

The bioeconomy

- Developing new regional statistics



The bioeconomy Developing new regional statistics

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Preface

Statistics Sweden has, on commission from Region Härjedalen Jämtland (national bioeconomy network) developed new regional statistics for industries within the bioeconomy. It covers industries that are fully, or partly producing goods and services that connects to the use of biomass. In this case biomass refers to plants, forestry, animals and fish.

The Environmental Accounts produced at Statistics Sweden also constitute a satellite system to the National Accounts that look at the environmental impact of the economy, such as concerning emissions to air and environmental economic instruments. There is a large international interest to connect the bioeconomy to the environmental accounts to measure the growth and the environmental impact of the bioeconomy.

This report has been produced by Nancy Steinbach, Susanna Roth, Max Jonsson and Ariun Byambakhorloo at the Environmental Accounts and Environment unit at Statistics Sweden.

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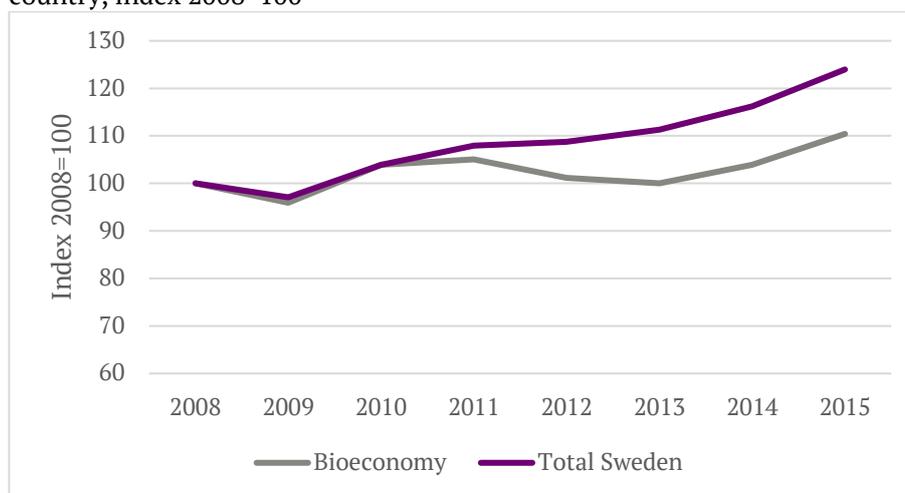
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Summary

This report describes the method and some development results of the production of new statistics on regional bioeconomy in Sweden.

The bioeconomy in Sweden accounts for 6 percent of GDP and, although the growth rate is slightly more gradual than the GDP, this proportion has been increasing since 2013.

Figure S1 Development of value added in the bioeconomy and the whole country, index 2008=100



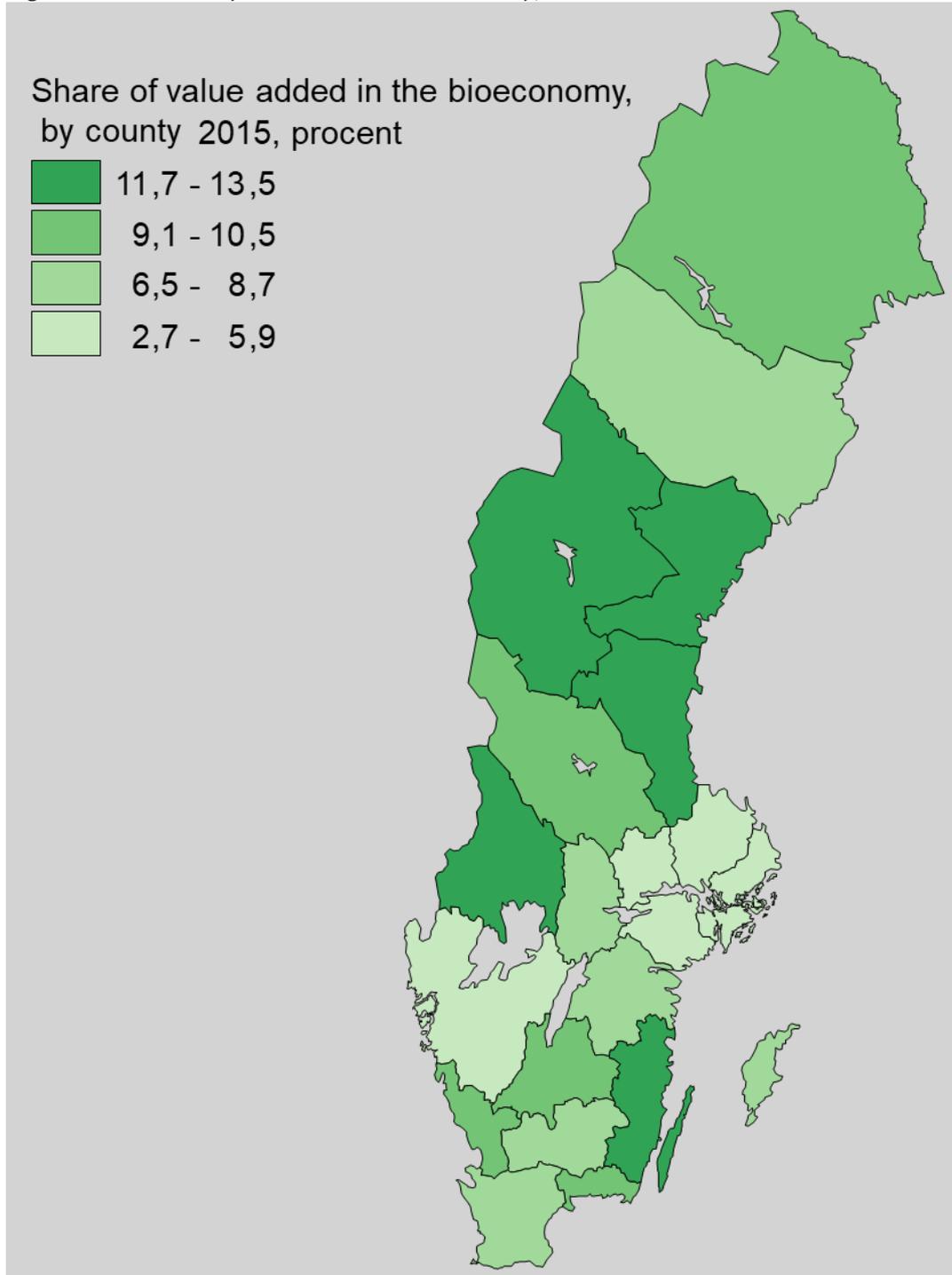
Source: Statistics Sweden, National Accounts and Environmental Accounts

Note: data is presented in current prices.

The highest bioeconomy employment rates in Sweden are found in Västra Götaland, Skåne and Stockholm counties, while the lowest bioeconomy employment rates are found in Gotland County and Västmanland County.

The bioeconomy is widespread at county level. See figure S2. Compared with the national level of 6 percent, Västernorrland, Värmland and Kalmar regions account for a high share of bioeconomic activities. Bioeconomy value added accounted for 13 percent of total value added in these counties in 2014.

Figure S2 Bioeconomy value added in each county, 2015



Source: Statistics Sweden, Environmental Accounts

The new method

The new method is based on a top-down approach. This means that statistics are based on aggregates of the whole economy, via the Swedish Standard Industrial Classification, and a share of this aggregate has then been identified. No new business survey was conducted to produce these statistics. Data on value added, net turnover, employment rates and greenhouse gases was compiled. The method, which is also used in Finland, is based on a 2016 Statistics Sweden study.

The Swedish Standard Industrial Classification is used as a foundation, and in this pioneer development effort on regional bioeconomy statistics, results are affected by a lack of regionally distributed shares, as these were designed for national statistics. There was no possibility, within the scope of this project, to regionalise share calculations.

Many industries belong to 100 percent to the bioeconomy. This means that everything these industries do, directly or indirectly, contributes to production or biomass value added. These industries comprise agriculture, forestry, fishing, food and tobacco, wood, paper and paper pulp, accounted for 45 percent of bioeconomy value added in 2015, and the regional level statistics are quality assured. Other industries' regional contributions should be viewed with caution in this pioneer project on regional statistics.

These statistics have not taken account of planetary boundaries, and how forest and biomass growth compares with economic activities that use natural resources. However, statistics from the Swedish University of Agricultural Sciences indicate that total drain is less than harvest¹, although it approaches total growth.

Opportunities for further development

This project has identified several areas in which the method can be improved.

- Develop new shares adapted to regional conditions and include annual fluctuations.
- Reexamine whether parts of the bioeconomy are not currently included in the statistics. In part, this refers to biodiesel production from refineries, as well as veterinary services, that are not adequately identified using the current method.
- Switch methods entirely to use a bottom-up approach and create a database on microdata about bioeconomy enterprises to enable better analyses at regional level and also to connected with other aspects, such as education.

¹Swedish University of Agricultural Sciences, annual total drain and annual harvest, retrieval 20181121

Introduction

Background

On behalf of Region Härjedalen Jämtland (national bioeconomy network), Statistics Sweden has developed regional statistics on bioeconomy industries. These industries fully, or in part, produce goods or services that are linked to the use of biomass. In this report, biomass refers to various plants, forest, animals and fish.

In 2016, Statistics Sweden produced a first table on the structure of the bioeconomy and scope with regard to net turnover, value added, imports, exports and employment. The assignment results were reported to the Ministry of Enterprise and Innovation in the form of data and documentation. In the same year, the data documentation was used by the Swedish Agency for Growth Policy Analysis in their report “Den svenska bioekonomins utveckling – statistik och analys (report Svar Direkt 2016:23)”.

A definition of bioeconomy presented by Formas (2012) was used as the starting point for these statistics.

- “An economy based on sustainable biomass production to enable increased use in a number of various sectors of society. The aim is to reduce climate impact and the use of fossil raw materials.
- Increased value added of biomass, together with minimised energy consumption, and utilisation of nutrients and energy from finished products and by-products. The aim is to optimise the value of ecosystem services and their contribution to the economy.”

In summary, the assignment focused on what Formas describes as “enabling greater use of biomass in a number of different sectors of society” and “contributing to improved value added of biomass.” Within the framework of the commission, it was not possible to assess whether the production of biomass, or the bioeconomy, are sustainable, nor was it possible to identify the substitution of fossil raw materials.

This assignment builds on the method and approach in the 2016 commission, but with an additional regional perspective.

Purpose

The network for regions collaborating on the bioeconomy has produced basic information for carrying out regional analyses on the bioeconomy in Sweden. The context is that a growing number of regions need to regularly measure the economic impact of the bioeconomy and how it affects regional development.

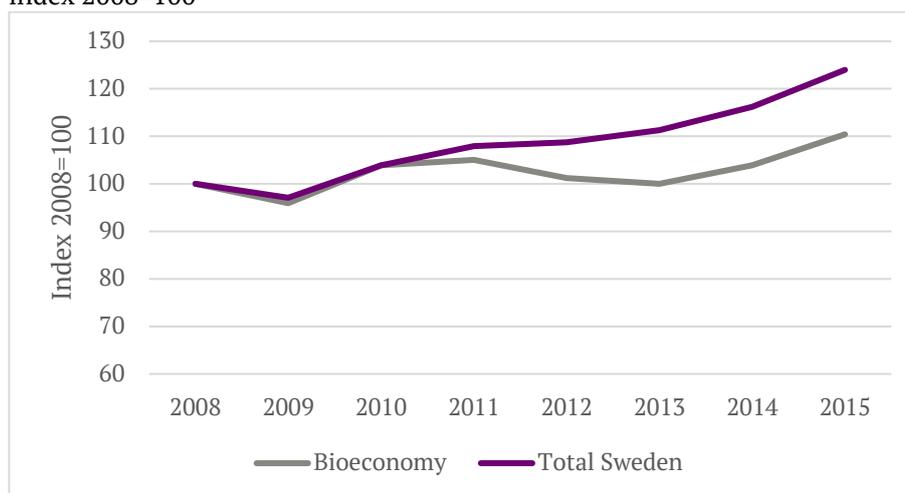
This report has its starting point in the first development effort carried out on national statistics, in 2016, and has progressed to regional bioeconomy statistics.

This report, and associated data, has been produced by the project team at Statistics Sweden: Nancy Steinbach, Susanna Roth, Max Jonsson and Ariun Byambakhorloo.

Results

In 2015, the value of the bioeconomy in Sweden was estimated at SEK 258 billion, which represents 6 percent of GDP. The bioeconomy is growing at a slightly slower rate than GDP, but has been increasing since 2013. The decline in 2012 in the bioeconomy was largely due to decreases in forestry and the manufacturing industry.

Figure 1 Progress of value added in the bioeconomy and the whole country, index 2008=100



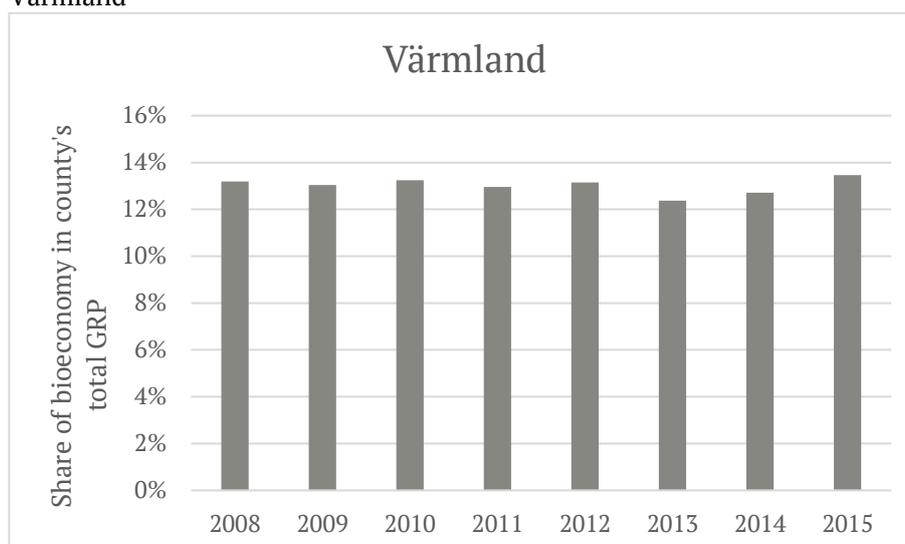
Source: Statistics Sweden, National Accounts and Environmental Accounts

Note: data is presented in current prices.

Kalmar, Halland, Värmland, Dalarna, Gävleborg, Västernorrland and Jämtland counties stand out by having a larger share of the bioeconomy than other counties in Sweden.

Figure 2 shows value added in Värmland County between 2008 and 2015, as share of Gross Regional Product (GRP). The development in Värmland is stable, around 13 percent of total GRP. More detailed information on industries that contribute to the bioeconomy in each county is also available. In general, the bioeconomy market production of goods (SNI A01-F43) dominates over market production of services (SNI G45-T98) in all counties.

Figure 2 Value added in the bioeconomy, share of Gross Regional Product, Värmland



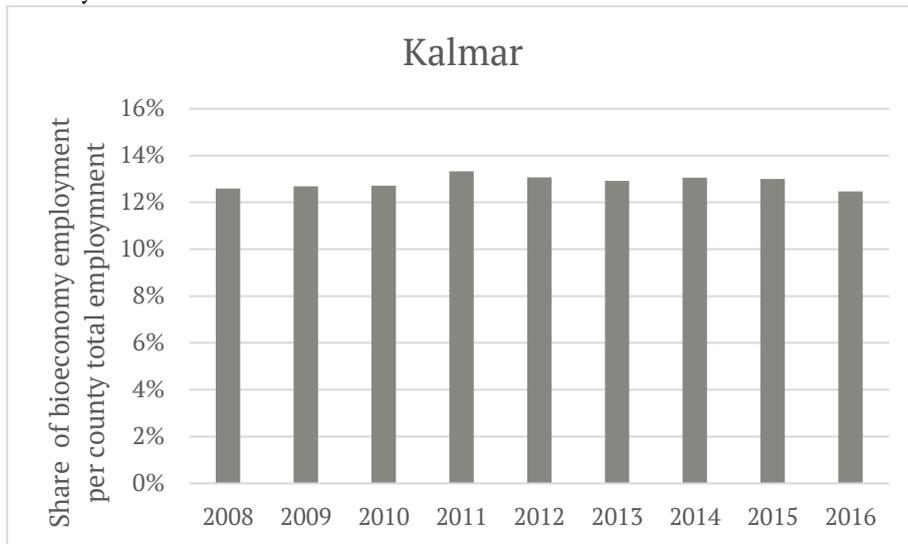
Source: Statistics Sweden, Environmental Accounts

At national level, bioeconomic sectors employ 330 000 persons, which represents 7 percent of total employment in Sweden. At national level, the employed persons are mainly men, at 75 percent. At county level, the range of men employed is 70 to 80 percent. However, statistics broken down by goods and service production show that service production is more gender equal; employment in essentially all counties is 50 percent women and 50 percent men. In goods production, on the other hand, the share of men employed is significantly larger. The distribution between men and women in the statistics should be interpreted with some caution, as a general share has been applied to the number of persons employed. This means that real distribution may look very different. Examining this would require statistics built on microdata, which is not the case here.

In many counties, the share of those involved in the bioeconomy is 10 percent or more of total employment. The highest share, 12 percent, in Kalmar. See Figure 3.

In Kalmar County, 14 000 persons are employed in the bioeconomy. Figure 3 shows the share of persons employed in the bioeconomy as a share of total employment in Kalmar County. This share is relatively stable over time. Just as with value added, most employed persons (in all counties) are employed in market production of goods.

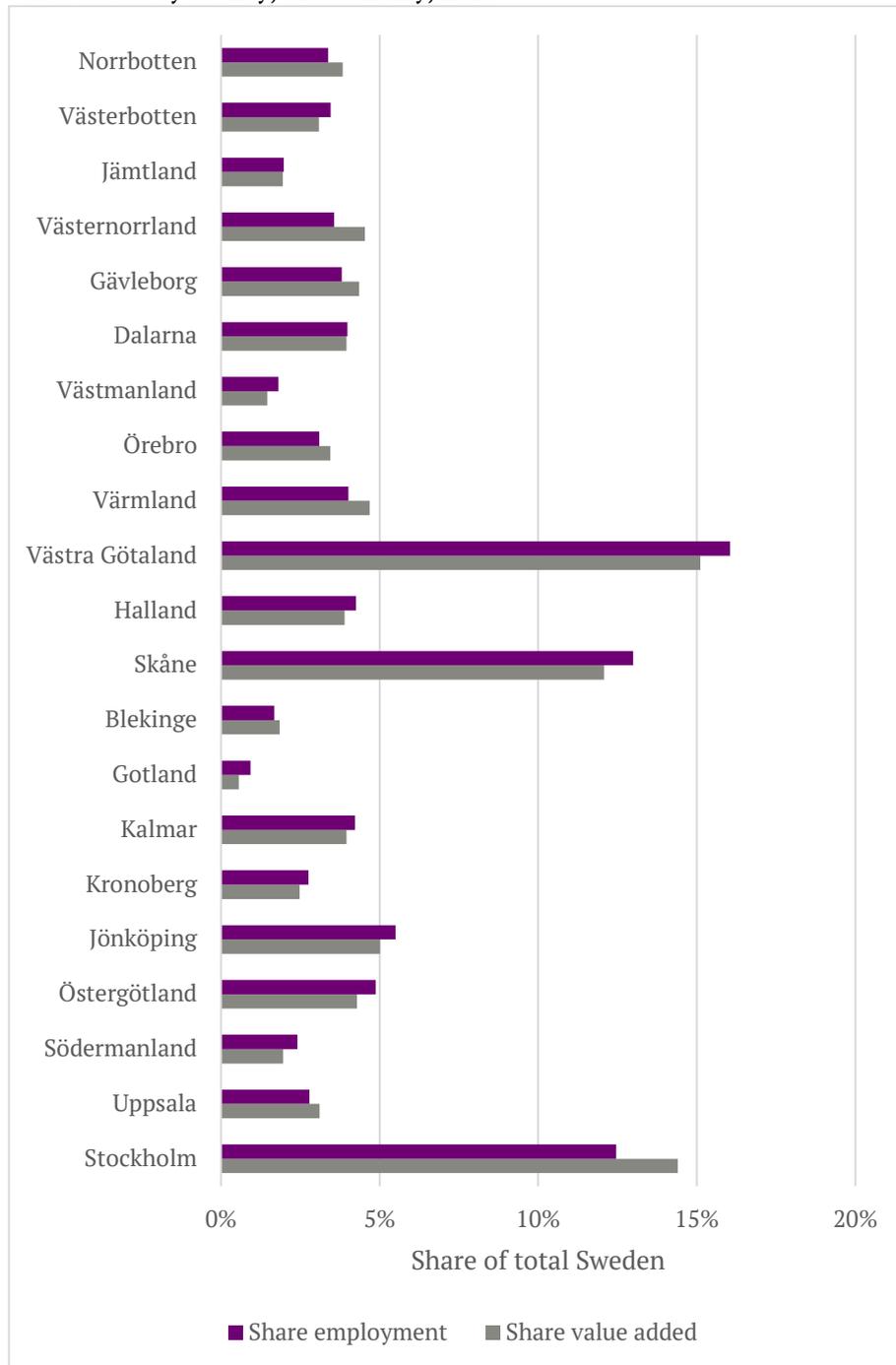
Figure 3 Bioeconomy employment, share of total employment in Kalmar County



Source: Statistics Sweden, Environmental Accounts

Figure 4 shows a structural overview of breakdown of employment by county, that is, how counties compare with each other. Each column shows the share of total employment and value added in the bioeconomy in each county. Västra Götaland and Stockholm had the largest share of employed persons and the largest share of value added among all counties in the bioeconomy in 2014. Gotland and Västmanland had the lowest share in the bioeconomy.

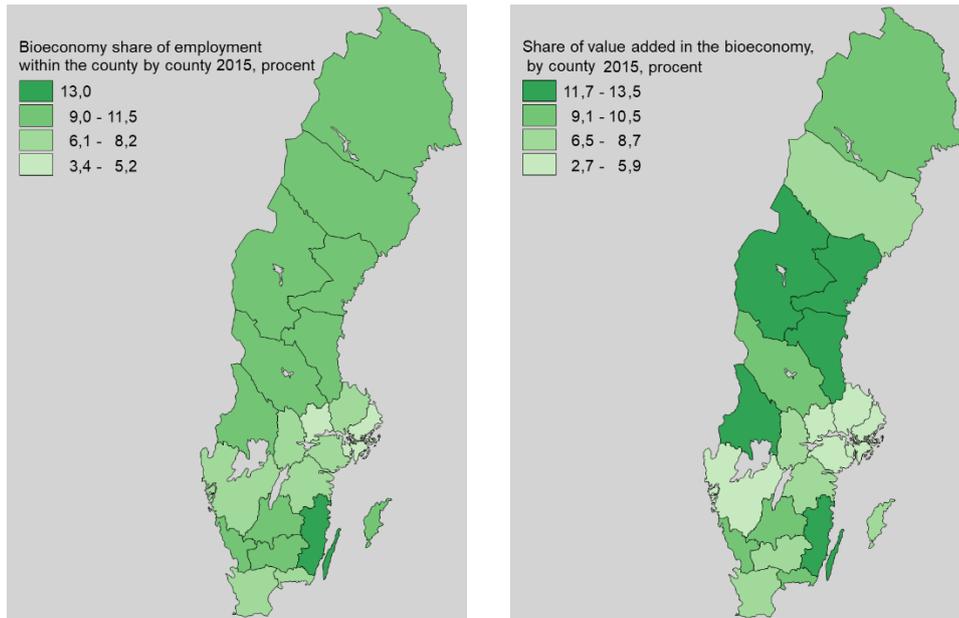
Figure 4 Environmental-economic profile - breakdown by employment and value added by county, bioeconomy, 2015



Source: Statistics Sweden, Environmental Accounts

There are also major differences within counties, depending on the focus. In 2015, the bioeconomy accounted for 6 percent of total value added (contribution to GDP) in Sweden. In many counties, such as Västernorrland and Jämtland, the bioeconomy accounted for an even larger share. With regard to employment, which was 7 percent at national level in 2015, more counties lay just above this average. See Figure 5.

Figure 5 Share of bioeconomy employment and value added in the county, 2015



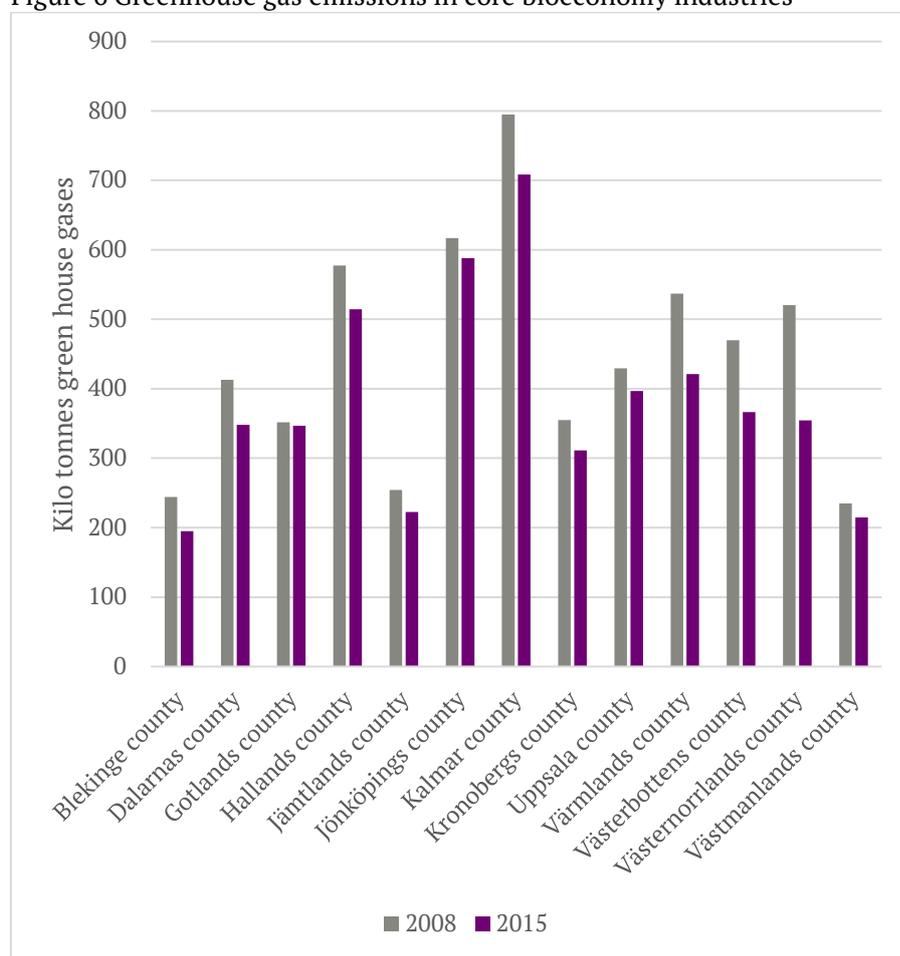
Source: Statistics Sweden, Environmental Accounts

An important aspect of the bioeconomy and its products is that it is possible to use biomass to substitute fossil products, although bioeconomic activity also affects greenhouse gases.

This project has produced statistics on industries identified as 100 percent belonging to the bioeconomy. These industries comprise agriculture, forestry, fishing, food and tobacco, wood, paper and paper pulp.

Between 2008 and 2015, greenhouse gas emissions from production in these industries decreased in all counties (see Figure 6) by 14 percent on average. The largest decline was in Västernorrland, at 32 percent between 2008 and 2015.

Figure 6 Greenhouse gas emissions in core bioeconomy industries



Source: Statistics Sweden, Environmental Accounts

Note: Core industries are those with 100 percent share: these industries comprise agriculture, forestry, fishing, food and tobacco, wood, paper and paper pulp,

Demand for bioeconomy

A number of industries are classified as fully belonging to the bioeconomy. This means that everything these industries do, directly or indirectly, contributes to production or biomass processing. These industries comprise agriculture, forestry, fishing, food and tobacco, wood, paper and paper pulp, In printing and graphic design, 92 percent are considered to belong to the bioeconomy, which is why it is also included here.

The statistics produced and described in this report are based on a production perspective. This means that all economic activities that in some way add value and sell products linked to the bioeconomy have been included. The results describe the number of persons employed in the bioeconomy, the distribution by sex among the persons employed, the sector's contribution to GDP and its own contribution to greenhouse gas emissions.

Driving forces in production can also be identified - where demand comes from for the goods and services. This can be done via the national accounts' supply and demand tables at the national level. Here, there is a brief description of how this type of statistics can be used to analyse the bioeconomy on the demand side.

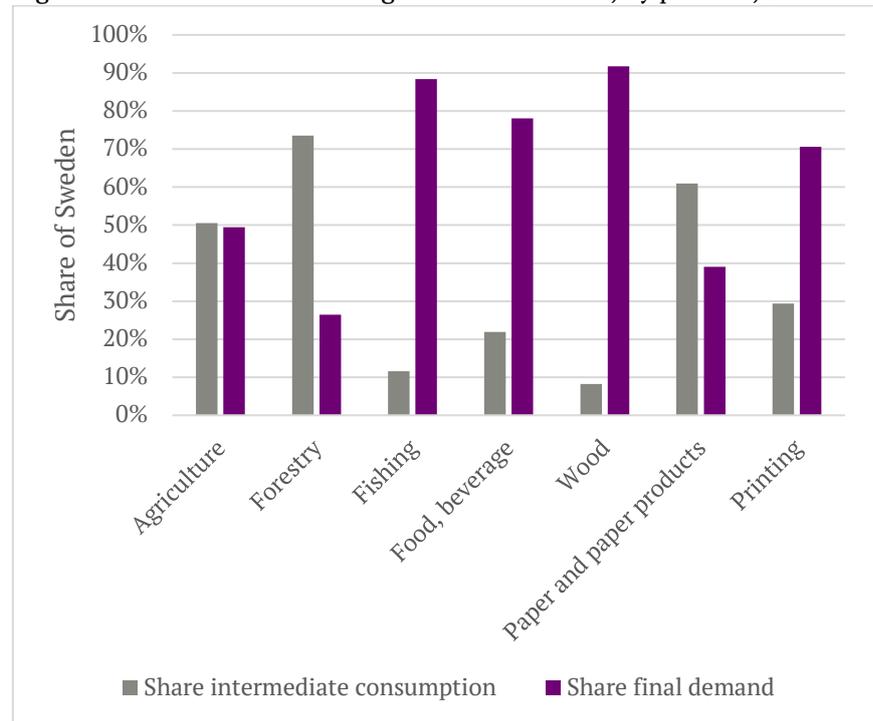
How are the products used in the bioeconomy?

Interesting observations can be made using statistics concerning the use of products from the bioeconomy. Parts of the products are intermediate goods and are therefore used in other industries' production processes. Other parts of the products are used in final use, that is, in households, public sector, warehousing, investments and exports. Among products identified as belonging to the bioeconomy, 34 percent were intermediate goods and the rest went to final use in 2014.

Figure 7 shows how the share per product included in the bioeconomy was distributed in 2014 with the help of the national accounts' use tables from a monetary perspective.

In 2014, agricultural products were used to the same extent as intermediate goods in other industries and in final use. Forestry products are mainly used as intermediate goods. Within fishing, food, beverages, as well as wood and printing, final use is the main driver of demand for the products.

Figure 7 Share of intermediate goods and final use, by product, 2014



Source: Statistics Sweden, National Accounts, supply and use table

A product perspective

About 34 percent of the supply of bioeconomic products were used as intermediate goods in the economy in Sweden. In 2014, agricultural and forestry products were used to a great extent, in part, by themselves, as well as in mining and manufacturing industry, in which manufacturing industry is dominant. See Table 1.

With regard to wood and paper products, these are used as intermediate goods to a large extent (52 percent and 13 percent, respectively) by service industries, followed by mining and manufacturing industry. The construction sector uses some wood products in its production, but compared with the manufacturing industry's use, this demand is small. However, the construction sector uses a large share of paper and paper products in its production.

In both water supply and water management, demand for these products comes mainly from service industries and manufacturing industries.

Table 1 The use of products as intermediate goods, 2014 share of total product

Product/industry	Agriculture, forestry fishing	Mining Manufacture	Electricity, gas	Construction	Service
Agriculture	22%	63%	0%	1%	14%
Forestry	4%	95%	0%	0%	1%
Fishing	1%	31%	0%	0%	69%
Food, beverages	10%	40%	0%	0%	50%
Wood	1%	44%	0%	3%	52%
Paper and paper products	1%	41%	6%	39%	13%
Printing	0%	70%	0%	1%	29%
Water supply	0%	16%	0%	1%	83%
Sewage, waste, recovery	0%	8%	2%	1%	89%

Note: each line totals 100 percent.

Source: Statistics Sweden, National Accounts, supply-use table

How does distribution look in final use among these products?

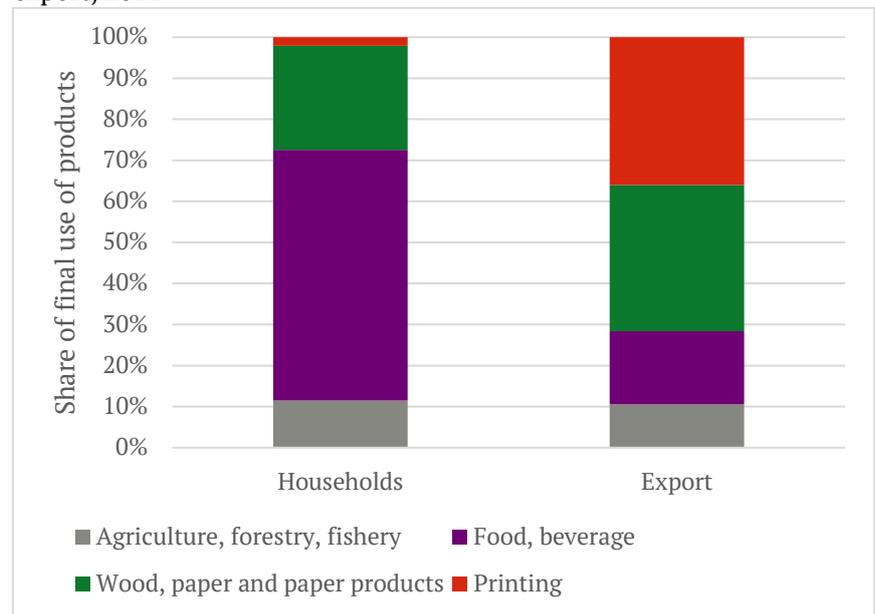
In 2014, final use accounted for 66 percent of demand for bioeconomic products.

Households and demand from around the world, in the form of exports of products that drive demand in final use. A very small share goes to the public sector, warehousing and investments (roughly 5 percent).

Households account for roughly 60 percent of demand and exports account for roughly 35 percent.

Figure 8 shows distribution in the household sector and in exports for products that they demand. Households' largest demand lies in food and beverages, followed by wood, paper and paper products. Exports include wood, paper and paper products as the largest share of export, followed by printing.

Figure 8 Share of use of bioeconomic products in households and in export, 2014



Source: Statistics Sweden, National Accounts, supply-use table

Discussion

There are currently no regional supply-use tables, which is a limitation for seeing regions' specific demand.

However, national statistics stake out a direction and provide an overview of demand, such as in the example above in households and for exports. Statistics can also contribute to greater understanding of which products are important to the economy in general and where there is room to grow.

On future development

This report has described how new statistics on the bioeconomy was produced at regional level, by county, for the time period 2008-2016 in a number of areas, such as value added (only until 2015), turnover, employment and greenhouse gases.

In developing the statistics within the framework of this project, the easiest way forward was taken, that is, by reusing the method developed in 2016, and applying it to regional statistics. As a top-down method was used, in which all, or parts, of the existing frameworks of the economic activity distribution has been present, the statistics were produced with some ease. A weakness in such a method is that regional differences are difficult to identify, where one share, one for all regions, has identified size classes. The rough estimate of the breakdown of women and men, and the size of enterprise in employment is a particularly palpable weakness.

A strength in using this method is its transparency and that it gives clear picture of the industries that are identified as fully belonging to the bioeconomy. It also provides a good structural overview of counties, compared with other counties, since the underlying statistics on employment, turnover and other parameters guide the assumptions. The method is also cost-efficient and minimises the need for a new statistical business survey.

Possibilities for improvement

There are major possibilities to improve the method for statistics on the bioeconomy. These include taking into account shares that change over time and regionally adapted shares. Both are completely possible to carry out, given time and budget. However, certain areas on how shares are produced are slightly weaker and would require additional research on how regions function. It would be interesting to take part in an exchange at regional level to work further on this.

A few paths can be listed to further develop the analysis and documentation to monitor the progress of the bioeconomy and the implementation of its products. Important products from the bioeconomy include bio-based fuels and their potential use as a substitution for fossil fuels, both in combustion and plastic products. In addition, there are studies linking sustainability aspects to the area of natural resources and its capacity to manage increased use.

It may also be possible to completely change the method to bottom-up without developing a business survey. It could be possible, using available statistical registers, to develop a specific database of

enterprises or local units included in the bioeconomy, and build the statistics this way. It would then be possible to include information on trade patterns for the enterprises and training patterns among staff at the enterprises.

Briefly about the statistics

The use and content of the statistics

The network for regions in cooperation about bioeconomy has developed a knowledgebase for working with regional analysis for bioeconomy in Sweden. The background to that is the increasing need for regions to measure on a regular basis the importance of bioeconomy and how it effects regional development.

In this assignment, the bioeconomy consists of activities and products included in the production process of biomass, enabling the production of biomass and biomass processing.

The Swedish Standard Industrial Classification, SNI (the Swedish version of NACE), is the main starting point for identifying the bioeconomy. SNI is a statistical standard used to classify units such as enterprises and local units by their economic or environmentally impacting activities.

The same method was used in the 2016 commission on behalf of the Ministry of Enterprise and Innovation. A macro-perspective was used for whole groups in the SNI classification to extract shares and to estimate the size of the bioeconomy.

Information on the processing of statistics

Data sources

As the area of bioeconomy covers several statistical fields different data sources are necessary to collect and combine.

Statistics on the bioeconomy includes the following data sources:

Labour statistics based on administrative registers (RAMS)

Statistics Sweden's labour statistics based on administrative registers (RAMS) is an annual total population survey, which is largely based on employers' statement of earnings and self-employed persons' tax return statements.

RAMS describes the population's employment and regional conditions. All persons contained in the population register on 31 December are included in the annual labour statistics based on administrative registers (RAMS). These statistics describe employment in the form of gainful employment and are uniquely linked between persons who are working and their place of work and enterprises. The link between a person and their place of work makes it possible to describe commuting, personnel and business structures.

The number of employees, by sex and company size, have been used as variables in the assignment.

Structural Business Statistics

The purpose of Structural Business Statistics is to illuminate the structure of the business sector (excluding the financial and public sectors, and households' non-profit organisations) with regard to primarily profitability, growth, development, financing and production. The area of use is to provide answers to macro-economic questions with regard to levels, as well as over time.

The assignment has included the variable net turnover.

National Accounts

Regional accounts are the regional equivalent to a country's national accounts, that is, national accounts with regional and geographic divisions. Regional accounts include gross regional products (GRP), expressed both in current prices and as figures for volume change, as well as employment and gross wages, fixed gross investments and household's disposable income - the latter three expressed in current prices.

The GRP is calculated on the production side, that is, as the sum of the region's value added. This is the regional equivalent of the GDP. The sum of the region's value added to base price and the difference between product taxes and product subsidies comprises the GRP at market price for the region. Employment calculations are an important part of and support to production calculations. National Accounts' account system includes all economic transactions in the country.

Gross regional product has been used as a variable in this assignment.

Environmental accounts

Economic activities and households in Sweden form the framework for the environmental accounts, which means that all activities in the different modules that are produced are included.

The environmental accounts have been constructed based on the national accounts and present national environmental statistics and economic statistics in a joint system. Environmental data has been systematised using the same industrial classification and the same final use areas as the economic data. Systematising the statistics in this way makes it possible to analyse the relationship between the economy and the environment for both production and consumption.

Greenhouse gas emissions have been used as a variable in this assignment.

Methodology

In this assignment, the bioeconomy consists of activities and products included in the production process of biomass, enabling the production of biomass and biomass processing.

The Swedish Standard Industrial Classification, SNI (the Swedish version of NACE), is the main starting point for identifying the bioeconomy. SNI is a statistical standard used to classify units such as enterprises and local units by their economic or environmentally impacting activities.

The same method was used in the 2016 commission on behalf of the Ministry of Enterprise and Innovation. A macro-perspective was used for whole groups in the SNI classification to extract shares and to estimate the size of the bioeconomy.

Regional perspective

Identifying a subset of the economy, that is, bioeconomy employment and value added, can be done at national level with an analysis of each industry. Identifying the regional perspective requires more data and detailed analysis of the activities in a specific region.

Specific regional statistics is used in this project, but the share of bioeconomy per industry is the same regardless of region. This means that the regional bioeconomic feature is not as clearly visible as in a regional assessment made by county, in particular in industries that are not completely classified as bioeconomic. For example, the chemical industry may produce more or less bio-based goods in some regions, but this is not visible in the statistics that have been produced. All industries have the same share, regardless of region. Industries identified as fully bioeconomic do not have this effect, and the production in the region can be fully identified.

Calculating new shares per region was not included in the scope of this project. This would require more data and resources, and is a possible further development of this project.

Employment and greenhouse gases

In this project, statistics on employment and greenhouse gases were produced at regional level. As the focus lies on the bioeconomy, the statistics must be interpreted in a certain way.

The breakdown between men and women in the statistics, and the breakdown of employed persons in various sizes of enterprise should be interpreted with some caution, since a general share has been applied to the number of employed persons. This means that real distribution may look very different. However, ensuring this requires that statistics be built on microdata, which is not the case in this project. In industries identified fully as bioeconomic, this is not an issue, since statistics in the basic material has already distributed the real number of women

and men, or the number of employed persons by size category in the statistics. However, where there is a share of, for example, chemical industry, it is assumed that the same share applies to total employment as for employed women and employed men. There could be structural differences, for instance, women to a larger degree are employed in bioeconomic activities, or the reverse, but this is not identified in these statistics.

With regard to greenhouse gases, the statistics show how much the industry in focus in the analysis has emitted in its product, that is, it describes the impact of the bioeconomy itself on the climate. No share was calculated with regard to greenhouse gases in industries that are not classified as 100 percent bioeconomic. Today, there is no documentation available that can be used in a macro-perspective to describe the impact of the bioeconomy on greenhouse gases, except in industries that are 100 percent bioeconomic.

About bioeconomic shares

Estimates of the size of the bioeconomy are based on the Swedish Standard Industrial Classification (SNI)². This section describes the method used to estimate shares and proposals on how to improve the shares. No geographic adjustments were made for the different counties.

This assignment is based on estimated shares of various economic activities according to the shares produced by Statistics Sweden in 2016 to calculate Sweden's national bioeconomy, most often at the two-digit SNI level. However, some modifications have been made.

In some cases, confidentiality issues in input data from national accounts or from structural business statistics, at national or regional level, have led to a presentation of SNI groups at a more aggregate level than two SNI digits. The shares have been set at the most aggregate level possible to ensure that they are equal for the various economic values in the bioeconomy, such as, both employment and value added, and over time. The alternative would have been to first calculate the bioeconomy at the most detailed level possible, and then to aggregate. This would have led to different shares over time and in different economic variables. In this assignment, it was preferable to avoid such a development, but it is, of course, a possible future method adaptation.

Table 2 describes bioshares in different industries.

²See <http://www.sni2007.scb.se/> for more information on the economic activities included in each economic activity accounting to the SNI structure.

Table 2 Bioeconomy shares by industry (SNI 2007)

Activity (SNI 2007)	Bio share, %
A01 – Agriculture	100
A02 – Forestry	100
A03 – Fishing	100
C10-12 Manufacture of food products, manufacture of beverages, manufacture of tobacco products	100
C13-15 – Manufacture of textiles, Manufacture of wearing apparel, Manufacture of leather and related products	48
C16-17 – Manufacture of wood, Manufacture of paper and paper products	100
C18 – Printing and reproduction of recorded media	92
C20-21 – Manufacture of chemicals and chemical products, Manufacture of basic pharmaceutical products and pharmaceutical preparations	15
C22 – Manufacture of rubber and plastic products	7
C28 – Manufacture of machinery and equipment n.e.c.	11
C31-32 – Manufacture of furniture, Other manufacturing	33
D35 – Electricity, gas, steam and air conditioning supply	24
36-39 Water supply; sewerage, waste management and remediation activities	30
F41-43- Construction of buildings, Civil engineering, Specialised construction activities	17
I55-56 – Accommodation, Food and beverage service activities	2
M69-72 – Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Scientific research and development	0.3
N78-82 – Employment activities, Travel agency, tour operator and other reservation service and related activities. Security and investigation activities, Services to buildings and landscape activities.	3
R90-93 – Arts, entertainment and recreation	2

Industries fully classified as belonging to the bioeconomy

In industries that are considered to be 100 percent bioeconomic, no adjustments need to be made over time, or regionally, unless the underlying definition of the bioeconomy changes. The following industries are considered to fully belong to the bioeconomy:

- SNI 01 – Crop and animal production, hunting and related service activities
- SNI 02 – Forestry and logging
- SNI 03 – Fishing and aquaculture
- SNI 10-12 Manufacture of food products, Manufacture of beverages, Manufacture of tobacco products
- SNI 16-17 – Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, Manufacture of paper and paper products

Industries that are partially classified as bioeconomic

The bioshare of the industries that are assumed to be partially classified as bioeconomic are described below. The shares are described for the industry aggregate to avoid disclosing confidential data.

The shares that are used in this project have not taken into account changes in structural transformation in the industries. However, this chapter shows how a changed industry share would look like in certain industries. This is then compared with the calculated value added to show whether the changed size of the share would affect the results.

On the whole, analysis shows that even if an annually emphasised share would be applied, the results would not change significantly for the relevant industries, that is, graphic production, manufacture of agricultural and forestry machinery, and electric production. On the other hand, the results would probably be different in the construction sector and in nature-based tourism, if an annual share would be used.

SNI 13-15 – Manufacture of textiles, Manufacture of wearing apparel and manufacture of leather and related products

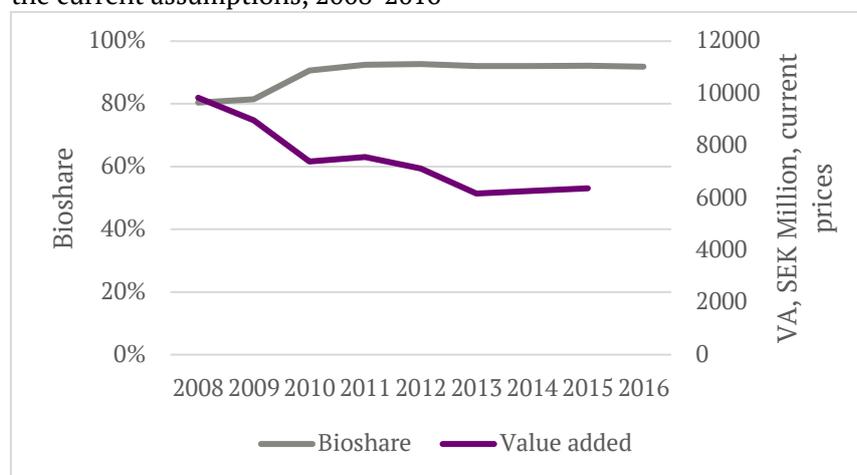
Estimation is based on data from 2013 in the national accounts that shows manufacture of various products in each economic activity. The product groups that contain natural or bio-based materials were selected and compared with the total manufacture in each economic activity. This resulted in a bioshare of 48 percent.

SNI 18 – Printing and reproduction of recorded media

Only the subcategories SNI 18.11 (Printing and service activities related to printing), SNI 18.12 (Other printing) and SNI 18.14 (Binding and related services) are considered to belong to the bioeconomy. These comprise 92 percent of the total turnover in the industry (SNI 18) in 2014. The share is estimated based on information on the economic activity's net turnover in the structural business statistics survey.

Figure 9 shows that if the bioshare is adjusted for annual fluctuation, the share still remains stable over the years. Using the current method, applying the same share regardless of the year shows a decreasing value added in graphic production. This is due to a decrease in the total value added in graphic production, which would continue to decline with annual shares.

Figure 9 Bioshare and value added for the bioeconomy in SNI 18 with the current assumptions, 2008-2016



Source: Statistics Sweden, Structural Business Statistics, National Accounts and Environmental Accounts

SNI 20-21 – Manufacture of chemicals and chemical products and Manufacture of basic pharmaceutical products and pharmaceutical preparations

No good quantitative data was found for SNI 20-21 on which to base the share estimate. It is worth noting that the production of biofuel, such as ethanol, is included in SNI 20. However, the share is not estimated based on quantitative data, but is rather estimated based on a literature study from NMR (2014) (EU average), concerning SNI 20, and a study on biopharmaceuticals (see Scarlat et al 2015), also an EU average.

The above estimate resulted in a bioshare of 15 percent for SNI 20-21.

SNI 22 – Manufacture of rubber and plastic products.

The same challenges as for SNI 20-21. No good quantitative data was found here to make the share estimate from the outside. Instead, the share was estimated based on a study from NMR (2014) that indicates 7 percent for the entire EU with regard to SNI 22.

SNI 28 – Manufacture of machinery and equipment n.e.c.

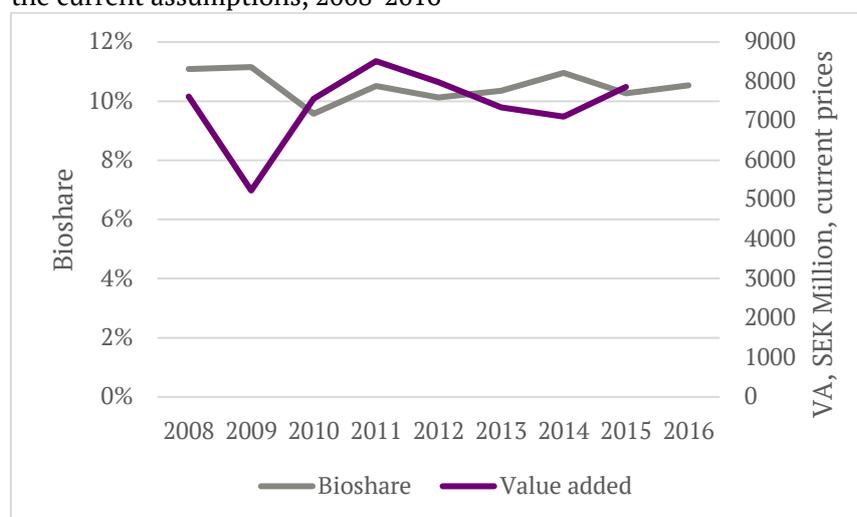
Only the subcategories 28.3 (Manufacture of agricultural and forestry machinery), 28.93 (Manufacture of machinery for food, beverage and tobacco processing), 28.94 (Manufacture of machinery for textile, apparel and leather production), and 28.95 (Manufacture of machinery for paper and paperboard production), are considered to belong to the bioeconomy.

The industries listed above accounted for 11 percent of total net turnover in the economic sector in 2014. Machinery is not manufactured from biomass, but are considered to be necessary to enable production of biomass. Furthermore, the main purpose of the

machinery is considered to be the manufacture of different bio-based products and is used only in the bioeconomy.

Figure 10 shows that if the bioshare was adjusted for annual fluctuation, the share would still remain stable over the years. With the current method, using the same share regardless of the year, shows that value added in the manufacture of machinery for agricultural and forestry production varies slightly over the years. This is due to a variation in the total value added in this industry over the years.

Figure 10 Bioshare and value added in the bioeconomy in SNI 28 with the current assumptions, 2008-2016



Source: Statistics Sweden, Structural Business Statistics, National Accounts and Environmental Accounts

SNI 31-32 – Manufacture of furniture and Other manufacturing

Only manufacture of furniture, SNI 31, is considered to be included in the bioeconomy, but due to a risk of disclosing confidential data, the industry is presented as a single aggregate, SNI 31-32. Via detailed statistics in the national accounts and industry goods production, product classes of KN codes that contain wood, and how production value of these related to the production value of SNI 31 was estimated. This results in a bioshare of 33 percent for SNI 31-32 in 2014.

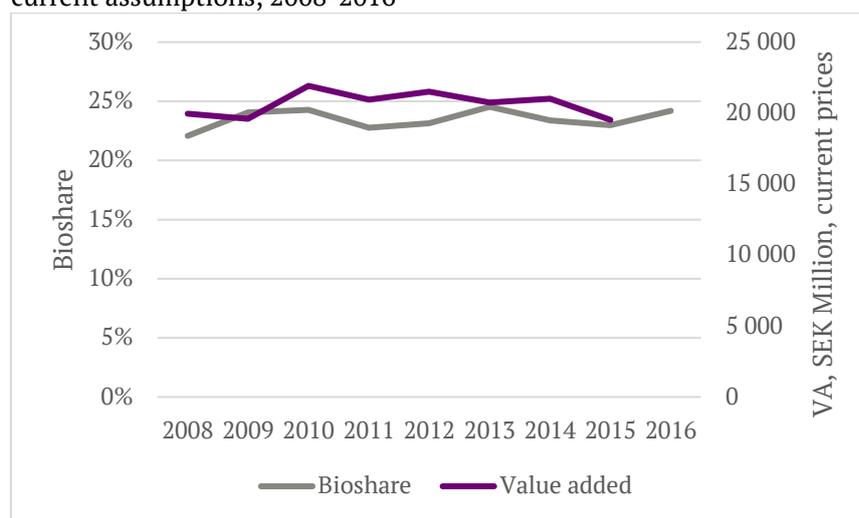
SNI 35 – Electricity, gas, steam and air conditioning supply

The 24 percent share was estimated based on Sweden's total production of electricity and district heating in 2014. The share was calculated by calculating the size of biopower in Sweden's electrical production and the bio-based share of Sweden's district heating production. This is based on the Swedish Energy Agency's energy balance data. The share is estimated based on one year. Figure 11 shows how the share varies over time. Some improvement can be made by applying the share's variation over time.

Figure 11 shows that if the bioshare was adjusted for annual fluctuations, the share would still remain stable over the years. Using

the current method, applying the same share regardless of the year, shows that there is a minor variation in value added in electrical production per year. This is because total value added in electrical production is stable.

Figure 11 Bioshare and value added in the bioeconomy in SNI 35 with current assumptions, 2008-2016



Source: Swedish Energy Agency and Statistics Sweden, National Accounts and Environmental Accounts

SNI 36-39 – Water supply; sewerage, waste management and remediation activities

SNI 36 and SNI 37 are considered to be classified fully as bioeconomy. For waste, SNI 38, the share was calculated based on processed waste, including pretreatment. Waste statistics produced by the Swedish Environmental Emission Data (SMED) contains information on the type of waste and the waste volumes processed by each industry. The goal has been to identify the proportion of bio-based waste volumes. Waste information refers to 2014.

Overall, this resulted in a 30 percent bioshare for SNI 36-39.

SNI 41-43 – Construction of buildings, Civil engineering, Specialised construction activities

SNI 41 comprises 41.1 (Construction of buildings) and 41.2 (Construction of residential and non-residential buildings). 41.2 is clearly the largest subcategory in economic terms. Net turnover in the subcategory SNI 41.2, compared with the whole SNI 41, varies from 96 to 99 percent in the 2008-2016 time series.

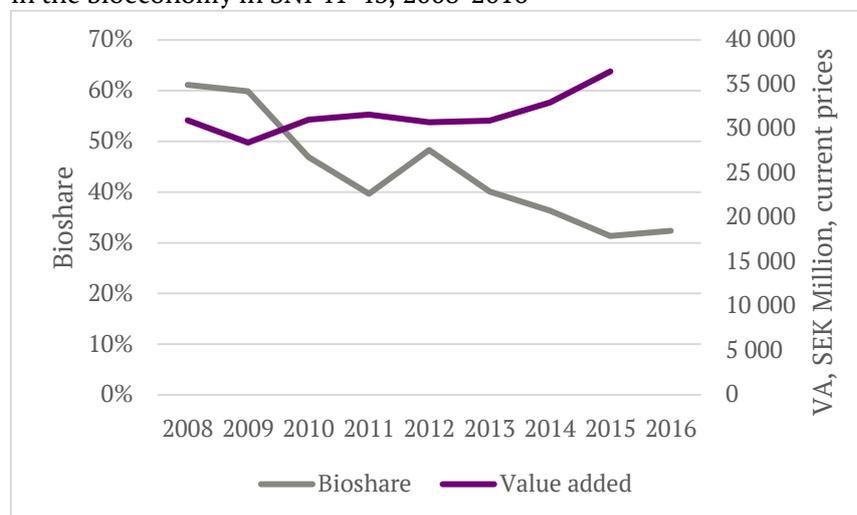
The bioshare in SNI 41 is estimated at 37 percent, which is based on the share of newly built apartments with wooden frames in 2014. For statistical purposes, the term dwelling refers to both dwellings in multi-dwelling buildings and housing in, for example, one- or two-dwelling houses. The assumption is that all one- or two-dwelling houses are built

with a wooden frame and in multi-dwelling buildings, new statistics shows that 1 700 (9%) multi-dwelling buildings are built with a wooden frame.

When the same assumption is made for all years in the 2008-2016 time series, it reveals a downward trend in the bioshare. See Figure 12. The number of multi-dwelling buildings with a wooden frame has more than doubled between 2014 and 2016. In 2016, 3 600 multi-dwelling buildings were built with a wooden frame. However, most multi-dwelling buildings are still constructed in concrete, and the number of concrete buildings has also increased sharply. In 2016, there were 29 200 multi-dwelling buildings with a concrete frame, compared with 17 000 in 2014.

Figure 12 indicates that if the bioshare was adjusted for annual fluctuations, results would probably be different such that the bioeconomic share drops when the share of construction that uses wood in the frame and roofing drops compared with total construction. See Figure 13. Using the current method, applying the same share regardless of the year, shows increased value added in the construction sector. This is because total value added in the construction sector increases.

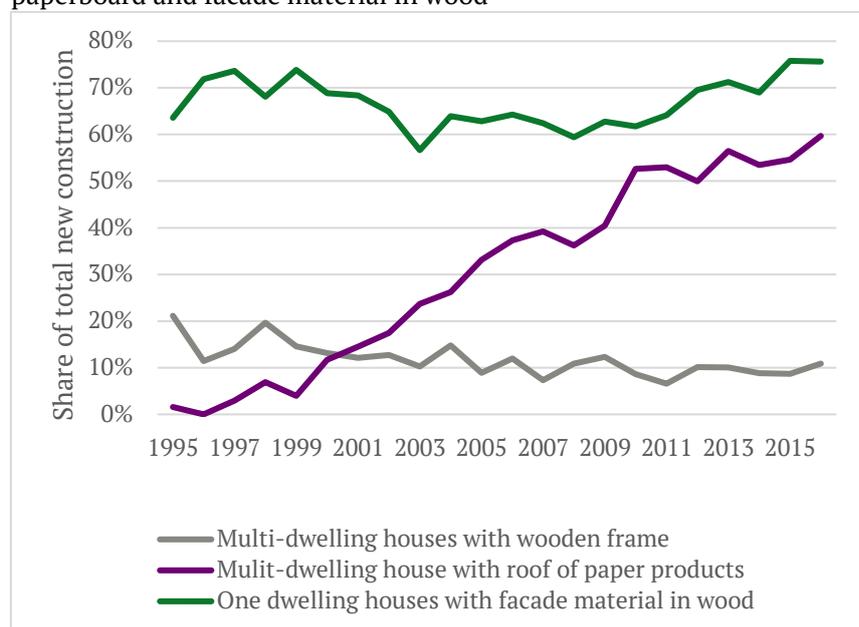
Figure 12 Bioshare in SNI 41 with current assumptions and value added in the bioeconomy in SNI 41-43, 2008-2016



Source: Statistics Sweden, Completed dwellings, National Accounts and Environmental Accounts

SNI 42 is not considered to belong to the bioeconomy. Under SNI 43, only 43320 (Joinery installation) is considered to be part of the bioeconomy. On the whole, this leads to a share of 17 percent for F41-F43.

Figure 13 Share of wood material in the frame, roofing material in paperboard and facade material in wood



Source: Statistics Sweden, Housing and building

SNI 55-56 – Hotel and accommodation activities and restaurant, catering and beverage service activities

This share was estimated based on a study by the European Tourism Research Institute, ETOUR, (2014) that charted Swedish nature-based tourism. The bioshare was calculated based on estimated turnover in nature-based tourism (SEK 3.6 billion) in relation to turnover in SNI 55, 56, 79 and 93, which led to a 2 percent share for SNI 55-56.

Note that the shares are subject to some uncertainty. It may be an overestimation, as part of turnover in nature-based tourism (SEK 3.6 billion) is, in fact, classified under, for instance, SNI 01, 02, 03, 91. It may also be an underestimation, if the SEK 3.6 billion estimate is subject to undercoverage.

SNI 69-72 – Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Scientific research and development

Only 72110 (Research and experimental development on biotechnology) is included as part of the bioeconomy. This subcategory represented roughly 0.3 percent of turnover in SNI 69-72 in 2014.

Also 72.190 (Other research and experimental development on natural sciences and engineering) could be partially included. This subcategory accounts for a substantial part of turnover and represents roughly 94 percent of total turnover in SNI 72.

SNI 78-82

Only parts of SNI 79 and SNI 81 are considered to belong to the bioeconomy.

In SNI 79, the share was estimated based on a study by the European Tourism Research Institute ETOUR (2014) that charted Swedish nature-based tourism. The bioshare was calculated based on estimated turnover in nature-based tourism (SEK 3.6 billion) in relation to turnover in SNI 55, 56, 79 and 93, which led to a 2 percent share for SNI 79.

With regard to SNI 81, only 81300 (Landscape service activities) are included as part of the bioeconomy.

On the whole, these assumptions led to a share of 3 percent in the industry aggregate SNI-78-82.

SNI 90-93

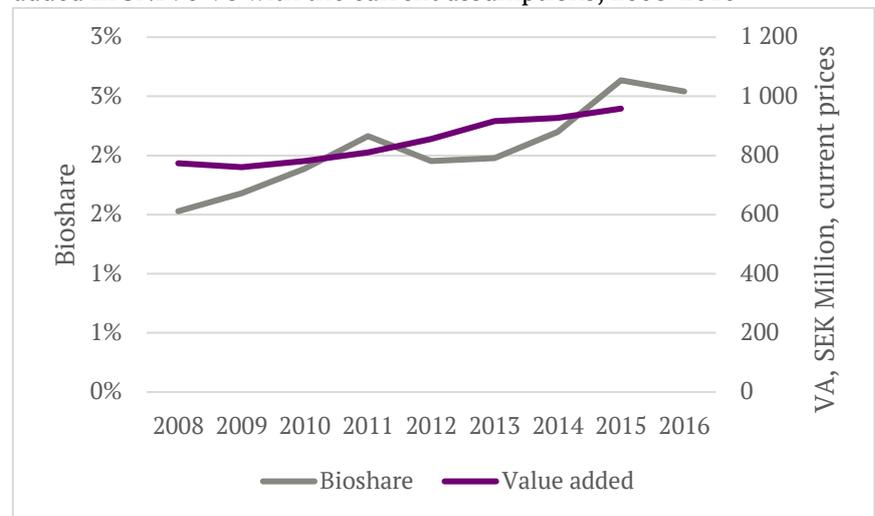
Parts of SNI 91 and SNI 93 are considered to belong to the bioeconomy.

In SNI 93, the share was estimated based on a study by the European Tourism Research Institute ETOUR (2014) that charted Swedish nature-based tourism. The bioshare was calculated based on estimated turnover in nature-based tourism (SEK 3.6 billion) in relation to turnover in SNI 55, 56, 79 and 93, which led to a 2 percent share for SNI 79.

In SNI 91, only 9104 (Botanical and zoological gardens and nature reserves activities) is identified as belonging to the bioeconomy.

Figure 5.6 shows that if the bioshare was adjusted for annual fluctuation, value added would increase. Using the current method, applying the same share regardless of the year, shows that value added in nature-based tourism and botanical gardens increased slightly. This is due to an increase in total value added in these industries. Applying annual fluctuation shares, value added would increase more quickly.

Figure 14 Development of bioshare over time in SNI-90-93 and value added in SNI 90-93 with the current assumptions, 2008-2016



Source: Statistics Sweden, Structural Business Statistics, National Accounts and Environmental Accounts

Information about the quality of the statistics

Uncertainties in bioeconomic shares

The shares are estimated using different methods. Simpler methods were applied in some industry categories, and the shares would need further review to more fully identify the bioeconomy. Table 3 contains an assessment of the share estimate uncertainty.

A - means that uncertainty is relatively low, that is, the share estimate can be considered high quality. Industries included here are those that, for example, are identified as fully belonging to the bioeconomy, or include only a single subcategory in the SNI structure.

B - means there is some uncertainty. This includes, for example, industry aggregates in which the share is estimated using information from the industry's goods production with product classes that are classified as bio-based.

C - industry aggregates in which uncertainty is high and where methodology need to be developed. This may include, for example, share estimates based on a limited number of literature studies.

Table 3 Assessment of the significance of the bioshare

Activity (SNI2007)	Bioshare, %	Industry share of total bioeconomy in Sweden (2015), %*	Assessment of significance of bioshare
A01 Agriculture	100	5	A
A02 Forestry	100	14	A
A03 Fishing	100	0.3	A
C10-12 Food	100	17	A
C13-15 Textiles	48	1	B
C16-17 Wood, paper	100	23	A
C18 Printing	92	2	A
C20-21 Chemicals, pharmaceutical products	15	5	C
C22 Rubber	7	0.4	C
C28 Other machinery	11	3	A
C31-32 Furniture, other	33	3	B
D35 Electricity, gas	24	8	A
E36-39 Water supply; sewerage, waste management and remediation activities	30	3	B
F41-43 Construction	17	14	C
I55-56 Accommodation, food service activities	2	1	C
M69-72 Legal, consultancy activities	0.3	0.3	C
N78-82 Public activities, travel agency	3	1	C

Activity (SNI2007)	Bioshare, %	Industry share of total bioeconomy in Sweden (2015), %*	Assessment of significance of bioshare
R90-93 Arts, entertainment	2	0.4	C

* The share is calculated on value added based on current assumptions on shares

Note that the confidence assessment is carried out on the national shares. In a potential future development in which assumptions at regional level must be made, more uncertainties will be added.

Industries that are not identified as belonging to the bioeconomy

A number of industries have been identified as not belonging to the bioeconomy. These are linked to mining minerals, mining coal and manufacture of crude petroleum, steel and metal production, retail trade, transport and large parts of the service business. For a detailed description of industries not included in the statistics, see Appendix 1.

Several economic activities may be interesting to reassess, to see whether it is possible to measure or whether they can be identified as bioeconomic, such as biorefineries for biodiesel (SNI 19), veterinary services (SNI 75) and various consulting services (SNI M70-71).

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Appendix 1 Industries not included in bioeconomy statistics

Note that these industries are at the two-digit level and may be part of one of the above industry aggregates. At the two-digit level, these industries (SNI 2007) are excluded from the bioeconomy.

- SNI B05-09 – Mining and quarrying
- C19 - Manufacture of coke and refined petroleum products
- C23 - Manufacture of other non-metallic mineral products
- C24 - Manufacture of basic metals
- C25 - Manufacture of fabricated metal products, except machinery and equipment
- C26 - Manufacture of computer, electronic and optical products
- C27 - Manufacture of electrical equipment
- C29 - Manufacture of motor vehicles, trailers and semi-trailers
- C30 - Manufacture of other transport equipment
- C32 - Other manufacturing
- C33 - Repair and installation of machinery and equipment
- C39 - Remediation activities and other waste management services
- F42 – Civil engineering
- G45 - Wholesale and retail trade and repair of motor vehicles and motorcycles
- G46 - Wholesale trade, except of motor vehicles and motorcycles
- G47 - Retail trade, except of motor vehicles and motorcycles
- H49 - Land transport; transport by pipeline
- H50 – Water transport
- H51 – Air transport
- H52 - Warehousing and support activities for transportation
- H53 - Postal and courier activities
- J58 – Publishing activities
- J59 - Motion picture, video and television programme production, sound recording and music publishing activities
- J60 - Programming and broadcasting activities
- J61 – Telecommunications
- J62 - Computer programming, consultancy and related activities
- J63 – Information service activities
- K64 - Financial service activities, except insurance and pension funding
- K65 - Insurance, reinsurance and pension funding, except compulsory social security
- K66 - Activities auxiliary to financial services and insurance activities
- L68 – Real estate activities
- M69 - Legal and accounting activities
- M70 - Activities of head offices; management consultancy activities

- M71 - Architectural and engineering activities; technical testing and analysis
- M73 - Advertising and market research
- M74 - Other professional, scientific and technical activities
- M75 - Veterinary activities
- N77 - Rental and leasing activities
- N78 - Employment activities
- N80 - Security and investigation activities
- N82 - Office administrative, office support and other business support activities
- O84 - Public administration and defence; compulsory social security
- P85 - Education
- Q86 - Human health activities
- Q87 - Residential care activities
- Q88 - Social work activities without accommodation
- R90 - Creative, arts and entertainment activities
- R92 - Gambling and betting activities
- S94 - Activities of membership organisations
- S95 - Repair of computers and personal and household goods
- S96 - Other personal service activities
- T97 - Activities of households as employers of domestic personnel
- T98 - Undifferentiated goods- and services-producing activities of private households for own use
- U99 - Activities of extraterritorial organisations and bodies

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