



UNIVERSITY OF MINNESOTA EXTENSION

CENTER FOR COMMUNITY VITALITY

Economic Contribution of the Biobased Industrial Products Industry in Minnesota: 2019

A Report of the Economic Impact Analysis Program

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A REPORT OF THE ECONOMIC IMPACT ANALYSIS PROGRAM

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Table of Contents

EXECUTIVE SUMMARY	1
INTRODUCTION	2
ECONOMIC CONTRIBUTION OF CONSTRUCTION	3
Direct Effect	3
Total Contribution	3
Top Industries Affected	4
Tax Impacts	5
ANNUAL ECONOMIC CONTRIBUTION OF OPERATIONS	5
Direct Effect	5
Total Contribution	7
Top Industries Affected	7
Tax Impacts	8
THE BIOINCENTIVE PROGRAM	8
COMPARISON OF RESULTS TO 2014 ANALYSIS	9
BIOBASED PRODUCTS IN THE CONTEXT OF MINNESOTA’S ECONOMY	10
APPENDIX: METHODS AND TERMS	13





Authored by Brigid Tuck

EXECUTIVE SUMMARY: ECONOMIC CONTRIBUTION OF THE BIOBASED INDUSTRIAL PRODUCTS INDUSTRY IN MINNESOTA: 2019

Minnesota has long been an industry leader in the development of biobased industrial products. Biobased companies transform a feedstock (e.g., grain, oilseeds, energy crops, crop residuals, wood, municipal organic waste) into a product, such as biofuels, renewable chemicals, and heat. There are many examples of biobased companies in Minnesota, including plants that produce cellulosic ethanol, wood pulp for use in textiles, and biodiesel.

During the 2015 legislative session, the Minnesota Legislature enacted the Minnesota Bioincentive Program. The program's design supports the growth and development of the state's bioeconomy. Funding comes from the Agricultural Growth, Research, and Innovation (AGRI) program appropriation. As of January 2020, funding was \$2.5 million per each year of the biennium.

The Great Plains Institute hired University of Minnesota Extension to quantify this economic contribution of Minnesota's biobased industrial product industry in 2019. To quantify the contribution, Extension partnered with the Great Plains Institute to gather data from biobased product companies in the state that currently, or plan to, receive support from the Minnesota Bioincentive Program. Ten of the 12 businesses currently operating responded to the data request. Extension then extrapolated the data to account for the two businesses not included.

Major findings include:

Construction: Minnesota's biobased industrial product companies that received the incentive directly spent \$690.5 million on construction projects to retrofit or expand their facilities. As a result, Minnesota's biobased industrial companies generated an estimated \$1.2 billion of economic activity in the state. This includes \$540.6 million in labor income. They also supported employment for 8,325 workers. In addition, construction generated an estimated \$46.5 million in tax collections.

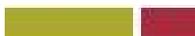
The top industries affected by the construction activities of biobased industrial product companies included wholesale trade, owner-occupied dwellings (housing), and real estate. These are one-time effects resulting from the construction activity and will dissipate once construction is complete.

Operations: Minnesota's biobased industrial product companies spent \$438.8 million to operate in 2019. Major expenditures for the biobased industrial products industry included feedstock and labor. The biobased industrial products companies in this analysis utilized either corn grain, corn kernel fiber, or wood as their primary feedstock.

Minnesota's biobased industrial product companies generated an estimated \$610.7 million of economic activity resulting from their operations, including \$127.0 million in labor income. They also supported employment for 2,415 workers in the state. In addition, the companies generated an estimated \$13.3 million in tax collections. These impacts are annual and will continue as long as the companies operate at current levels.

Top industries affected by the operations of the biobased industrial product companies include wholesale trade, owner-occupied dwellings (housing), and real estate.

Minnesota Bioincentive Program: In 2019, companies claiming the Minnesota Bioincentive received \$1.5 million in incentives. Thus, for every tax dollar invested in incentives, \$407.10 is generated in the economy. In addition, for every dollar of incentive, approximately \$8.90 is collected in taxes.



INTRODUCTION

With its strong agricultural economy, Minnesota is a national industry leader in the development of biobased industrial products.¹ Biobased companies transform a feedstock (e.g., grains, oilseeds, energy crops, crop residuals wood, or municipal organic waste) into a product, such as biofuels, renewable chemicals, and heat. There are many examples of biobased companies in Minnesota, including plants that produce cellulosic ethanol, wood pulp for use in textiles, and biodiesel.²

The Minnesota Legislature enacted the Minnesota Bioincentive Program in 2015. The program's design supports the growth and development of the state's bioeconomy. Funding for the program comes from the Agricultural Growth, Research, and Innovation (AGRI) program appropriation. As of January 2020, funding was \$2.5 million per year of the biennium.³ Companies receiving the incentive must meet certain qualifications that include the following:

- Use biomass from agricultural or forestry sources, or the organic portion of solid waste.
- Source 80 percent of the biomass (feedstock) from Minnesota.
- Follow standards for harvesting designed to protect natural resources and the environment.
- Meet quarterly minimum production levels.
- Begin production before June 30, 2025.

The Great Plains Institute hired University of Minnesota Extension to quantify the economic contribution of Minnesota's biobased industrial product industry in 2019, specifically looking at companies that participated in, or plan to participate in, the Bioincentive Program. This report presents the results. The analysis follows up on a 2014 Extension study.⁴ In that study, Extension explored the potential economic impact of the development of 14 new biobased industrial product companies. Since then, 12 companies have expanded to produce biobased industrial products in the state.

Economic contribution is comprised of direct, indirect, and induced effects. The direct effect of an industry is the economic activity generated by the industry itself. This includes total sales, employment, and labor income paid by businesses in the industry. To quantify the direct effects, Extension partnered with the Great Plains Institute to collect data from biobased product companies in Minnesota that have received, or plan to receive, support from the Minnesota Bioincentive Program. Ten of the 12 businesses operating responded to the data request. Extension then extrapolated the data to account for the two businesses not included.

Indirect and induced effects are often referred to as "ripple effects." They account for additional economic activity generated in the economy when biobased industrial product businesses spend money to buy inputs and pay their employees. Indirect effects are business-to-business effects. These occur when the biobased businesses purchase inputs. In turn, this causes their suppliers to increase purchases. Induced are consumer-to-business effects. These occur when biobased businesses pay their employees and the employees then spend their wages in the local economy.

¹ <https://www.auri.org/wp-content/uploads/2013/12/MinnesotasAgbioscienceStrategy-FinalReport-1.pdf>

² Learn more at mnbioeconomy.org.

³ Data on the program available at <https://www.leg.state.mn.us/docs/2020/mandated/200253.pdf>.

⁴ Full report available at <https://conservancy.umn.edu/handle/11299/171600>.

Extension used the input-output model IMPLAN⁵ to calculate the indirect and induced effects of the biobased product industry. Input-output models capture the flow of goods and services within an economy. Using this pattern, the model can show how a change in one part of the economy affects other parts of the economy. Extension used IMPLAN model 3.1 with Type SAM multipliers.

Since 2015, biobased industrial product companies have contributed to Minnesota's economy in two ways. First, eight of the responding companies began construction projects—either to build a new facility or to retrofit a current facility for biobased production. The economic impact of construction activities are shorter term and dissipate once construction ends. Second, the companies generate economic activity annually due to their operations. These impacts are longer term and will occur annually, as long as the plants operate at current levels. Thus, this report examines each effect separately.

ECONOMIC CONTRIBUTION OF CONSTRUCTION

Direct Effect

Minnesota's biobased industrial product companies directly spent \$690.5 million on construction projects to retrofit or expand their facilities. These projects employed an estimated 5,055 people and paid \$354.5 million in labor income (Table 1). Employment and labor income are estimates from the model based on \$690.5 million in spending.

Eight of the 10 biobased industrial products companies that responded to the survey reported they began a construction project to retrofit or expand their operation. Their responses included total costs, as well as a breakout of costs for land acquisition, site development, equipment, and general construction.

The responding companies also provided an estimate of the percent of equipment purchased from Minnesota-based companies. This is important, as only transactions with Minnesota companies are counted as direct impacts. In highly specialized industries, such as biobased industrial products, a small number of businesses manufacture the equipment required to operate. If the equipment is manufactured outside Minnesota, then ripple effects are not generated.

Extension used the survey responses to calculate the direct effect of \$690.5 million.

Total Contribution

Minnesota's biobased industrial companies generated an estimated \$1.2 billion of total economic activity resulting from construction, including indirect and induced impacts. This includes \$540.6 million in labor income. They also supported employment for 8,325 workers in the state.

⁵ www.implan.com

Table 1: Economic Impact of the Construction of 12 Biobased Industrial Product Facilities in Minnesota

Impact Type		Employment	Labor Income (millions)	Output (millions)
Direct	At the 12 biobased facilities	5,055	\$354.5	\$690.5
Indirect	Supply chain related to inputs	700	\$52.9	\$153.0
Induced	Supply chain related to employee spending	2,570	\$133.2	\$385.1
Total		8,325	\$ 540.6	\$ 1,228.6

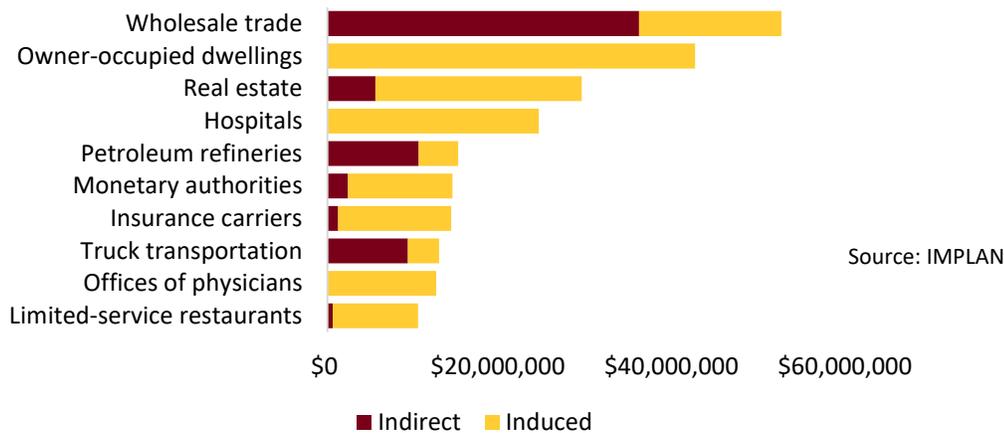
Estimates by University of Minnesota Extension Center for Community Vitality based on IMPLAN model

The table above shows cumulative effects across the time period since projects occurred during different years.

Top Industries Affected

According to the model, wholesale trade, owner-occupied dwellings (housing), and real estate are the top industries affected by the construction activities of biobased industrial product companies (Chart 1).

Chart 1: Top Industries Affected, Construction of 12 Bio-based Industrial Product Facilities in Minnesota



Indirect effects are higher in wholesale trade, petroleum refineries, and truck transportation. These are important inputs into the construction process. Wholesale trade transactions are business-to-business sales (no retail presence). Construction companies purchase many of their supplies in bulk from wholesale trade companies.

Induced effects are higher in owner-occupied dwellings, hospitals, and real estate. Owner-occupied dwellings include mortgage payments. A major portion of any household's expenditures is housing, so it is not surprising the spending of construction workers generates impacts in housing.

Tax Impacts

Construction projects also generate tax payments in the economy. Minnesota's biobased industrial product companies generated an estimated \$46.5 million in tax collections through construction (Table 2). This includes \$13.3 million in sales taxes, \$10.9 million in property taxes, and \$16.1 million in income taxes. These taxes were collected during the construction period (which, in this analysis, is 2015 to 2019) and are not annual.

Table 2: Tax Impact of the Construction of 12 Biobased Industrial Product Facilities in Minnesota

Tax Type	Value (millions)
Sales tax	\$13.3
Property tax	\$10.9
Income tax	\$16.1
Other	\$6.2
Total	\$46.5

Estimates by University of Minnesota Extension Center for Community Vitality based on IMPLAN model

ANNUAL ECONOMIC CONTRIBUTION OF OPERATIONS

Direct Effect

All 10 of the responding companies provided details about their operational expenditures for 2019. Data collected included total expenditures, number of employees, feedstock expenditures, and other expenditures by major category (utilities, royalties, etc.)

Biobased industrial product manufacturing is an innovative industry that continues to adapt to new technologies and production approaches. Thus, to analyze the industry within the IMPLAN model, Extension used analysis by parts (see Appendix for details). In other words, Extension separated the analysis into feedstock expenditures, operational expenditures, and labor expenditures.

Feedstock

The biobased industrial products companies in this analysis utilized corn grain, corn kernel fiber, or wood as their primary feedstock. In the survey, the companies provided their total feedstock purchases, their feedstock purchases directly attributable to their biobased products line, and the percent of their feedstock sourced in Minnesota (Table 3). Companies must source a minimum of 80 percent of feedstock from the state to qualify for the state incentive. Survey results indicate the companies sourced approximately 80 percent of wood feedstock and nearly 100 percent of corn feedstock in Minnesota.

Minnesota biobased industrial products companies reported spending \$229.4 million for corn in 2019. While this is a significant expenditure, Extension did not include corn purchases in the

modeling. Most of Minnesota’s tillable land is already planted with crops. The companies making purchases do not generate additional corn production. Therefore, there are no new economic impacts from corn production.

While Extension did not model new corn production, it is important to note that, although not modeled here, the development of new uses for corn can potentially play a role in stabilizing and increasing its commodity price.⁶ A higher price received by farmers will, in turn, generate additional economic activity.

Companies using wood as a feedstock reported spending \$66.6 million within the state of Minnesota. The purchase of wood was modeled as an increase in logging activity.

Table 3: Estimated Direct Impact of Annual Feedstock Purchases by 12 Biobased Industrial Product Facilities in Minnesota, 2019

Feedstock Type	Total Feedstock Purchases (Millions)	Included in Analysis?
Corn	\$229.4	No, no impact on corn production
Wood	\$66.6	Yes, as an increase in logging
Total	\$296.0	

Estimates by University of Minnesota Extension Center for Community Vitality based on survey results

Operational and labor expenditures

Feedstock purchases are the largest expenditure by biobased industrial products companies. However, the companies also spend money to operate. Expenses include utilities, maintenance and repairs, and supplies. In addition, companies pay their workers.

In 2019, Minnesota’s biobased industrial products companies spent \$67.5 million on operational expenditures (see above feedstock costs). They also spent \$75.3 million on labor (Table 4).

Extension estimated total employment at the companies based on survey results. In 2019, Minnesota’s biobased industrial products companies employed 1,320 workers.

Table 4: Estimated Direct Impact of Annual Operational Expenditures by 12 Biobased Industrial Product Facilities in Minnesota, 2019

	Total
Operational expenses (millions)	\$67.5
Labor expenses (millions)	\$75.3
Employment	1,320

Estimates by University of Minnesota Extension Center for Community Vitality based on survey results

⁶ https://www.everycrsreport.com/files/20060106_RL33204_79fa0fd63b92e9621e2bb9bfab44473bda614ced.pdf

Total expenditures

In total, Minnesota's biobased industrial product companies spent \$438.8 million to operate in 2019 (Table 5).⁷ This includes \$75.3 million in labor income. The companies directly employed 1,320 workers.

Total Contribution

Minnesota's biobased industrial product companies generated an estimated \$610.7 million of economic activity resulting from their operations, including \$127.0 million in labor income. They also supported employment for 2,415 workers in the state. These impacts are annual, as long as the companies operate at current levels.

Table 5: Economic Contribution of the Operations of 12 Biobased Industrial Product Facilities in Minnesota

Impact Type		Employment	Labor Income (millions)	Output (millions)
Direct	At the 12 biobased facilities	1,320	\$75.3	\$438.8
Indirect	Supply chain related to inputs	620	\$27.1	\$100.6
Induced	Supply chain related to employee spending	475	\$24.6	\$71.3
Total		2,415	\$ 127.0	\$ 610.7

Estimates by University of Minnesota Extension Center for Community Vitality based on the IMPLAN model

Top Industries Affected

Top industries affected by the operations of the biobased industrial product companies include wholesale trade, owner-occupied dwellings (housing), and real estate (Chart 2).

⁷ Spending is for the companies' biobased industrial product operations. Several companies produce other products. Spending for those other products are not included in this analysis. Total expenditures include spending for corn. However, since Minnesota is already at or near full corn production, the analysis did not include additional corn production.

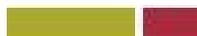
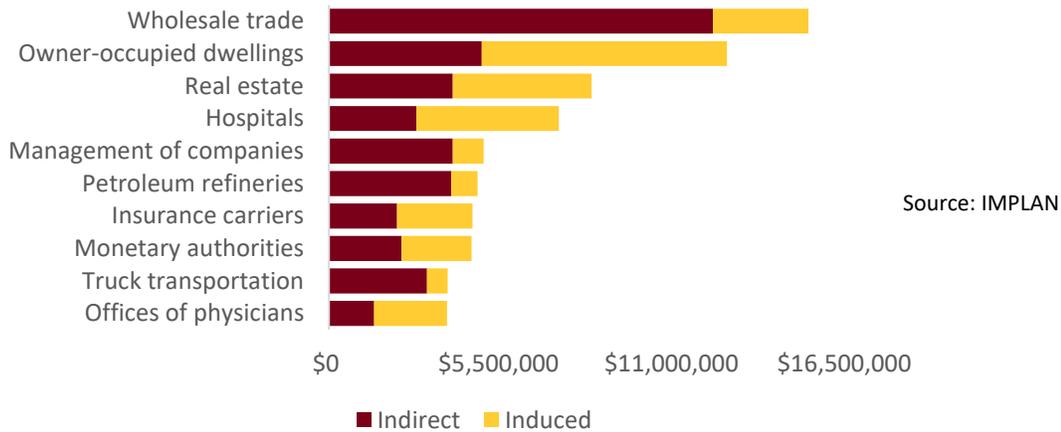


Chart 2: Top Industries Affected, Operations of 12 Biobased Industrial Product Facilities in Minnesota



Tax Impacts

In 2019, biobased industrial product companies generated an estimated \$13.3 million in tax collections (Table 6). This includes \$5.0 million in sales taxes, \$4.0 million in property taxes, and \$2.6 million in income taxes. These are annual impacts and will continue as long as the businesses operate at these levels.

Table 6: Tax Contribution of the Operations of 12 Biobased Industrial Product Facilities in Minnesota

Tax Type	Value (millions)
Sales tax	\$5.0
Property tax	\$4.0
Income tax	\$2.6
Other	\$1.7
Total	\$13.3

Estimates by University of Minnesota Extension Center for Community Vitality based on IMPLAN model

THE BIOINCENTIVE PROGRAM

During the 2015 legislative session, the Minnesota Legislature enacted the Minnesota Bioincentive Program. The program provides a production incentive for companies producing renewable chemicals, advanced biofuels, and biomass thermal energy.

Biobased industrial products companies can receive a production incentive if they meet the conditions listed at the beginning of this report.

Companies only receive the incentive after beginning to produce a biobased product. There are no upfront payments or payments for production that does not occur. Incentives are awarded using a formula defined in the state statute (MINN. STAT. 41A.12).

Appropriations for the Minnesota Bioincentive Program have increased with time. During the first years of the program, the legislature appropriated \$500,000 per year for the program. By 2020, total appropriations increased to \$2.5 million per year (Table 7). In 2019, Minnesota biobased industrial products companies filed claims for slightly more than the \$1.5 million available. As of first quarter 2020, companies had already filed for \$1.8 million. Industry experts anticipate claims will exceed \$2.5 million in 2020.⁸

Table 7: Minnesota Bioincentive Program Appropriations

Biennium (two years)	Per Year
2016-2017	\$500,000
2018-2019	\$1,500,000
2020-2021	\$2,500,000

Source: AGRI Bioincentive Program report

In 2019, companies claiming the Minnesota Bioincentive received \$1.5 million in incentives. Their operations generated \$610.7 million in economic activity in the state. Thus, for every dollar invested in incentives, \$407.10 is generated in the economy (Table 8). Biobased industrial product companies also generated taxes with their operations. In 2019, operations created an estimated \$13.3 million of tax collections. Thus, every dollar of incentive paid leads to approximately \$8.90 in tax collections.

Table 8: Minnesota Bioincentive Program Appropriation and Economic Contribution

Year	Appropriations	Economic Contribution	Contribution per Dollar of Appropriations	Taxes Generated	Taxes per Dollar of Appropriations
2019	\$1,500,000	\$610,700,000	\$407.10	\$13,300,000	\$8.90

Sources: AGRI Bioincentive Program report and University of Minnesota Extension estimates

COMPARISON OF RESULTS TO 2014 ANALYSIS

In 2014, Extension studied the potential economic impact of an expanded biobased industrial products industry in Minnesota. Based on input from industry experts, the report considered the impact of 14 potential plants. For its 2014 analysis, Extension surveyed seven potential companies about their planned expenditures. The surveyed companies were identified based on their known plans to expand into biobased products. Data for the seven companies was then extrapolated to represent 14 facilities.

In 2014, Extension estimated the construction of 14 biobased industrial products plants would generate \$1,531.4 million in economic activity in Minnesota (Table 9). The 2019 analysis shows the

⁸ More information is available at <https://www.leg.state.mn.us/docs/2020/mandated/200253.pdf>

12 companies that began production in the state generated \$1,228.6 million in economic activity from construction. Based on 2019 actual data, had 14 facilities started production as predicted, the economic activity generated would have been \$1,433.4 million.

Table 9: Total Economic Contribution, 2014 Estimates Compared to 2019 Actuals, Construction Contribution

	2014 Estimate (14 facilities)	2019 Actual (12 facilities)	2019 Extrapolated (14 facilities)
Output (millions)	\$1,531.4	\$ 1,228.6	\$1,433.4
Employment	8,690	8,325	9,710

Estimates by University of Minnesota Extension Center for Community Vitality

Extension’s 2014 analysis predicted the 14 plants would generate \$837.6 million in economic activity (Table 10). The 2019 analysis showed the 12 facilities actually operating generated \$610.7 million of activity. Had 14 facilities begun production as predicted, the 2019 activity generated would have been \$712.4 million.

Table 10: Total Economic Contribution, 2014 Estimates Compared to 2019 Actuals, Operations Contribution

	2014 Estimate (14 facilities)	2019 Actual (12 facilities)	2019 Extrapolated (14 facilities)
Output (millions)	\$837.6	\$610.7	\$712.4
Employment	3,190	2,415	2,817

Estimates by University of Minnesota Extension Center for Community Vitality

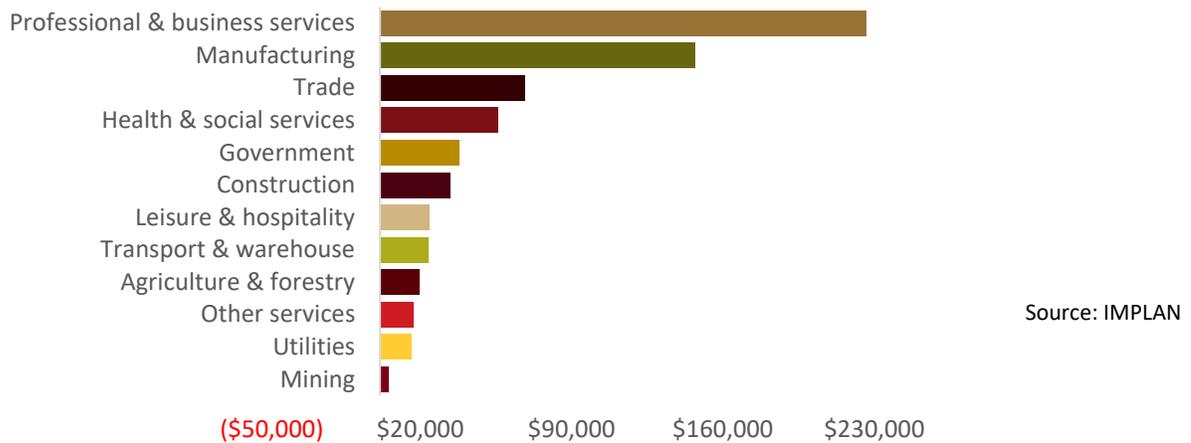
The comparison shows estimates from 2014 were fairly close to the actual economic activity generated. There are two primary reasons the operational contribution was slightly lower than anticipated: 1) the companies reported lower general operating expenses than predicted and 2) the companies used a slightly different mix of corn versus wood as feedstock.

BIOBASED PRODUCTS IN THE CONTEXT OF MINNESOTA’S ECONOMY

In 2017, Minnesota businesses and enterprises created \$658 billion of output. Industries producing the highest levels of output, according to the IMPLAN model, included professional and business services, manufacturing, and trade (Chart 3).

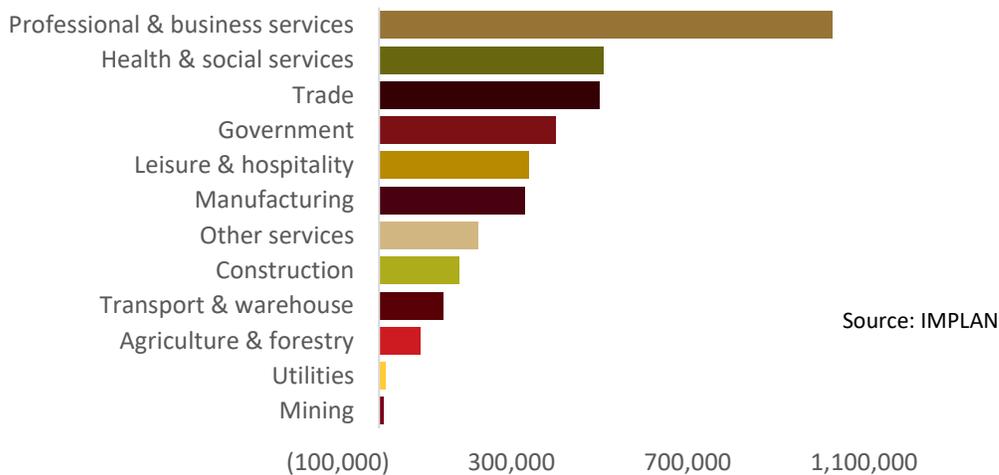
Agriculture and forestry-related manufacturing is an important driver of Minnesota’s manufacturing economy, accounting for 29 percent of all manufacturing output in the state. The biobased industrial products industry is a component of agricultural and forestry-related manufacturing.

**Chart 3: Output by Industry, Minnesota, 2017
(Millions)**



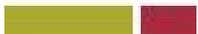
In 2017, businesses and enterprises employed 3.8 million workers. Major industry employers included professional and business services, health and social services, and trade (Chart 4). In the model, one job is one job, regardless if it is full-time, part-time, or seasonal. Thus, industries like trade—that often have a high number of part-time employees—correspondingly also have a higher number of jobs compared to other industries, such as manufacturing.

Chart 4: Employment by Industry, Minnesota, 2017



Biobased industrial products drive employment in two of Minnesota’s key industries—agriculture and manufacturing. Location quotients measure the concentration of jobs in an industry. A location quotient of one means an industry has roughly the same concentration in the region as the nation. A location quotient of more than one indicates a higher concentration or a specialization in an industry. Minnesota’s highest location quotients are in management of companies (1.89), agriculture, forestry, fishing, and hunting (1.34), and manufacturing (1.31). Thus, in many ways, the biobased

industrial products industry is feeding into Minnesota’s current economic strengths and developing new products to grow both industries.



APPENDIX: METHODS AND TERMS

Special models, called input-output models, exist to conduct economic contribution analysis. There are several input-output models available. IMPLAN (IMpact Analysis for PLANning) is one such model. Many economists use IMPLAN for economic contribution analysis because it can measure output and employment impacts, is available on a county-by-county basis, and is flexible for the user. IMPLAN has some limitations and qualifications, but it is one of the best tools available to economists for input-output modeling. Understanding the IMPLAN tool, its capabilities, and its limitations helps ensure the best results from the model.

One of the most critical aspects of understanding economic contribution analysis is the distinction between the local and non-local economy. The local economy is identified as part of the model-building process. Either the group requesting the study or the analyst defines the local area. Typically, the study area (the local economy) is a county or a group of counties that share economic linkages. In this study, the study area is the entire state of Minnesota.

A few definitions are essential to properly read the results of an IMPLAN analysis. These terms and their definitions are provided below.

Output

Output is the quantity of goods or services produced in a given time period by a firm, industry, or county, whether consumed or used for further production. The concept of national output is essential in the field of macroeconomics.

Output represents the value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are listed in producer prices. Output is measured in dollars and is equivalent to total sales.

Employment

Employment includes full- and part-time workers, as well as seasonal workers. Employment is measured in annual average jobs, not full-time equivalents (FTEs). IMPLAN includes total wage and salaried employees, as well as the self-employed, in employment estimates. Because employment is measured in jobs and not in dollar values, it tends to be a very stable metric.

Labor Income

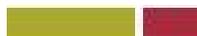
Labor income includes all forms of employment income, including employee compensation (wages, salaries, and benefits) and proprietor income. Labor income measures the value added to the product by the labor component.

Direct Impact

Direct impact is equivalent to the initial activity in the economy. In this study, it is the expenditures of the biobased industrial products companies.

Indirect Impact

The indirect impact is the summation of changes in the local economy that occur due to spending for inputs (goods and services) by the industry or industries directly impacted. For instance, if



employment in a manufacturing plant increases by 100 jobs, this implies a corresponding increase in output by the plant. As the plant increases output, it must also purchase more inputs, such as electricity, steel, and equipment. As the plant increases its purchase of these items, its suppliers must also increase production, and so forth. As these ripples move through the economy, they can be captured and measured. Ripples related to the purchase of goods and services are indirect impacts.

Induced Impact

The induced impact is the summation of changes in the local economy that occur due to spending by labor; that is, spending by employees in the industry or industries directly impacted. For instance, if employment in a manufacturing plant increases by 100 jobs, the new employees will have more money to purchase housing, buy groceries, and go out to dinner. As they spend their new income, more activity occurs in the local economy. This can be quantified and is called the induced impact.

Input-Output, Supply and Demand, and Size of Market

Care must be taken when using regional input-output models to ensure they are being used in the appropriate type of analysis. If input-output models are used to examine the impact or the contribution of an industry that is so large that its expansion or contraction results in such major shifts in supply and demand that prices of inputs and labor change, input-output can overstate the impacts or contributions. This may be a concern in this study, as biobased industrial products companies do have the potential to change commodity prices. Care should be taken when interpreting the results. Further research may be warranted to address this potential issue.

Analysis by Parts

Analysis by parts (ABP) is an IMPLAN modeling technique. ABP allows the analyst to enter each expenditure as its own category, as opposed to relying on a standard production function. Standard production functions are built into IMPLAN. For well-established industries with companies that follow a similar spending pattern, the production functions provide accurate estimates of spending. However, for developing industries or industries comprised of companies with differing spending patterns, analysis by parts provides a more accurate estimate, since the analyst enters spending data directly.