

Working paper

**Business Special Surveys and Technology Statistics
Division Working Papers**

Results from Statistics Canada's Bioproducts Production and Development Survey 2009

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December 2011

Catalogue no. 88F0006X, no. 1

ISSN 1921-300X

ISBN 978-1-100-19858-3

Frequency: Occasional

Ottawa

Cette publication est également disponible en français.

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Symbols

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- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- p preliminary
- r revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- A excellent data quality
- B very good data quality
- C good data quality
- D acceptable data quality
- E use with caution
- F too unreliable to be published

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Results from Statistics Canada's Bioproducts Production and Development Survey 2009

by Neil Rothwell and Beau Khamphoune, Statistics Canada and Catherine Neumeyer, Agriculture and Agri-food Canada.

1 Highlights

- In 2009, 208 firms were engaged in the production or development of bioproducts. Of these, 89 had been engaged in bioproducts related activity for five years or less. This represented 43% of all bioproducts firms.
- Bioproduct firms saw an increase in revenue from bioproducts from just over \$1.0 billion to approximately \$1.3 from 2008 to 2009.
- Research and development spending on bioproduct development remained stable with \$49.9 million in 2008 compared to \$50.2 billion in 2009.
- In 2009, bioproduct firms employed just over 3,000 workers engaged in bioproduct related activities with total salary expenditures of approximately \$210 million.
- In 2009, 29 bioproduct firms were involved in fuel-based ethanol activity. Twenty of these firms had ethanol in production or on the market. Meanwhile, 40 firms were involved in biodiesel production or development with 29 of these having biodiesel in production or on the market.
- Agricultural biomass was the primary biomass source for 87 bioproduct firms in 2009, while forestry biomass was the primary biomass source for a further 46 firms.
- Bioproduct firms obtained their biomass primarily from farms over any other source.
- 41% of firms' primary biomass was transported less than 100 km to their processing facility (25% less than 50km), whereas 19% was transported over 500 km.
- Government sources were the main source of external funding for bioproduct related activities. In 2009, bioproduct firms raised \$60.5 million through government grants and \$47.5 million through government loans. In contrast, \$35.5 million was raised through Canadian based private venture capital.
- When deciding on the location of a new facility more bioproduct firms (78%) rated financial incentives such as government programs as more important than any other factor.
- Research and development was the primary activity contracted out by bioproduct firms (73). This was followed by engineering services which was contracted out by 58 firms.

2 The Survey

This working paper presents results from Statistics Canada's Bioproducts Production and Development Survey 2009. This survey is the third survey on bioproduct activity, conducted on a cost recovery basis. In 2004, in recognition of the potential commercial value of technologies being developed in bioproducts, an inter-departmental working group (Federal Working Group on Bioproducts) brought together interested stakeholders from across government, industry, and non-governmental organizations to discuss how to organize the collection of statistical information on commercial activities in this emerging sector. The first survey by Statistics Canada collected 2003 data and this was followed by a 2006 survey.

The Bioproducts Production and Development Survey 2009 targeted all firms in Canada that use renewable biomass feedstocks/materials to develop or produce bioproducts (Box 1) with the aim of providing statistical information on the emerging Canadian bioproducts sector and to generate a profile of firms engaged in the production and/or development of bioproducts in Canada. The target population for this survey was a subset of the bioproducts sector. The survey was sponsored by Agriculture and Agri-Food Canada (AAFC) and the survey content was developed through a partnership between Statistics Canada and AAFC.

The 2009 survey focused on the key characteristics and activities of firms that develop or produce bioproducts as part of their firm's activities in Canada. As such, the firms surveyed do not constitute an 'industry' in the sense that they are not defined by a specific output. Rather, bioproducts firms are defined by their use of specific *inputs*. Moreover, these inputs have to be used in a novel manner and/or to produce novel products. As a result, firms surveyed are from many different industries.

The survey targeted the population of firms involved in the use of renewable biomass (more commonly referred to as feedstock) as an input to produce intermediate or final consumer products. Capturing activities of firms at this level provides insights into the industry and the challenges faced in growing this sector. The survey was specifically designed to capture a relatively new and emerging field of activity which is constantly evolving. The survey considered renewable biomass from agricultural, forestry, and marine/aquaculture sources. In addition, biomass derived from recyclable by-products from mills, food processing and municipal sources that were used as inputs were also considered.

Firms in the survey operate across different industries as classified under the North American Industry Classification System (NAICS) 2007 (Statistics Canada, 2007) and some engage in multiple activities. Statistics provided in this report refer to firms' activities in the fiscal year 2009/2010 unless otherwise stated and encompass only the bioproduct activities of a firm considered separately from its non-bioproduct activities.

The strict criteria used to define a bioproduct firm in this survey resulted in a small target population. Because of this, the survey used a census approach to obtain a robust responding population in order to produce estimates. In addition, the small target population means that estimates presented throughout this paper tend to be less reliable than survey estimates calculated from larger populations. This instability is explicitly noted in upcoming tables through the use of alphabetic characters advising on the reliability of the estimates.

The frame was constructed from three sources: a) enterprises from the business register that were in scope during the 2006 Bioproducts survey, b) lists of firms obtained from federal partners, provincial/territorial bioproducts industry associations and industry experts, and c) enterprises from the business register that were in scope during the 2007 Survey of Emerging Technology (Pre-contact survey SET). The frame for SET 2007 was constructed from Statistics Canada's Business Register. The frame contained certain NAICS from which a subset was used to construct the current frame. Pre contact was used to help target the population. All enterprises indicating that they had developed or produced bioproducts received a questionnaire along with those who were part of the frame and could not be contacted.

The survey had an unweighted response rate of 59%. Weights are given to each firm in order to account for non-response and, as a result, the total population is represented by a weighted estimate.

Box 1 Definitions and scope

Bioproducts definition

As used in the Bioproducts Production and Development Survey 2009, industrial bioproducts are products made from renewable biological inputs (often referred to as biomass feedstock).

It should be noted that industrial bioproducts exclude food, feed and medicines. Therefore, those firms that only produce food, feed and medicine are not found in this survey. They are covered in other surveys conducted by Statistics Canada.

This survey focuses on non-conventional industrial bioproducts. Examples include biofuels (e.g., ethanol and biodiesel), organic chemicals (e.g., biopolymers), pesticides, non-conventional building/construction materials and composites. Traditional bioproducts, such as wood products, would be considered in-scope for this survey only if they were made by a non-conventional or novel process.

Examples of excluded bioproducts are food, nutraceuticals, feed, medicines, structural lumber, dimensional wood products, paper and conventionally made fiberboards, wood pellets, parallum, oriented strand board (OSB), composite wood products and compost.

Biomass definition

Biomass refers to renewable biological materials. For the purpose of this survey biomass feedstocks include: biological materials from agriculture, forestry, marine and aquaculture sources or of a micro-biological origin; by-products from processing (e.g., agricultural, forestry, pulp and paper, food and feed processing; recycled bio-materials (e.g., construction/demolition materials); waste materials (e.g., municipal solid wastes).

Survey scope

Firms that were **included** in the Bioproducts Production and Development Survey 2009 were those that:

Had an operating plant in Canada that produced and/or developed bioproducts in 2009. It should be noted that this does not preclude firms who have their head office outside of Canada.

The survey **excluded** firms that were:

Producing only food, feed and medicines

Involved only in providing technology or services and were not directly producing/developing bioproducts or using biomass

Conducting only biomass improvement

Producing only traditional bioproducts by conventional means, Examples include forestry mills, furniture makers and bakeries

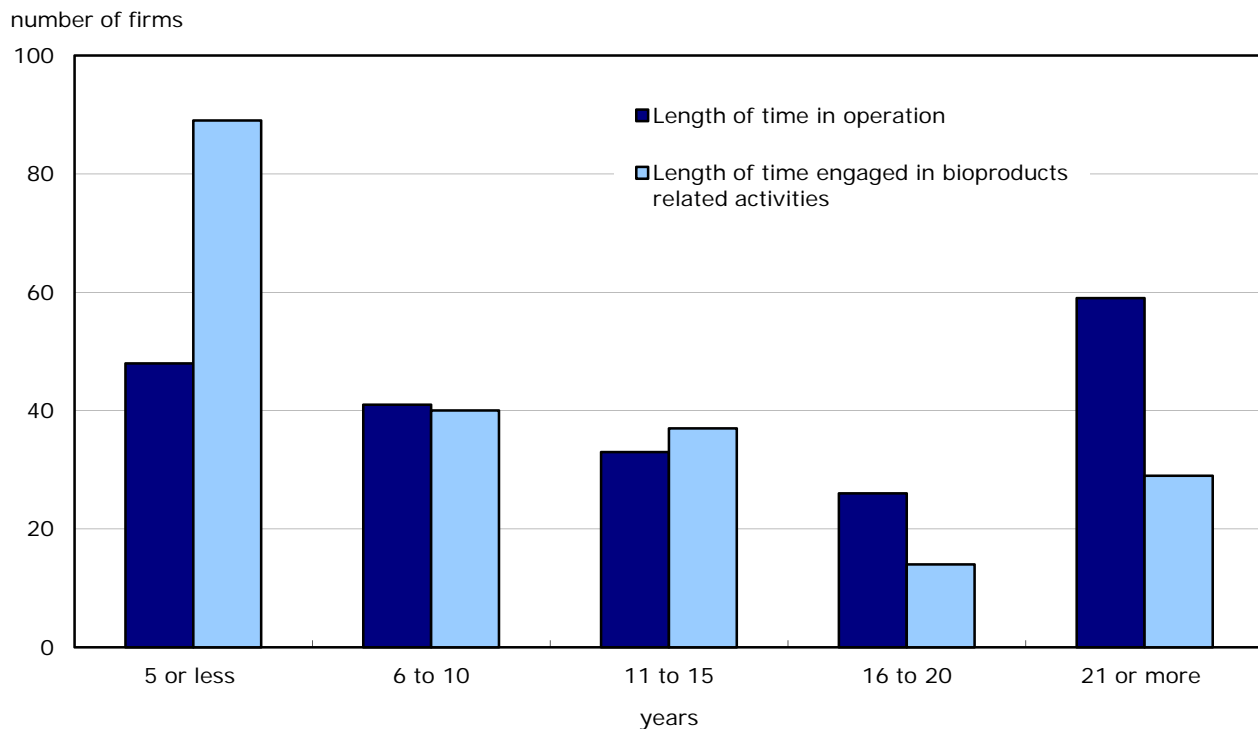
3 Sector profile

3.1 Number of firms, types of bioproducts and development stage

In 2009, an estimated 208 firms were active in Canada's bioproducts sector. That is, they produced and/or developed bioproducts. Chart 1 shows the number of bioproduct firms by length of time in operation and how long they had been engaged in bioproduct-related activity as of 2009.

The bioproduct sector is characterized by having many new entrants. 23% of firms have been in operation for 5 years or less. A further 20% have been in operation for 6 to 10 years. The number of persistent firms steadily declines as the length of time in operation increases - moving from firms that have been in operation for 5 years or less up to firms in the 16 to 20 year age category, while 28% of firms had existed for 21 years or more.

Chart 1
Bioproduct firms by length of time in operation and by length of time engaged in bioproducts related activity, Canada, 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Young firms, those in operation for 5 years or less, accounted for the largest number (89 firms or 43%) of bioproduct firms engaged in bioproducts related activities. The length of time in operation contrasts with the length of time engaged in bioproducts related activities. Forty-three percent of firms had been engaged in bioproducts related activities for 5 years or less. This compares to 7% for those who had been engaged for 16 to 20 years. This suggests that firms not originally involved with bioproducts may have adapted their operations to engage in bioproducts related activities in recent years.

Bioproduct firms were involved in fuels, organic chemicals, bio-pesticides, bio-catalysts and bio-enzymes and materials and composites. In 2009, an estimated 29 firms were involved in ethanol (for fuel) production (Table 1). Ten of these firms were involved with research and development on ethanol, and 11 firms were involved with proof of concept/product development. In addition, 20 firms had ethanol in production or on the market and the ethanol produced generated \$910 million of revenue.

Forty firms were involved in biodiesel (for fuel) production, 23 of which were involved with research and development on biodiesel and 21 were involved with biodiesel proof of concept/product development. Moreover, 29 of these firms actually had biodiesel in production or on the market.

For organic chemicals, as estimated 13 firms were involved in lubricants and greases in 2009, with 9 of these firms involved in research and development on lubricants and greases and 9 firms actually having product in production or on the market. Sixteen firms were involved with polymers. Among these 16 firms, 12 were involved in research and development and 10 were involved in proof of concept/product development. In addition, 10 of these firms had polymers in production or on the market. This production of polymers generated \$28 million in revenue.

In the area of bio-pesticides and bio-catalysts, 19 firms were involved with bio-pesticides (which include insecticides, fungicides and herbicides) with 14 of these firms being involved in bio-pesticide research and

development and 8 firms being involved with bio-pesticide proof of concept/product development. Eighteen firms had bio-pesticides in production or on the market with this production generating a little over \$1 million of revenue in 2009. In 2009, 10 firms were involved in bio-catalysts and bio-enzymes and all 10 were involved in research and development and all 10 had bio-catalysts and bio-enzymes in production/on the market.

Table 1
Type of bioproduct by stage of development or production, bioproduct firms, Canada, 2009

	Total number of firms	Research and development	Proof of concept/product development	In production/on the market	Bioproduct revenue
	number				thousands of dollars
Fuels and Energy					
Ethanol (for fuel)	29 ^C	10 ^D	11 ^D	20 ^C	909,530 ^D
Biodiesel (for fuel)	40 ^B	23 ^C	21 ^C	29 ^C	x
Other liquid fuels (e.g., methanol, butanol, etc.)	18 ^C	10 ^D	13 ^D	14 ^D	x
Gaseous Fuels (e.g., bio-gas, syngas, hydrogen, etc.)	14 ^C	10 ^D	10 ^D	x	x
Solid Fuels (e.g., agri-straw pellets, agri-wood pellets, etc.)	16 ^D	7 ^D	11 ^D	x	779 ^E
Bioenergy (e.g., electricity, heat, co-generation, etc.)	42 ^B	27 ^C	29 ^C	21 ^C	46,643 ^D
Organic Chemicals					
Lubricants and greases	13 ^D	9 ^D	x	9 ^D	x
Polymers	16 ^C	12 ^D	10 ^D	10 ^D	28,166 ^D
Adhesives	x	x	x	x	0
Fine chemicals	12 ^D	7 ^D	x	x	x
Solvents	6 ^D	x	x	x	x
Other organic chemicals	31 ^B	16 ^C	17 ^C	20 ^C	155,497 ^E
Bio-pesticides and Bio-catalysts					
Bio-pesticides (e.g., insecticides, fungicides, herbicides)	19 ^C	14 ^D	8 ^D	18 ^C	1,052 ^E
Bio-catalysts and Bio-enzymes	10 ^D	10 ^D	x	10 ^D	x
Materials and Composites					
Composites	12 ^D	x	x	8 ^D	x
Fibreboard/agri-fibre panels	7 ^D	5 ^D	x	x	0
Materials (e.g., foam, insulation, masonry, road materials, cement, geofibres, geotextiles, etc.)	13 ^C	7 ^D	x	9 ^D	x
Other Bioproducts					
Other Bioproducts	57 ^B	23 ^C	26 ^C	43 ^B	x

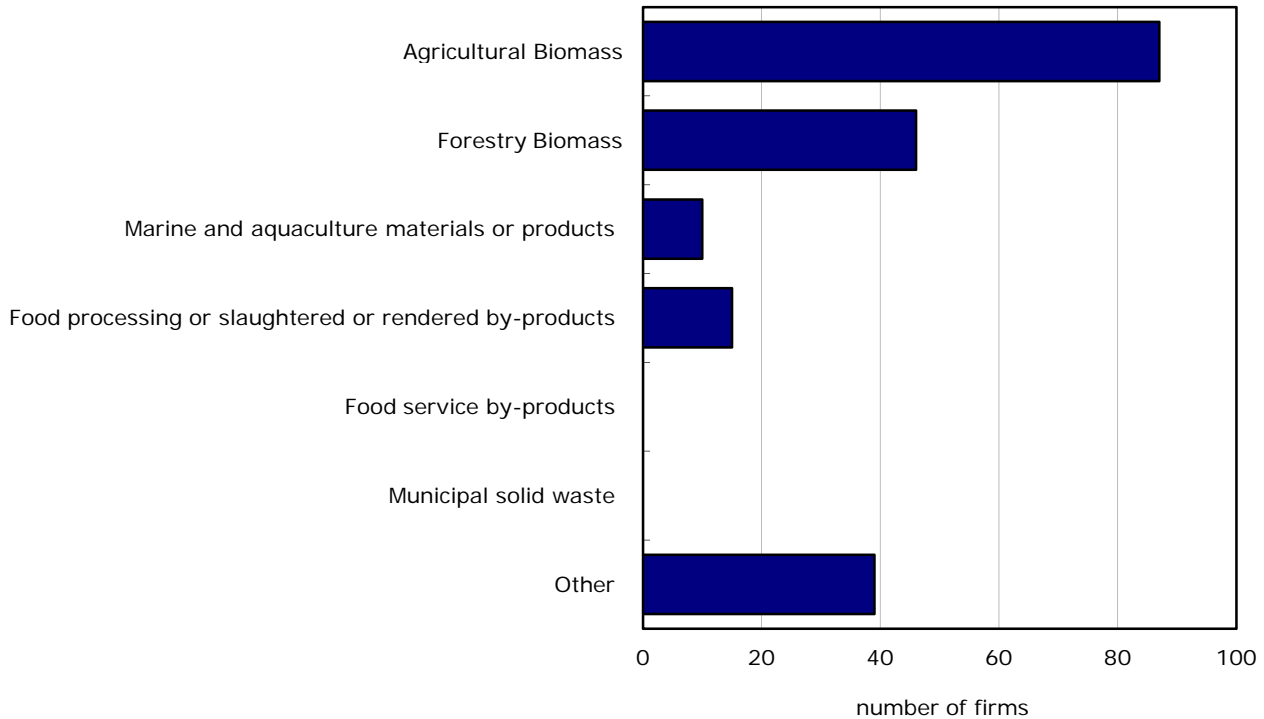
Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

3.2 Biomass

The Bioproducts Production and Development Survey 2009, probed the use of biomass by bioproducts firms. Biomass represents the raw materials that bioproduct firms use to produce final products or inputs used in further processing. Firms were asked to indicate their primary source of biomass (the biomass which represented the greatest proportion of their operating costs) from a list of six specific sources. Among bioproducts firms, an estimated 87 used an agricultural biomass as their primary source of raw material (Chart 2). The primary biomass for a further 46 firms was from a forestry source. In contrast, the primary biomass for 10 firms came from marine and aquaculture materials or products, while 15 firms used food processing or slaughtered or rendered by-products as their primary biomass source.

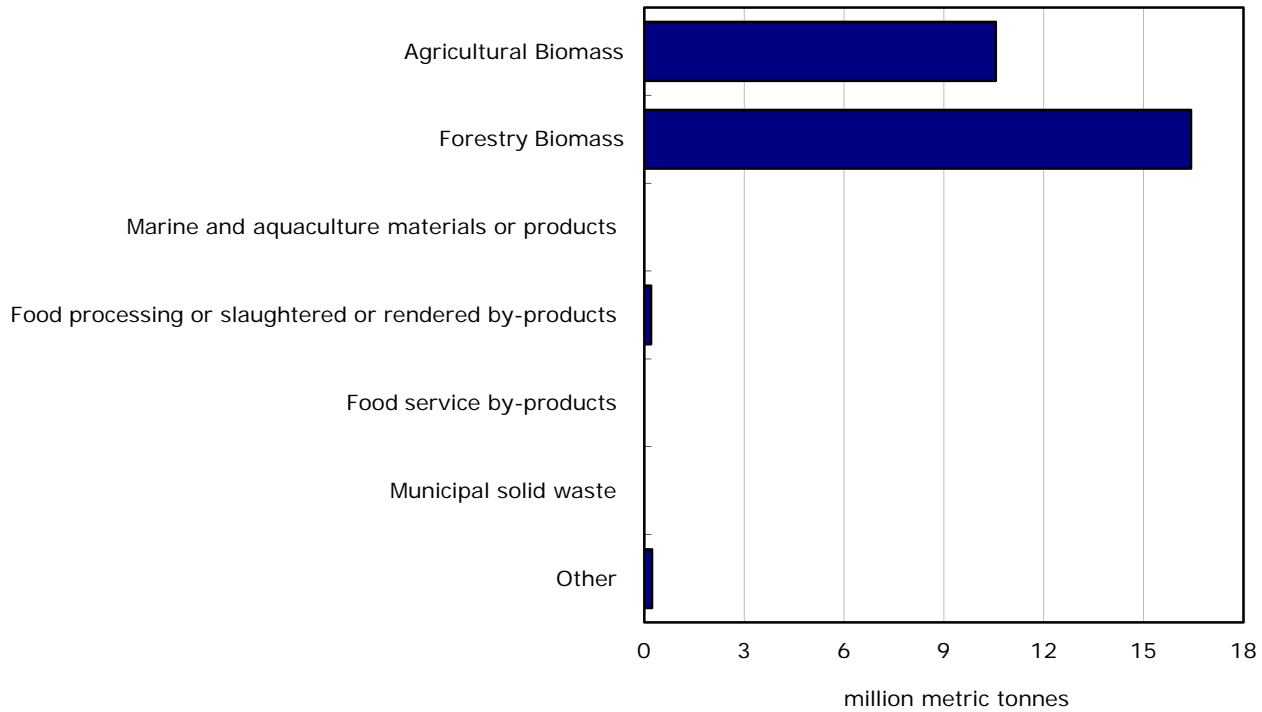
Chart 2
Bioproducts firms by primary biomass source, Canada, 2009



Note(s): Data for food service by-products and municipal solid waste have been suppressed to meet the confidentiality requirements of the *Statistics Act*.
Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Bioproduct firms used a large amount of forestry and agricultural biomass. Although more firms used agricultural biomass than used forestry biomass, the amount (measured by weight) of forestry biomass was greater. Canada’s bioproducts firms used over 27 million metric tonnes of biomass in 2009 (Chart 3). Forestry biomass accounted for 16 million metric tonnes and agricultural biomass use was 11 million metric tonnes.

Chart 3
Different types of biomass used by bioproduct firms, Canada, 2009

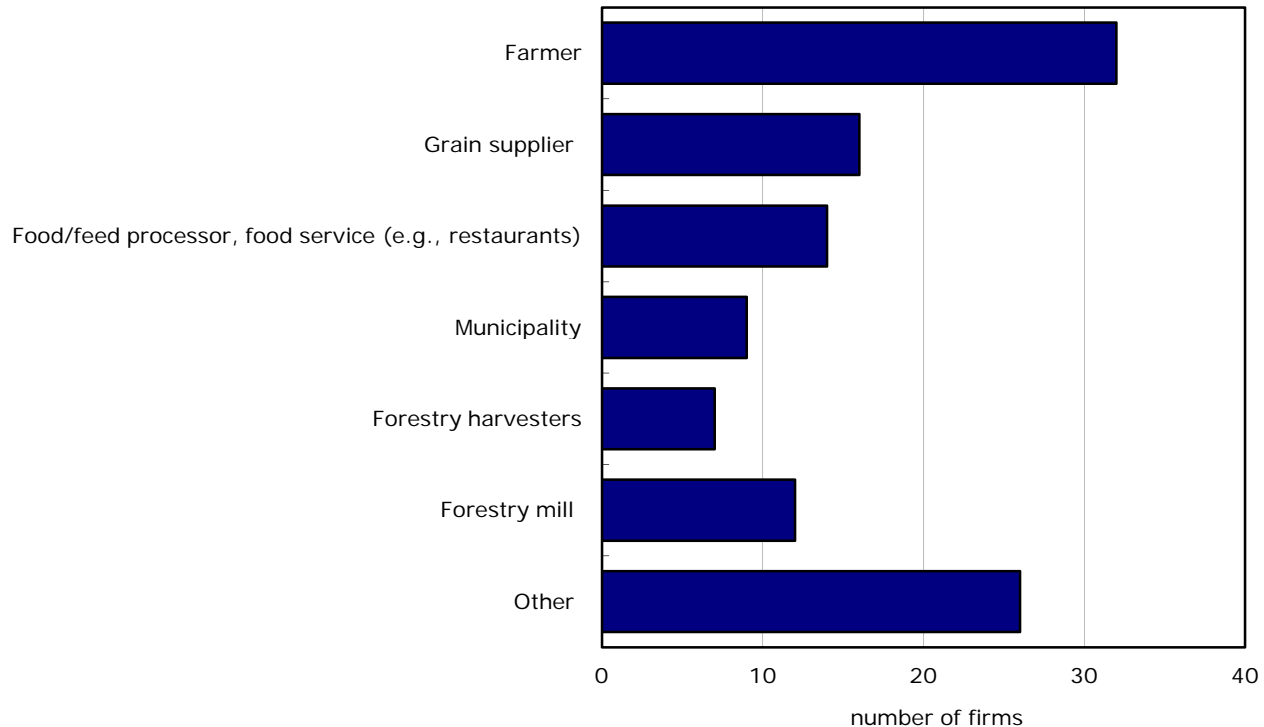


Note(s): Data for marine and aquaculture materials or products, food service by-products and municipal solid waste have been suppressed to meet the confidentiality requirements of the *Statistics Act*.

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In Canada, 95 bioproduct firms had contracts with one or more suppliers to provide biomass for their Canadian operations. More bioproduct firms obtained their biomass from farms than from any other source. Thirty-two bioproduct firms had had at least one contract with a farmer, 16 had at least one contract with a grain supplier, and 14 had at least one contract with a food/feed processor or a food service establishment (Chart 4). By comparison, seven had at least one contract with a forestry harvester and 12 had at least one contract with a forestry mill.

Chart 4
Bioproduct firms by type of biomass supplier, Canada, 2009

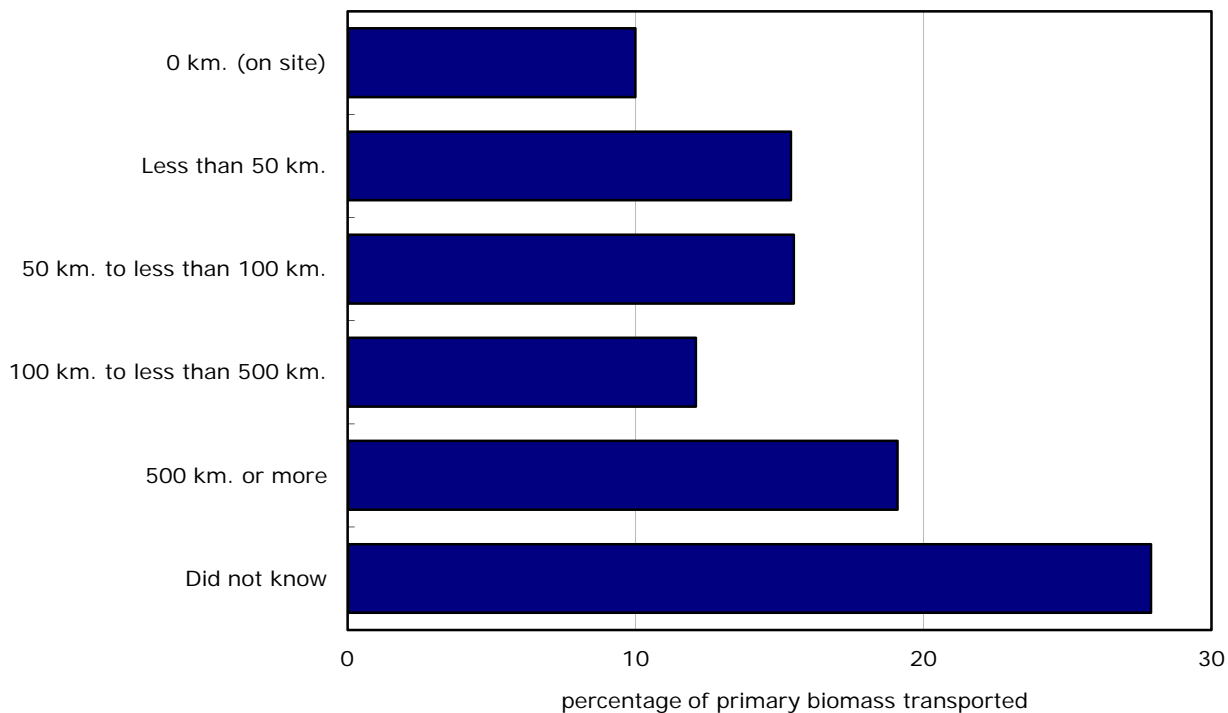


Source(s): Statistics Canada, Bioproducts production and development survey 2009.

The distance that biomass was transported from original source to the processing facility is generally recognized as having a bearing on both profitability and environmental impact (e.g., from fuel emissions). The 2009 Bioproducts Production and Development Survey shows that 10% of the firms' primary biomass was obtained on site, 15% was transported less than 50 km while a further 15% was transported between 50 km and 100 km (Chart 5). Nearly 20% of primary biomass was transported 500 km or more from its source to the processing facility.

Nearly 30% of the primary biomass that was used was transported from an unknown distance. This relatively large share may be the result of the fact that a number of firms are using intermediaries to supply their biomass and so would not necessarily know the location of the biomass source. In addition, firms may use many different biomass substances without a primary one. The existence of multiple processing facilities and multiple locations to source primary biomass may also mean that respondents cannot calculate single, representative distances.

Chart 5
Distance that the firm’s primary biomass was transported from its original source to the processing facility, Canada, 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

4 Financial profile

In 2009, bioproduct firms had total firm revenues of just under \$15 billion (Table 2). This total included revenue from both bioproduct related activity and non-bioproduct related activity. Revenues generated from bioproduct related activity amounted just over \$1.3 billion. In 2008, total firm revenues amounted to \$20 billion. However, revenues from bioproducts increased from 2008 to 2009 – from approximately \$1.0 billion in 2008 to approximately \$1.3 billion in 2009. In 2008, revenues from bioproducts represented just 5.3% of total revenues from all sources. In 2009 this had risen to 9%.

Table 2
Revenues, costs and research and development (R and D) expenditures, bioproduct firms, Canada, 2008 and 2009

	2008	2009
	thousands of dollars	
Total firm revenues (all sources)	19,685,698 ^D	14,898,795 ^D
Revenues from bioproducts	1,047,418 ^C	1,333,503 ^C
Revenues from bioproducts that were exported	187,976 ^D	438,667 ^E
Total cost of biomass input	1,731,080 ^C	1,852,135 ^C
Total R and D spending	305,924 ^E	127,389 ^D
R and D spending on bioproduct development	49,934 ^B	50,152 ^B
R and D spending on biomass development	14,540 ^D	14,428 ^C
Bioproducts R and D spending contracted out	13,497 ^C	9,438 ^C

Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

The cost of biomass input reported by firms increased from an estimated \$1.7 billion in 2008 to just under \$1.9 billion in 2009. The total cost of biomass was greater than the revenues generated from bioproducts. However, in 2009, 39 firms reported producing biomass for internal use at a cost savings of \$980 million and 69 firms reported the sale of co-products (such as distillers, grains and glycerin) from the same production stream as their bioproducts. In addition, many firms use biomass for the development of bioproducts which are not currently on the market.

Spending on research and development (R and D) specifically related to bioproducts by bioproduct firms is broken into three categories. The first category, R and D spending on bioproduct development, remained stable with \$49.9 million in 2008 and \$50.2 million in 2009. The second category, R and D spending on biomass development, remained relatively unchanged at approximately \$14.5 million. The third category was spending on contracting out of bioproduct R and D. This declined from \$13.5 million in 2008 to just under \$9.5 million in 2009.

In 2008, R and D spending on bioproduct development comprised an estimated 4.8% of the revenues specifically derived from bioproducts. In 2009, this figure declined to 3.8%. Meanwhile, R and D spending on biomass development represented 1.4% of total revenues from bioproducts in 2008 and 1.1% in 2009.

Total research and development (R and D) spending, which included spending related to non-bioproduct R and D by these firms, declined from \$306 million in 2008 to \$127 million in 2009. As a result, the share of total R and D spending represented by bioproduct development increased from 16% in 2008 to 39% in 2009.

5 Benefits and barriers to producing and developing bioproducts

Firms were asked to indicate the degree of importance of three potential benefits that influenced the firm's decision to produce or develop bioproducts. Three out of four firms saw in bioproducts an opportunity to increase product range. Second in importance was the opportunity to benefit from reducing environmental impact (chosen by 62% of firms). More than a third used biomass for the purpose of reducing production costs.

Table 3
Factors which influence firm's decision to produce or develop bioproducts, Canada, 2009

	Degree of importance			
	Low	Medium	High	Not applicable
	percent			
Using biomass to reduce production costs	14.9 ^A	13.7 ^A	37.8 ^A	33.6 ^A
Expectation of opportunities to benefit from reducing environmental impact (e.g., greenhouse gas reduction)	12.1 ^A	16.9 ^A	62.0 ^A	9.0 ^A
Seeing an opportunity to increase product range to increase sales and market share (e.g., products targeted at green markets)	4.1 ^A	11.3 ^A	74.3 ^A	10.2 ^A
Other	0.0	2.2 ^A	13.8 ^A	84.0 ^A

Note(s): Percentages may not add to 100% due to rounding.

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In 2009, an estimated 106 bioproduct firms were considering a new location for a bioproduct establishment in Canada in the previous three years or in the coming two years. These firms were then asked to rate the importance of six factors in making that decision.

Among bioproduct firms that had considered a new location for a bioproduct establishment, 78% rated financial incentives (such as government programs) as high (Table 4). Among the same group of firms that had considered a new location, the importance of the proximity to biomass was considered high by 62%. Meanwhile, community driven incentives to encourage firms to locate in a particular place were considered highly important to 44% of bioproduct firms that were considering locating a bioproduct establishment.

Table 4
Factors affecting the firm's decision in locating a bioproducts facility, Canada, 2009

	Degree of importance			
	Low	Medium	High	Not applicable
	percent			
Proximity to biomass	13.3 ^A	22.0 ^A	61.9 ^B	2.7 ^A
Proximity to head office or other existing firm facilities	41.5 ^B	36.5 ^B	16.4 ^A	5.6 ^A
Local infrastructure (e.g., transportation facilities, hospitals, colleges, etc.)	25.7 ^B	35.0 ^B	37.8 ^B	1.6 ^A
Access to skilled labour	12.4 ^A	61.7 ^B	25.9 ^B	0.0
Financial incentives (e.g., government programs)	1.2 ^A	19.2 ^A	78.0 ^A	1.6 ^A
Community driven incentives to encourage firms to locate	20.6 ^A	31.7 ^B	43.6 ^B	4.1 ^A
Other	0.0	4.1 ^A	9.9 ^A	86.0 ^A

Note(s): For firms that considered a new location for a bioproduct establishment in Canada in the last three years or over the next two years. Percentages may not add to 100% due to rounding.

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

5.1 Barriers

Bioproduct producing firms were asked to rate the degree of importance of barriers to production and/or development of bioproducts by their firm. More than one-half of bioproduct firms rated the lack of financial capital as a barrier to production and development of bioproducts as high (Table 5). Similarly, the importance of the cost and timeliness of regulatory approval was rated as a high barrier by over one-half of bioproduct firms. In addition, 42% of firms rated the cost of biomass as a barrier production and development as high while 34% of firms rated the difficulty in entering the commercial marketplace as high. Meanwhile, nearly 18% of firms rated unreliability in the supply of

biomass as high. Similar numbers were reported when they were asked to rate the unreliability in the quality of their biomass as a barrier.

Table 5
Barriers to production or development of bioproducts, Canada, 2009

	Degree of importance			
	Low	Medium	High	Not applicable
	percent			
Unreliable quantity of biomass	43.4 ^A	21.7 ^A	17.9 ^A	17.0 ^A
Unreliable quality of biomass	39.2 ^A	26.2 ^A	17.4 ^A	17.2 ^A
Cost of biomass (e.g., price, transport cost etc.)	14.2 ^A	33.5 ^A	41.6 ^A	10.8 ^A
Difficulty in entering commercial marketplace	15.4 ^A	33.3 ^A	34.1 ^A	17.3 ^A
Cost of developing environmental indicators (e.g., lifecycle analysis)	28.7 ^A	27.2 ^A	12.4 ^A	31.7 ^A
Lack of skilled human resources	32.9 ^A	37.5 ^A	9.3 ^A	20.3 ^A
Lack of financial capital	9.1 ^A	26.1 ^A	53.0 ^A	11.9 ^A
Cost and timeliness of regulatory approval	15.7 ^A	21.0 ^A	50.3 ^A	13.0 ^A
Ongoing regulatory costs/requirements (e.g., on-site requirements for engineers, etc.)	26.2 ^A	26.4 ^A	29.3 ^A	18.1 ^A
Lack of adequate product standard certification	46.6 ^A	31.7 ^A	6.4 ^A	15.2 ^A
Other	0.0	2.5 ^A	10.8 ^A	86.7 ^A

Note(s): Percentages may not add to 100% due to rounding.

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

6 Characteristics of bioproduct firms

6.1 Ownership structure and involvement in bioproducts

The Bioproducts Production and Development Survey 2009 estimated that 27 firms were sole proprietor/partnerships, 147 were private corporations based in Canada, and 26 were Canadian-based publicly traded corporations. Moreover, 25 of the respondent firms were a subsidiary of another larger multi-national enterprise (MNE).

Table 6
Bioproduct firms by means of initial involvement in the production or development of bioproducts, Canada, 2009

	Number
Mainly as a result of domestic activities of your firm (e.g., utilization of by-products, as part of a R and D project etc.)	124 ^A
Mainly as a result of International activities of your firm (e.g., utilization of by-products, etc.)	x
In co-operation/collaboration with other firms or organizations	15 ^D
Merger with/acquisition of another firm/or firm's bioproducts activities	x
Acquired/licensed technology from a domestic firm or lab	16 ^C
Acquired/licensed technology from a foreign firm or lab	16 ^C
Other	23 ^C

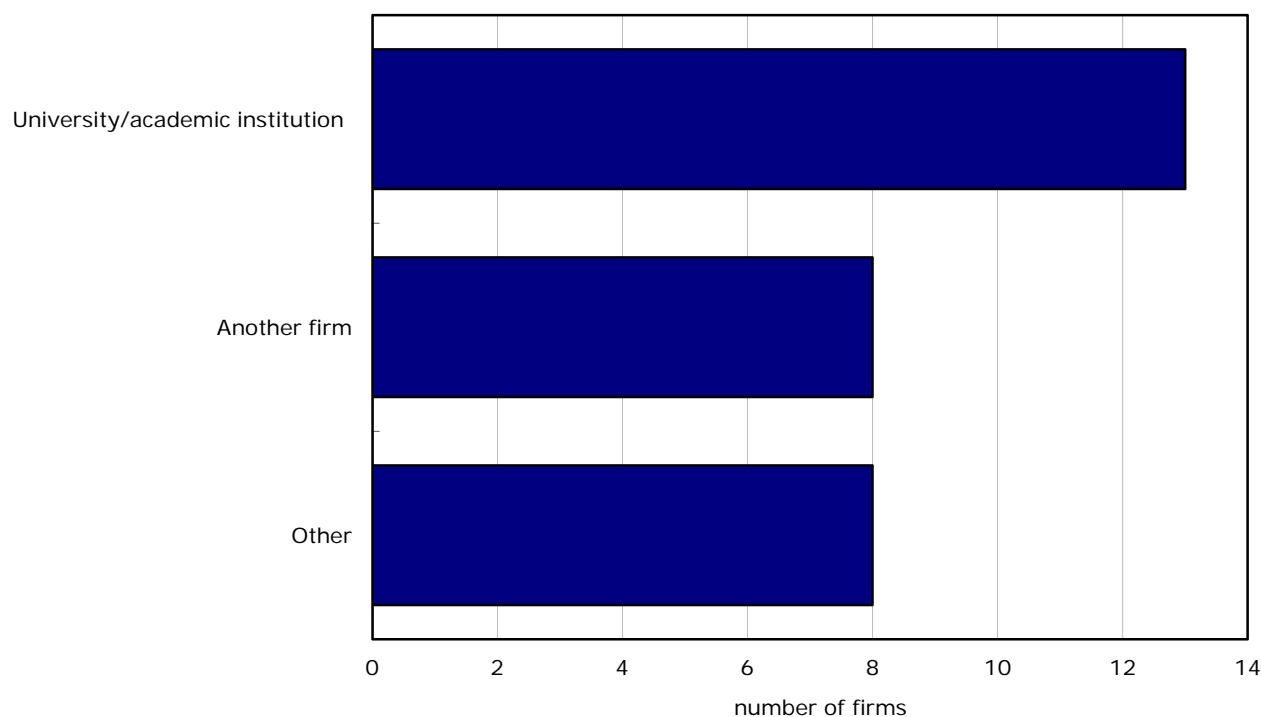
Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In 2009, an estimated 124 industrial bioproduct firms reported becoming involved in developing or producing bioproducts as a result of domestic activities of the firm (Table 6) – for instance, as utilization of a by-product or as part of a research and development (R AND D) project. This was far more than the 15 firms who became involved in developing or producing bioproducts through co-operation/collaboration with other firms or organizations or the 16 firms that became involved through the acquisition or licensing of a technology from a domestic firm or laboratory. A further 16 firms became involved in bioproducts by acquiring/licensing technology from a foreign firm or laboratory.

Among bioproduct firms that identified themselves as spin-offs, more spun-off from university/academic institutions than from either another firm or a government agency/laboratory. Twenty nine bioproduct firms identified themselves as a spin-off. That is, they were a new firm created to transfer and commercialize inventions and technology developed in universities, firms or government laboratories. Of these 29 firms, nearly one-half (13 firms) spun-off from a university/academic institution (Chart 6). A further 8 spun-off from another firm. The remaining firms reported 'other'.

Chart 6
Bioproduct firms that identified themselves as spin-offs indicating their origin, Canada, 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

6.2 Human resources

In 2009, bioproduct firms employed nearly 46,000 individuals across all sectors accounting for salaries totaling an estimated \$3.5 billion (Table 7). Of these employees, a little over 3,000 were involved in bioproduct related activities. These were employees who spent at least one-half of their time performing duties related to the production, development or administration of bioproducts. These bioproduct related employees had salaries totaling a little over \$200 million.

Table 7
Employees who worked at least 26 weeks for the firm and total salary costs for bioproduct firms, Canada, 2009

	Number	Total salary (thousands of dollars)
All employees	45,675 ^D	3,557,104 ^E
Bioproduct related employees	3,019 ^B	210,369 ^C

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Firms were asked to provide the number of employees in 2009 who spent at least fifty percent of their time performing duties related to the production, development, or administration of bioproducts for five specified occupation activities. The majority, 1,627 were production workers or operators (Table 8). Three hundred and forty two individuals were in scientific research and development (e.g. scientists, R AND D managers, etc.). A further 226 were classed as engineers and 241 as laboratory technicians.

Table 8
Number of employees with bioproducts responsibilities by occupation activities, Canada, 2009

	Number of employees
Scientific research and development (e.g. scientists, R and D managers, etc.)	342 ^C
Engineers	226 ^C
Laboratory technicians	241 ^B
Management/marketing/finance	431 ^B
Production/operators	1,627 ^C
Other	153 ^C

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Sixty-one firms (30%) reported that they did have bioproducts related job vacancies. These firms were then asked to assess the importance of six specific factors that affected their efforts to fill bioproducts related job vacancies in 2009. The importance of the lack of highly qualified candidates was rated as high by one-quarter of bioproduct firms and as low by a further 30% of firms (Table 9). Difficulty attracting candidates due to insufficient capital/resources was judged as highly important by 23% of firms, while a further 19% rated the importance of this factor as low. In contrast, a high candidate compensation requirement was highly important to 7% of firms and of low importance to just under 40% of firms.

Table 9
Factors affecting the firm's efforts to fill bioproduct related job vacancies, Canada, 2009

	Degree of effectiveness			
	Low	Medium	High	Not applicable
	percent			
Compensation requirements by candidates too high	39.2 ^B	33.2 ^B	7.2 ^A	20.4 ^B
Candidates unwilling to relocate	45.9 ^B	12.5 ^A	14.4 ^B	27.1 ^B
Capital/resources insufficient to attract candidates	19.0 ^B	31.1 ^B	22.9 ^B	27.1 ^B
Lack of highly qualified candidates	30.3 ^B	26.2 ^B	25.2 ^B	18.3 ^B
Lack of bioproduct specific education available in colleges, universities, etc.	40.7 ^B	27.2 ^B	8.9 ^A	23.1 ^B
Sector instability/insecurity	23.6 ^B	27.7 ^B	21.2 ^B	27.5 ^B
Other	0.0	2.1 ^A	0.0	97.9 ^A

Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

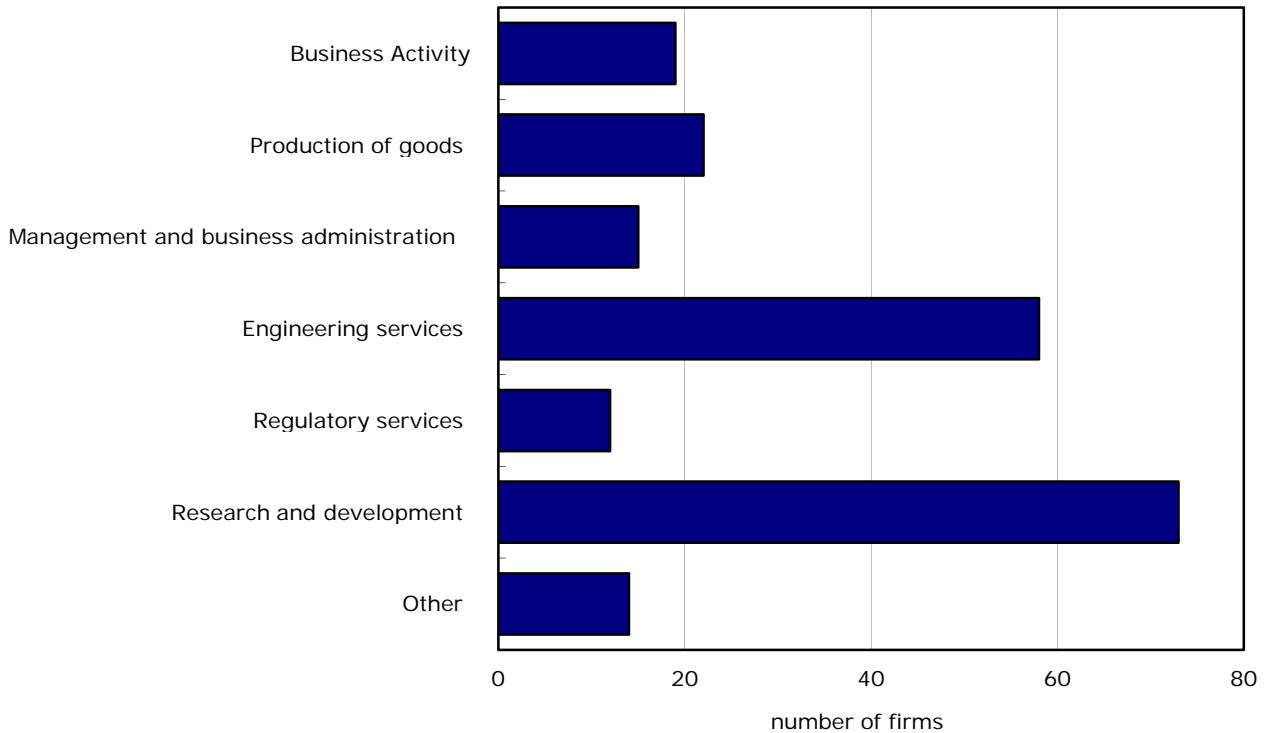
7 Business practices

7.1 Contracting out and collaboration

In 2009, an estimated 117 of bioproduct firms indicated they had contracted out bioproducts related activities. It was specified that contracting out work could be referred to as outsourcing whereby money was paid for a service on a contractual agreement

Bioproduct firms contracted out primarily research and development (R and D) and engineering services in their bioproduct related activity. Among the 117 firms that contracted out some bioproducts related activities, an estimated 73 firms indicated they contracted out research and development R and D (Chart 7). Contracting out of engineering services was reported by 58 firms. In contrast, 22 firms contracted out some goods producing activities and 15 firms contracted out some management and business administration activities.

Chart 7
Bioproduct firms indicating bioproduct related activities that were contracted out (outsourced), Canada, 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

The 117 firms that reported contracting out any bioproducts related activity were asked to rate the degree of importance of eight sponsor-specified reasons for their decision to contract out in 2009. Nearly 84% rated the importance of accessing outside scientific expertise/knowledge as high (Table 10). Among the same 117 firms, a little over one-half rated the importance of the contracted out activity being outside the core competence of the firm as high. Moreover, 45% rated accessing external R and D expertise as a highly important reason for contracting out. In contrast, 18% cited lower risks to the firm and 17% cited access to production facilities as highly important reasons for contracting out bioproducts related activities.

Table 10
Reasons invoked to contract out bioproduct related activities, Canada, 2009

	Degree of importance			
	Low	Medium	High	Not applicable
	percent			
Access outside scientific expertise/knowledge	5.7 ^A	5.3 ^A	83.9 ^A	5.1 ^A
Activity area outside core competence of firm	10.5 ^A	20.7 ^A	52.2 ^B	16.6 ^A
Faster completion of the work	21.4 ^A	28.2 ^A	37.4 ^A	13.0 ^A
Lower risks to the firm	34.3 ^B	30.0 ^A	18.1 ^A	17.6 ^A
Increase physical capacity (infrastructure, equipment, etc.)	24.0 ^A	23.3 ^A	34.5 ^B	18.2 ^A
Access external R and D expertise	8.4 ^A	30.7 ^A	45.0 ^B	15.9 ^A
Access regulatory affairs expertise	33.3 ^A	26.8 ^A	23.0 ^A	16.9 ^A
Access production facilities	48.2 ^B	8.1 ^A	16.6 ^A	27.1 ^A
Other	0.0	1.1 ^A	2.4 ^A	96.5 ^A

Note(s): Due to rounding, components may not add to totals

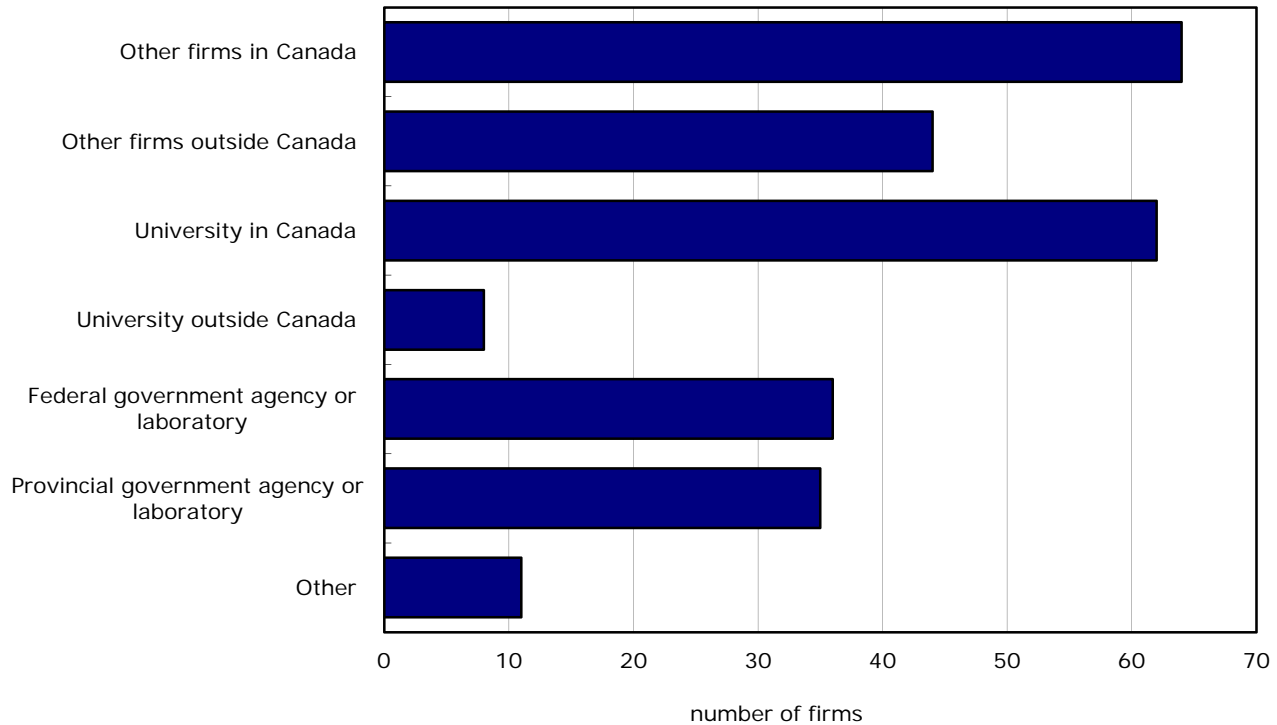
Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In contrast to pure contracting-out where money is paid for a particular and specific service, cooperative and collaborative arrangements involve the active participation in projects between one company and other companies or organizations in order to develop and/or continue work on new or significantly improved bioproducts processes and/or products.

In 2009, just under 100 firms (98) indicated they were involved in bioproducts related cooperative/collaborative arrangements including both those inside and outside of Canada. These 98 firms reported a total number of 459 cooperative/collaborative arrangements with other companies or organizations and that 154 of these cooperative/collaborative arrangements involved more than one partner.

Firms were asked to indicate the type of partner they collaborated with during the previous three years among a list of six specific partner types. Bioproduct firms more often collaborated with other firms in Canada and universities in Canada than with any other type of partner. Sixty four firms collaborated with other firms within Canada and 62 collaborated with a university within Canada (Chart 8). Meanwhile, 36 firms collaborated with a federal government agency or laboratory while 35 collaborated with a provincial government agency or laboratory.

Chart 8
Firms indicating they collaborated by type of partner, Canada, 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Firms were asked to indicate the level of importance that eight specific reasons had on the firm's decision to cooperate or collaborate with partners. As with the rating of the importance of reasons for contracting out, accessing outside scientific expertise/knowledge was also rated by the highest percentage of firms (70%) as a highly important reason on the firm's decision to collaborate with partners (Table 11). This was followed by conducting research and development, which was considered highly important by just under 60% of firms. On the other hand, accessing marketing/distribution channels was rated as highly important by 17% of firms and accessing regulatory affairs expertise was considered as a highly important reason for the firm to collaborate with partners by 15% of firms.

Table 11
Reasons given by firm's to collaborate with partners, Canada, 2009

	Degree of importance			
	Low	Medium	High	Not applicable
	percent			
Access outside scientific expertise/knowledge	6.2 ^A	19.5 ^A	70.0 ^B	4.3 ^A
Conduct research and development	13.1 ^A	22.0 ^A	59.4 ^B	5.5 ^A
Access to biomass	55.4 ^B	13.3 ^A	6.9 ^A	24.4 ^A
Access production/manufacturing facilities	49.6 ^B	18.0 ^A	10.5 ^A	21.8 ^A
Access marketing/distribution channels	42.8 ^B	23.5 ^A	16.6 ^A	17.0 ^A
Access partners intellectual property	25.6 ^B	27.7 ^B	28.6 ^B	18.1 ^A
Access capital	21.5 ^B	30.3 ^B	30.9 ^B	17.3 ^A
Access regulatory affairs expertise	44.6 ^B	18.1 ^A	15.4 ^A	21.9 ^A
Other	1.7 ^A	3.2 ^A	7.6 ^A	87.5 ^A

Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

7.2 Intellectual property

Bioproduct firms reported holding most of their patents in Europe followed by the United States and then Canada. Sixty-seven Bioproduct firms reported patenting in Canada, 62 patented in the United States and 34 patented in Europe (Table 12).

Table 12
Bioproducts related patenting activities of bioproducts firms, by patent delivering office, Canada, 2009

	Firms with patents	Number of patents in 2009	
		Existing patents	Pending patents
	number		
In Canada (Canadian Intellectual Property Office (CIPO))	67 ^B	81 ^C	x
In the United States (U.S. Patent & Trademark Office (USPTO))	62 ^B	93 ^C	202 ^C
In Europe (e.g., European Patent Office)	34 ^B	110 ^D	x
Other	25 ^C	278 ^E	x

Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In 2008, bioproduct firms reported submitting 119 unique bioproduct patent applications. In 2009, this dropped to 69.

In 2009, 77 bioproduct firms indicated they held at least one bioproduct trademark (Table 13). These firms indicated they held 198 registered trademarks and 232 unregistered trademarks in 2008. In 2009, the number of trademarks, registered and unregistered, increased to 204 and 376, respectively.

Table 13
Bioproduct firms indicating they had bioproduct trademarks in 2009 and number of registered and unregistered trademarks held by these firms in 2008 and 2009, Canada

	Firms with bioproduct related trademarks	Registered trademarks	Unregistered trademarks
	number		
2008	...	198 ^C	232 ^D
2009	77 ^B	204 ^C	376 ^C

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

In 2009, 26 bioproduct firms assigned or licensed bioproduct related intellectual property (IP) rights to another firm. Meanwhile, 17 firms acquired bioproduct related IP rights from another firm.

8 Raising capital and government support

One hundred and forty eight bioproduct firms indicated they attempted to raise capital (including capital from government sources) for purposes related to bioproducts in 2008 or in 2009. These firms were asked to indicate the reasons why their firm attempted to raise capital related to bioproducts in 2008 or 2009. One hundred and eight firms indicated they attempted to raise capital for R and D purposes or to expand R and D capacity (Table 14). Meanwhile, 79 firms indicated they attempted to raise capital in order to enact a proof of concept or pilot project and 83 firms attempted to raise capital for investment in new plant or facility.

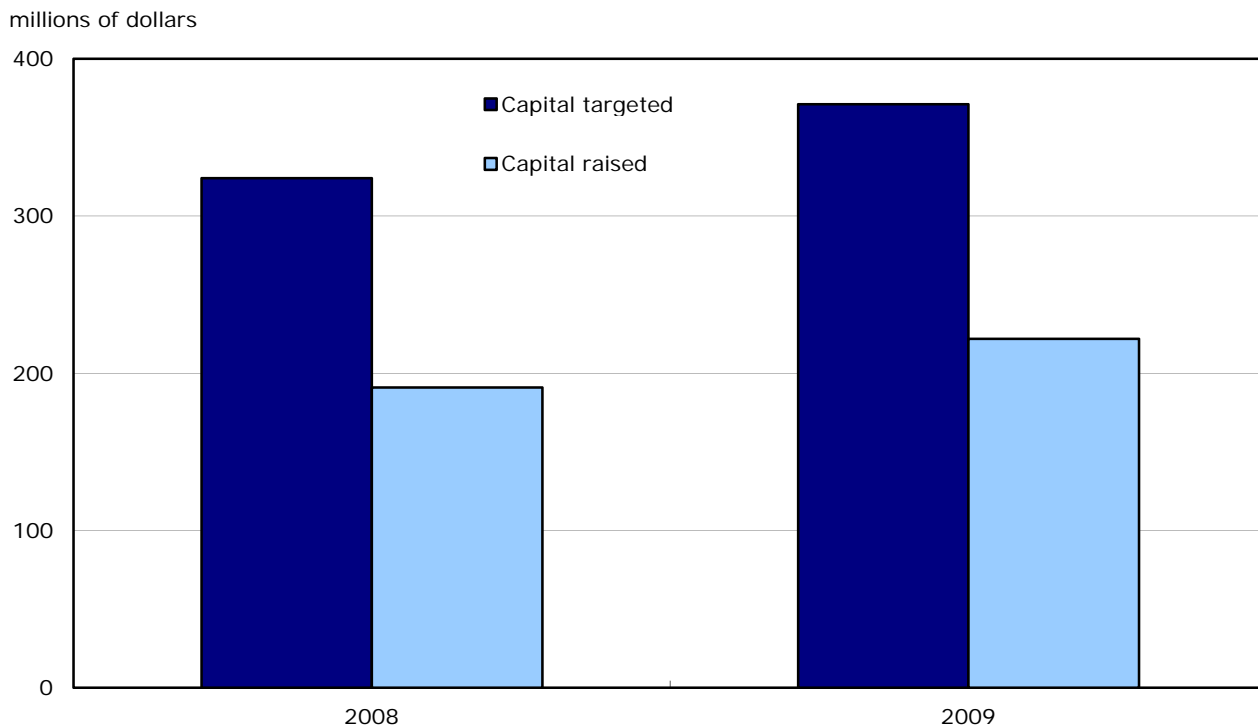
Table 14
Reasons provided by firms attempting to raise capital related to bioproducts in 2008 or 2009, Canada

	Number
R and D purposes/expand R and D capacity	108 ^B
Proof of concept/pilot project	79 ^B
New plant/facility	83 ^B
Expanding current facility	41 ^B
Marketing/commercialization	66 ^B
Operating funds	67 ^B
Repay current investors	x
Retrofit of existing facility	23 ^C
Other	x

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

One hundred and thirty nine bioproduct firms indicated they were successful in raising some capital in the two years 2008 or 2009. This represents a 94% success rate among the 148 firms who attempted to raise capital. In 2008, these firms collectively indicated they had a target of raising nearly \$325 million (Chart 9). They indicated they raised a little over \$190 million. In 2009, the target was indicated as just over \$370 million and a little more than \$220 million was indicated to have been raised.

Chart 9
Value of capital indicated by bioproduct firms as targeted and capital indicated that was raised for purposes related to bioproducts, Canada, 2008 and 2009



Source(s): Statistics Canada, Bioproducts production and development survey 2009.

The Bioproduct Production and Development Survey 2009 asked bioproduct firms to report the percentage of total funds that was raised from a list of eight specified sources. Using this figure the value of the funds raised in 2009 was calculated by applying the percentages to the total value of the funds raised. In 2009, Canadian-based private venture capital was the largest source of funds followed by angel investors or family among private sources of funds for bioproducts activities (Table 15). In 2009, bioproduct firms raised approximately \$35.5 million for bioproduct activities through Canadian-based private venture capital . This compares to \$17.5 million raised through angel investors/family.

In contrast, the total value of funds from government sources was higher. A total of approximately \$114 million was raised from government sources, with \$60 million (53% of all government money) of this coming from grants.

Table 15
Capital funds raised for bioproduct activities in bioproduct firms by funding source, Canada, 2009

	thousands of dollars
Private sources	
Canadian based private venture capital	35,657 ^E
American based private venture capital	0
Other private venture capital	2,575 ^D
Banks, Cooperatives, Credit unions	x
Angel investors/family	17,599 ^D
Government sources	
Government loans (e.g. BDC, FCC, EDC, STDC)	47,460 ^E
Matching funds	2,218 ^D
Grants (e.g. IRAP)	60,493 ^D
Other	3,794 ^E
Other sources	
IPO (Initial Public Offering) /SPO (Secondary Public Offering)	0
Private placements	x
Other	F

Note(s): Due to rounding, components may not add to totals

Source(s): Statistics Canada, Bioproducts production and development survey 2009.

Bioproduct firms were asked questions about use of specific government support programs. One hundred and twenty bioproduct firms indicated they applied for benefits for bioproduct related activities under the Scientific Research and Experimental Development (SR and ED) tax program and 68 firms indicated they received Industrial Research Assistance Program (IRAP) funding in the past five years.

9 Comparing to previous surveys

Statistics Canada has conducted three cost-recovery surveys investigating Canada's bioproducts activity, in 2003, 2006 and 2009. These surveys should be considered separate point-in-time profiles of the Canadian bioproducts sector and the data should not be treated as a time-series. The aim of these surveys was not to study trends or changes in the characteristics of bioproduct firms over a period of time but rather to capture the current activity and picture of the bioproduct sector for the specific reference period.

Before attempting to compare surveys, careful consideration should be given to two aspects of the surveys: i) changes related to the survey methodologies, including frame, sampling method, edit, imputation and weighting and ii) changes related to questionnaire content and concept definitions.

The target population of bioproducts firms is complex and hard to discern as it is an activity carried out as an emerging technology. Moreover, these surveys relied on firms to self identify as belonging to this population through a series of questions relating to type of bioproduct and type of biomass used. There is no internationally-standardized definition of bioproduct.

The identification of the target population differed for each iteration of the survey. The fact that the survey uses a census approach does not guarantee a census population. Different lists were used to develop the frame in 2006 and 2009.

Changes in questionnaire content include modifications to the questionnaire design throughout the years to ensure its ongoing relevance to the cost recovery sponsor. Questions have been removed, revised or incorporated to adjust to lessons learned from previous iterations.

The development of bioproducts as novel uses of biomass is relatively new. As a consequence, definitions need to be developed. However these definitions must adjust to rapidly evolving phenomena. In each survey a trade-off is required between the need to be somewhat comparable to previous surveys while remaining relevant to recent developments.

There was a significant change of concept between 2003, 2006 and 2009. In 2003, a bioproduct firm was a firm that either was developing a bioproduct or was using biomass. After 2006, a bioproduct firm was a firm that uses biomass to develop or produce a bioproduct. Furthermore in 2009 firms involved solely in biomass improvement or provided services only were excluded from the population.

When comparing results from the three bioproducts surveys, changes observed can be attributed to; methodological changes, changes in definition or questionnaire content or changes occurring in actual activities of firms. At this point, it is not possible to determine which of these three sources of change most explains the differences observed among the different surveys.

For further information on the definitions, data sources and methods uses in any of the three reference periods please refer to the Statistics Canada website. Definitions, data sources and methods: survey number 5073.

Bioproducts Production and Development Survey -

<http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5073&lang=en&db=imdb&adm=8&dis=2>

10 Concluding remarks

Established literature confirms that bioproducts, and the industries on which they are based, are a significant facet of agricultural and manufacturing activity, both in Canada and globally. The Bioproduct sector is viewed by some as a potential engine of environmentally sustainable economic growth. The increasing instability of global energy pricing, concerns over the environmental impacts of petroleum use, and the interest of many countries to limit dependence on foreign sources of energy have helped position the bioproducts sector as part of economic and environmental considerations. The importance of this sector to Canada is further underlined by the country's sizeable farmlands and forests that produce key inputs required by bio-based industries.

Statistics Canada's Bioproducts Production and Development Survey 2009 attempted to survey all firms in Canada that made novel use of inputs consisting of renewable biomass feedstocks/materials to develop or produce bioproducts. The survey was designed to furnish statistical information on recent developments in Canada's emerging bioproducts sector and generate a profile of firms involved in this activity within Canada. While this paper only presents data at the Canada level, the survey was designed to present data by region and by firm size. This breakdown is available in the summary tables which are available upon request.