



**CASA**

Common Agricultural  
and wider bioeconomy  
reSearch Agenda



# STATE OF PLAY OF CENTRAL AND EASTERN EUROPE'S BIOECONOMIES



22/11/2018



**EUROPEAN UNION**

Project co-funded by  
**H2020 Programme** under  
Grant Agreement n° 727486

**Written by: Dr. Stephan Piotrowski and Lara Dammer,  
nova-Institute GmbH, Huerth, Germany**

**This study is part of the work program of the SCAR Bioeconomy Strategic Working Group and support by CASA**

The overall objective of CASA, a Coordination and Support Action (CSA), is a **consolidated common agricultural and wider bioeconomy research agenda** within the European Research Area.

CASA will achieve this by bringing the Standing Committee on Agricultural Research (SCAR), which has already contributed significantly to this objective in the past, to the next level of performance as a research policy think tank. CASA will efficiently strengthen the strengths and compensate for the insufficiencies of SCAR and thus help it evolve further into “SCAR plus”.

## Introduction

This study has been carried out by the nova-Institute between July and November 2018. The objective of this study was to map information and to help establishing data-driven support for the development and implementation of national bioeconomy policies in the BIOEAST macro-region.

The study could contribute to the BIOEAST ultimate aim to create an interoperable, fully integrated observing and forecasting system. The results might help to further develop and enforce the national level strategic thinking on bioeconomy and moreover to direct attention to the work of SCAR and its Strategic Working Groups.

The analysis for this study was limited to only a few number of sources, namely an assessment of turnover and employment in the national bioeconomies based on the methodology presented in the study by Piotrowski et al. 2018, several Eurostat datasets and 11 English-language studies that describe the bioeconomies in the BIOEAST countries.

## Summary

Overall, the BIOEAST macro-region is characterized by low shares of turnover in the total EU-28 bioeconomy but high shares in employment, mainly in the primary sectors, according to an analysis of Eurostat data. This reflects the overall lower productivity of Eastern European countries compared to the rest of the EU.

For a better understanding, the whole macro-region can be divided in the Baltics (Latvia, Lithuania, Estonia), Central-Eastern Europe (CEE; Poland, Hungary, Czech Republic, Slovakia) and South-Eastern Europe (SEE; Romania, Bulgaria, Croatia, Slovenia). The Baltics show a higher specialisation in forestry and, consequently, also in the forest-based industry and bioenergy. In the CEE countries, a broader range of industries contribute to the bioeconomy, including notable shares of the forest-based industry, pulp and paper and chemicals and plastics. The SEE countries show a high specialisation in the bio-based textile sector as well as in agriculture and forestry, which are, however, sectors that generate high employment but low turnover.

Also regarding agricultural production, the three sub-regions can be roughly characterised according to their specialisation. While cereals dominate in the whole macro-region, the Baltics are stronger in the production of green plants from arable land (mainly temporary grasses, leguminous plants and green maize), the CEE countries are strong in the production of potatoes and sugar beet and the SEE countries are stronger in the production of oilseeds and permanent crops (vine and fruits). For all main crops (cereals, oilseeds, potatoes, sugar beet) significant yield gaps persist in all sub-regions compared to the rest of the EU-28.

A literature review shows that the BIOEAST macro-region is a biomass-rich region, with traditionally high importance of primary sectors agriculture, forestry and fishery. Furthermore, the food industry and bioenergy and biofuels are important bioeconomy sectors in the whole macro-region. However, the unused or underutilised biomass potentials from side streams from the sectors are increasingly recognised. In all three sub-regions (Baltics, CEE and SEE), bio-based pharmaceuticals and chemicals are



recognised as key sectors which are still small but highly productive. Biorefineries are underrepresented in the macro-region compared to the rest of the EU.

Insufficient infrastructure, missing links between industries (e.g. between agriculture and the petro-chemical industry in Romania) and the regional abundance of fossil resources are main hurdles for the further development of a higher value bioeconomy.

Identified needs and challenges to further develop regional bioeconomies are to increase productivity in agriculture and forestry, identify regional strengths and potential in different types of biomasses, produce valued-added industrial products from biomass in the region instead of exporting raw materials and start thinking in bioeconomy clusters where regional feedstock supply, existing industrial infrastructure, know-how and innovation potential and public support are combined. Examples of successful Western-European regional bioeconomy clusters show that the focus on regional biomass supply, linkages to existing industries and strong public support are key.

### The position of the BIOEAST macro-region in the EU-28 bioeconomy

In April 2018, nova-Institute published a study which estimated employment and turnover in different sectors of the EU-28 bioeconomy and the national bioeconomies (Piotrowski et al. 2018). Figure 1 and Figure 2 show the main results for the EU-28 as a whole. Main data sources for all of the sectors of the bioeconomy shown were the Eurostat databases PRODCOM and the Structural Business Statistics (SBS).

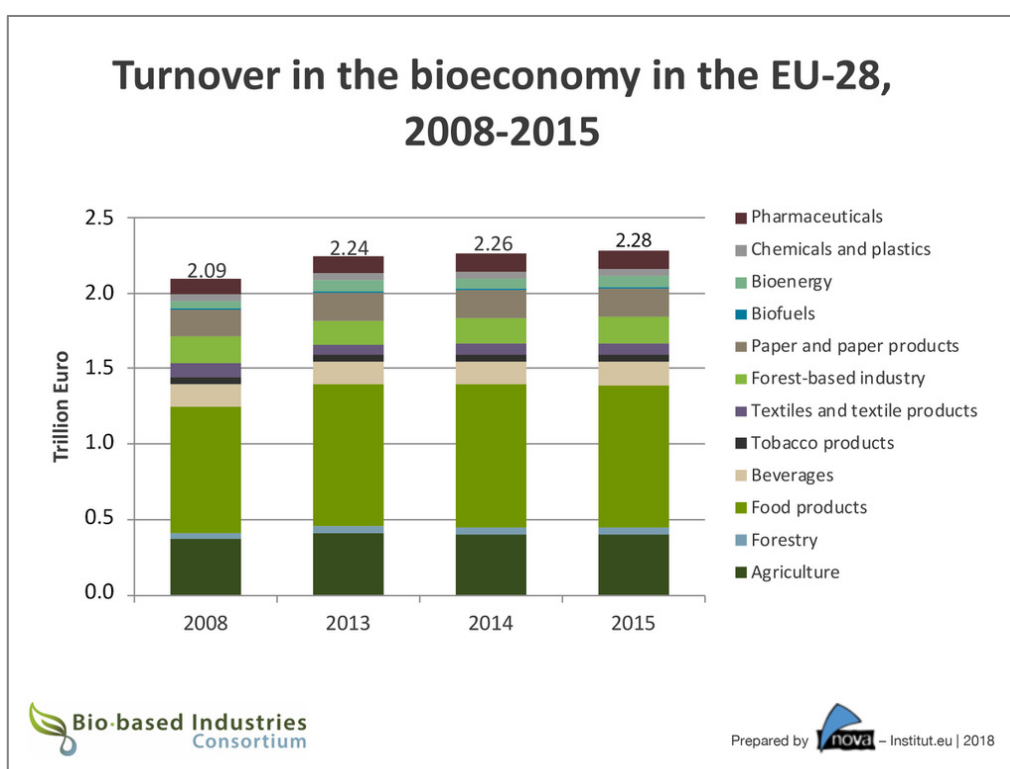


Figure 1: Turnover in the bioeconomy in the EU-28, 2008-2015  
Source: Piotrowski et al. 2018



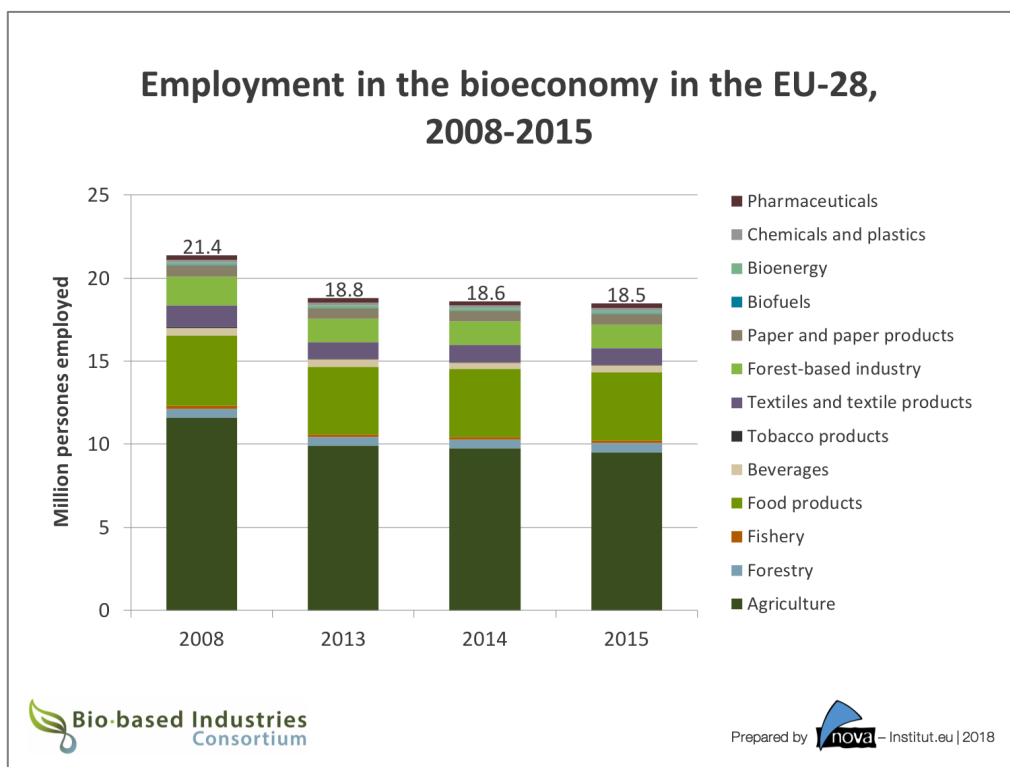


Figure 2: Employment in the bioeconomy in the EU-28, 2008-2015  
Source: Piotrowski et al. 2018

PRODCOM contains for all Member States data for the production quantity and production value of about 3,900 manufactured goods. These goods are coded based on the European Classification of Products by Activity (CPA) system, where the first four digits indicate the Division, Group and Class that the product is belonging to according to the NACE classification of economic activities in the European Community.

Further economic indicators, such as employment and turnover, are only contained in the SBS and other databases at higher levels of aggregation, i.e. the NACE Class and Division level, which sum up several products, for which production value information is available in PRODCOM.

Some of the NACE Divisions can be fully attributed to the bioeconomy, meaning that they consist only of bio-based products. For those sectors, the data on turnover and employment was directly obtained from the respective Eurostat dataset without any modification.

For those sectors that contain both fossil-based and partly or fully bio-based products, the bio-based shares were estimated on product level, to be as accurate as possible. These bio-based shares were then multiplied with the respective total production values of each product and then summed up to the Division level.

In order to infer information about turnover and employment, the assumption was then made that the bio-based share in the total production value of each Division would be approximately equivalent to the bio-based share in employment and turnover.

Figure 3 below then shows the shares of the BIOEAST macro-region in the total EU-28 turnover and employment in the different sectors. The figure shows that the BIOEAST macro-region generates about 50% of EU-28 employment in agriculture and forestry while the shares in turnover are only 20-30%.

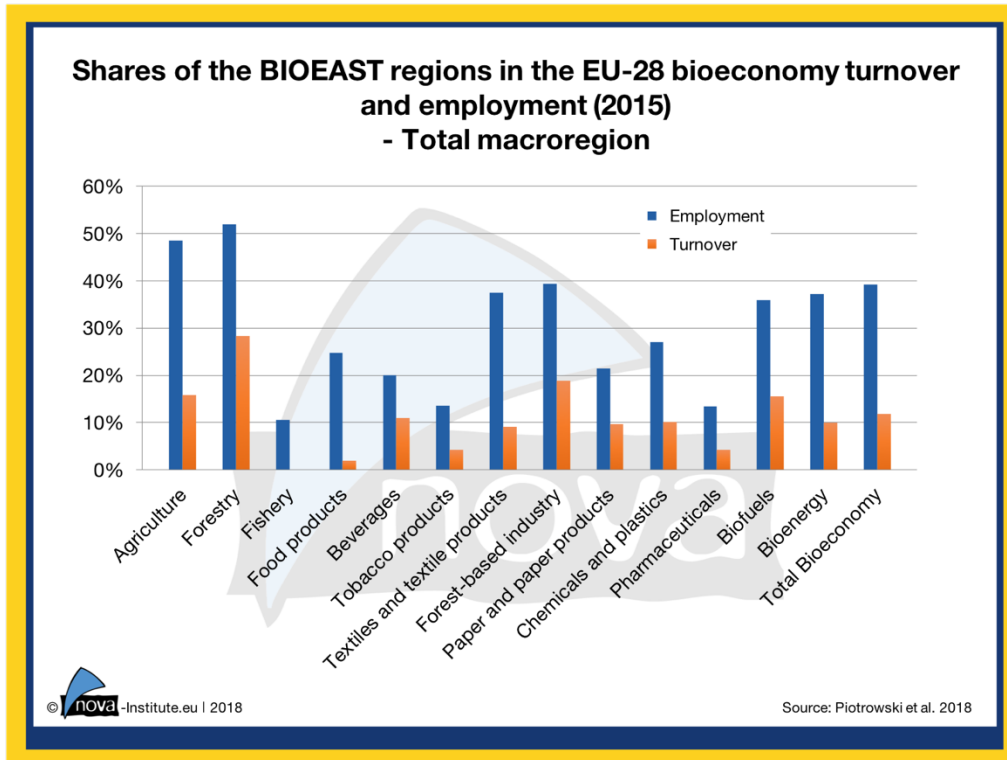


Figure 3: Shares of the BIOEAST macro-region in the EU-28 bioeconomy turnover and employment (2015)  
Source: Piotrowski et al. 2018

BIOEAST shares in employment are also high (around 40%) in the textiles, forest-based, biofuels and bioenergy sectors, but less (around 20-30%) in the paper, bio-based chemicals and plastics and bio-based pharmaceuticals sectors.

Shares in turnover are consistently lower than the BIOEAST shares in employment in the respective bioeconomy sectors, with the exception of the beverages sector (50% turnover compared to 30% employment).

Overall, the BIOEAST macro-region contributes 40% of employment to the EU-28 bioeconomy compared to only 13% of turnover.

The whole BIOEAST macro-region can be roughly divided into the Baltics (Latvia, Lithuania, Estonia), the Central-Eastern European (CEE) countries (Poland, Hungary, Czech Republic, Slovakia) and the South-Eastern European (SEE) countries (Romania, Bulgaria, Croatia, Slovenia). While also within these groups there are significant differences in the state of the bioeconomy, the main part of the study will break down the macro-region into these three groups.

As the following figures (Figure 4, Figure 5, Figure 6) show, compared to the other two country groups, the bioeconomy of the Baltics shows a higher specialisation in forestry and, consequently, also in the forest-based industry and bioenergy.

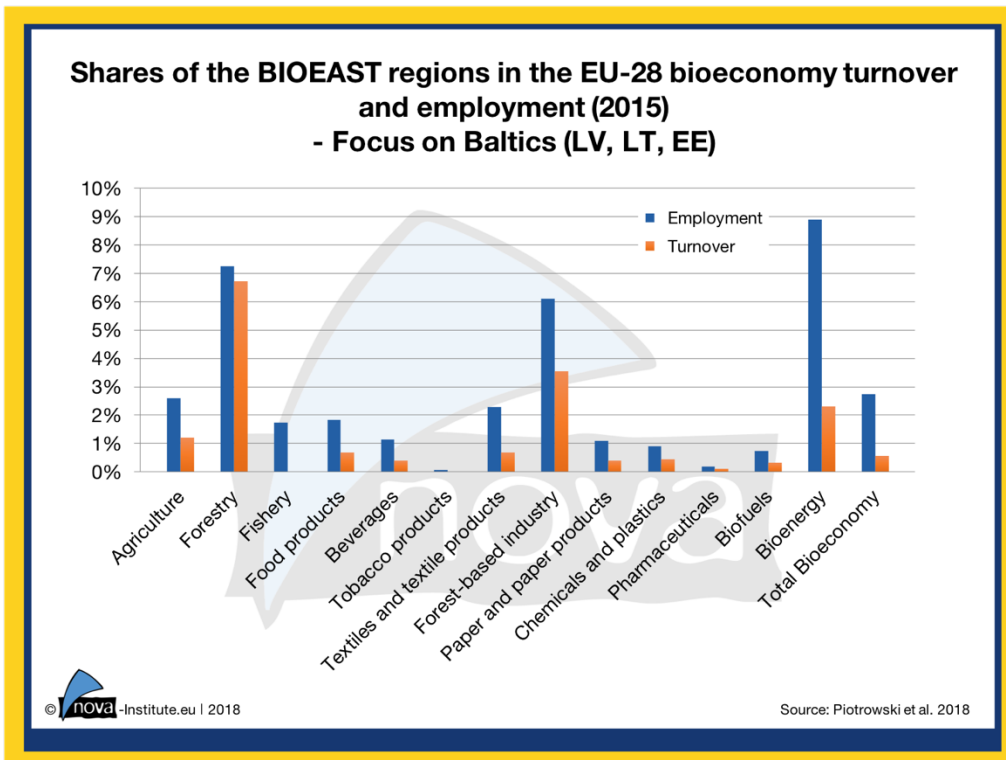


Figure 4: Shares of the Baltics in the EU-28 bioeconomy turnover and employment (2015)  
Source: Piotrowski et al. 2018

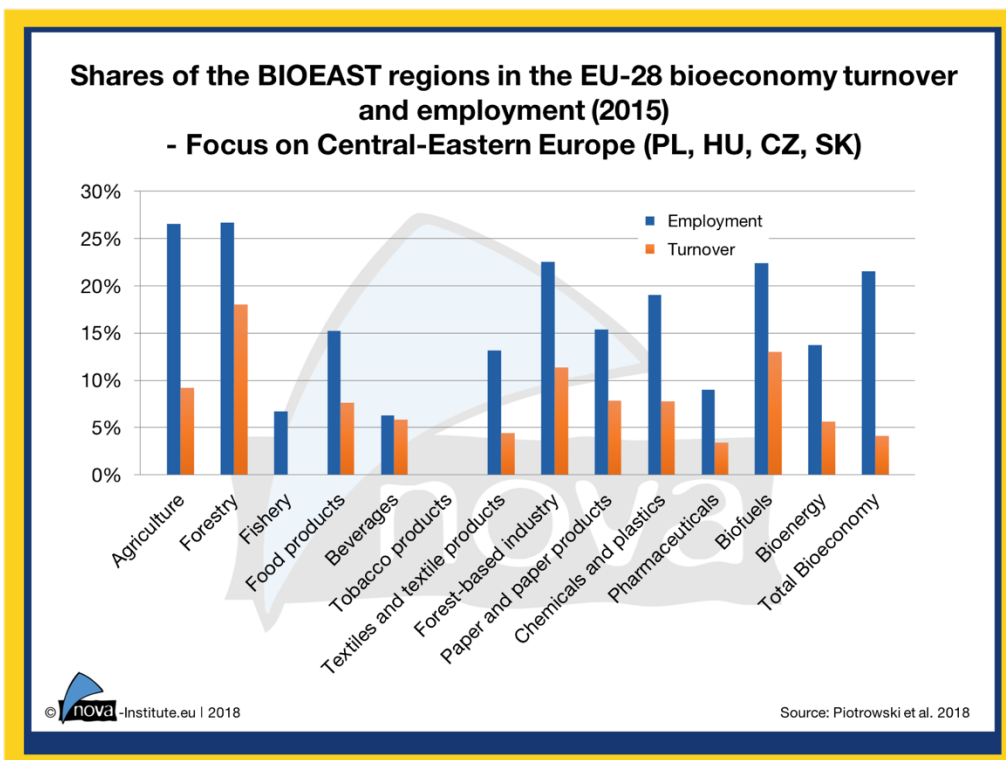


Figure 5: Shares of the Central-Eastern European countries in the EU-28 bioeconomy turnover and employment (2015)  
Source: Piotrowski et al. 2018



In the CEE countries, a broader range of industries contribute to the bioeconomy, including notable shares of the forest-based industry, pulp and paper and chemicals and plastics.

The SEE countries show a high specialisation in the bio-based textile sector as well as in agriculture and forestry, which are, however, sectors that generate high employment but low turnover.

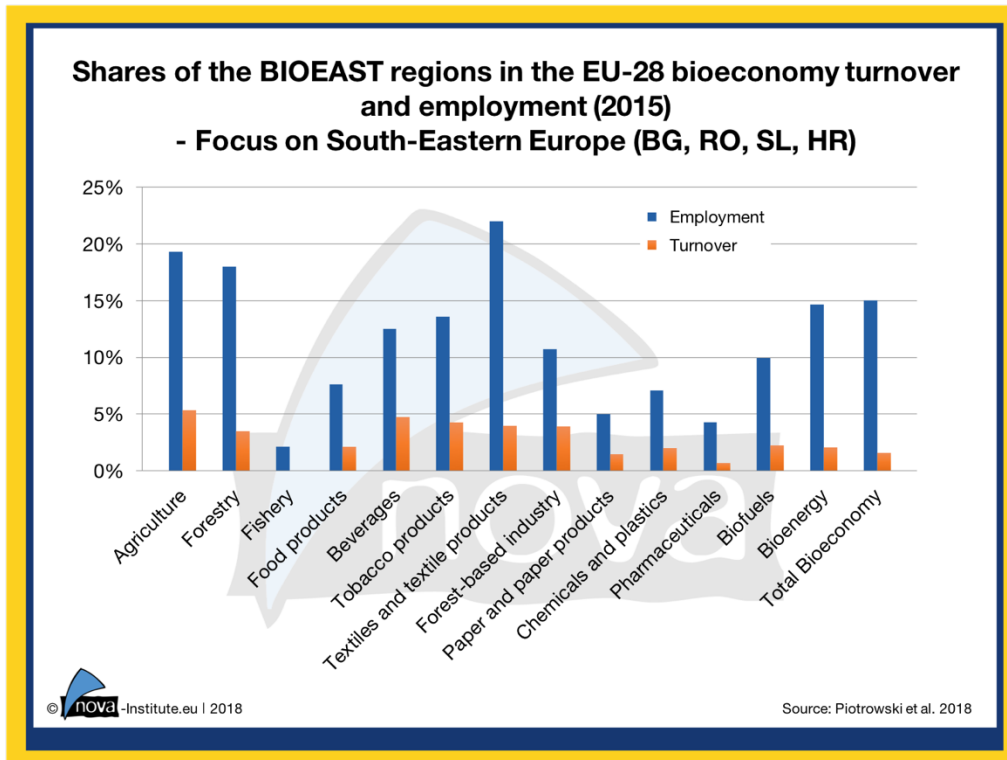


Figure 6: Shares of the South-Eastern European countries in the EU-28 bioeconomy turnover and employment (2015)  
Source: Piotrowski et al. 2018

Overall, shares in employment are consistently higher in all bioeconomy sectors and the three country groups. This is also reflected by the large differences in hourly labour costs in industry between the BIOEAST subregions and the rest of the EU-28 (Figure 7). Apparently, the BIOEAST macro-region has, due the low labour costs, a strong comparative in labour intensive industries compared to the rest of the EU-28.

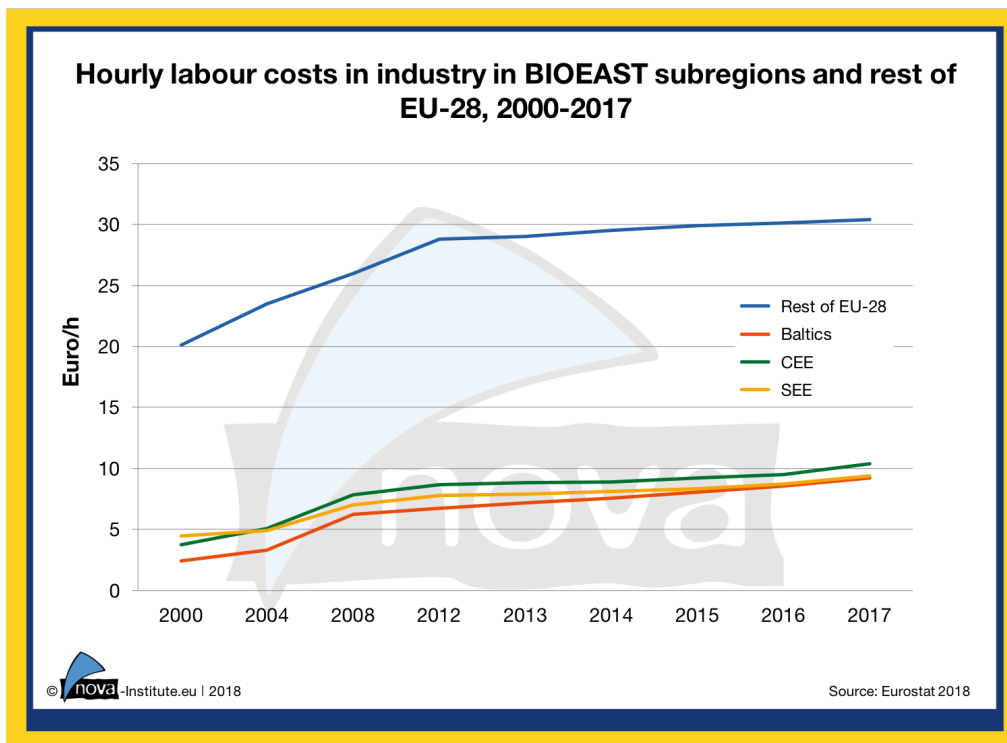


Figure 7: Hourly labour costs in industry in BIOEAST subregions and rest of EU-28, 2000-2017  
Source: Eurostat 2018

## Biomass production in the BIOEAST macro-region

### Agricultural biomass

Figure 8 to Figure 11 show the total agricultural production in the BIOEAST macro-region as well as the relative specialisation of the three sub-regions.

While cereals dominate in the whole macro-region, the data roughly indicate a specialisation of the three sub-regions in other areas of agricultural production. While the Baltics are stronger in the production of green plants from arable land (mainly temporary grasses, leguminous plants and green maize), the Central-Eastern European countries have higher shares in the production of potatoes and sugar beet and the South-Eastern European countries in the production of oilseeds and permanent crops (vine and fruits).

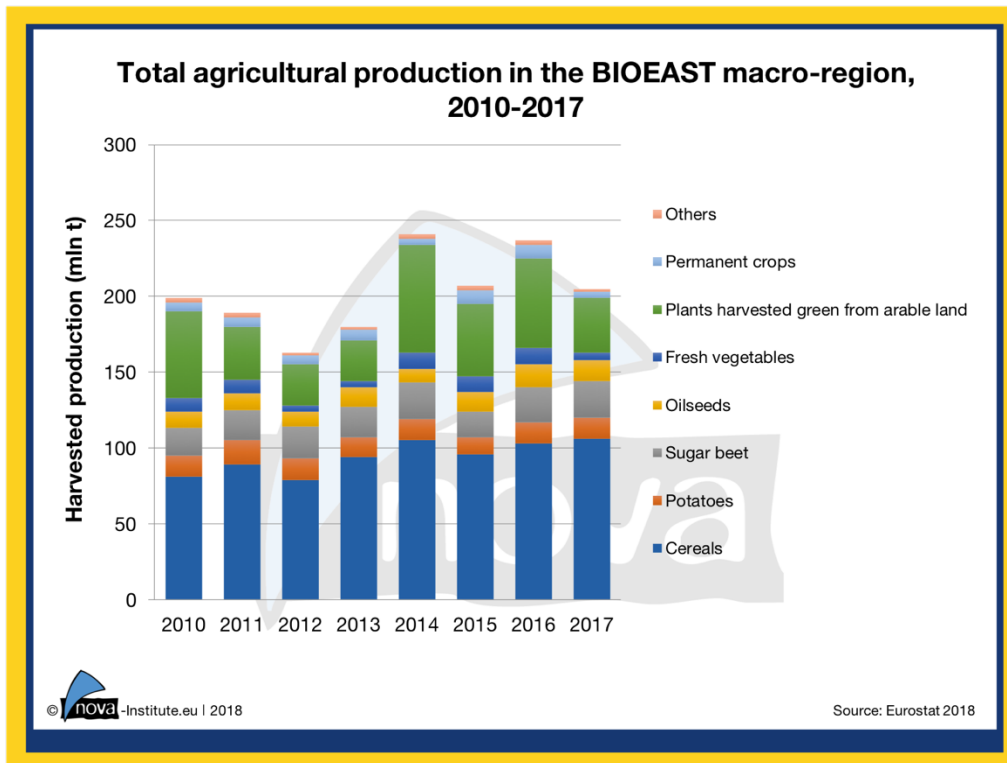


Figure 8: Total agricultural production in the BIOEAST macro-region, 2010-2017  
Source: Eurostat 2018

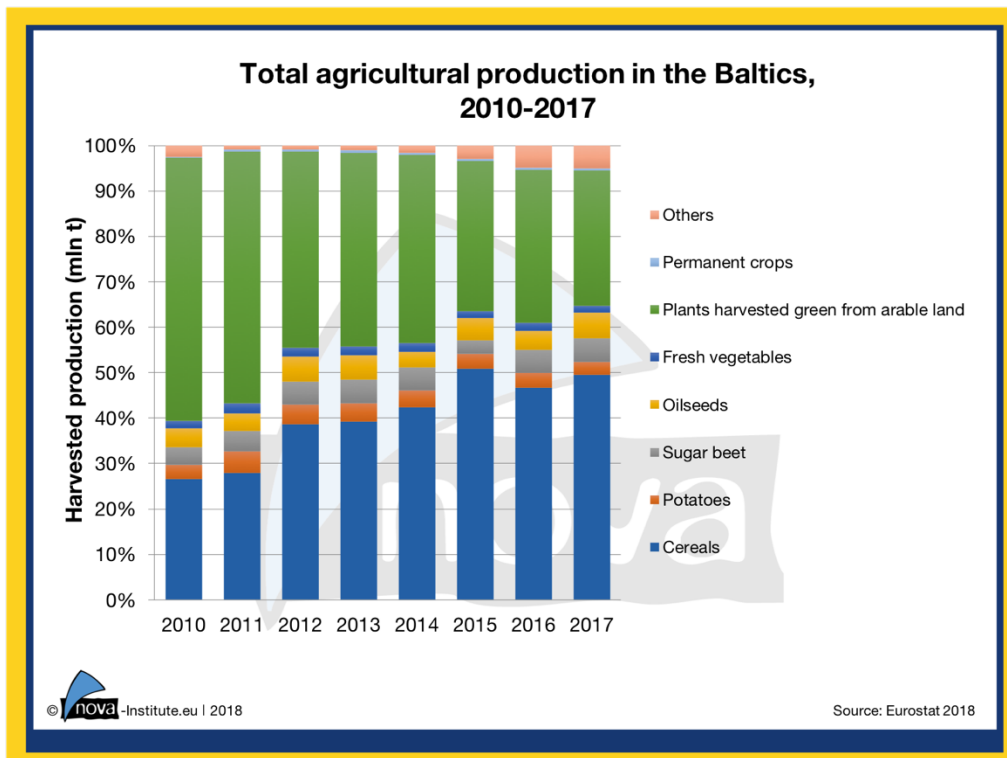


Figure 9: Total agricultural production in the Baltics, 2010-2017  
Source: Eurostat 2018



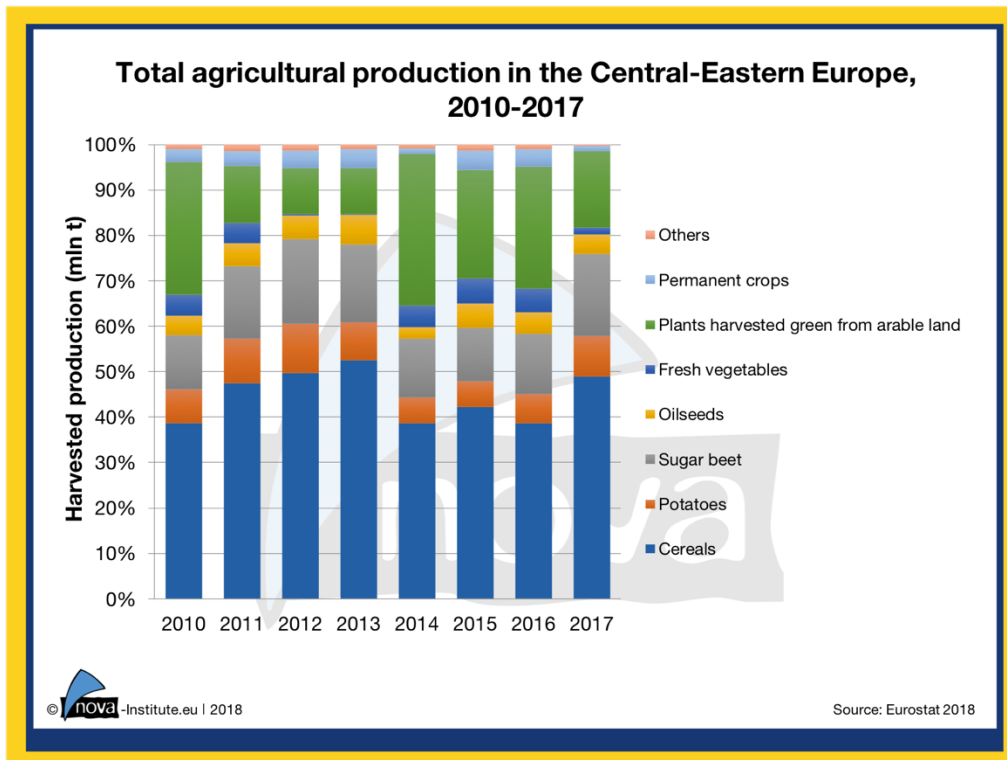


Figure 10: Total agricultural production in the Central-Eastern Europe, 2010-2017  
Source: Eurostat 2018

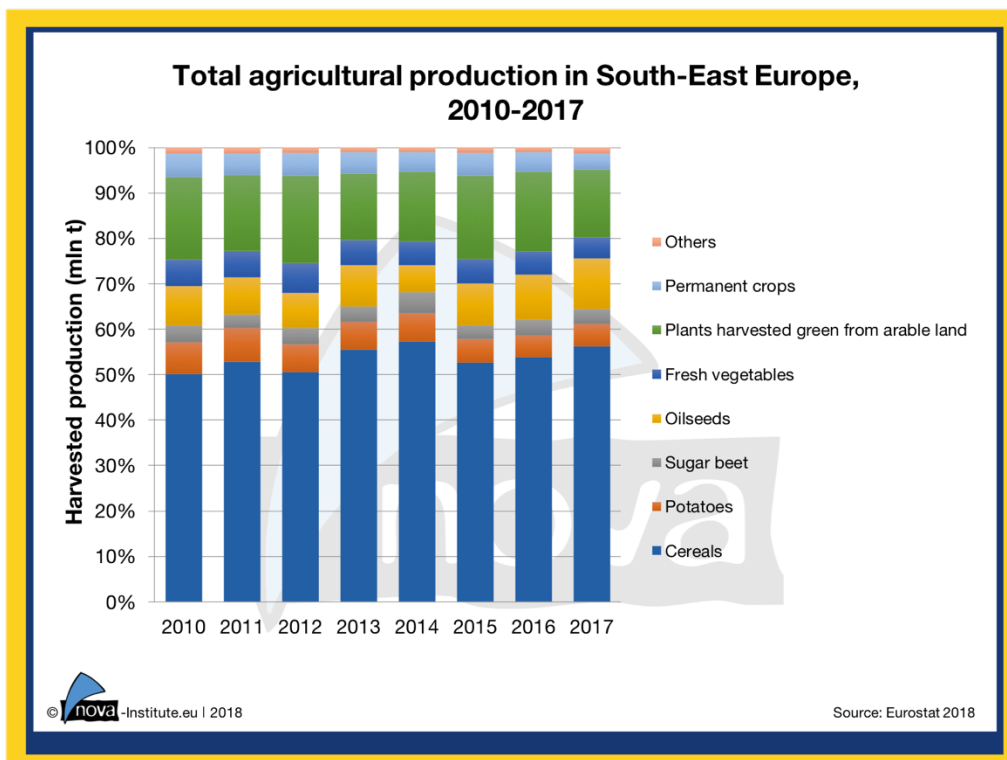


Figure 11: Total agricultural production in South-East Europe, 2010-2017  
Source: Eurostat 2018

Figure 12 to Figure 15 show yields of the main crop groups (cereals, oilseeds, potatoes and sugar beet) for the recent years for the BIOEAST macro-region, the subregions and the rest of the EU-28.

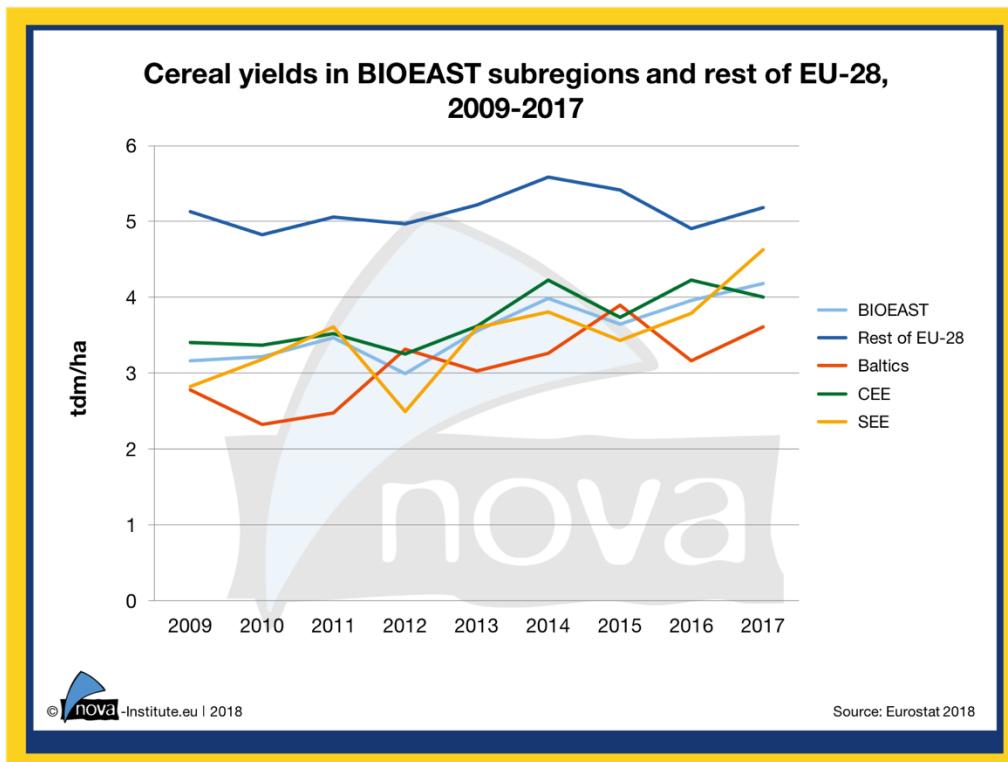


Figure 12: Cereal yields in BIOEAST subregions and rest of EU-28, 2009-2017  
Source: Eurostat 2018

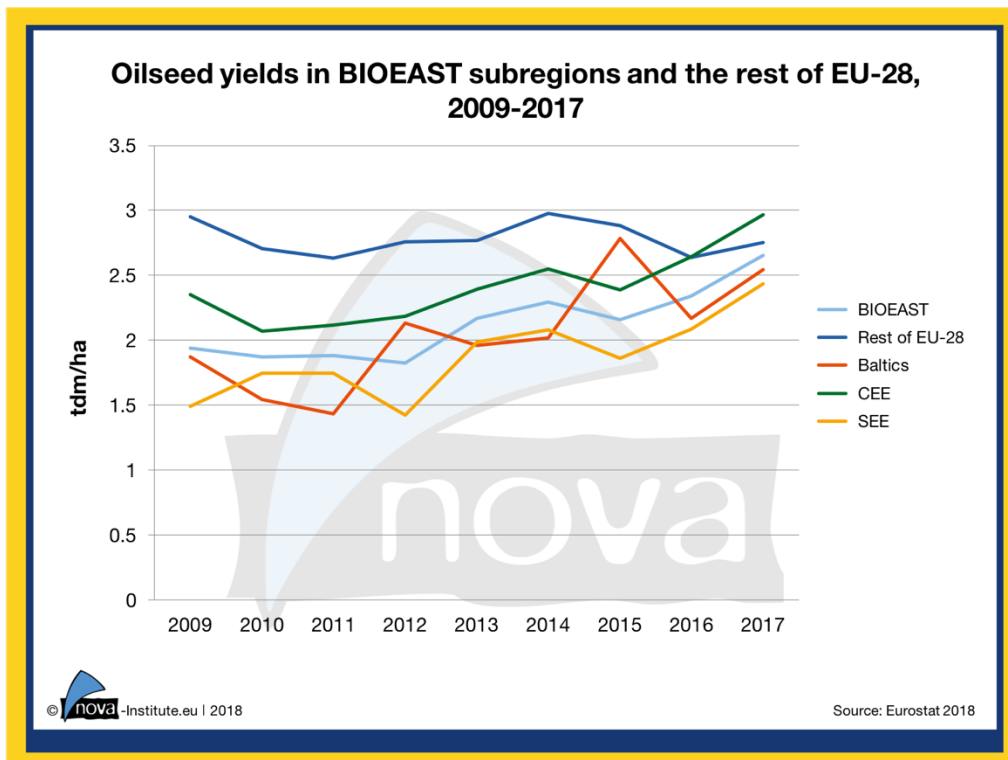


Figure 13: Oilseed yields in BIOEAST subregions and the rest of EU-28, 2009-2017  
Source: Eurostat 2018

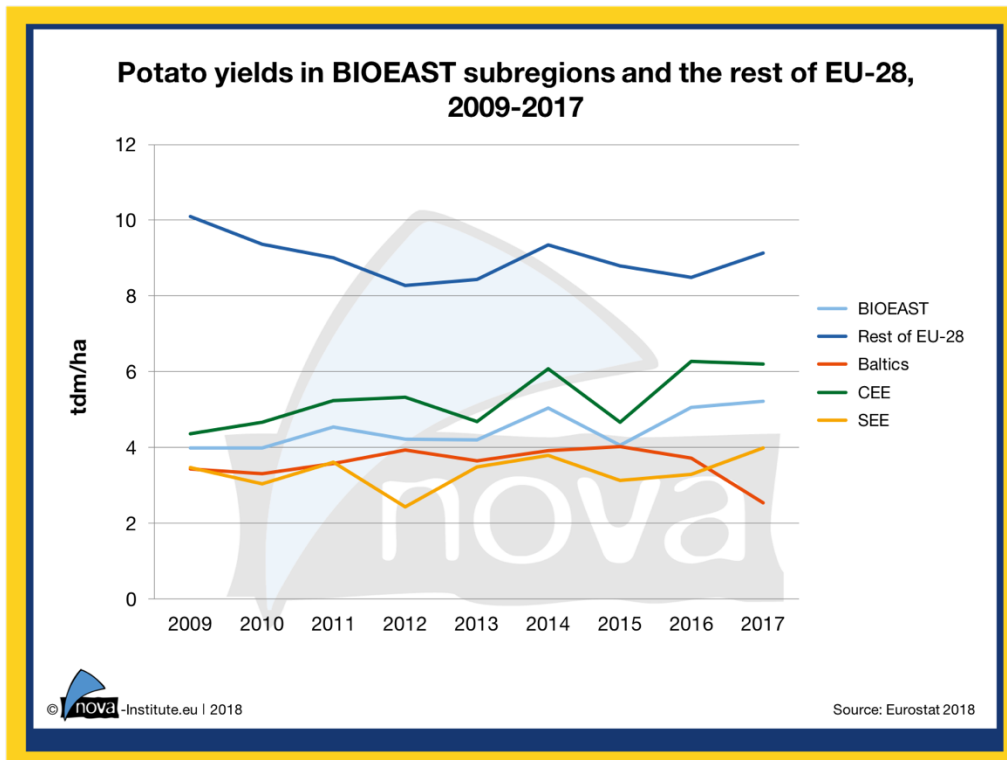


Figure 14: Potato yields in BIOEAST subregions and the rest of EU-28, 2009-2017  
Source: Eurostat 2018

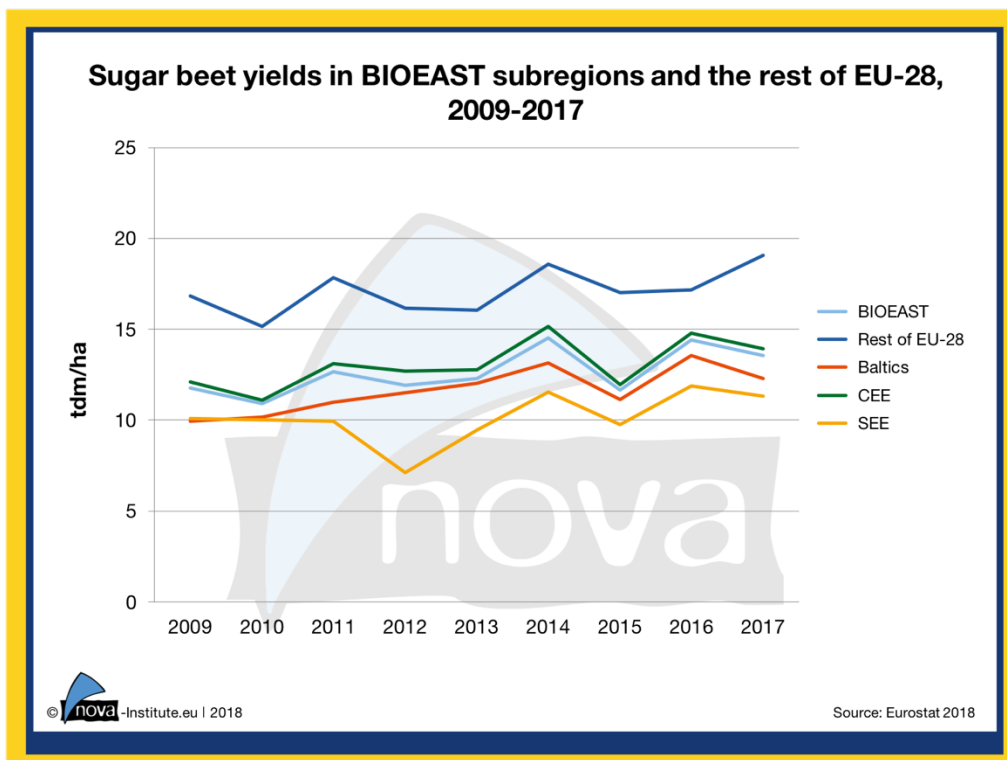


Figure 15: Sugar beet yields in BIOEAST subregions and the rest of EU-28, 2009-2017  
Source: Eurostat 2018



The figures show that for all crop groups, there are persistent yield gaps between BIOEAST and the rest of the EU-28, though less pronounced for the oilseeds. Finding reasons for these yield gaps is beyond the scope of this study, but closing these gaps should be one area of priority for the BIOEAST bioeconomies.

## Forestry

Figure 16 shows the production of roundwood in the BIOEAST subregions and the rest of EU-28 in recent years. Overall, the BIOEAST subregions follow the same trend as the rest of the EU-28, i.e. a slightly increasing roundwood production.

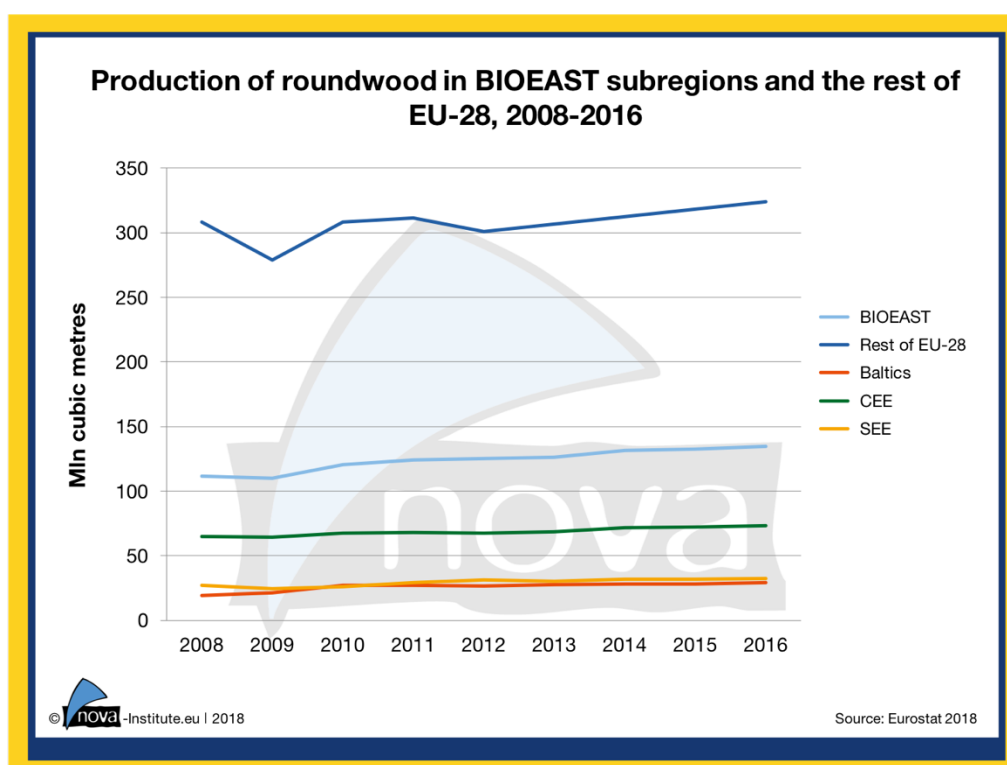


Figure 16: Production of roundwood in BIOEAST subregions and the rest of EU-28, 2008-2016  
Source: Eurostat 2018

## Fishery (Aquaculture)

Figure 17 and Figure 18 show the increase of production of aquaculture products in recent years as well as the increase of its value of production in Euro per tonne for the EU-28 as well as the BIOEAST focus regions. Apparently, especially the Baltics have increased their aquaculture production by about 40% in the last nine years. Also the SEE region has increased its production while it remained stable in the CEE region, in line with the rest of the EU-28.

In terms of production value (Figure 18), all regions follow a similar trend of slight increases over the years, but with the EU average increasing more steeply than the Eastern countries.

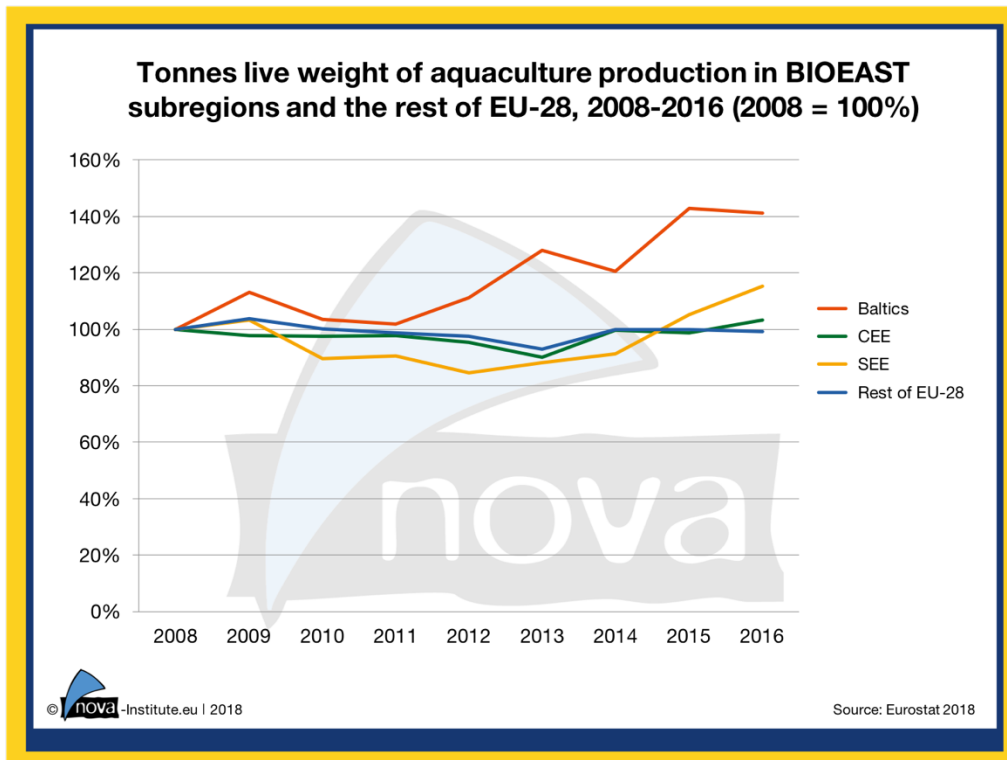


Figure 17: Tonnes live weight of aquaculture production, 2008-2016 (2008 = 100%)  
Source: Eurostat 2018

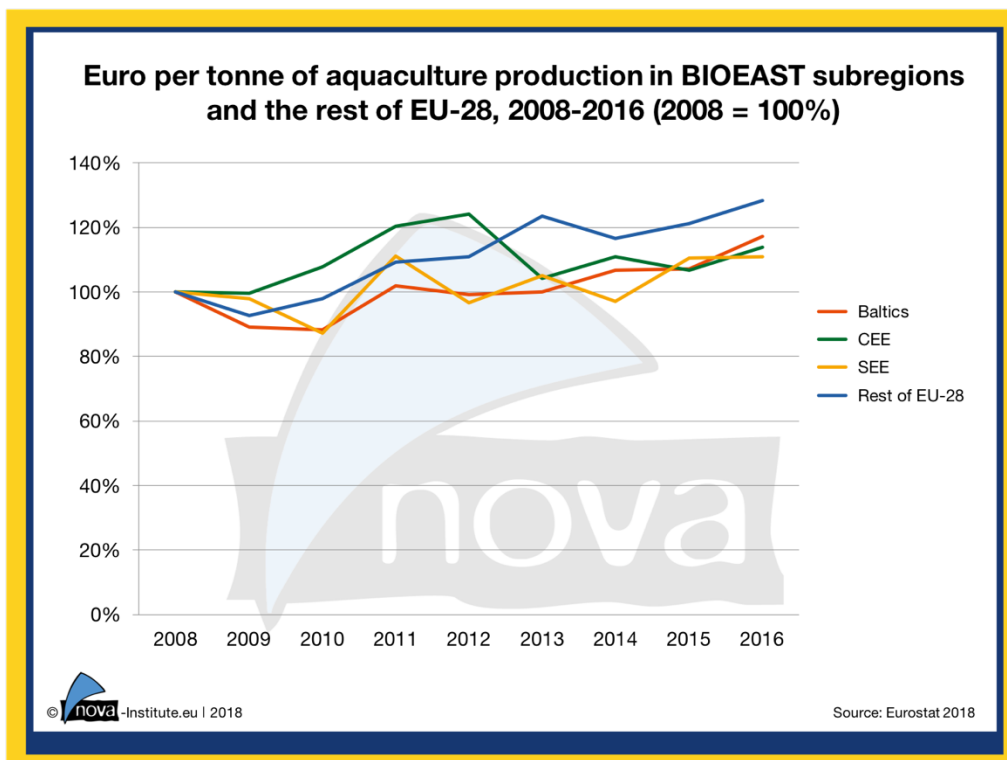


Figure 18: Euro per tonne of aquaculture production, 2008-2016 (2008 = 100%)  
Source: Eurostat 2018

Finally, Figure 19 and Figure 20 show the total domestic extraction of biomass in the BIOEAST Member States for the latest available year 2016, extracted from the Eurostat Material Flow Accounts (MFA).

The figures highlight that agricultural biomass dominates by far in most of the Member States, with the notable exceptions of Latvia and Estonia with very high shares of wood, while aquatic biomass is only marginal in all of them. They also show that Poland dominates biomass extraction in the macro-region with a share of almost 40%.

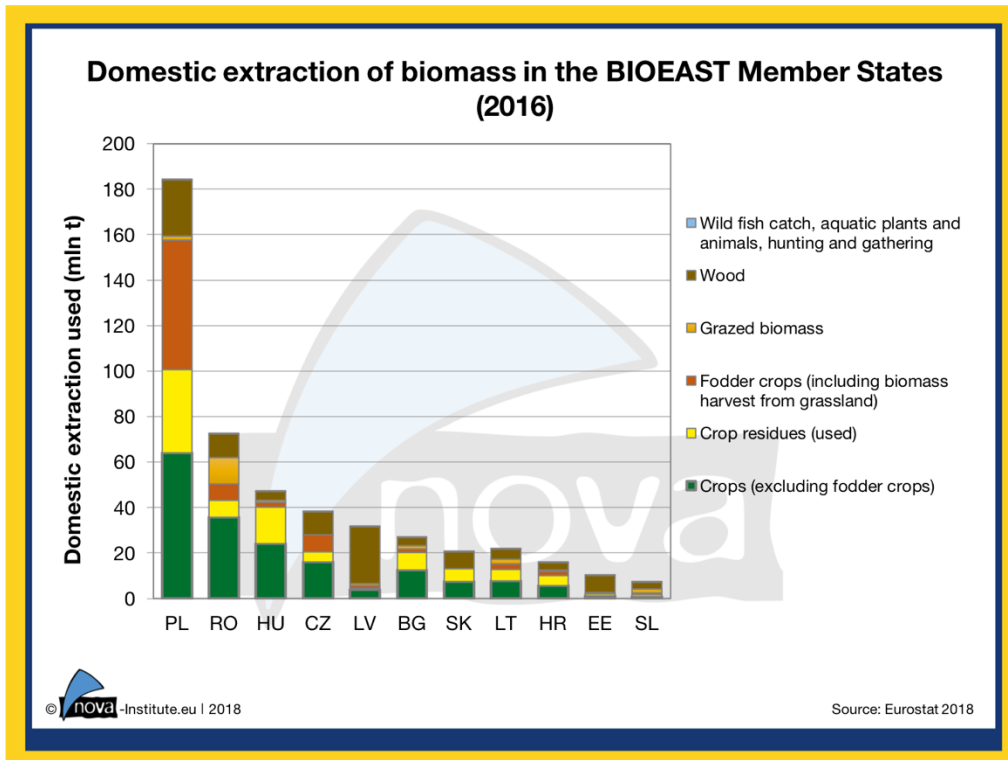


Figure 19: Domestic extraction of biomass in the BIOEAST Member States, in mIn t (2016)  
Source: Eurostat 2018

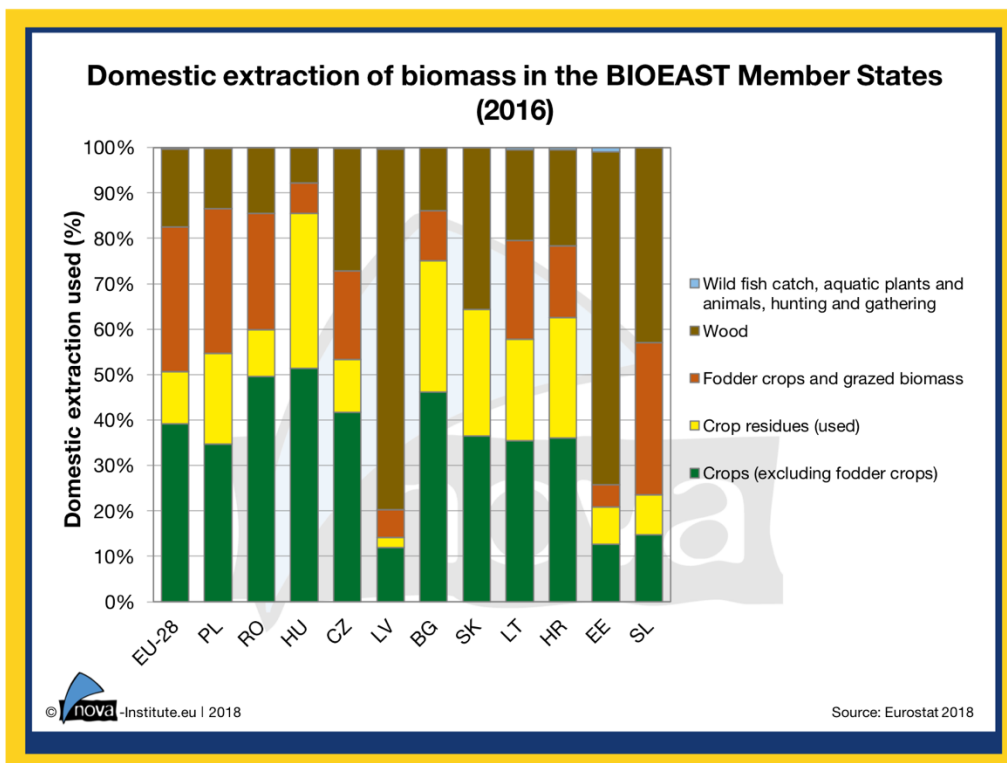


Figure 20: Domestic extraction of biomass in the BIOEAST Member States, in % (2016)  
Source: Eurostat 2018

### Biomass use in the BIOEAST macro-region

The Eurostat Material Flow Accounts (MFA) show at Member State levels the domestic extraction used (DME), imports, exports and the domestic material consumption (DMC) of the main types of materials, including different types of biomasses and fossil materials.

The MFA therefore highlight a country's material resources and demand and may help in understanding deficits and potential for bio-based industries.

The following Figure 21 and Figure 22 first compare the import and export structures of different types of biomass between the BIOEAST Member States and the EU-28. Additionally to the domestic extraction of biomass, the MFA import and export data contain two further biomass categories: live animals and animal products (apart from aquatic origin) and product mainly from biomass. The latter category sums up different kinds of semi-finished and finished products. Unfortunately, the exact composition of this category of products is not disclosed by Eurostat, but apparently it is dominated by non-food products such as paper but may also still include some food products (Reisinger et al. 2011).

In any case, the relation between this category and the other biomass categories can be regarded as a rough indicator for the level of processing from raw materials to products. As Figure 21 and Figure 22 clearly show, import shares of processed, biomass-derived products are larger than the export shares for most of the BIOEAST countries, indicating that the value creation from biomass mainly takes place outside the macro-region.

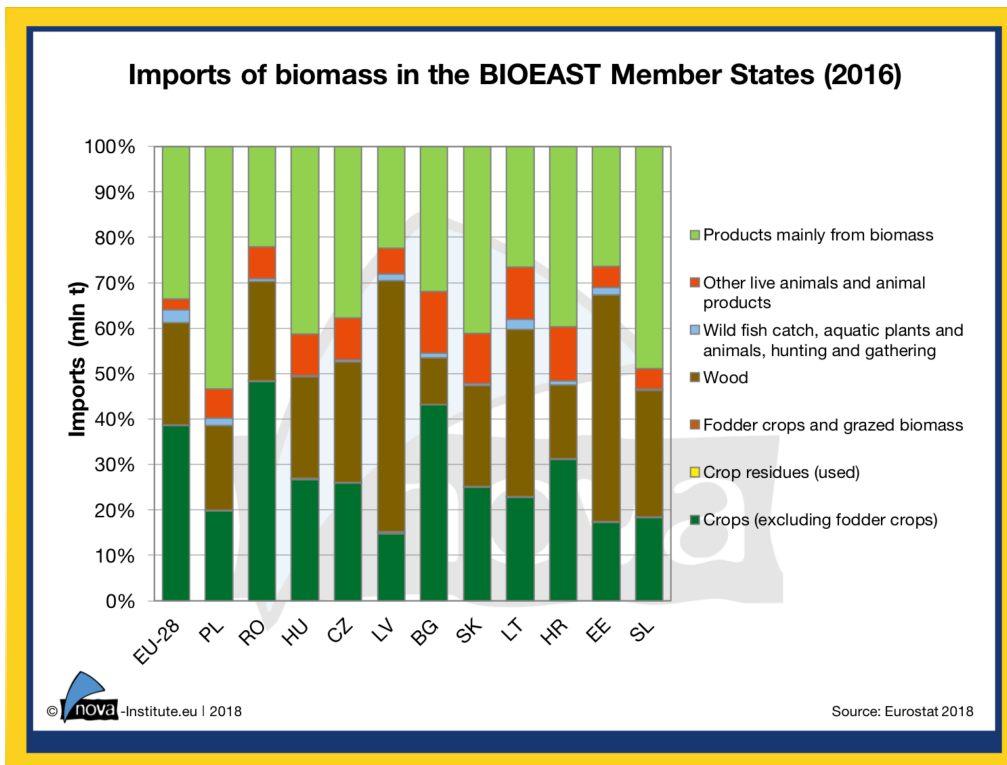


Figure 21: Imports of biomass in the BIOEAST Member States (2016)  
Source: Eurostat 2018

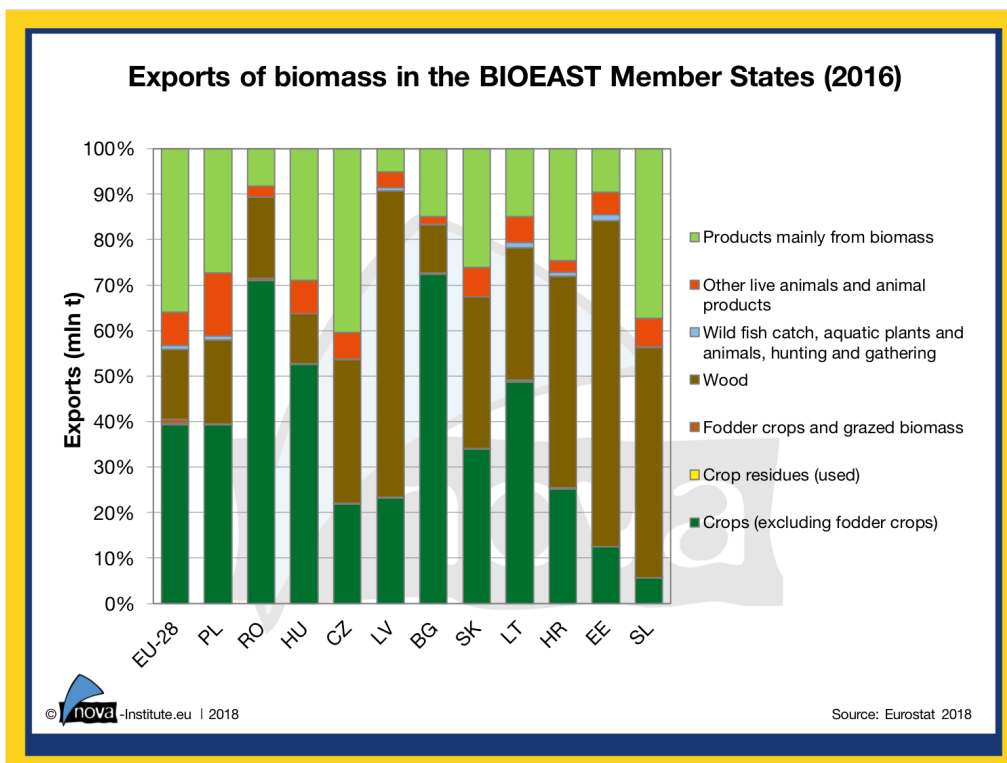


Figure 22: Exports of biomass in the BIOEAST Member States (2016)  
Source: Eurostat 2018

Additionally, Figure 23, Figure 24 and Figure 25 compare the MFA indicators between the BIOEAST sub-regions and the EU-28 for all types of materials.

They show that Latvia and Lithuania have a significantly higher share of biomass in their DME (almost 70% in Latvia and 50% in Lithuania compared to 20-30% in the EU-28) while Estonia is more reliant on the extraction of fossil energy carriers (mainly oil shale and tar sands).

Only Estonia, Czech Republic, Bulgaria and Poland have shares of fossil energy materials/carriers in their DME of 20% and more. In Czech Republic, Bulgaria and Poland it is mainly lignite and hard coal.

As a conclusion, the regional abundance of fossil energy carriers may be seen as a hurdle for the bioeconomy; while the macro-region is also rich in biomass sources, the relatively cheap fossil energy hampers higher value uses of biomass.

Overall, the BIOEAST macro-region has an import share of fossil energy materials/carriers that is less than half that of the EU-28, but an import share of non-metallic minerals (mainly clay, sand, limestone and gypsum) that is about 6 times higher than in the EU-28.

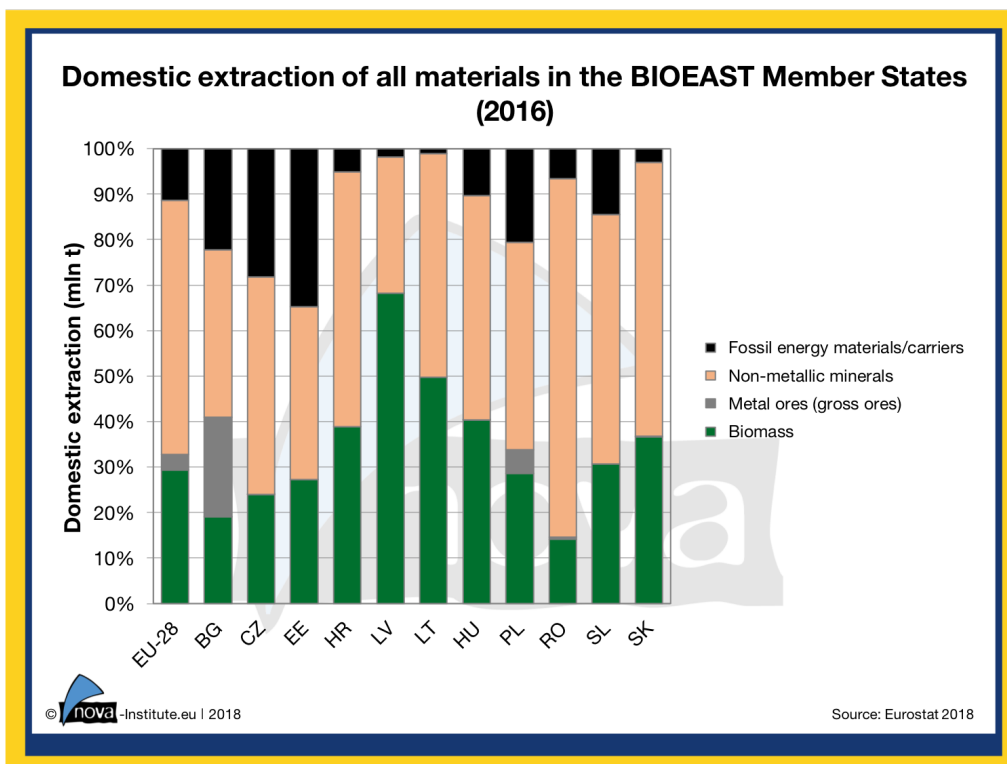


Figure 23: Domestic extraction of all materials in the BIOEAST Member States (2016)  
Source: Eurostat 2018



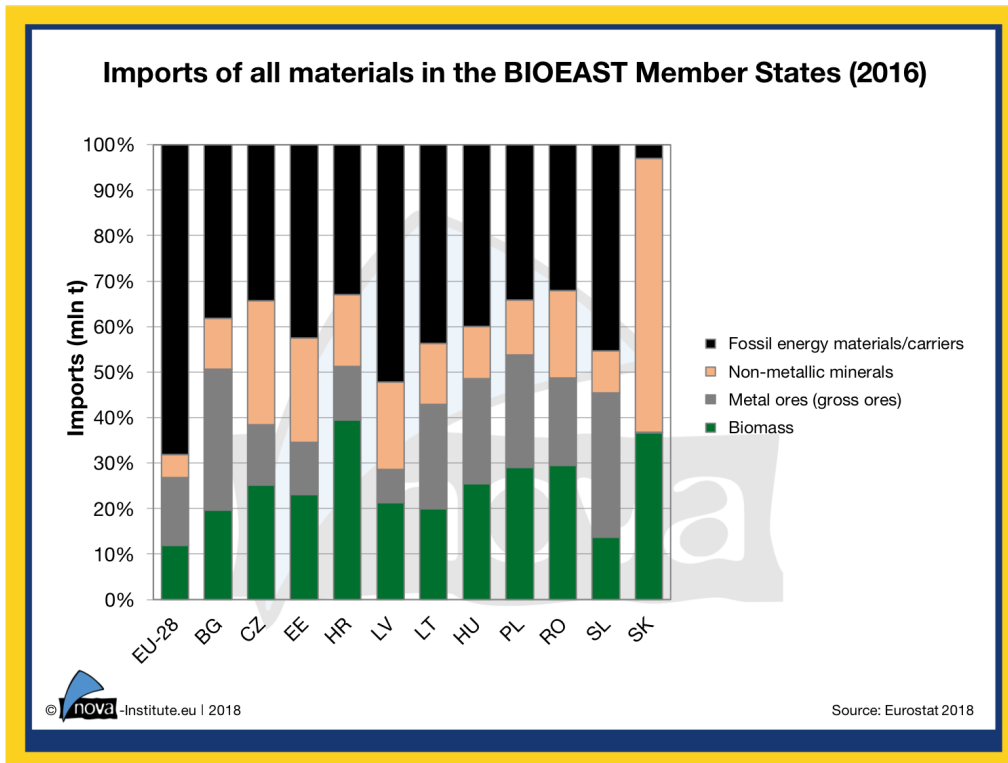


Figure 24: Imports of all materials in the BIOEAST Member States (2016)  
Source: Eurostat 2018

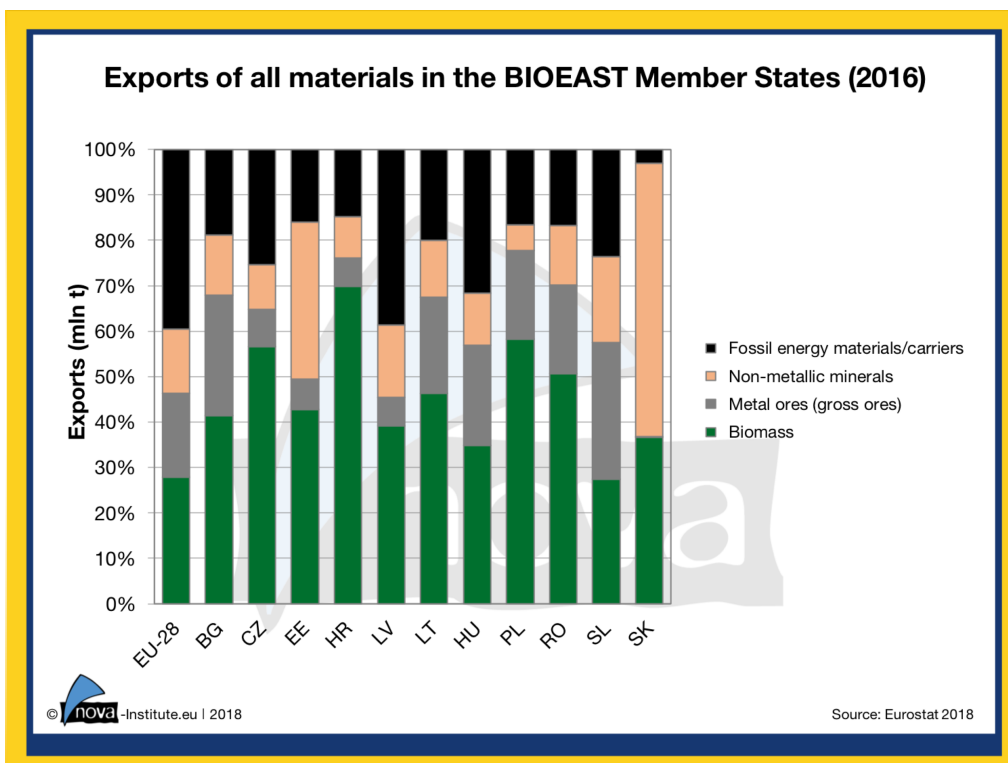


Figure 25: Exports of all materials in the BIOEAST Member States (2016)  
Source: Eurostat 2018

Closely related to the bioeconomy is the concept of a circular economy and the intersection of both can be termed “circular bioeconomy” (Carus and Dammer 2018). A circular bioeconomy includes the sharing, reuse, remanufacture and recycling of bio-based products, cascading uses, utilisation of organic waste streams and resource-efficient bio-based value chains.

It is therefore also interesting to compare the BIOEAST macro-region with the rest of the EU-28 in terms of its treatment of bio-based wastes. Figure 26 first shows the shares of recovered total wastes (i.e. all kinds of wastes that are not disposed of but either recovered for energy generation or recycled). These shares are much lower in the SEE region than in the rest of the EU-28 while recovery rates in the CEE region are even above.

Figure 27 and Figure 28 then show recovery rates for two types of bio-based wastes: paper and cardboards and animal and mixed vegetal/food wastes. In the case of paper and cardboard wastes, recovery rates are near 100%, except for the SEE region, which shows declining recovery rates since 2008 (mainly due to a decline of recovery rates in Bulgaria). Also recovery rates of animal and food waste had declined in this region since 2006 but then apparently increased again after 2014.

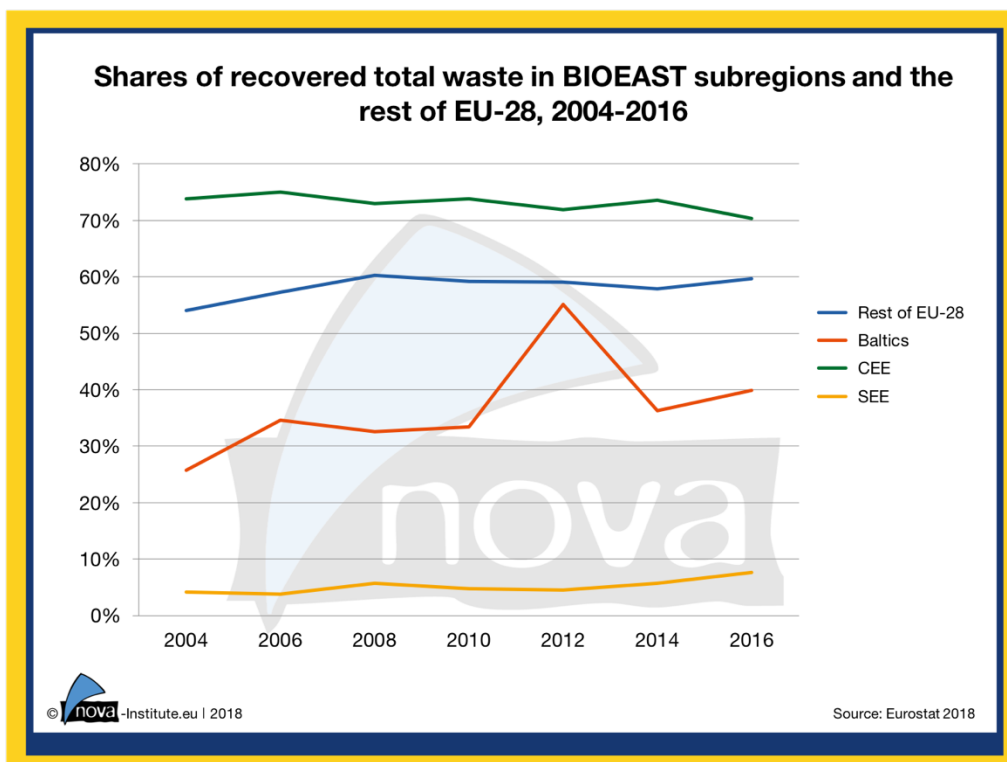


Figure 26: Shares of recovered total waste, 2004-2016  
Source: Eurostat 2018

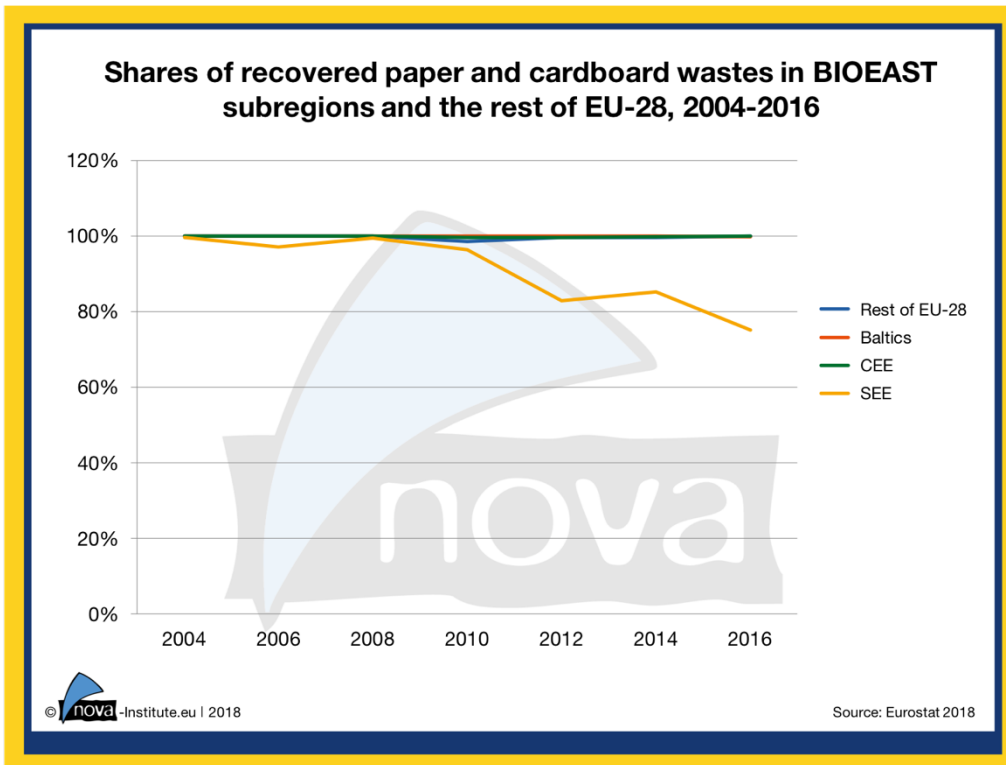


Figure 27: Shares of recovered paper and cardboard wastes, 2004-2016  
Source: Eurostat 2018

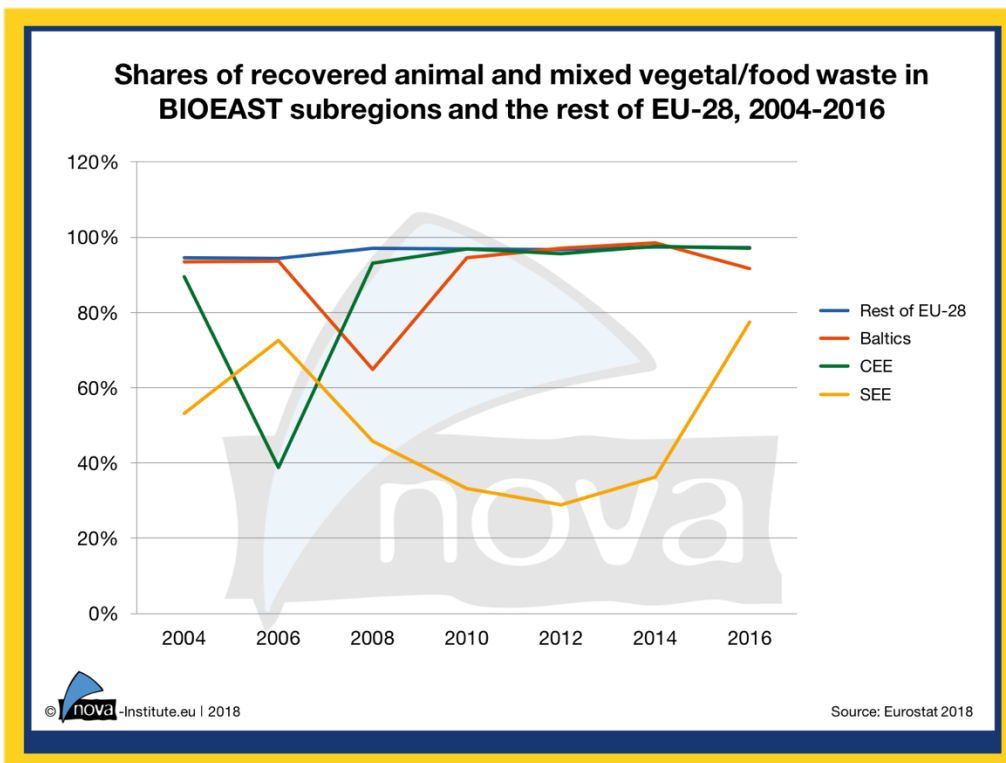


Figure 28: Shares of recovered animal and mixed vegetal/food waste, 2004-2016  
Source: Eurostat 2018

To depict a complete picture of biomass uses by different sectors of the bioeconomy is very challenging, since the official statistics miss a link between biomass supply and use. The Joint Research Centre (JRC) developed a methodology to fill this gap (Gurría et al. 2017). Figure 29 and Figure 30 were calculated based on the data extracted from the online database related to this publication<sup>1</sup>. The data is not complete for all years, therefore average values for the period 2011-2015 were calculated.

This comparison between biomass use in the EU-28 and the BIOEAST region mainly shows a higher share used for feed and bedding in the BIOEAST region (73% compared to 50%) and a much lower share of wood pulp. Regarding biomass used for other materials, including bio-based chemicals, the data suggest that the share is very low (0.2%), both in the BIOEAST region and the EU-28 as a whole.

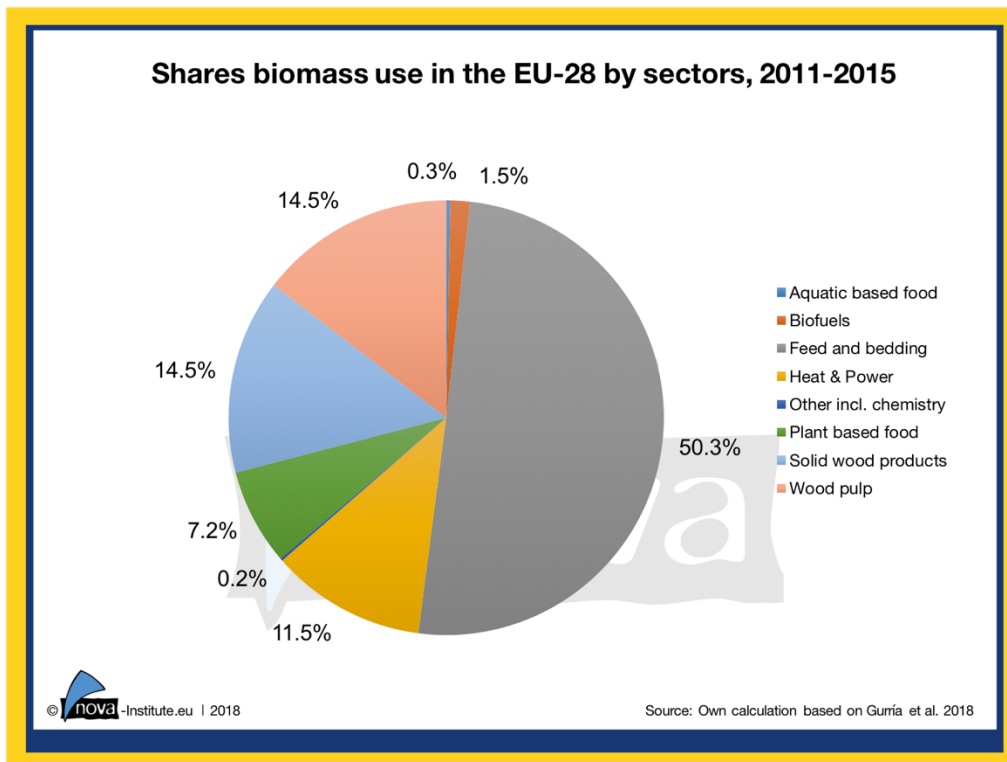


Figure 29: Shares biomass use in the EU-28 by sectors, 2011-2015  
Source: Own calculation based on Gurría et al. 2018

<sup>1</sup> <https://datam.jrc.ec.europa.eu/datam/public/pages/news.xhtml?newsId=243>

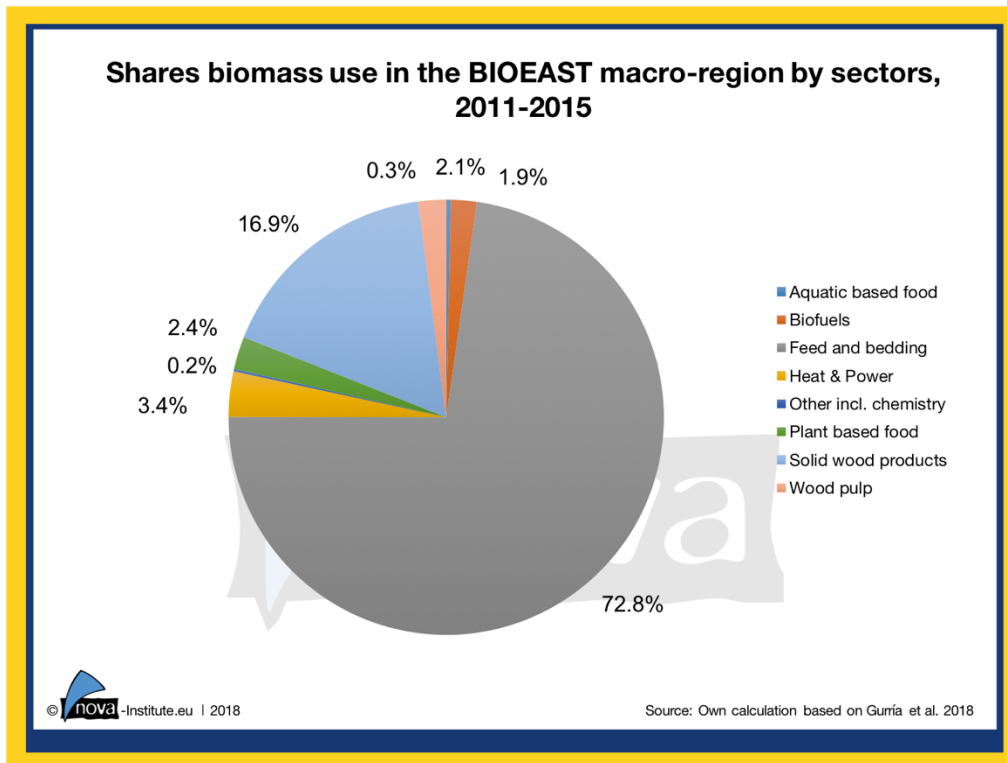


Figure 30: Shares biomass use in the BIOEAST macro-region by sectors, 2011-2015  
Source: Own calculation based on Gurriá et al. 2018

## The state of the national bioeconomies in the BIOEAST macro-region

Apart from the Eurostat statistics, that have been shown so far to highlight and compare the BIOEAST bioeconomies with the rest of the EU, several studies have been evaluated that give insights to the bioeconomies of single Member States in the macro-region. Highlights of these studies are summarised below.

### Biomass availability and potential

Overall, the BIOEAST region is described as rich in biomass resources that are currently not used to its full potential. According to Winther 2016, Estonia and Latvia are abundant with bio-resources (arable land, forest and marine resources) but at the same time lacking “smart, value-adding and sustainable value-chains and between their components a bioeconomy strategy”. According to Vitunskienė et al. 2017 about 80% of all of Lithuania’s biomass are found in forests, but the majority of wood resources are used traditionally, i.e. in manufacture of wood, its products and furniture, also as biofuel in energy.

Barta 2014 describes Hungary also as biomass-rich country with high potentials for bioenergy: sunflowers stems, oilseed rape straw, residuals from pruning vineyards and from orchards could supply significant amounts of biomass but recently most of these by-products were burned or used as soil amendment. Barta 2014 calculates that the traditional structure of production could be feasibly maintained on 3.3-3.4 million ha arable land, therefore at least 1 million ha land could be utilized for non-food purposes.

Poland and Romania have very strong agricultural sectors. In Poland, agriculture is the main biomass source with 76% (fastest growing: sugar and rapeseed production), forestry follows with 24%. Also, there are large side streams from fruit and vegetable agriculture (Biobased Industries Consortium 2017, Biobased Industries Consortium 2018). Apart from being one of the largest agricultural sectors in Europe, Romania also has a strong (petro) chemical industry, indicating high potentials for a bio-based chemical industry (Biobased Industries Consortium 2018a).

In the South-Eastern European countries Slovenia and Croatia, wood resources are also described as having high potentials. Due to the high share of forest in Slovenia (58,4%) and increasing growing stock and increment higher share of use of wood for bioenergy is expected (Langeveld, J. 2015). In Croatia, the available wood mass of about 19 million m<sup>3</sup> in the country's forests and the annual yield which amounts to about 344,000 m<sup>3</sup> of gross wood mass, are good grounds for further development of the wood processing industry (Koch et al. 2017).

### Current key sectors

In the Baltics, current key sectors of the bioeconomy are forestry and wood-based products, food and feed industry, bio-energy and biofuels (Vitunskienė et al. 2017, Klarlund 2016, Winther 2016)

Bioenergy and Biofuels are also key sectors in Hungary, reflected by several legislatives (The Hungarian Renewable Energy Utilisation Action Plan 2010-2020, The National Energy Strategy 2030, The Electricity Act 2007). Apart from renewable energy, green innovation and energy efficiency are mentioned as further important sectors (Barta 2014, NNFCC 2015, Langeveld, J. 2015).

Slovakia shows a strong growth in agriculture with several strong strategic industries (steel, automotive, IT, chemical, agrifoods, plastics) in the Kosice region (Vitunskienė et al. 2017, Biobased Industries Consortium 2017).

Poland is characterised by strong regional diversification, e.g. the Lodzkie region has a modern textiles and fashion industry (including design), power engineering, including renewable energy sources. In the Malopolska region, the focus is on circular economy sectors (biorefineries, biomass processing, waste re-use), organic synthesis, biotechnology (Winther 2016, Biobased Industries Consortium 2017)

In Romania, agriculture is the largest bioeconomy sector. However, according Biobased Industries Consortium 2018a, 30-40% of the agricultural land is owned by foreign investors. The fishing sector of Romania grew from 2010 to 2014 by 25% per year, forestry by 44.1% in total (Vitunskienė et al. 2017).

Fishing and aquaculture are also important sectors in Croatia and Bulgaria. In Croatia, the share of this sector in the GDP is 6.3 times higher than the European average. Further prominent sectors in Croatia are forestry, smart agriculture and bioenergy (Vitunskienė et al. 2017, Koch et al. 2017). Fishing in Bulgaria grew from 2010 to 2014 by 14% per year, manufacturing of food, beverages and tobacco by 27.9% in total (2010-2014) and the manufacturing by 21.2% (Vitunskienė et al. 2017).

Figure 31 shows a map of biorefineries in Europe. It highlights the lack of biorefineries in the BIOEAST macro-region.



# Biorefineries in Europe 2017

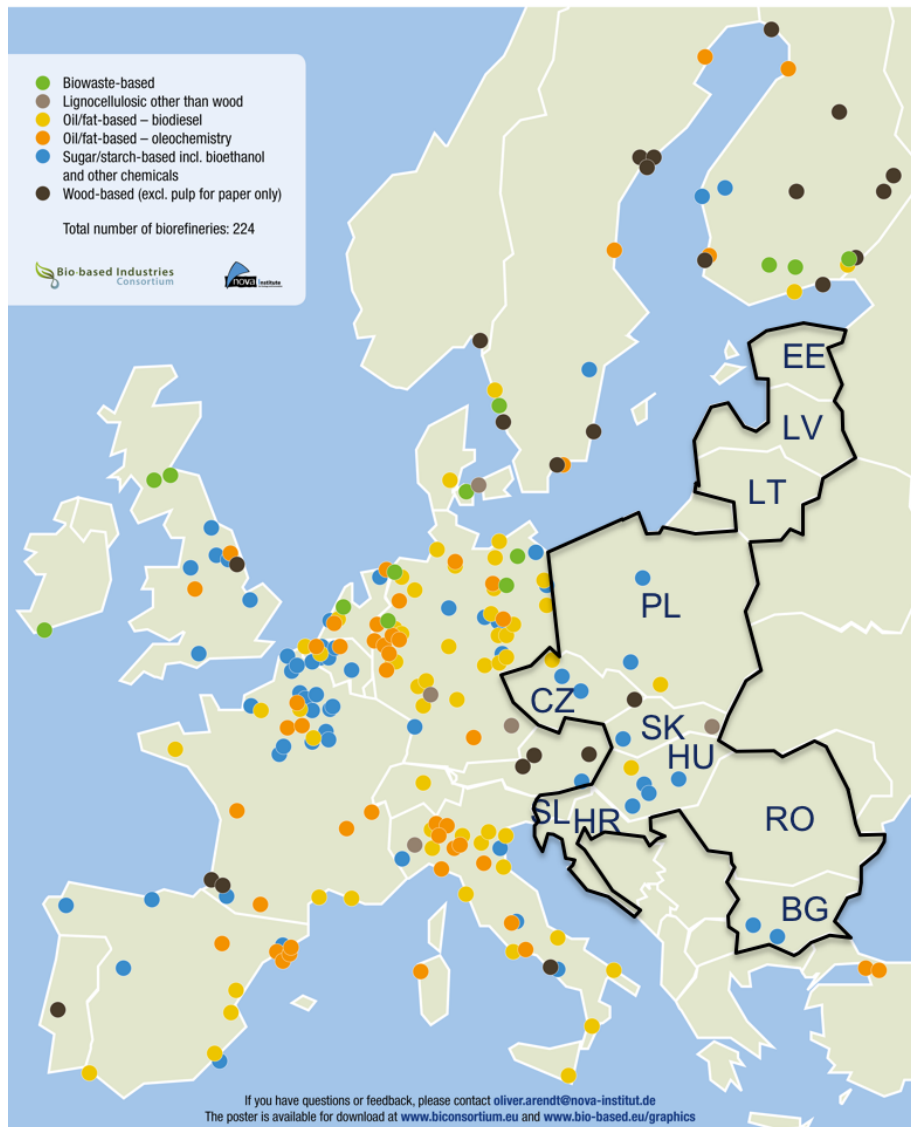


Figure 31: Biorefineries in Europe 2017  
Source: Biobased Industries Consortium 2018b

## Unused or underused sources of biomass

In several studies, residue and waste streams are listed as being underutilised. For example, even though Lithuania has one of the most modern biological waste treatment infrastructure in the EU, most of the waste end up with landfilling and there is no efficient biodegradable waste sorting collection system (Vitunskienė et al. 2017). Barta 2014 sees high potentials in Hungary in the better utilisation of by-product streams, sewage and waste (e.g. agricultural, municipal solid waste) as well as agricultural by-products (e.g. cosmetics: Oil, phospholipid, Vitamins).

Marine biomass is described as another underused source of biomass. The Latvian bioeconomy strategy lists exploring untapped marine bioresources such as sea grass, mussels and algae as a priority (German Bioeconomy Council, 2018). Also algae are mentioned in several studies as a potential new source of biomass. In both Poland and Romania, at least one company appears to produce algae-based products commercially (Biobased Industries Consortium 2018, Biobased Industries Consortium 2018a).

Apart from new sources of biomass, increasing productivity in agriculture and forestry is also described as a major issue, especially in Romania, due to missing equipment and insufficient roads (Biobased Industries Consortium 2018a)

### Key untapped (niche) sectors

In several studies, bio-based chemicals are regarded a product group with high potential. As Vitunskienė et al. 2017 point out, manufacture of bio-based pharmaceuticals in Lithuania is still a small but very rapidly developing, highly productive, knowledge-intensive partly bio-based manufacturing subsector. On the other hand, Vitunskienė et al. 2017 calculate that this subsector accounts for a very small share in turnover (0.3%) and GDP (0.4%) and thus its rapid development would have no significant impact on the development of Lithuanian bioeconomy.

As mentioned above, the strong petrochemical sector could play an important role in the transition towards a bio-based economy in Romania, if it could be managed to start (let alone increase) the uptake of bio-based resources for chemical purposes instead of only fossil ones. (Biobased Industries Consortium 2018a).

In Hungary, there are companies active in the energy, pharmaceutical and chemical sectors but, since it is not their main activity, their attitude towards bio-based products is unknown and efforts should be made to involve them (Barta 2014).

### Bioeconomy strategies and general developments

A recent overview by the European Commission's Bioeconomy Knowledge Centre shows that the Eastern European Member States largely lack dedicated national bioeconomy strategies (Figure 32). However, in several countries there are such strategies or related initiatives under development.

At the end of 2017, the Latvian government published a dedicated national bioeconomy strategy 2030 (LIBRA). Latvia is therefore currently the only country in the BIOEAST macro-region with such a strategy (see Figure 32). This strategy was developed in compliance with the Latvian Sustainable Development Strategy 2030 and the National Development Plan 2014-2020 and is also strongly aligned with the European Union's bioeconomy strategy of 2012 (German Bioeconomy Council 2018).

In Estonia, there is a national Bioeconomy Strategy under development. This strategy will aim to "create a strategic framework that connects the many different areas of bioeconomy with a view to fully utilise the value of the existing land and water resources; grow the welfare of the people; and support effective and environmentally friendly production and use of biomass" (Winther 2016).

In Lithuania, there is no dedicated bioeconomy strategy yet, but the National Industrial Biotechnology Development Programme (2007-10) and the Smart Specialization Programme linked to the country's "Innovation Development Programme" (2014–2020), which also features biotechnology as a key area (Winther 2016).

In Hungary, there is a dedicated bioeconomy strategy under development (NNFCC 2015). Bioeconomy related aspects are currently split between three ministries (Agriculture, National Economy and National Development). However, there is no up-to-date information available of the current state of the strategy's development.

In Poland, there is no dedicated bioeconomy strategy yet. However, the country's Smart Specialisation Strategy has strong linkages to the bioeconomy (healthy society, agro-food, forestry-timber and environmental bioeconomy, sustainable energy, natural resources and waste management, innovative technologies and industrial processes (in a horizontal approach) (Winther 2016).

In Slovenia, there is a number of national strategies in place that are linked to the bioeconomy. The 2014 Strategy of Agriculture implements the resolution on the strategic development of agriculture and agri-food sectors 2020 (Langeveld, J. 2015). Furthermore, the country's Smart Specialisation Strategy lists technologies for sustainable biomass transformation and new bio-based materials, technologies for use of secondary and raw-materials and reuse of waste and production of energy based on alternative sources as focus areas (Government Office for Development and European Cohesion Policy 2015).

In Croatia, an industrial strategy focuses on the food-processing industry and furniture industry as strategic activities. There is also a smart specialization strategy based on 5 thematic areas with one of them being the food and bio-economy (and the subtopics sustainable food production and processing and sustainable wood production and processing). Also in 2017, the Development strategy of the wood processing industry and furniture manufacturing of the Republic of Croatia 2017-2020 was adopted (Koch et al. 2017).

**Strategies and other policy initiatives dedicated to the bioeconomy in the EU Member States**  
[status as of March 2018]

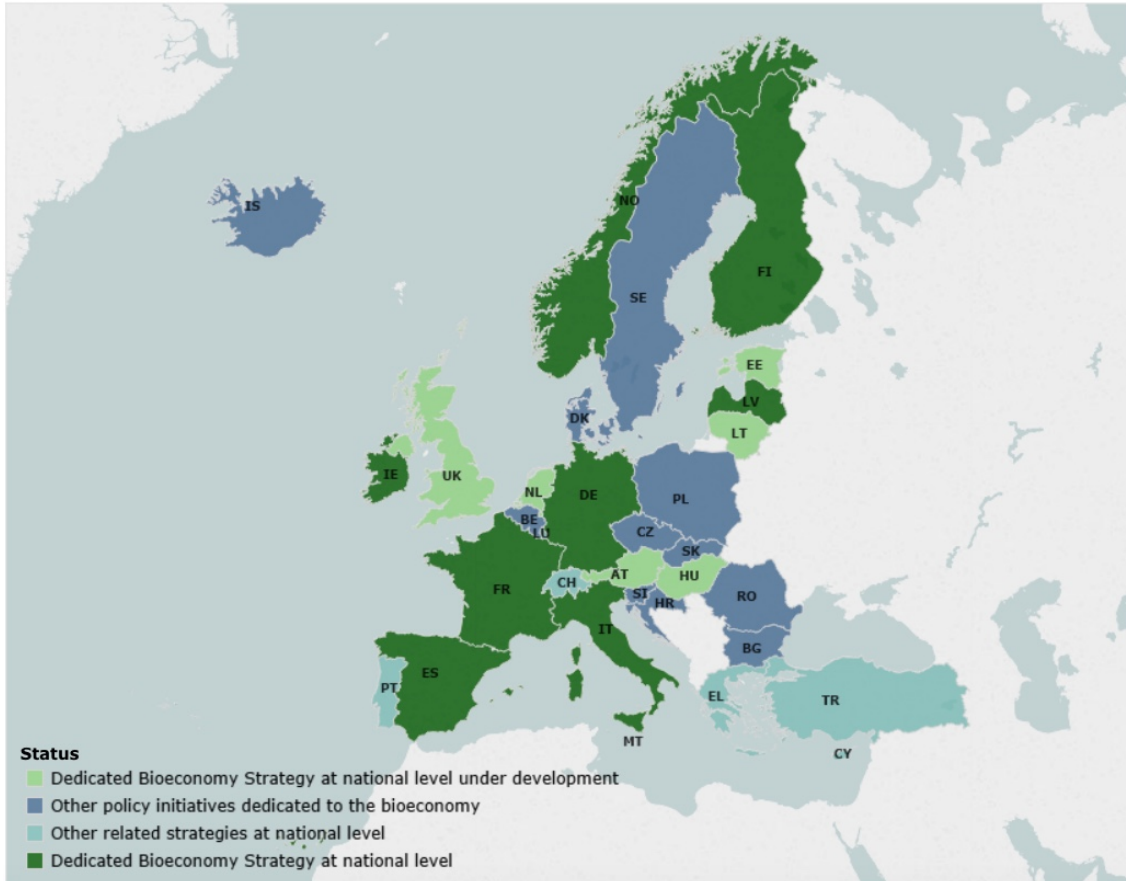


Figure 32: Strategies and other policy initiatives dedicated to the bioeconomy in the EU Member States  
Source: European Commission's Bioeconomy Knowledge Centre

### Summary of literature review

Overall, the literature review leaves an impression of the BIOEAST macro-region as a biomass-rich region, with traditionally high importance of primary sectors agriculture, forestry and fishery. Furthermore, the food industry and bioenergy and biofuels are important bioeconomy sectors in the whole macro-region. However, the unused or underutilised biomass potentials from side streams from the sectors are increasingly recognised. In all three sub-regions (Baltics, CEE and SEE), bio-based pharmaceuticals and chemicals are recognised as key sectors which are still small but highly productive.

Insufficient infrastructure, missing links between industries (e.g. between agriculture and the petro-chemical industry in Romania) and the regional abundance of fossil resources are main hurdles for the further development of a higher value bioeconomy.

## Conclusion and recommendations

This short study based on secondary sources and limited economic data can only give recommendations at a very high level of aggregation regarding the promotion of the bioeconomy in the BIOEAST Member States. In general, economic progress could be made in two different ways. As a first option, productivity could be increased in the primary sectors agriculture and forestry in order to close the yield gap and create more value from the same area.

The second option would be to shift the focus towards the secondary sector and establish a modern and sustainable manufacturing industry in the BIOEAST countries that will process bio-based resources – both virgin and from side-streams. This is generally considered more attractive from an economic perspective since further processing creates more value than providing primary resources.

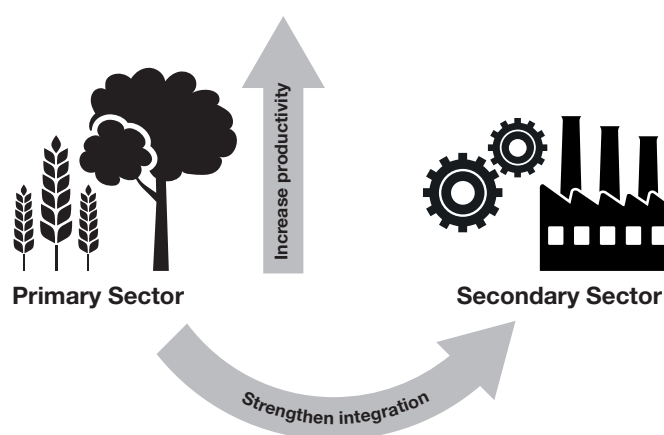


Figure 33: Priority areas for the further development of bioeconomies in the BIOEAST macro-region  
Source: Own representation

### Closing the yield gap

The study showed that the traditional sectors, which generate high employment but low turnover, dominate in the BIOEAST Member States' bioeconomies. Biomass is mainly processed in the food and feed industry or exported. The study also showed that there are underutilised potentials in biomass supply. First, there are persistent yield gaps in main agricultural crops compared to the rest of the EU-28. Increasing productivity in agriculture is therefore an important aspect which could also avoid conflicts between existing uses of biomass and new bio-based industries.

It is beyond the scope of this study to analyse the reasons for the existence of the yield gap and provide proposals for solutions. However, this issue is widely known and tackled in a plethora of publications and research projects, which was also shown by the fact that several presentations addressed it during the BIOEAST conference on 8 November 2018. Investments in infrastructure and technology must play a crucial role for sure to enable the Eastern European countries to catch up with Western EU Member States.

Assuming that there is willingness to invest in a sustainable bioeconomy, the current lack of infrastructure can be seen as an opportunity to make use of emerging technologies that can **make agriculture “smarter”**, thus reducing its negative impact on soil, water and biodiversity. Careful long-term planning of such developments could make a valuable contribution towards a sustainable bioeconomy that is equipped to deal with the challenges of the future.

### Establishing bioeconomy clusters

In order to make progress towards option two – shift the region's economic focus towards the secondary sector – it could be a realistic first step to promote the establishment of bioeconomy clusters. They could help to connect regional feedstock supply, existing industrial infrastructure, know-how and innovation potential and public support. This strategy of establishing bioeconomy clusters is also followed in Western European Member States. A few prominent examples are:

- the BioEconomy Cluster in Germany (<http://www.bioeconomy.de>)
- the Biobased Delta in the Netherlands (<https://biobaseddelta.com>)
- the BioVale Cluster in the UK (<https://www.biovale.org>)
- IAR – The French Bioeconomy Cluster (<https://www.iar-pole.com>)

These clusters focus on the regionally available types of biomass, so the identification of **regional biomass potentials** should be the first step in the formation of a new bioeconomy cluster. Furthermore, especially for the BioEconomy Cluster in East Germany, the existence of the petro-chemical site of Leuna, with a long tradition, was an important prerequisite for the formation of the cluster.

Clusters are also established in several of the BIOEAST Member States, at least, according to the available sources, in Poland, Slovakia and Romania. These clusters are, however, mainly focussed on the agri-food sector and bioenergy (Bioeconomy Cluster 2018, Biobased Industries Consortium 2018 and 2018a). As an example, the Slovakian Bioeconomy Cluster defines bioeconomy as the

“sustainable use of renewable biological resources to produce food, feed or energy. It is a cross-cutting industry which involves not only agriculture, food industry and forestry but also other sectors such as bioenergetics, eco-construction, paper industry, phytopharmaceutical industry, waste management, biotechnologies, biochemistry, biopolymers, etc.” (<http://bioeconomy.sk/en/>).

The potential of bio-based products for material uses is therefore recognised, but is not in the focus of the cluster activities. Possibly, there is therefore a lack of awareness of the potential value chains from biomass to products. The following Figure 34 highlights the large number of possible value chains and could serve as a starting point for defining the scope of regional bioeconomy clusters.



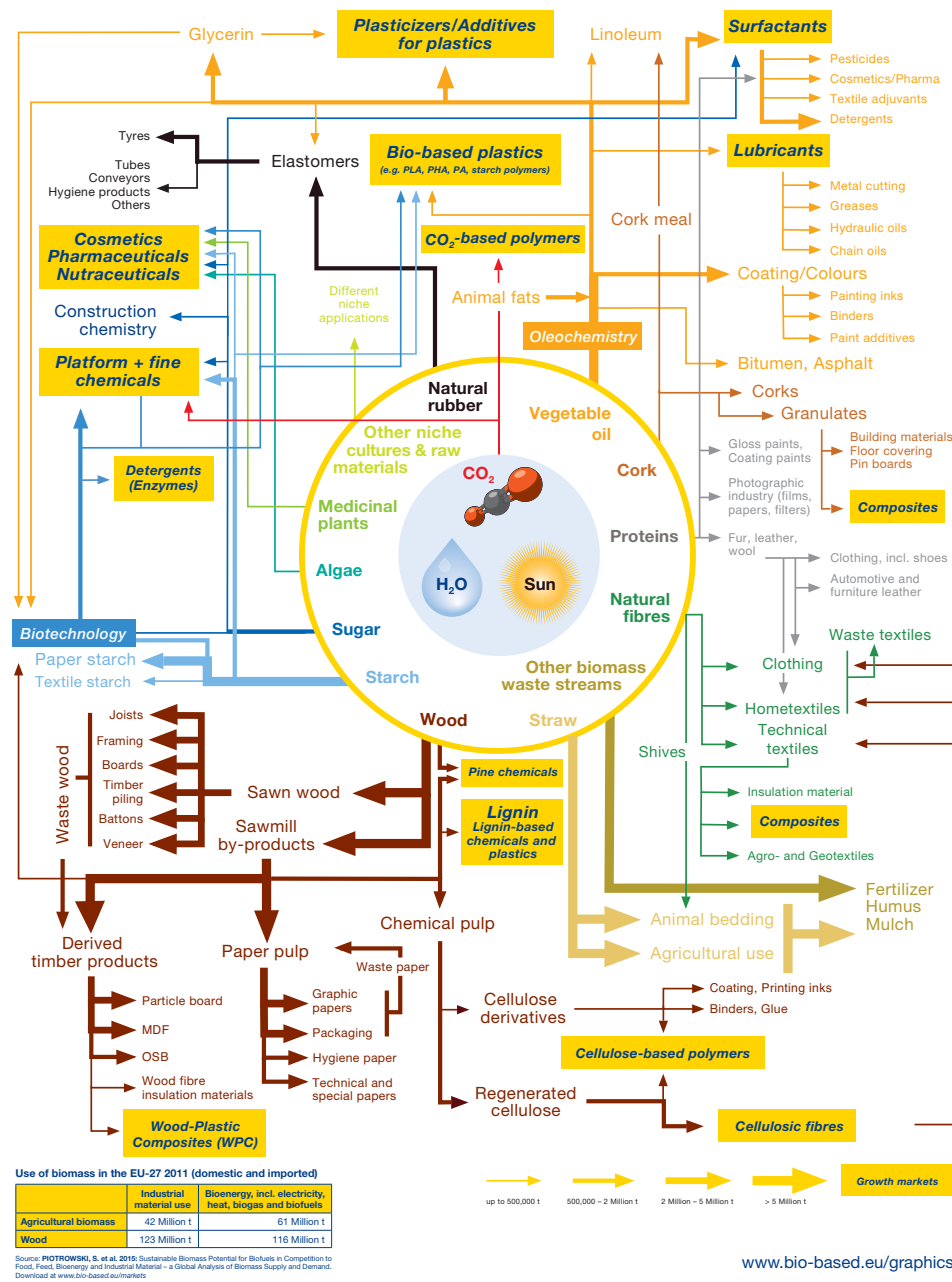


Figure 34: Industrial material use of biomass in Europe 2015  
 Source: nova-Institut GmbH 2015

In order to strengthen integration also with higher value-adding industries, it would be necessary to go beyond established structures, **create new networks** and find **convincing business cases**. The BIC country study on Romania (BIC 2018a) stresses that **existing petrochemical industry infrastructures** can play a role to bolster bio-based manufacturing if it can be managed to encourage the uptake of bio-based resources instead of fossil ones. However, the abundance of fossil resources creates a significant burden for such a shift of resource use at least in a number of Eastern European countries. Strong **political will** would be necessary to implement such a shift.

Especially **training of qualified personnel** will also be essential in a second step to enable potential clusters to fulfil the innovative role which is often attributed to them.

The following Figure 35 illustrates the framework of the Innovation Ecosystem Stakeholder Model which the MIT Regional Entrepreneurship Acceleration Program developed in order to highlight that the five depicted stakeholder groups must collaborate to build-up successful regional innovations. This framework could serve as a model to develop new regional bioeconomy clusters.



Figure 35: The Innovation Ecosystem Stakeholder Model  
Source: MIT REAP 2018

### Tapping into underutilised resources: residues and waste streams

Residue and waste streams are reported to be underutilised in the BIOEAST Member States; at least as far as the limited number of sources allows to draw generalised conclusions. Recovery rates of selected bio-based wastes (wood, paper and cardboard and animal and mixed vegetal/food waste) are markedly lower in some of the BIOEAST Member States than in the rest of the EU-28. Increasing these recovery rates would increase resource efficiency and the supply of biomass to bio-based industries. However, it needs to be kept in mind that the abundance of agricultural and forest resources is often a negative influence with regard to recycling and not a positive one. As long as it is economically more viable to use virgin resources than to recycle them, resource efficiency is not key for many stakeholders. A case study on wood cascading in Poland carried out in 2015 for the Worldwide Fund for Nature (WWF) described the following situation:

Poland is rich in forest resources, with the majority of the forest area being economically exploited. In 2009, the volume of timber removals amounted to approximately 34 million m<sup>3</sup> with an additional 1.93 million m<sup>3</sup> slash being removed. This makes Poland attractive as a location for wood-based industries, but gives little incentive for a repeated use of the resource, i.e. through increasing the cascading use. Furthermore, Poland relies heavily on co-firing of wood resources in coal plants for its renewable energy production, creating a strong market distortion allocating wood to the energy sector. This means that even the first stage of a cascade is never reached for a significant amount of wood materials. It should be noted that high-grade wood is excluded from the co-firing (under criminal

liability) except for small-scale installations, which is positive in terms of cascading use. The verification of the origin of wood resources proves quite difficult in Poland, though.

In terms of recycling, the data basis is quite weak. Vague estimations for a recycling quota of wood products range between 0% and 10%. However, the transposition of the EU waste directive has only recently taken place, establishing a collection system for solid wastes only in 2013. Attitude and perception towards recycling is slowly changing as a result, and research is done by different actors. This might constitute a promoting factor for increased cascading use of wood, but effects need to be seen. (Dammer et al. 2015)

As the report mentions, it needs to be seen how the Waste Directive as well as the recently increased recycling quotas stemming from the Circular Economy initiative will be transposed into national law, and then how effectively national law will be implemented.

Another aspect is the utilisation of side streams or residues that are incurred for example in forest or food industries, which exist plenty in the BIOEAST Member States. Interesting instances of such usages are textile fibres made from waste milk protein, surfactants or solvents made from citrus peels or wood composite materials made from shavings of the forest industries. To tap into the existing potentials, it is necessary – again – to interconnect different industries and come up with innovative business cases, as was described in the paragraphs on bioeconomy clusters above.

All of the measures described require smart policy planning, political will and investment into the sustainable future of the BIOEAST countries' bioeconomies.

## References

- Barta, Z. et al. 2014: The future landscapes of bioeconomy: Hungary.
- Biobased Industries Consortium 2017: Bioeconomy Regions in Europe.
- Biobased Industries Consortium 2018: Mapping the Potential of Poland for the Bio-based Industry.
- Biobased Industries Consortium 2018a: Mapping the Potential of Romania for the Bio-based Industry.
- Biobased Industries Consortium 2018b: Biorefineries in Europe 2017, [https://biconsortium.eu/sites/biconsortium.eu/files/downloads/MappingBiorefineriesAppendix\\_171219.pdf](https://biconsortium.eu/sites/biconsortium.eu/files/downloads/MappingBiorefineriesAppendix_171219.pdf).
- Bioeconomy Cluster 2018: Basic information, <http://bioeconomy.sk/en/>.
- Carus M. and Dammer L. 2018: The "Circular Bioeconomy" – Concepts, Opportunities and Limitations, Hürth 2018-01. Available online at [www.bio-based.eu/nova-papers](http://www.bio-based.eu/nova-papers).
- Dammer, L., Bowyer, C., Breitmayer, E., Eder, A., Nanni, S., Allen, B., Carus, M., Essel, R. 2015: Mapping Study on Cascading Use of Wood Products. Final Report for Worldwide Fund for Nature (WWF) and Mondi. Hürth 2015.
- German Bioeconomy Council, 2018: Bioeconomy Policy (Part III), <http://biooekonomierat.de/fileadmin/Publikationen/berichte/>.
- Government Office for Development and European Cohesion Policy (Ed.) 2015. Slovenia's smart specialisation strategy: S4. Ljubljana: Government Office for Development and European Cohesion Policy.
- Gurría, P., Ronzon, T., Tamosiunas, S., López, R., García Condado, S., Guillén, J., Cazzaniga, N. E., Jonsson, R., Banja, M., Fiore, G., M'Barek R. 2017: Biomass flows in the European Union: The Sankey Biomass diagram - towards a cross-set integration of biomass, <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106502/kjna28565enn.pdf>.
- Klarlund, H. 2016: Realising the Bioeconomy in the Baltic Sea Region.
- Koch, B. et al. 2017: Local Action Plan for Competence Center - Wood Sector.
- Langeveld, J. 2015: Results of the JRC-SCAR Bioeconomy Survey.
- MIT REAP 2018: Overview - MIT REAP: Achieving Economic Growth Through Innovation-Driven Entrepreneurship, [http://reap.mit.edu/assets/MITREAP\\_Overview\\_03.08.2018.pdf](http://reap.mit.edu/assets/MITREAP_Overview_03.08.2018.pdf).
- NNFCC 2015: Bioeconomy Factsheet Hungary.
- Piotrowski, S., Carus, M. und Carrez, D. 2018: European Bioeconomy in Figures 2008 – 2015, [https://biconsortium.eu/sites/biconsortium.eu/files/documents/European\\_Bioeconomy\\_in\\_Figures\\_2008-2015\\_06042018.pdf](https://biconsortium.eu/sites/biconsortium.eu/files/documents/European_Bioeconomy_in_Figures_2008-2015_06042018.pdf).
- Reisinger, H., van Acoleyen, M., O'Connor, C., Hestin, M., Laureysens, I., Morton, G., Dolley, P., Nelen, D., Vanderreydt, I. 2011: Evolution of (Bio-) waste generation/prevention and (bio-) waste prevention indicators, Final Report,

September 16<sup>th</sup>, 2011,

[http://ec.europa.eu/environment/waste/prevention/pdf/SR1008\\_FinalReport.pdf](http://ec.europa.eu/environment/waste/prevention/pdf/SR1008_FinalReport.pdf).

Vitunskienė, V. et al. 2017: Lithuanian Bioeconomy Development Feasibility Study.

Winther, T. 2016: Bioeconomy Strategies and Policies in the Baltic Sea Region Countries.

