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# A National Survey of Biobased Product Companies

**R. A. Cox**
Director, Center for Industrial Research and Service (CIRAS)
rcox@iastate.edu

**S. Devlin**
Director, Business Development Program
University of Missouri Extension
devlinsl@missouri.edu

**R. Basu**
Economics Specialist, CIRAS
rbasu@iastate.edu

Iowa State University
Ames, Iowa 50011

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**Summary**

Over the past decade, Iowa State University has identified nearly 28,000 end-use biobased products produced or sold by about 3,500 manufacturers and distributors. Information on these companies was compiled for USDA as part of Iowa State's support of the BioPreferred program. To better understand some of the basic characteristics of companies that produce end-use biobased products and intermediate materials, Iowa State conducted convenience surveys of these companies in 2008, 2010, and 2012. The companies included in the three surveys were selected from a database that contained roughly 1,900, 2,500 and 3,500 companies in the respective year. The 2012 survey had the largest number of survey responses, with about 60% of the companies where contact was made responding - nearly 1,600 distinct companies.

The BioPreferred program is part of an effort by USDA to satisfy portions of the Farm Security and Rural Investment Act of 2002 and the Food, Conservation, and Energy Act of 2008. Companies in the database produce and distribute more than 100 types of products including bath products, candles and wax melts, facial care products, intermediate feedstocks, multipurpose cleaners, gasoline fuel additives, graffiti and grease removers, laundry products, disposable tableware, hydraulic fluids, sorbents, and animal repellants.

Companies responding to all three surveys were very diverse, ranging from large multinational corporations to small start-ups companies. About one-third of the respondents had five or fewer employees. Approximately eighty percent of the companies were located in a metropolitan area, with about forty percent of those in cities with a population less than 20,000. The majority of the products the survey respondents sold were categorized in the chemical sector. The largest sub-category was soap, cleaning compound, and toilet preparation.

Just under half of all respondents only sold biobased products; the other companies sold both biobased and non-biobased products. Some of the biobased products cost less than alternative non-biobased products, but about 50 percent of the respondents stated their products cost 10 percent or more. In the most recent survey, about one third of the respondents stated they had been in business for less than ten years; slightly over half had been selling biobased products for less than ten years.

## Introduction

The Food, Conservation, and Energy Act of 2008 (FCEA) reauthorized and expanded provisions related to the federal biobased procurement and labeling statute originally established by Section 9002 of the Farm Security and Rural Investment Act of 2002 (FSRIA) [1, 2]. The statute includes provisions to encourage the procurement of biobased products by federal agencies and a voluntary biobased-labeling program. USDA refers to the programs collectively as BioPreferred.

As defined by FCEA, "biobased products" are products determined by the U.S. Secretary of Agriculture to be commercial or industrial goods (other than food or feed) that are composed in whole or in significant part of biological products, including renewable domestic[1] agricultural materials and forestry materials or intermediate ingredients or feedstocks.

The goals of the BioPreferred program are to lessen U.S. dependence on foreign oil to improve security and decrease the trade deficit; promote economic development by creating new jobs in rural communities and new markets for farm commodities; and to improve the environment. These might occur from substitutions of petroleum-based products with biobased equivalents, by incorporating improvements over petroleum-based products, or by the development of entirely new products.

Federal agencies are required to give preference to BioPreferred-designated biobased products when the biobased product is reasonably available, reasonably priced, and comparable in performance. The development of a list of items (or generic groupings of biobased products) for preferred procurement is a core element of the BioPreferred program. Once an item is designated, every manufacturer/vendor producing and marketing products that fit within that designation can claim preferred procurement status for their products when marketing to federal agencies.

For the purposes of this study, the definition of a biobased product was further constrained to new-use products. Mature market products (e.g., cotton shirts) are not included in the current analysis since many do not consider these types of products as part of a new bioeconomy. Items like cotton shirts were developed in the marketplace because of basic consumer demand for the product and not as a mechanism to reduce U.S. dependency on oil, help rural economies, or improve the environment.

As defined by USDA, mature markets generally refer to items sold prior to 1972 [2]. Some companies that sold products that were available prior to 1972 are still included in the BioPreferred database and were included in the survey for two reasons. First, the database used for the survey includes companies that have not yet been analyzed in-depth by USDA to determine when the products were initially sold and whether they should receive preferred preference under the BioPreferred program. The number of companies that fall into this category is fairly small since the products that were analyzed first by USDA included new-use items that were sold by a significant number of companies. Second, USDA still considers

[1] In practice USDA has eliminated the "domestic" qualifier associated with agricultural materials to comply with World Trade Organization regulations.

some products sold prior to 1972 as acceptable for preferred procurement because information gathered indicated that these products did not constitute a significant portion of the market and therefore would still qualify for preferred procurement.

End-use biobased products are defined as items sold directly to end-use consumers (point of purchase) or business-to-business sales. Business-to-business sales might include transactions where only minor modifications to the product are made (e.g., repackaging) or wholesale distribution of end-use products. End-use biobased products include all products that are not categorized as a biofuel.

In this report, biochemicals refer to non-fuel chemicals made from biobased feedstocks, as opposed to a petrochemical feedstock, that are predominantly considered to be new uses. These could include commodity chemicals and intermediates. Some of these biochemicals could also be classified as end-use products (e.g. biobased 1, 3-propanediol). The recent Farm Bill specifically refers to intermediate ingredients that "are or can be used to produce items that will be subject to the preference" targeted by the BioPreferred program. These may be commercial or industrial products [1].

Since the definition of biobased products is not easily defined nor universally understood, the following definition was developed for use in the survey conducted in this work:

"A biobased product is a commercial or industrial product other than food or feed that is made from biologically-based materials, such as plant or animal products, and that traditionally has been made from other kinds of materials. This includes products like chemicals that are plant-based rather than petroleum-based, or like clothing made from corn or hemp. Biobased products are sometimes referred to as "green" products."

Over the past decade, ISU had identified nearly 28,000 biobased products produced or sold by about 3,500 manufacturers and distributors.

**Survey Methodology**

Iowa State University's Center for Survey Statistics and Methodology was contracted by CIRAS to conduct telephone surveys of manufacturers and distributors of biobased products.

Questionnaires were developed that covered a variety of topics associated with the size of the companies and constraints to growth. The surveys were purposely kept short in an attempt to achieve a high response rate.

Telephone surveys were conducted to maintain a consistent focus on biobased products, per the definition. Interviewers were able to clarify the definition when needed and to probe further to determine if the company was actually involved in the biobased products industry.

There is currently no available listing of all companies involved in the biobased products industry. As a result, the sample for this project was a convenience sample[2] developed by ISU through support of the USDA BioPreferred program. Over the 2008-2012 period of surveys, companies that identified themselves in promotional materials or on their websites as either manufacturing or distributing biobased products increased from nearly 2,000 in 2008 to 3,500 in 2012 [X, Y, Z]. The sample consisted primarily of U.S. companies. If a company was composed of two or more establishments, only a single establishment was included. This was typically the company headquarters.

Both 2008 and 2010 surveys only included companies in predominantly English-speaking countries because of a potential language barrier between the interviewers and the company personnel. Specifically, companies in the United States, Canada, Australia, and United Kingdom were interviewed. In 2012, 85 companies from the rest of the world were added to the data base, but only a few responded to the survey.

Advance letters were sent to the sampled companies prior to data collection to explain the purpose of the research and to notify them that a research interviewer would be contacting them to conduct an interview.

Attempts were made to call all sampled companies with an available telephone number. When no contact name was available, attempts were made to locate someone in the firm who was knowledgeable about biobased product lines. Anywhere from eight to fifteen unsuccessful call attempts were made before companies were removed from the calling queue.

Of the original businesses in the sample, some were classified as either not eligible for a variety of reasons, no personal contact could be made with the company, or a working telephone number was not available.

The businesses that were deemed ineligible consisted of those that were verified as closed or merged with other firms, duplicate listings, exclusively involved in research and development, or planning to manufacture in the future but were currently in developmental stages. A few of the businesses manufactured biologically-based products that were excluded from the study by definition, either because all of their products are food, feed, or pharmaceuticals or because all of their products are mature products like wooden pallets, wood flooring, or standard compost. The largest portion of ineligible businesses simply stated that they do not manufacture or distribute any biobased products, based on the study definition.

In all three surveys there was no personal contact made with a certain fraction of these cases; only answering machines or ringing numbers. They were removed after a maximum number of calls were made.

[2] Convenient sampling is a type of nonprobability sampling in which people are sampled simply because they are "convenient" sources of data for researchers [3]. For a more detailed explanation of convenience sampling one can refer to [4, 5].

There were businesses that did not have a working telephone number available. Some of these businesses may have closed or merged with other companies, but their actual status is unknown. Some are operating businesses but no phone numbers or company employees are available to the public.

There were additional companies where personal contact was made but a survey was not completed. Some refused to complete an interview; a portion of these because company policy prohibited them from completing surveys. The remaining involved some personal conversation with an employee. They did not actively refuse to participate, but no interview could be conducted within a maximum number of call attempts within the data collection period.

The distinct interviews that were completed with buisness in all the three surveys comprised about 60% of the companies where personal contact was made and the company was deemed to be a manufacturer or distributer of a biobased product as defined above. This amounted to 1,559 completed interviews in the latest survey.

The company interviews were held from February to May in each of 2008, 2010, and 2012. Standard interviewing protocols were followed. Interviews were monitored at random intervals by supervisory staff to ensure proper protocols were being followed. Since convenience sample was used, the data was not weighted.

**Business Summary**

While there was variation in the total number of companies reporting over the years, many company characteristics remained relatively unchanged over the three surveys. Slightly over 70% of respondents primarily considered themselves a manufacturer, just over a quarter a wholesaler or retailer, and the remaining classified themselves as something different. Many of the companies manufactured and distributed products. Roughly 80% of the companies did at least some manufacturing. Just over fifty percent of the companies also manufactured or distributed a non-biobased product.

**Biobased Products**

The respondents' biobased products were categorized into one of three broad types – end use, intermediates, or fuels. Over the course of the three surveys there was little change in the fraction of companies that manufactured or distributed the various types of products. The make-up of the respondents for 2012 is displayed in Figure 1. The total in the chart adds up to more than 100% because some companies sold products that fall into more than one category.

The majority of the respondents sold end-use biobased products; many fewer companies sold intermediates. This is not surprising since there generally are fewer companies that produce intermediates than those that buy commodity feedstocks to produce a product. Companies that produce intermediate chemicals tend to be larger and more established, whereas many

companies that sell end-use biobased products are small and have been in existence for a shorter period of time. In addition, ISU researchers began the search for companies that produce biobased intermediate feedstocks after the search for end-use products began. As well, the survey samples may have a lower fraction of companies that produce intermediates.

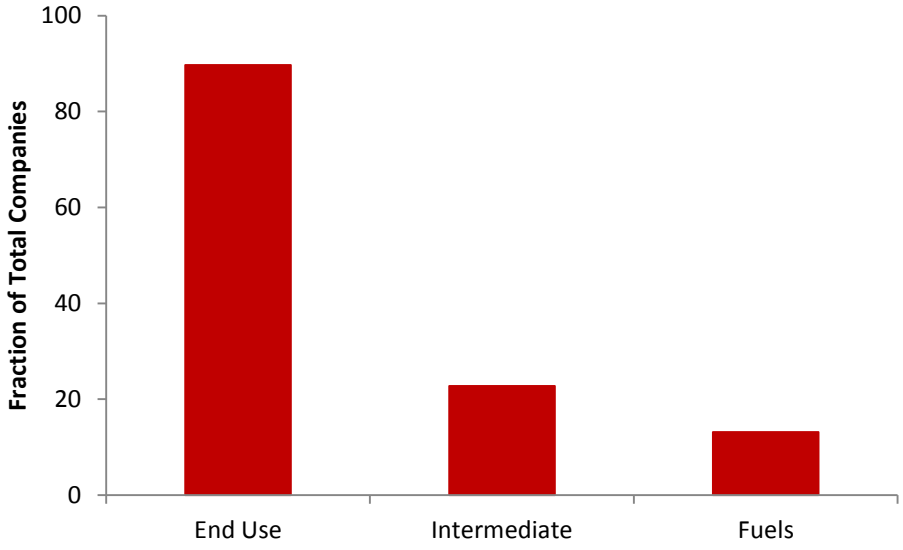


**Figure 1: Products sold by biobased product companies, (2012 results).**

Only 13 percent responded that they manufacture or distribute fuels, which is fewer than what might be expected given the number of ethanol and biodiesel plants in the U.S., [6, 7, 8]. One reason the number of respondents is low is because of how the survey lists were generated. The company list did not include all of the biofuel companies since the list was generated based on the FSRIA product definition. Specifically, companies were only included if they sold fuels targeted as a fuel-additive since non-fuel products was the primary focus of the legislation. Other legislation is focused on the growth of the biofuels industry targeted to the transportation sector.

The median size of the companies that produce end-use products, intermediates, and fuels varied little over the three surveys. In the most recent survey, the median company size was 10, 24, and 37, respectively.

The companies were asked what primary product they sell and the corresponding three-digit NAICS category [9]. Figure 2 displays the distribution of the companies providing a NAICS code, averaged over the three surveys. More than sixty percent of the respondents were categorized as being in the chemical industry (325).

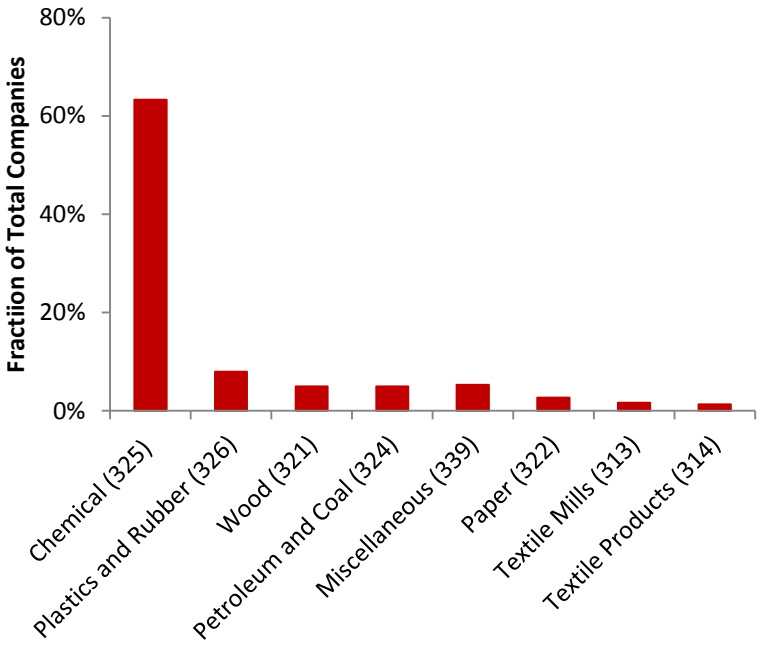


**Figure 2: Top NAICS categories of survey respondents.**

In the three surveys, between a third and a half of the respondents provided three-digit NAICS information on their products. The remaining companies were asked additional questions in an attempt to understand their three-digit NAICS. A fraction of these provided enough additional information so the authors were able to further classify those products to a four-digit code. The primary sub-categories of the chemical companies where a four-digit code could be ascertained are displayed in Figure 3, averaged over the three surveys. The product descriptions associated with these four-digit NAICS are listed in Table 1.

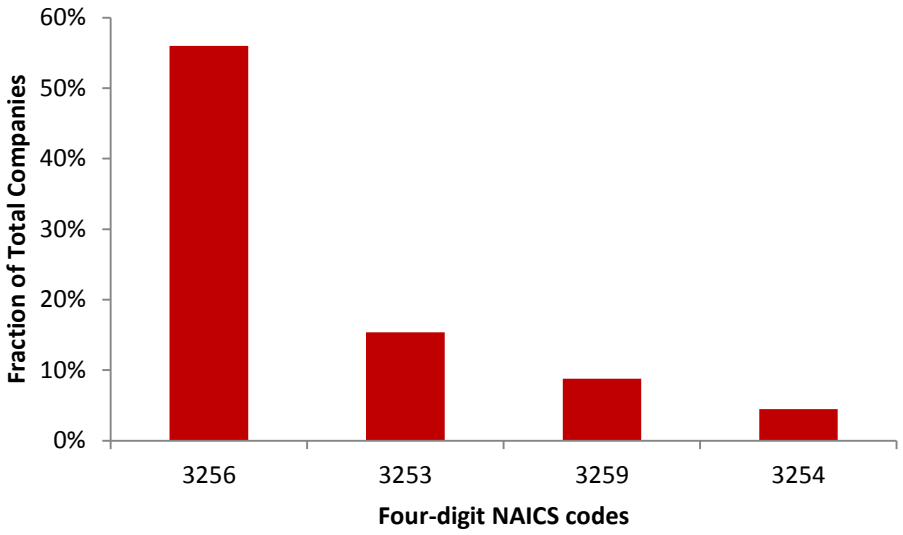


**Figure 3: Products sold by chemical companies –NAICS 325.**

**Table 1: Four-digit NAICS code descriptions.**

| 4-Digit NAICS | Description |
|---|---|
| 3256 | Soap, cleaning compound, and toilet preparation |
| 3253 | Pesticide, fertilizer, and other agricultural chemicals |
| 3259 | Other chemical products and preparation |
| 3254 | Pharmaceuticals and medicines |

## Company Location

Of all the distinct companies responding to the surveys, over 90% were located in the U.S., 4% in Canada, and the remaining in Australia and the U.K.

The companies were grouped by the four geographic regions used by the Bureau of Census. For companies with multiple establishments, only the establishment that completed the survey was included. There was little variation between the three surveys. Most companies were located in the Midwest region, followed by the West region. This comprised sixty percent of all companies. The least number of companies were located in the Northeast region. Slightly over forty percent of the companies resided in just seven states, California, Illinois, Ohio, Minnesota, Texas, Florida, and Iowa.

The locations of the respondents were classified in two separate ways, by a rural-urban classification and by the size of the town or city where the company was located.

The RUCA, Rural-Urban Commuting Area Codes, is a designation mechanism that uses the Bureau of Census Urbanized Area and Urban Cluster definitions and commuting information to classify Census tracts [10]. The ZIP Code RUCA approximation was used to categorize each biobased product company. The locations of the respondents by RUCA classification were relatively similar in all three surveys.

Figure 4 displays the locations of the U.S. survey respondents by grouped RUCA classifications for 2012. Specifically, metropolitan includes RUCAs 1-3, micropolitan 4-6, small town 7-9, and rural 10. As evidenced by the results, the vast majority of the biobased product companies are classified as metropolitan. This means the companies are located in a county with a city with 50,000 or more inhabitants or they are located in a county where 10% or more of the inhabitants commute to an urbanized area.

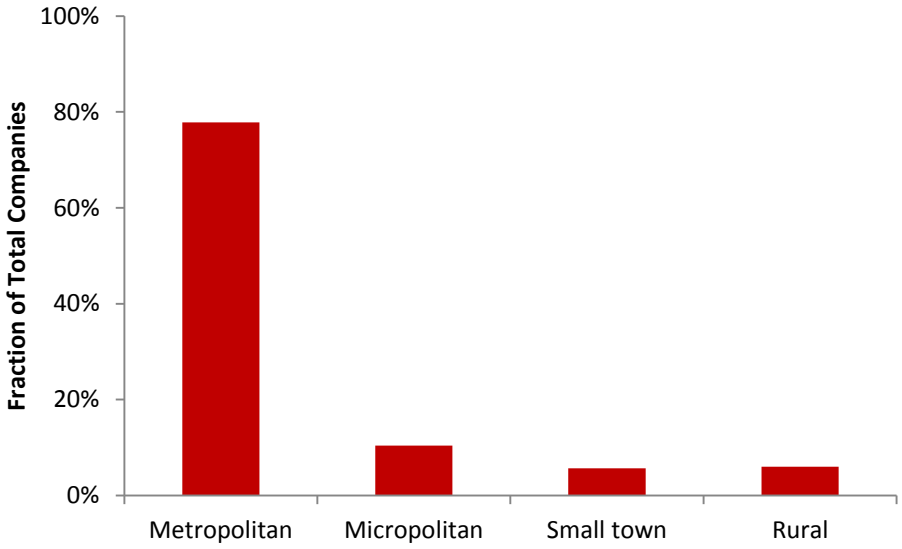


**Figure 4: U.S. biobased products survey respondent Locations –RUCA classification, (2012 results).**

There are strengths and weaknesses of any definition. For example, a company located in Nevada, Iowa, population 6,807, is considered a metropolitan company because of the proximity to Ames, population 59,042.

Since so much of the U.S. population is classified as living within metropolitan areas, a different definition of rural and urban was investigated. This second analysis of the respondents was conducted based on the size of the town or city where the company was located. Three broad classifications were used: Cities with 50,000 or more inhabitants, cities with 20,000-49,999 inhabitants, and cities with fewer than 20,000 inhabitants. The location of the respondents by city size were relatively similar in all three surveys. Figure 5 displays the locations of the respondents by city size for 2012.

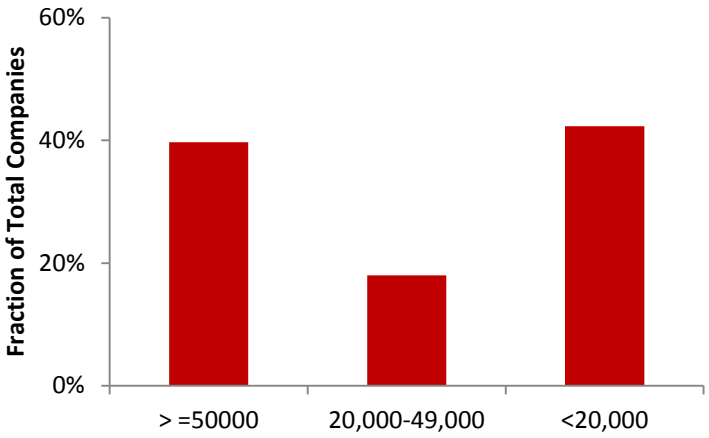


**Figure 5: U.S. biobased products survey respondent Locations –city size, (2012 results).**

A city-size approach has weaknesses as well. For example, a company located in Clive, Iowa, population 15,858, is designated to be within a small population city even though it is located seven miles, center-to-center, from Des Moines, population 206,599.

## Company Age

The fraction of companies with respect to company age showed some variability over the three surveys. Figure 6 displays information on the length of time in business of the survey respondents for 2012. Roughly one-third had been in business for ten years or less. About sixty percent have been in business for less than twenty years.

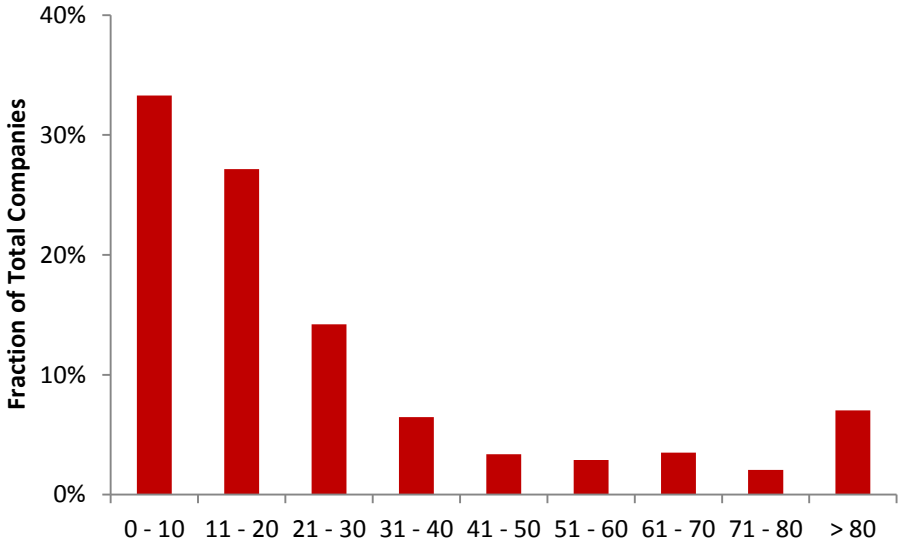


**Figure 6: Age of biobased product companies, (2012 results).**

The distribution of the respondents with respect to the age of biobased product companies had slight variability over the three surveys. Figure 7 displays the information on the length of time the respondents had been producing or distributing biobased products in 2012. Slightly more than half of the companies had been selling biobased products for less than ten years; nearly eighty percent for less than twenty years. Only 6% had been selling a biobased product for more than 50 years, though 16% had been in business for that length of time.

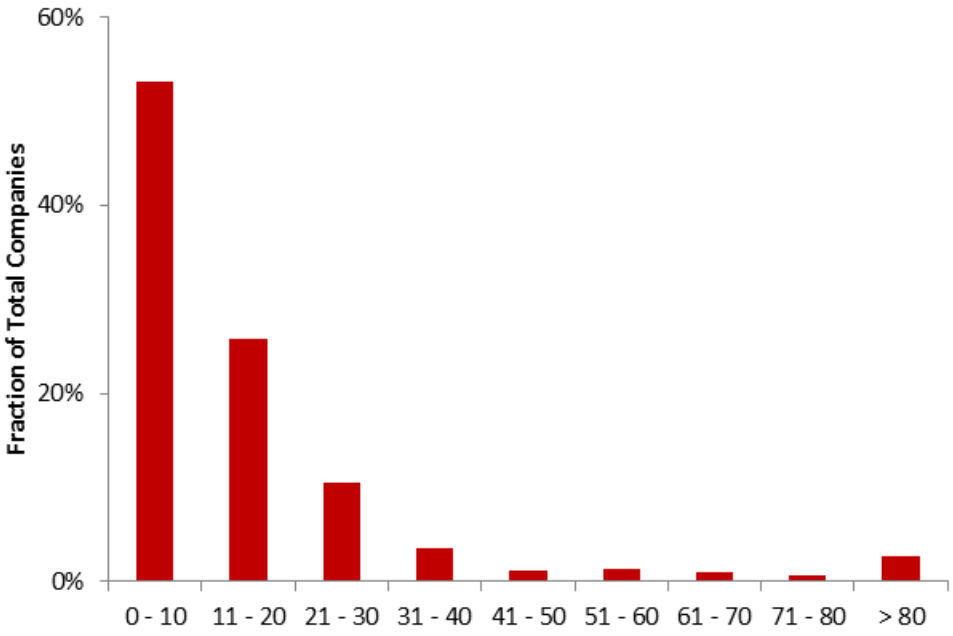


**Figure 7: Length of time selling biobased products, (2012 results).**

It is not surprising to find such a small number of companies selling biobased products for more than fifty years. As discussed earlier, the BioPreferred database was developed with a focus on new-use biobased products.

## Industry Size

The total number of individuals employed in the new-use biobased products industry is the most common question the authors receive. The answer to this question is not straightforward because there is not a well-known definition of new-use biobased products, the total number of biobased companies is not yet known, and a convenience sample was used in this survey.

The BioPreferred database, which was used as the basis of the three surveys, includes companies with products the authors believe are new-use products, as opposed to mature-market products. As such, survey results should not include employment information from biobased product companies only selling mature biobased products. It will also miss the

number of employees at new-use biobased product companies that have not yet been located. Lastly, it will not include the employees at the companies that did not complete the survey or did not answer this question when they completed the survey. Given this, it is very likely that the industry is larger than what can be computed by aggregating the survey responses.

Approximately 40% of the companies in the BioPreferred database produce one product, which is a new-use product. Employee counts for these companies can be fully attributed to the industry and could be used to compute a lower bound on the size of the industry. For the 2012 survey, there were a total of 38,000 employees in these companies.

A modified lower bound can be calculated by including the biobased employees in the remaining companies that produce both new-use and mature or non-biobased products. Companies responding to the 2008, 2010, and 2012 surveys reported 54,000, 163,000, and 280,000 employees engaged with new-use biobased products.

Some of this increase in employees over the three surveys can be explained by the increase in the number of companies responding to the survey. However, it is likely this modified lower bound is inaccurate. While reviewing the employment data for each company the authors observed that several large biobased product companies, producing both new-use and mature biobased products, may not have accurately interpreted the definition of new-use products and erroneously reported all of their employees as new-use biobased product employees. If so, the aggregate results over-estimate the number of new-use biobased jobs working in the respondents' companies. Given this, an accurate estimate of the size of the new-use biobased products industry is not possible.

**Company Characteristics**

The distribution of employee type remained similar over all three surveys. Data from the 2012 survey is displayed in Figure 10. Over one-fourth of the companies had five employees or fewer. About sixty percent had twenty employees or fewer.

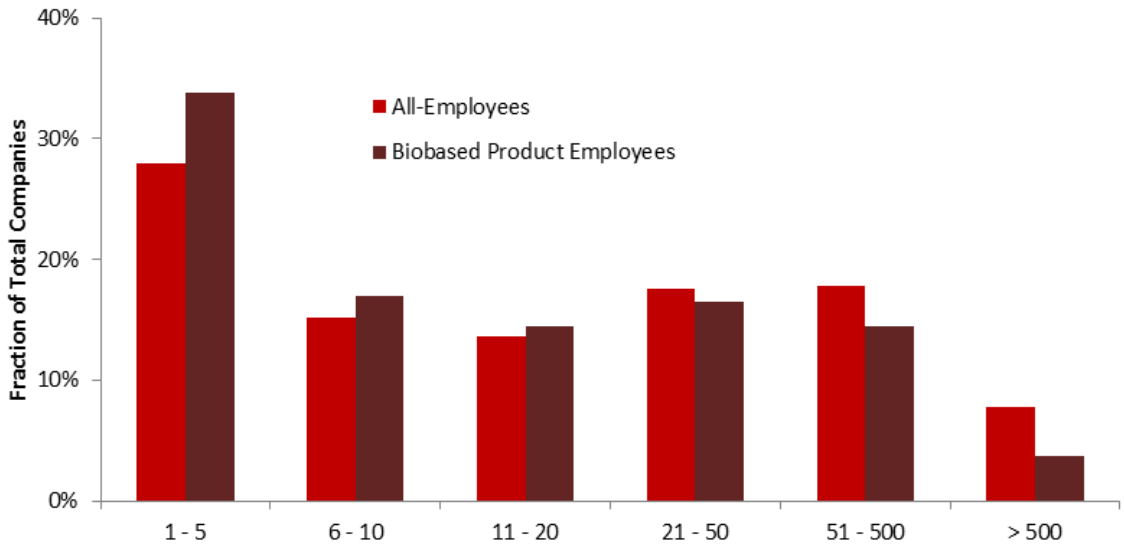


**Figure 10: Number of employees at biobased product companies, (2012 results).**

The companies were also asked how many of their employees, including support staff, contributed to the production or distribution of biobased products (see Figure 10). About one third of the companies had five employees or fewer working with biobased products. Fewer than 4 percent of the respondents to this question stated they have 500 or more employees working on biobased products.

Survey respondents could classify themselves into one of five business categories, manufacturing, wholesale trade, retail trade, product development, or something else. Over 90 percent primarily considered themselves a manufacturer.

Over ninety percent of respondents provided information on the age of the company, the length of time selling biobased products, the total number of employees, and the number of employees involved with biobased products. The relationship between the age of the company and the variation of the employment size remained virtually unchanged over all three surveys. The data from the 2012 survey is displayed in figure 11.

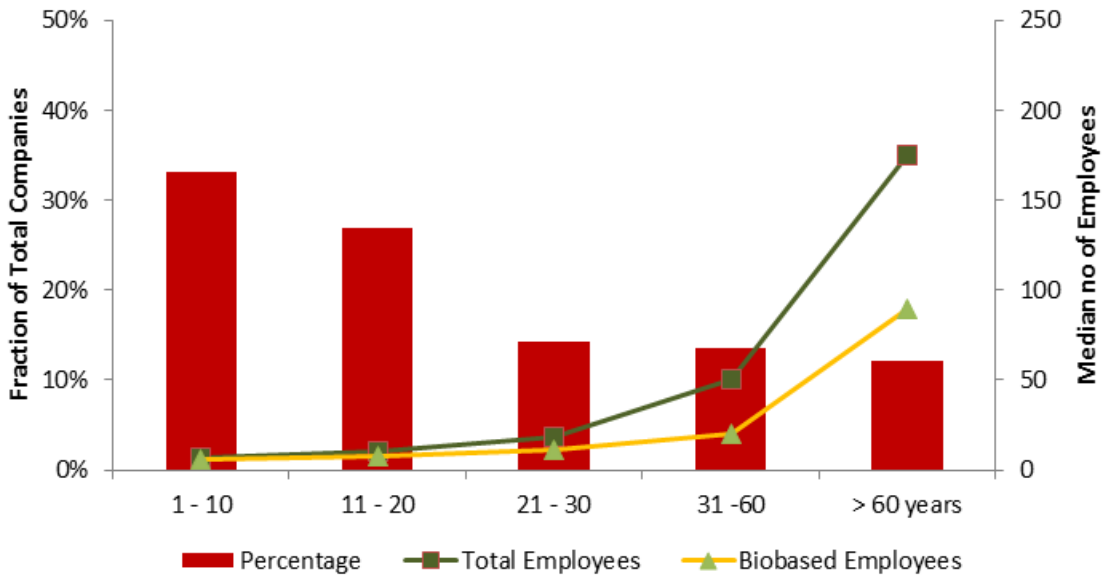


**Figure 11: Variation of employment size with company age, (2012 results)..**

As part of the 2010, 2012 surveys, investigators included four additional questions in an attempt to quantify the potential economic impact of the biobased products industry as it relates to jobs creation and quality. Respondents were asked to estimate the percentage of biobased employees in managerial, technical, production, clerical, or sales jobs. There were some slight changes in results from 2010 to 2012, mainly driven by differences in large firm job patterns and the higher fraction of large companies' respondents in the 2012 survey. As well, there was a decline in the number of jobs reported in sales from 20 percent in 2010 to 12 percent in 2012. This drop was reported by both small and large firms. Figure 12 displays the 2012 distribution of the number of biobased employees associated with each job type.

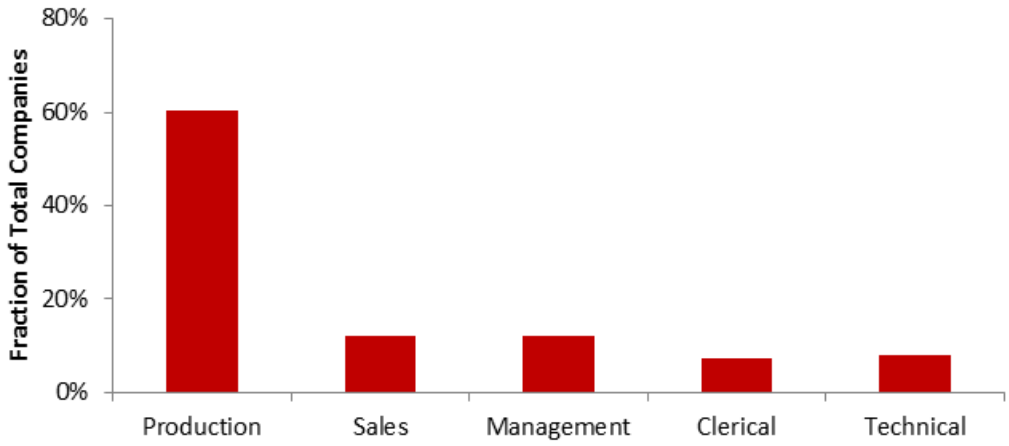


**Figure 12. Variation of biobased employees with job classifications.**

Two questions focused on benefits associated with biobased jobs. Roughly two-thirds of the companies responding indicated that health care insurance was made available to their employees. About half of responding companies indicated they have some type of pension plan or 401K for their employees.

Respondents were also asked if they had used any outside technical support or consultant services. In 2012, 60 percent of the companies responding to this question were engaging outside resources. There was no difference between companies in rural verses metropolitan areas in their usage of consulting services.

**Biobased Sales**

The variation of the number of companies with respect to the fraction of sales from biobased products were similar in all three surveys. We document the 2012 survey findings in figure 13.

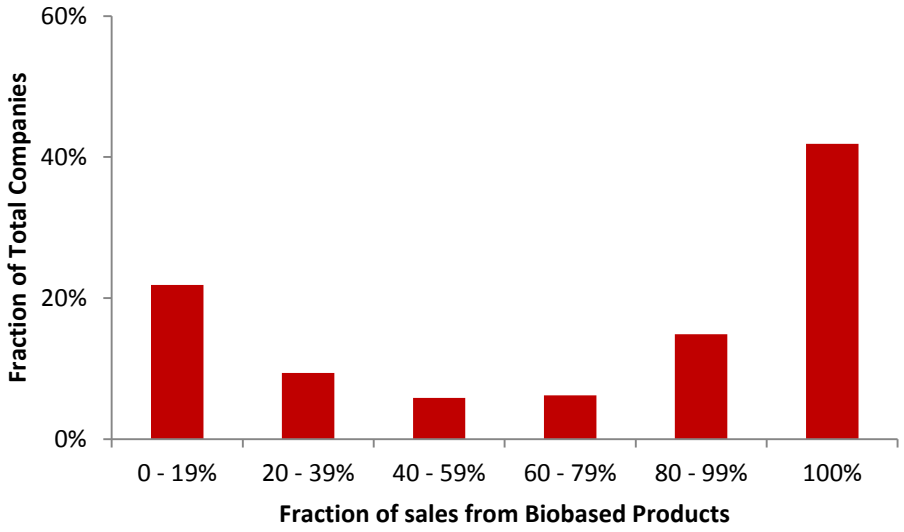


**Figure 13: Company sales from biobased products, (2012 results).**

The variation in the median number of employees with company dependency on biobased product sales was similar over all three surveys. See Figure 14. As expected, companies that sell predominantly biobased products have few employees selling non-biobased products. What was more interesting was that the median number of biobased employees was relatively constant at about ten employees, regardless of whether the companies only sold biobased products or if they primarily sold alternative products. It appears that companies that produce a mix of non-biobased and biobased products are able to become bigger companies, but primarily through growth in non-biobased product sales.

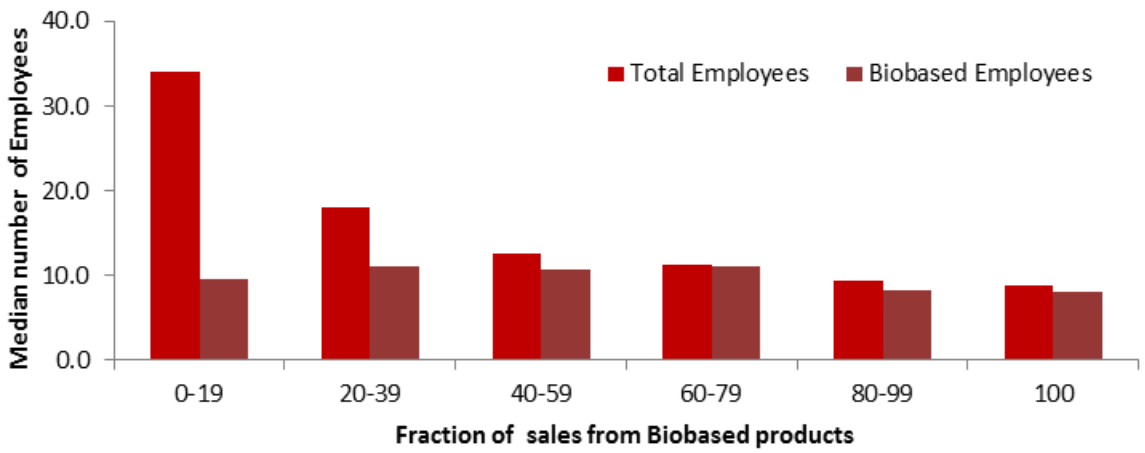


**Figure 14: Size variation with sales focus**

The respondents' methods for selling biobased products were categorized into one of three broad types – business-to business (B-to-B), direct to the final customer, or through a distributor. The companies that reported direct sales included companies that sold through a storefront, over the web, at public events, etc.

There were no significant differences in the distribution of companies by selling method across all the surveys. The make-up of the respondents for 2012 is displayed in Figure 15. The total in the chart adds up to more than 100% because some companies sold products through multiple channels.

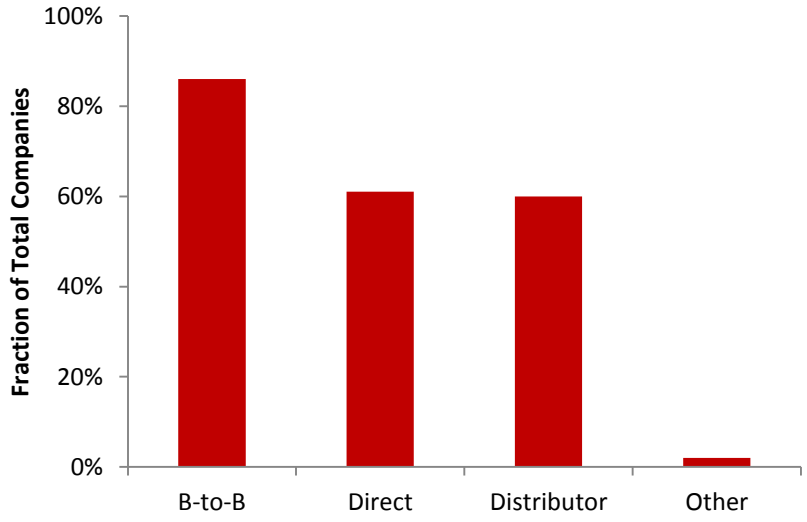


**Figure 15: Methods used by companies to sell their products, (2012 results).**

The respondents were asked to compare the price range of their primary biobased product to the non-biobased alternative. The variation of fraction of companies with respect to price range was similar across all the three surveys. Results from the 2012 survey are displayed in figure 16. About one third of the companies sold their primary biobased product at about the same cost as a non-biobased alternative product. Over half sold their products at something greater than 10 percent over the non-biobased alternative.

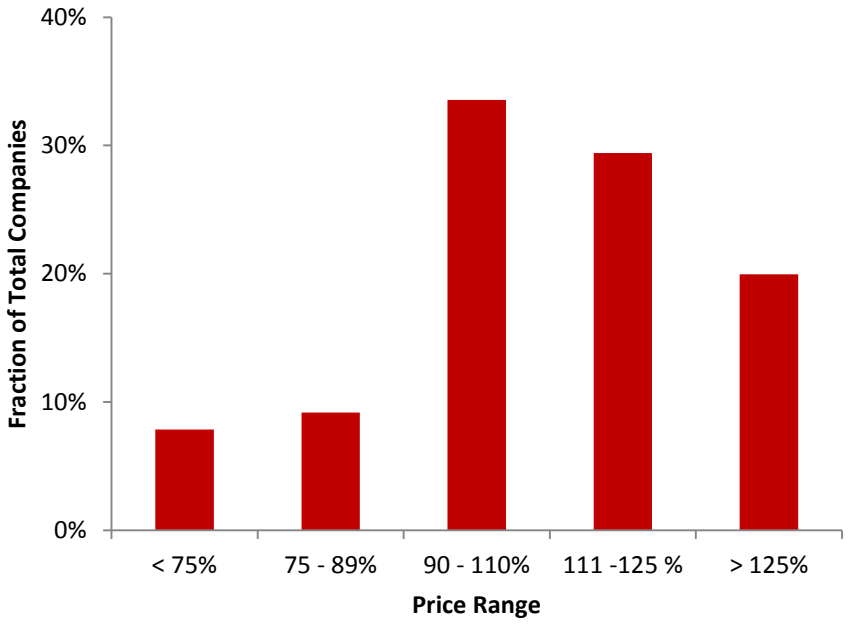


**Figure 16: Price comparison of biobased and alternative products, (2012 results).**

The companies were asked the reasons why customers buy their biobased products. In all the surveys, environmental benefit and performance were the top reasons given, with just over 90% of the companies responding in the affirmative for each. The data from the 2012 survey is displayed in figure 17.

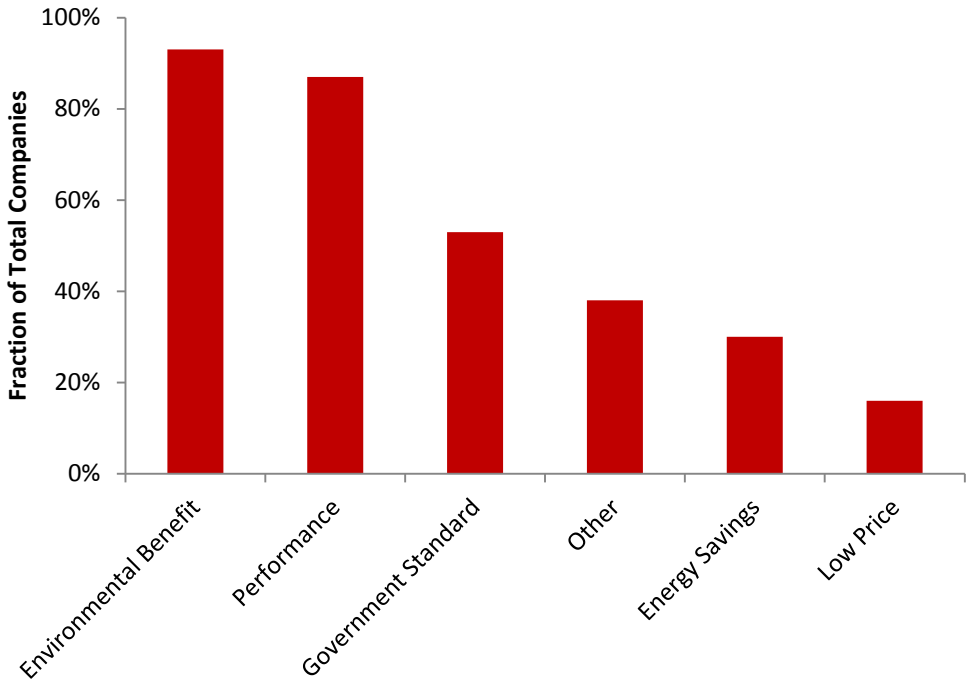


**Figure 17: Top reasons why customers buy biobased products, (2012 results).**

### Limitations to Growth

Companies were asked to rate the level of importance of 17 factors that may limit growth of sales of biobased products. In Figure 18 we display the level of importance given to various items that were limiting the growth of the companies, averaged over the three surveys.

The rating ranged from one (not at all limiting growth) to five (limiting growth to a great deal). In general, technical-related items were not limiting growth (standards, availability of technology, technical support). Items related to costs (transportation, raw materials) and items related to sales (competition, marketing, low sales and uncertain demand) were ranked higher.

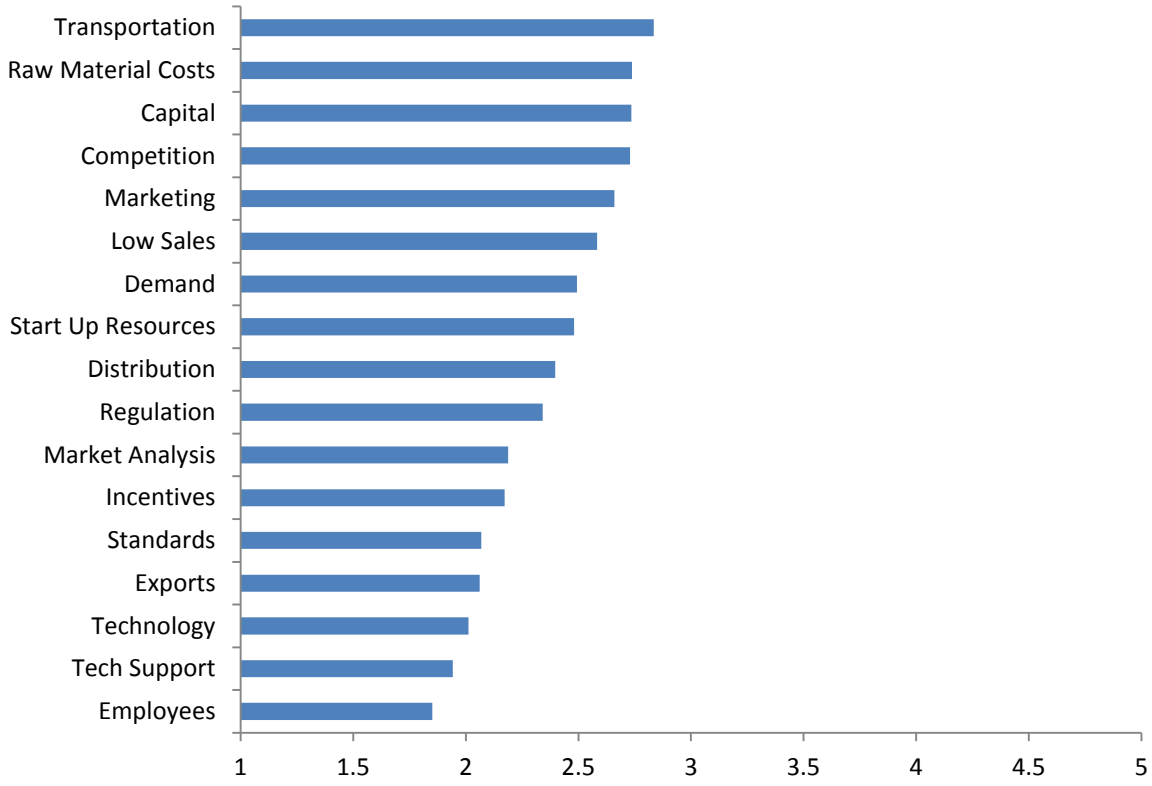


**Figure 18: Factors limiting the growth of biobased products companies.**

After the basic data were summarized, a more in-depth analysis was completed to see if there were any characteristics that surfaced between different types of companies. There was very little variation over the three surveys for the majority of the results. As such, three year averages are highlighted in the following three sections unless otherwise stated.

## Characteristics – High/Low Price

The responses were analyzed to determine if there were any distinguishing features between companies that primarily sold products at a high price compared to the alternative (>110%) and those companies that primarily have lower priced products (<90%).

Compared to companies that primarily sold higher priced biobased products, companies that sold at a low price had been in business for a slightly shorter time. No significant difference was noted between the two groups in the median number of years they were selling biobased products.

The overall sales results were similar for both the 2010 and 2012 surveys. The high priced companies had about two-thirds of their overall sales from biobased products. The low-priced companies had about three-fourths of overall sales from biobased products.

The fraction of companies that reported their overall sales growing dipped over 10 percent from 2008 to 2010, rebounding to the 2008 level in 2012. It is conjectured this was recession driven. Three-fourths of all companies reported overall sales to be growing pre and post-recession, with only a small difference between those selling at a high or a low price.

There was little change in the fraction of companies that reported growth in biobased sales over the three years. About 70 percent of both high- and low-priced companies reported biobased sales to be growing.

The median number of biobased employees at the low-price companies was 16 compared with a median of 7 employees for the high-price companies.

There was little variation in the size of companies with price over all three surveys. Approximately eighty percent of both the high- and low-priced companies were small (fewer than 50 employees).

Not surprisingly, about seventy percent of the companies that were selling at lower prices than the alternatives gave low price as a reason their products were purchased versus less than 2 percent of the companies selling at higher prices. Companies selling at lower prices also cited government standards and product performance as reasons why their products were purchased. There was little difference between the two groups in regard to environmental benefits or performance standards.

The top three factors that limited growth of high-priced companies were cost of raw materials, availability of financial capital, and transportation costs. The top three factors that limited growth of low-priced companies were transportation costs, availability of financial capital and competition from similar firms. High-priced companies tended to rank raw materials and low sales as higher in importance than low priced companies. Low-priced companies tended to rank government incentives higher in importance.

**Characteristics – Small/Large Size**

The responses were analyzed to determine if there were any distinguishing features between small companies and large companies. Small companies were defined as those with 50 or fewer employees and large companies, more than 50 employees. The median size of the group of small companies was 8 employees versus about 200 employees for the large companies.

The average time in business of the group of small companies was 18 years compared to 51 years for the large companies. The average length of time the small companies had been selling biobased products was 12 years compared to 26 years for the large companies.

In all three surveys, the typical small company had a higher fraction of their overall sales from biobased products. The small companies had about three-fourths of overall sales from biobased products. The large companies had about fifty percent of their overall sales from biobased products.

The fraction of companies that reported growth in overall sales decreased by 10 percent from 2008 to 2010, rebounding to the 2008 level in 2012. Three-fourths of all companies reported overall sales to be growing pre- and post- recession, regardless of whether the companies were small or large.

There was little difference between high and low-priced companies over the three surveys in regard to biobased sales growth. About three-fourths stated their biobased sales were growing.

The three-survey average of the median number of biobased employees for the small companies was 7 compared with a median of roughly 140 employees for the large companies.

Over all three surveys, there was little variation in the fraction of small and large companies in metro areas. About 75% of small companies were located in metro areas compared with 84% of large companies.

There was little difference between the two groups in regard to reasons given for why their products were purchased. A higher fraction of the large companies gave standards as a reason.

The top three factors that limited growth for small companies were availability of financial capital, transportation costs, and marketing. The top three factors that limited growth for large companies were cost of raw materials, competition from similar firms, and transportation costs. Small companies tended to rank availability of financial capital, marketing, distribution, and start up resources higher than large companies. Large companies tended to rank cost of raw materials and technology availability higher than small companies.

**Characteristics – Metro/Non-Metro Location**

The responses were analyzed to determine if there were any distinguishing features between companies in metro areas versus non-metro areas, according to the RUCA classification. Metro companies with a zip code in an area with a RUCA less than four were defined as metro. Companies with a RUCA greater or equal to four (micropolitan, small town, rural) were defined as non-metro.

The average time in business of the group of metro companies was 25 ears compared to 17 years for the non-metro companies. The average length of time the metro companies were selling biobased products was 16 years compared to 13 years for the non-metro group.

The typical non-metro company had a higher fraction of their overall sales from biobased products, averaging about 80 percent over the three surveys verses 67 percent for the metro companies.

The fraction of companies that reported their overall sales growing dipped over 10 percent from 2008 to 2010, rebounding to the 2008 level in 2012. Slightly over 70 percent of

companies reported overall sales to be growing pre and post-recession, regardless of whether they were metro or non-metro companies.

There was some difference between metro and non-metro companies over the three surveys in regard to biobased sales growth. On average three fourths of metro companies had biobased sales growth while two thirds of non-metro had growth.

No significant difference was noted between the two groups in the median number of total employees or the median number of employees involved with biobased products.

There was a substantial difference between the two groups regarding sale price compared to the alternative. An average of 15% of companies in the metro group sold products classified as low price (< 90% of alternative). This compares with 30% of non-metro companies. Of the metro companies, 49% stated their products were high price (>110% of alternative). This compares to 38% f non-metro companies.

There was little difference between the two groups in reasons given for why their products are purchased. A higher fraction of the non-metro companies gave low price as a reason, which aligns with the data on price comparison to alternatives.

The top three factors that limited growth for metro companies were cost of raw materials, competition from similar firms and transportation costs. The top three factors that limited growth for non-metro companies were transportation costs, cost of raw materials and availability of financial capital. Metro companies tended to rank standards higher than non-metro companies. Non-metro companies tended to rank transportation cost higher than metro companies.

## Conclusions and Recommendations

The biofuels sector has received considerable attention from federal and state legislators and the media, and the industry has seen substantial growth over the past decade. On the other hand, the end-use biobased products sector has received much less attention, partly because information about the sector is limited. This work is a summary of 3,700 responses to three separate surveys over a four year period. The pool included responses from 2421 different companies.

Since a convenience sample was used in this pilot study, definitive, detailed conclusions should be avoided. That said, since such a high fraction of companies where contact was made completed the survey (roughly sixty percent), since the biobased product companies in the sample were the result of a nearly ten-year effort to locate biobased product companies, and because of the authors' personal knowledge of the industry, it is felt that the results accurately describe high-level characteristics of the industry.

As a more accurate compilation of the companies in the industry becomes available and additional companies are removed from the BioPreferred database that do not meet the definition of new-use biobased products, more accurate analysis techniques can be explored.

Over the three surveys, each separated by a two-year period, there was little change in the majority of the high level characteristics of the end-use biobased products industry. In a few situations it appeared the 2008 recession slightly affected some of the 2010 survey results. More responses were received from large companies in the 2012 survey, which affected a few of the results as well. Given the slight variation in results over this four-year period and since the 2012 survey had the largest number of respondents (about sixty percent of all companies contacted), it is felt the results from this latest survey is a reasonable depiction of the industry.

The industry is not very large, composed of thousands of companies, out of over seven million in the U.S. [11]. Over the four year period, the authors located additional biobased companies to include in the survey pool. As such, the growth in survey respondents over the three surveys should not be construed as indicating there has been growth in this industry. About 500 distinct companies completed all three surveys. The aggregate employment in this subset of companies grew at an average of 2.7% per year over the four year period.[3] In addition, the majority of survey respondents, over all three surveys, did not indicate there was much constraining their growth. If the overall industry growth is as small as this subgroup and the companies say they are not being constrained, then future surveys might explore why biobased products are not replacing alternative products at a faster pace.

Companies responding to the surveys were very diverse, ranging from large multinational companies to small start-ups. One-third had been in business for less than ten years and about half of all respondents had been selling biobased products for less than ten years. About one-third of the respondents had five or fewer employees. The median number of employees of all companies was x. Since so many of the companies in the industry are so small, future surveys might try to ascertain more clearly how the root issues affecting the growth of these companies is different, if at all, from other small companies.

The majority of companies are in the chemical manufacturing sector, with the largest sub group in the soap, cleaning compound, and toilet preparation category. This sub-sector alone comprised about one-third of all companies that responded to the latest survey. Future surveys might explore how this sub-sector differs from the remaining sub-sectors to determine why so many of the biobased products produced and sold are in this narrow category. Understanding how capital costs, technology needs, performance, etc. differ between this sub-sector and the remaining sectors might be insightful.

About three percent of all respondents might be considered very large, with over 500 biobased employees. The biobased employees in these companies comprise x percent of all biobased employees that respondents reported. Since an understanding of the size of the industry receives so much attention, improving the survey methodology to get a more accurate count of the number of employees associated with new-use biobased products is critical. A more accurate description of who would or would not be considered a biobased employee should be developed and particular attention should be addressed to the large companies to make certain the numbers being reported are accurate.

[3] Total U.S. private sector employment contracted by slightly less than one percent per year during this period.

The median number of biobased employees at companies was essentially constant, regardless of whether a company only sold biobased products or if they predominantly sold non-biobased products. That is, companies that only sold biobased products had a median size of about ten; and companies that had eighty percent or more of sales in non-biobased products also had a median number of biobased employees of about ten (plus an additional x non-biobased employees). Future surveys might try to determine why there is this apparent ceiling on the median number of biobased employees as companies grow sales in non-biobased products. Understanding the size of the companies' distribution systems would be an important part of this study.

This work has found that some of the biobased products cost less than alternative non-biobased products, but nearly half of the respondents stated their products cost 10% or more. While some fraction of the population may choose to buy higher priced biobased products for personal reasons, it would be naive to think that the end-use biobased products industry can rapidly grow if prices do not become more in line with the prices of alternative products. More in-depth surveys might explore the cost structure of biobased products companies compared to companies selling alternative products. Understanding if companies feel they get a price premium because of biobased content should also be explored.

The goals of the BioPreferred program are to lessen U.S. dependence on foreign oil to improve security and decrease the trade deficit; to improve the environment; and to promote economic development by creating new jobs in rural communities and new markets for farm commodities. Given the length of time it has taken to scale up the development of the BioPreferred program and the size of the industry, it is unlikely there has been very much impact of the BioPreferred program to date on lessening U.S. dependence on foreign oil or improving the environment. As such, future surveys might be used to try to ascertain the effectiveness of the BioPreferred program. Information could be gathered on the fraction of the industry that uses the USDA biobased label, whether companies intend to incorporate the label in the future, whether companies feel the label has helped them grow sales, whether the preferred preference has led to increased sales to the Federal government, etc.

Since the Federal program was initiated, a variety of state programs have been developed to further enhance markets [12, 13, 14, 15, 16]. Future surveys to these states might incorporate additional questions to ascertain the effectiveness of these various programs.

Whether the BioPreferred program has assisted with the growth of biobased product companies in rural areas is not known. This work has revealed that, to date, this industry has mainly benefitted metropolitan areas, with 80% of all respondents being located in metropolitan areas. Slightly more than ten percent of all companies were located in small town or rural areas. A more in-depth analysis of these companies might help understand whether any of the difficulties of growing a company in rural areas can be offset by any potential benefits of locating biobased product companies closer to the source of biobased feedstocks.

Improvements to the survey tool process could also be incorporated. For instance, since it is difficult for a single person to accurately respond to a wide variety of questions, sending a copy of the survey with definitions in advance of the phone interviews might improve

accuracy and completeness. As well, completing a more comprehensive survey of a representative sample of the industry would likely provide a better picture of the problems and opportunities facing the industry.

As more detailed analyses of the biobased products sector are completed and disseminated, it is hoped that a better understanding of the industry will lead to the development of improved policies and economic development strategies, enhanced awareness of the industry by procurement officials, and a subsequent growth in the industry.

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