies reporting required compliance with the US Food and Drug Administration compared to 23% and 9% in Alberta and Manitoba respectively as reported in Section 9.0 Regulatory Requirements.

LOCATION OF SALES BY PROVINCE

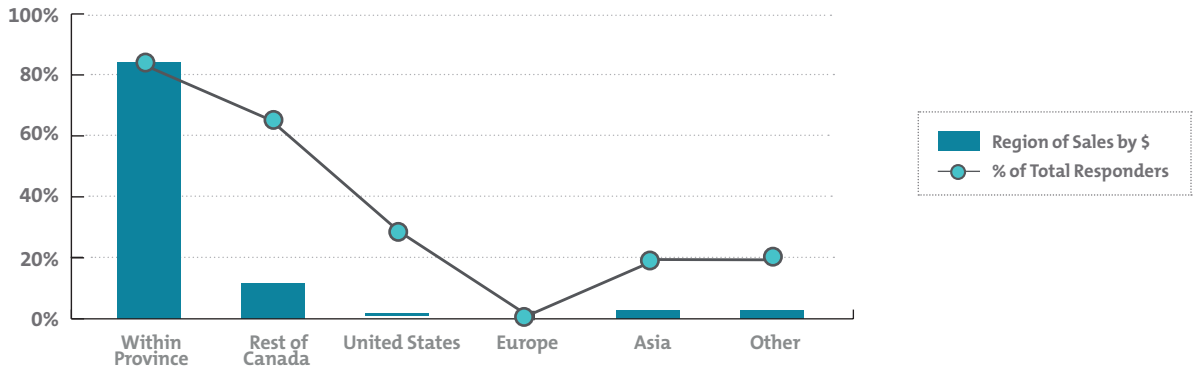
REGIONS	Manitoba	Saskatchewan	Alberta
WITHIN PROVINCE	85.9%	25.2%	64.1%
REST OF CANADA	11.2%	23.4%	31.4%
UNITED STATES	.5%	40.1%	1.8%
EUROPE	0.00%	7.0%	1.0%
ASIA	1.2%	3.7%	1.7%
OTHER	1.3%	.7%	0%

4.0 Location of Sales

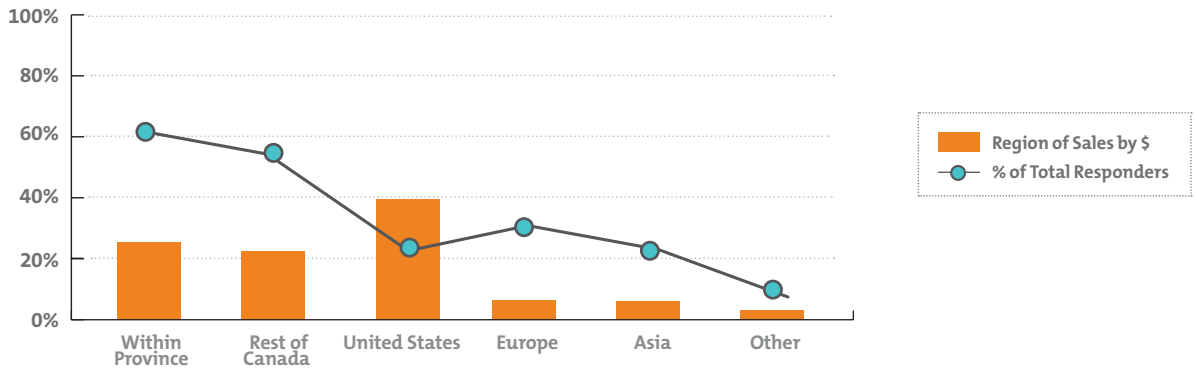
LOCATION OF SALES

By Revenue and % of Companies Selling in each Region

MANITOBA

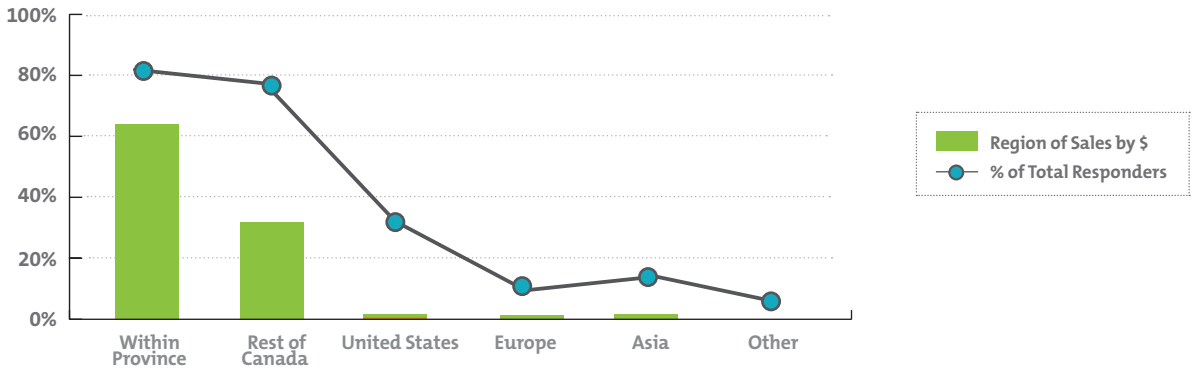


SASKATCHEWAN



4.0 Location of Sales

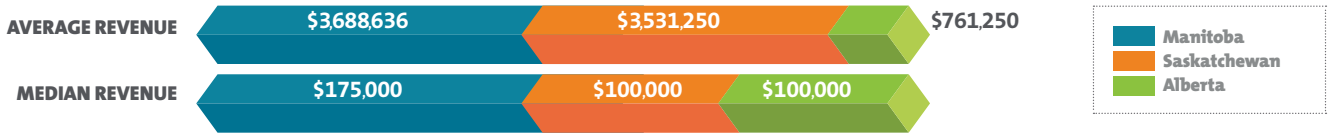
ALBERTA



5.0 Revenue/Sales

Average company revenue/sales in Manitoba was the largest, slightly greater than Saskatchewan. Alberta was the lowest at $761,250. This is likely due to the non-normal distribution of revenue with the distribution highly skewed to smaller revenue sizes (median revenues far less than average). This is very common in analyzing any industry sector since most often, a few companies account for a large share of total industry revenue/sales. From an analytical perspective, when acquiring a random sample of survey respondents, since Alberta has substantially more companies than the other provinces, there is a lower probability of receiving response from one or more of the larger companies. Therefore, population estimation using the methods and processes detailed in Section 2.0 were used.

SAMPLE RESULTS

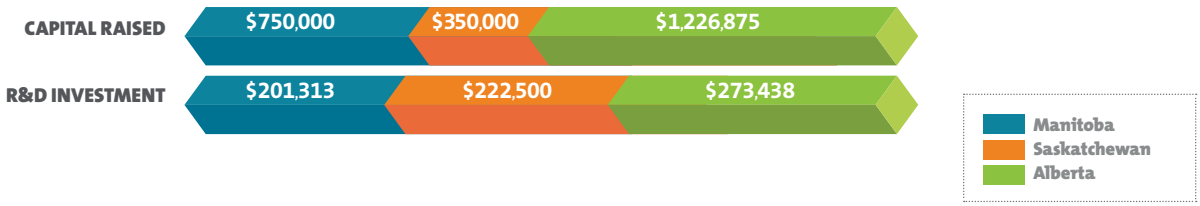


It is important to note that Saskatchewan's CBT industry is larger than Manitoba's with approximately 50% more total revenue and slightly less than twice as many businesses. Saskatchewan is also substantially larger than Manitoba with respect to environmental safety and energy conservation services, primarily environmental consulting and remediation services.

PROVINCE	TOTAL INDUSTRY SALES	TOTAL BUSINESSES
Manitoba	$624,102,839	119
Saskatchewan	$932,388,082	226
Alberta	$9,114,256,819	1,247

Despite the lower average revenue, Alberta reported the highest average capital raised and R&D invested. It is important to note that only 18% companies in Manitoba, 36% in Alberta, and 38% in Saskatchewan reported raising capital. This is in contrast to R&D investment with 64% companies in Manitoba, 77% in Alberta, and 85% in Saskatchewan having conducted R&D.

AVERAGE CAPITAL RAISED/R&D INVESTMENT



The majority of capital raised is from government programs and founder equity. However, angel investors and debt financing is also used. Comparing businesses in Alberta and Saskatchewan, which both raised proportionally more capital than Manitoba (only 18% in Manitoba), there appears to be a similar trend with respect to capital sources. Alberta and Saskatchewan rely on founder equity and friends and family at a similar rate. Government programs are used slightly more by Alberta, with Saskatchewan relying on debt financing. No companies use stock exchange as a source of capital which suggests that no company is publicly traded, or, all publicly traded companies are past their initial public offering stage.

CAPITAL SOURCES	MANITOBA	SASKATCHEWAN	ALBERTA
Founder equity	50%	60%	50%
Friends and family	0%	20%	25%
Government programs	100%	20%	38%
Stock Exchange (e.g TSX, Nasdaq)	0%	0%	0%
Angel Investors	50%	20%	13%
Venture Capital	0%	0%	13%
Debt Financing	50%	40%	25%
Other	100%	20%	38%
Total companies reporting raising capital	**2 out of 11**	**5 out of 13**	**8 out of 22**

6.0 Capital and R&D

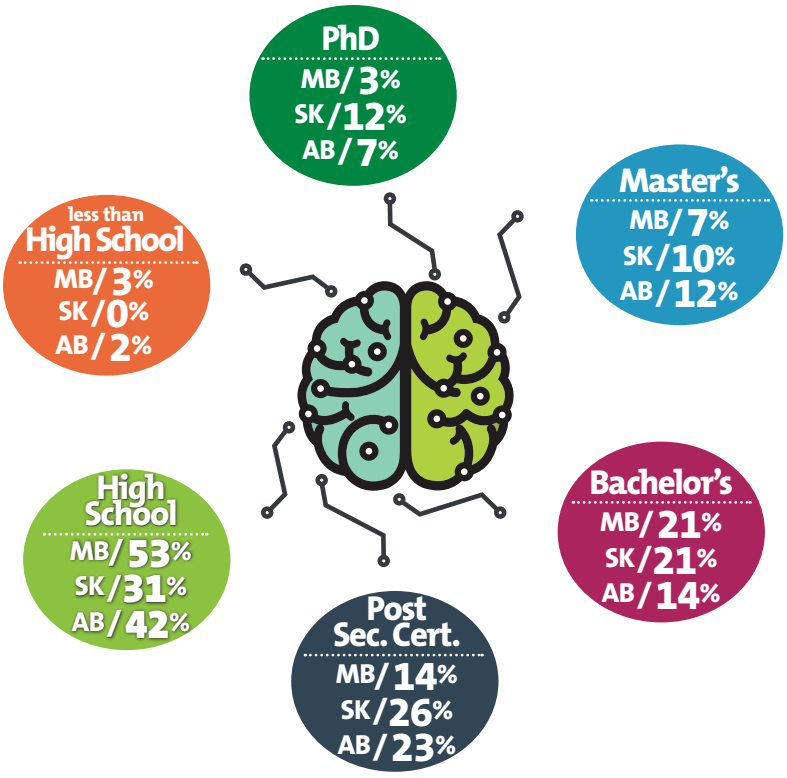
Manitoba and Alberta tend to finance R&D through private capital at a higher rate than Saskatchewan. Saskatchewan tends to finance R&D using company revenues. Although government programs are the biggest source of R&D financing across all three provinces, Manitoba and Saskatchewan rely on them slightly more than Alberta.

R&D SOURCES

R&D SOURCES	MANITOBA	SASKATCHEWAN	ALBERTA
Private Capital	39%	23%	39%
Government Programs	51%	50%	40%
Company Revenues	10%	27%	20%
Total companies reporting R&D Involvement	**7 out of 11**	**11 out of 13**	**17 out of 22**

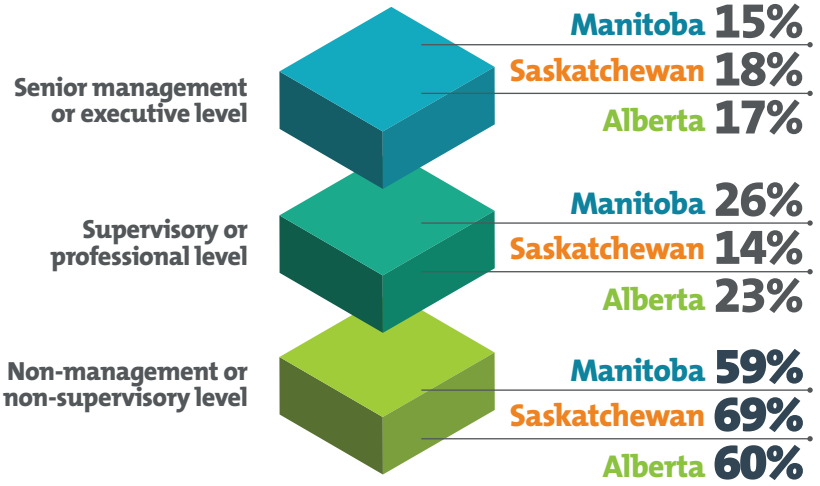
CBT companies have a highly educated workforce; however, not to the extent that is seen in the other bioscience sectors (Health Biotech and Ag Biotech). With respect to CBT across the prairie provinces, Saskatchewan and Alberta have the highest concentration of workers with at least a Master's degree, with 22% and 19% respectively. 53% of the workforce in Manitoba possess a high school diploma only, compared to 31% in Saskatchewan.

DEGREES/EDUCATIONAL QUALIFICATIONS



7.0 Workforce

The majority of the workforce in all three provinces consists of non-management and non-supervisory level positions with the greatest proportion of these in Saskatchewan.



The following table presents the proportion of unfilled positions by broad occupation category:

OCCUPATION CATEGORY	MANITOBA	SASKATCHEWAN	ALBERTA
Senior management or executive level	20%	17%	17%
Supervisor or professional level	**50%**	25%	33%
Non-management or non-supervisory level	30%	**58%**	**50%**
Total	**100%**	**100%**	**100%**

There are proportionally more unfilled senior management/executive level and supervisor/professional level positions in Manitoba compared to either Alberta and Saskatchewan. This suggests that recruitment of highly skilled occupations may be more difficult in Manitoba. This is confirmed in Section 7.1 Workforce Challenges with every company in Manitoba (responding to the survey) reporting that attracting the aforementioned occupations as either a major or minor obstacle. .

7.1 Workforce Challenges

Attracting a skilled workforce in Manitoba is reported as significantly more difficult than in the other two provinces.

Attracting

PROVINCE	SKILL SHORTAGES (ATTRACTING)	MAJOR OBSTACLE	MINOR OBSTACLE
Manitoba	Attracting senior management at an executive level	50%	50%
Saskatchewan		33%	0%
Alberta		29%	29%
Manitoba	Attracting employees at a supervisory or professional level	50%	50%
Saskatchewan		67%	0%
Alberta		29%	29%
Manitoba	Attracting employees at a non-management or non-supervisory level	0%	50%
Saskatchewan		0%	67%
Alberta		14%	14%
Manitoba	Overall difficulty in attracting the above broad positions	33%	50%
Saskatchewan		33%	22%
Alberta		24%	24%

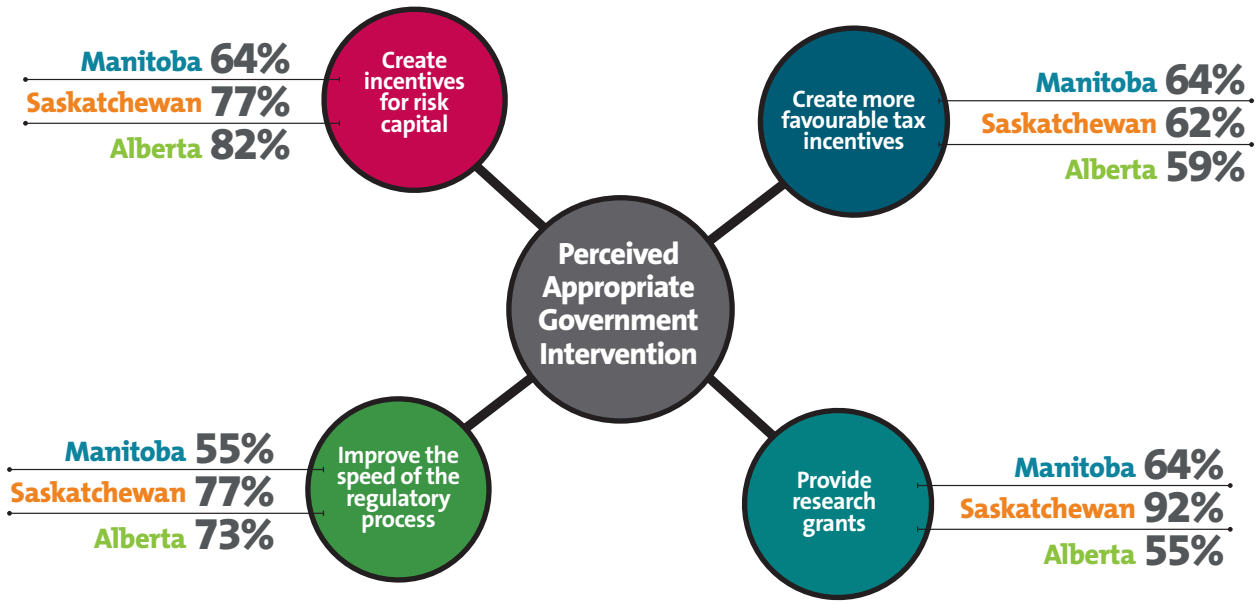
Retaining

PROVINCE	SKILL SHORTAGES (RETAINING)	MAJOR OBSTACLE	MINOR OBSTACLE
Manitoba	Retaining employees at a senior management or executive level	0%	100%
Saskatchewan		0%	0%
Alberta		14%	0%
Manitoba	Retaining employees at a supervisor or professional level	0%	100%
Saskatchewan		0%	33%
Alberta		14%	0%
Manitoba	Retaining employees at a non-management or non-supervisory level	0%	50%
Saskatchewan		0%	33%
Alberta		14%	14%
Manitoba	Overall difficulty in retaining the above broad positions	0%	83%
Saskatchewan		0%	22%
Alberta		14%	5%

A similar pattern holds for retention, which is an obstacle for all Manitoba companies responding to the survey (100% reported as “minor obstacle” in Manitoba). Retention is also more difficult in Manitoba than the other two provinces with few reported retention issues in Alberta and Saskatchewan for all broad occupation categories. Retention is reported as less of a challenge in all provinces compared to recruitment.

8.0 Required Areas of Government Intervention

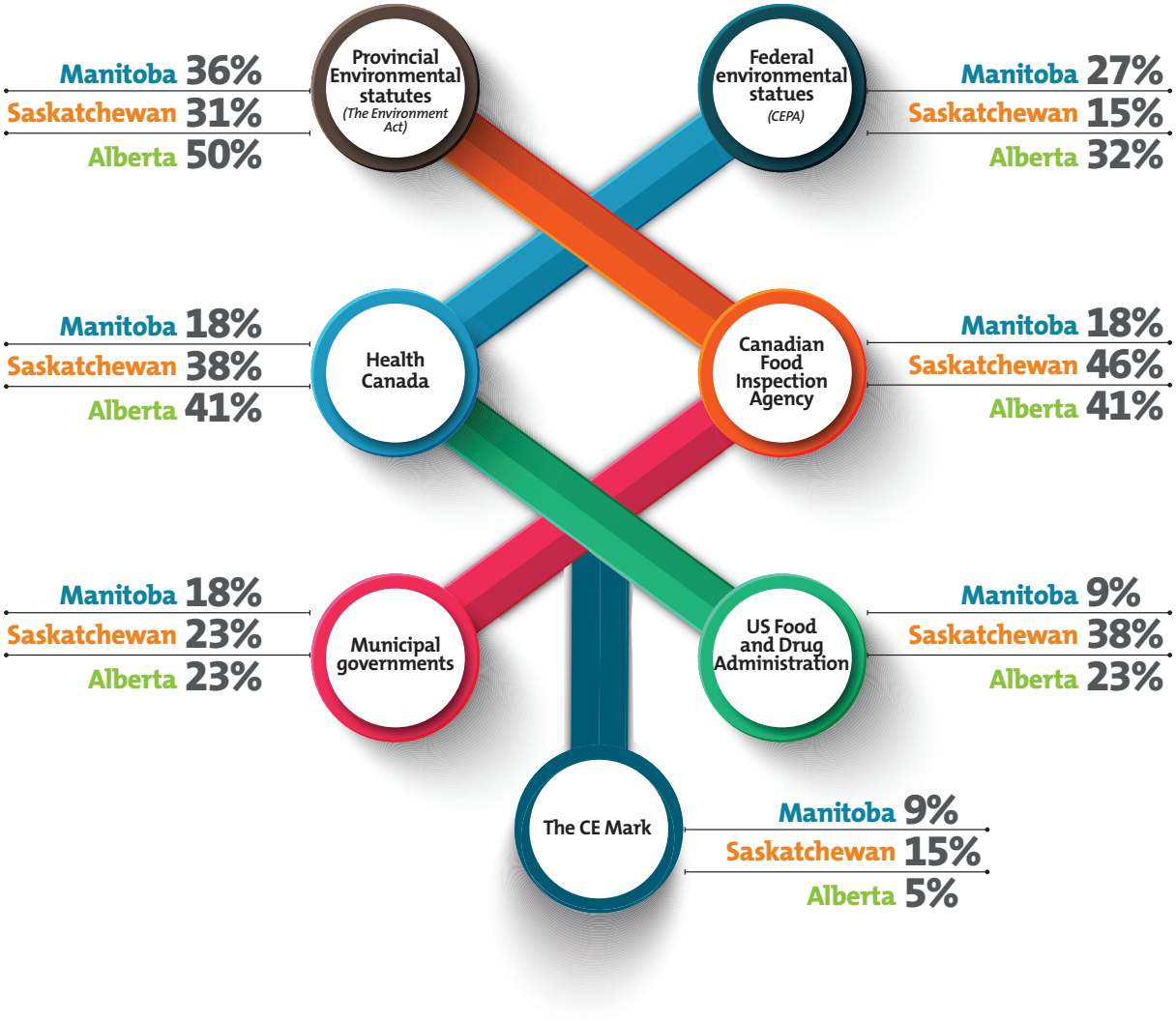
The CBT industry survey across the prairies suggests that there is a desire for government to be involved in all four (4) named categories: creating incentives for risk capital, creating more favourable tax incentives, providing research grants, and improving the speed of the regulatory process. 92% of Saskatchewan companies report that the government should be involved in providing research grants compared to 64% and 55% in Manitoba and Alberta respectively. Alberta and Saskatchewan companies suggest that the government should be involved in improving the speed of the regulatory process (73% and 77% respectively) compared to 55% in Manitoba. In summary, it appears that the CBT industry feels the need for increased government support in assisting the industry.



9.0 Regulatory Requirements

The Environment Act and the CFIA are reported as the greatest regulator of the CBT industry across the Prairie Provinces, followed by Health Canada and federal environmental statutes. As reported earlier, Saskatchewan exports more to the United States and Europe compared to the other provinces and therefore are required to comply with the US FDA and CE Mark regulations at a greater proportion.

REGULATORY BODY ISSUING CLEARANCE/APPROVAL FOR NEW PRODUCTS



10.0 Usage of Government Programs

PROVINCE	GOVERNMENT SUPPORTED INITIATIVES	USAGE RATE
Manitoba	Technology Advisory Services: National Research Council Industrial Research Assistance Program (NRC/IRAP)	**55%**
Saskatchewan		**46%**
Alberta		36%
Manitoba	Scientific Research and Experimental Development Tax Credit Program (SRED): Canada Revenue Agency	45%
Saskatchewan		**46%**
Alberta		41%
Manitoba	Growing Forward Agri-Innovation Program: Agriculture and Agri-Food Canada (AAFC)	45%
Saskatchewan		38%
Alberta		23%
Manitoba	Technology Innovation Projects: NRC/IRAP	45%
Saskatchewan		**46%**
Alberta		**50%**
Manitoba	Canadian Trade Commissioner Service: Department of Foreign Affairs Trade and Development	27%
Saskatchewan		38%
Alberta		32%
Manitoba	Engage Program: Natural Sciences & Engineering Research Council (NSERC)	32%
Saskatchewan		27%
Alberta		32%

11.0 Conclusion

The CBT industry across the prairies is unique, highly innovative, and produces a variety of different products and services, which ultimately share a common set of goals:

(1) To produce the same or a greater volume of goods with less resources required as inputs.

(2) To reduce environmental impacts for a given level of production.

The CBT economy spans a variety of sectors including agriculture, water and wastewater, fuels, advanced manufacturing, and technologies. The CBT economy amounts to approximately 1% of each prairie province's total direct GDP and less than 1% of the workforce. Despite this, CBT is a high value-added sector with GDP per worker of $83,500 in Manitoba, $90,400 in Saskatchewan, and $165,000 in Alberta.

Workforce challenges are characterized by a difficulty with recruitment, more than retention, indicating that once companies find the right workers for the job, they stay put. It is a highly educated sector with over 30% of the workforce in the prairies possessing at least a bachelor's degree.

12.0 Appendix

In 2018 Bioscience Association Manitoba (BAM) administered a survey across Manitoba, Saskatchewan, and Alberta to collect information related to the entire bioscience industry in Manitoba, and the CBT industry in Saskatchewan and Alberta. The survey was deployed using an online format. The survey resulted in 81 responses in Manitoba (11 of which were CBT), 13 in Saskatchewan, and 22 in Alberta. Respondents were asked a variety of questions pertaining to their operating sector, revenue/sales, human resources, challenges, exports, capital and R&D. Each respondent was requested to assign themselves to a unique North American Industry Classification System (NAICS) code based on their primary business area. Statistics Canada data was used to augment the survey sample and generate estimates of total industry parameters including revenue and employment. The following NAICS codes were used to define the CBT industry:

Renewable Energy	321111	Sawmills (except shingle and shake mills)
Bio - Industrial	313110	Fiber, yarn and thread mills - manufacturing [313110]
	314990	All other textile product mills [314990]
	322110	Pulp mills [322110]
	322121	Paper, except newsprint, mills [322121]
	322122	Newsprint mills [322122]
	322130	Paperboard mills [322130]
	325190	Other basic organic chemical manufacturing [325190]
	325610	Soap and cleaning compound manufacturing [325610]
	325991	Custom compounding of purchased resins [325991]
	325999	Other miscellaneous chemical product mfg. [325999]
	326290	All other rubber product manufacturing [326290]
	333416	Heating equipment and commercial refrigeration equipment manufacturing [333416]
Environmental Safety/ Energy Conservation Services	541620	Environmental consulting services [541620]
	562210	Waste treatment and disposal [562210]
	562910	Remediation services [562910]

These NAICS codes were selected based on the survey respondent's self-assignment of NAICS, a careful review of the NAICS manual and definitions, consultation with BAM and other industry experts, NAICS utilized in other provincial studies including Life Sciences Ontario and Life Sciences British Columbia, and a review of actual companies contained in each NAICS. For example, almost every company contained in NAICS 321111 Sawmills (except shingle and shake mills) are conducting research to become greener and more environmentally friendly and/or developing and/or utilizing processes which transform waste products into environmental goods.

To estimate population totals for provincial industry revenue, employment, and GDP, data obtained from Statistics Canada GDP data series, manufacturer's database, employment tables, and the business register were instrumented. Supply and use tables were used to compute various GDP measures for each NAICS.

Ag-West Bio

bio alberta
Association for Life Sciences Industry

bam

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