

BIOECONOMY CONCEPT PAPER

EXECUTIVE SUMMARY



LITHUANIA



EXECUTIVE SUMMARY OF THE STRATEGIC CONCEPT PAPER FOR BIOECONOMY: LITHUANIA

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Executive summary

1.1. Context and objectives

The European Commission defines the bioeconomy as an economy that “encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy” (2012). This definition is used as the official one in Lithuania.

The main goal is to develop a conceptual basis for the preparation of a national bioeconomy strategy and/or action plan to initiate a deeper discussion about the strategically oriented development of a knowledge-based circular bioeconomy in Lithuania. The analysis of policies and institutions related to the bioeconomy, the state of the bioeconomy, the synergy of its sectors, and the methods and factors of transformation was performed. The concept foresees intervention needs and strategic directions in bioeconomy sectors important for the country, such as the production of biological resources and food, biogas and biofuels. The concept document was prepared by the scientists of Vytautas Magnus University, based on the analysis of various information sources, studies and documents, as well as the SWOT analysis of niche bioeconomy sectors and expert assessments.

1.2. Main findings

1.2.1. Strategies / policies and institutions related to bioeconomy

Lithuania does not have a national bioeconomy strategy and none of them has action plan, despite its high biomass resource base and modern biorefining potential in many cases, as revealed in both studies Lithuanian Bioeconomy Development Feasibility Study (2017) and Strategic Provisions of Lithuanian Bioeconomy (2019). However, there are regulations, developmental targets and priorities that directly and implicitly touch upon the topics of bioeconomy and are encompassed in several national strategies and policies that serve as a general support for bioeconomy development in Lithuania.

In the Lithuanian National CAP Strategic Plan (2022), the necessity to pay special attention to the production of goods with high added value using biomass is identified. Strategic priorities included in the Comprehensive Plan of the Territory of the Republic of Lithuania (2021) cover sustainable economy, resource efficiency, sustainable use of resources, renewable energy sources, climate change mitigation, efficient use of the recreational potential of natural areas and other topics. In the National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030 (2019), it is planned that by 2030, biofuel will account for 9% and biogas for 2% of electricity production; also, reorientation of biogas power plants to biomethane gas production and supply of this gas to networks is provided. In the heating sector, the main part will be the heat energy produced from local biofuels. It is planned to reduce GHG emissions in the agricultural sector by 9% in 2021-2030 period. In the LULUCF sector, a lot of attention will be paid to the absorption of GHG in the perennial crop biomass by afforestation and promotion of perennial crop production on agricultural land. In the Lithuanian Concept of Scientific Research and Experimental Development and Innovation (Smart Specialization) (2022), the first and second R&D priorities include several topics directly related to bioeconomy, such as safe food and sustainable agrobiological resources, molecular technologies for medicine and biophar-

macy, advanced materials and structures, renewable energy resources, and flexible technology for product development, production and process management and design. There are other documents related to bioeconomy in Lithuania, such as the National Energy Independence Strategy (2018), the White Paper on Lithuanian Regional Policy (2017), and the Programme of the Eighteenth Government of the Republic of Lithuania (2020).

The Ministries of Agriculture and Environment mainly support the primary sectors of the bioeconomy (i.e. agriculture and fisheries, and forestry respectively). Moreover, the Ministry of Agriculture also supports the food manufacturing sector and the Ministry of Environment supports the biowaste management sector. The Ministry of Energy mainly supports the energy sector, including bioenergy. Certain functions of policy-making in bioenergy are also carried out by the Ministry of Agriculture. The Ministry of the Economy and Innovation mainly supports (as a part of policy-making) other bioeconomy sectors. Ministries such as the Ministry of Education, Science and Sport and the Ministry of the Economy and Innovation mainly support (as a policy-making) the bioeconomy related RDI. The Ministry of Agriculture is the coordinating institution of bioeconomy policy in Lithuania.

In Lithuania, many research institutes and universities actively support bioeconomy development by conducting bioeconomy related research projects. Such research institutes are: Lithuanian Research Centre for Agriculture and Forestry, Institute of Economics and Rural Development of the Lithuanian Centre for Social Sciences, Lithuanian Energy Institute, Nature Research Centre, Centre for Innovative Medicine and universities: Vytautas Magnus University (Agriculture Academy, Faculty of Natural Sciences), Vilnius University (Life Sciences Centre), Kaunas University of Technology (Biomedical Engineering Institute Food Institute, Institute of Mechatronics), Gediminas Technical University (Research Institute of Building Materials), Klaipėda University (Marine Research Institute), Lithuanian University of Health Sciences (Veterinary Academy). Also, there are private RDI institutions specialised in the bioeconomy in Lithuania, namely: “Thermo Fisher Scientific Baltics”, “Teva Baltics”, “Biotechpharma”. Enabling RDI Institutions related to bioeconomy in Lithuania: Nemunas Valley, Santara Valley, Santaka Valley, Marine Valley, “Open R&D Lithuania” network.

In Lithuania, there are few enabling institutions specialised in financial services for bioeconomy or bioeconomy related sectors in Lithuania: JSC “Agricultural Credit Guarantee Fund”, The Agency for Science, Innovation and Technology, Innovation Agency Lithuania, Research Council of Lithuania, INVEGA, Environmental projects Management Agency; “Livonia Partners” and “BaltCap” (private equity funds); “LitCapital”, “Business Angels Fund I”, “Practica Capital” (risk equity funds). Agriculture is the most supported sector of bioeconomy in Lithuania. It is highly dependent on the founding of Common agriculture policy, i.e., on the funding of the European agricultural guarantee fund and the European fund for rural development.

In Lithuania, a lot of attention is paid to bioeconomy related cluster development. Clusters first appeared in Lithuania several decades ago, but the pace of clusterisation increased dramatically during the period 2010–2015, with the implementation of EU financial instruments supporting their development. Clusters specialised in the bioeconomy in Lithuania: Smart Food Cluster, National Food Cluster, Alliance of Baltic Beverage Industry, Lithuanian prefabricated wooden house cluster – “PrefabLT”, Biopower Plant Development Cluster, Life Sciences Digital Innovation Hub Cluster, “Food Technologies Digitalization LT”, “InnoTekstil”, “Baltic Furniture Cluster”, “ECO Homestead Cluster”, “Cleantech Cluster Lithuania”.

1.2.2. Current state of the bioeconomy

Lithuanian bioeconomy generated about EUR 3.6 billion of value added, EUR 12.5 billion turnover, and employed around 186 thousand people in 2019. In the last decade, the share of the bioeconomy in Lithuania's GDP increased from 6.8 to 7.5%, meanwhile decreased in the labour market (from 16 to 13%) and in the overall turnover of non-financial corporations including agriculture (from 14 to 12%) as well. The agriculture, manufacture of food, beverages and tobacco and the manufacture of wood products and bio-based furniture are largest bioeconomy industries, altogether generating about 78% of the total value added and 82% of the total turnover in Lithuanian bioeconomy. These three industries provide 84% of the total employment in the Lithuania's bioeconomy (Figure 1).

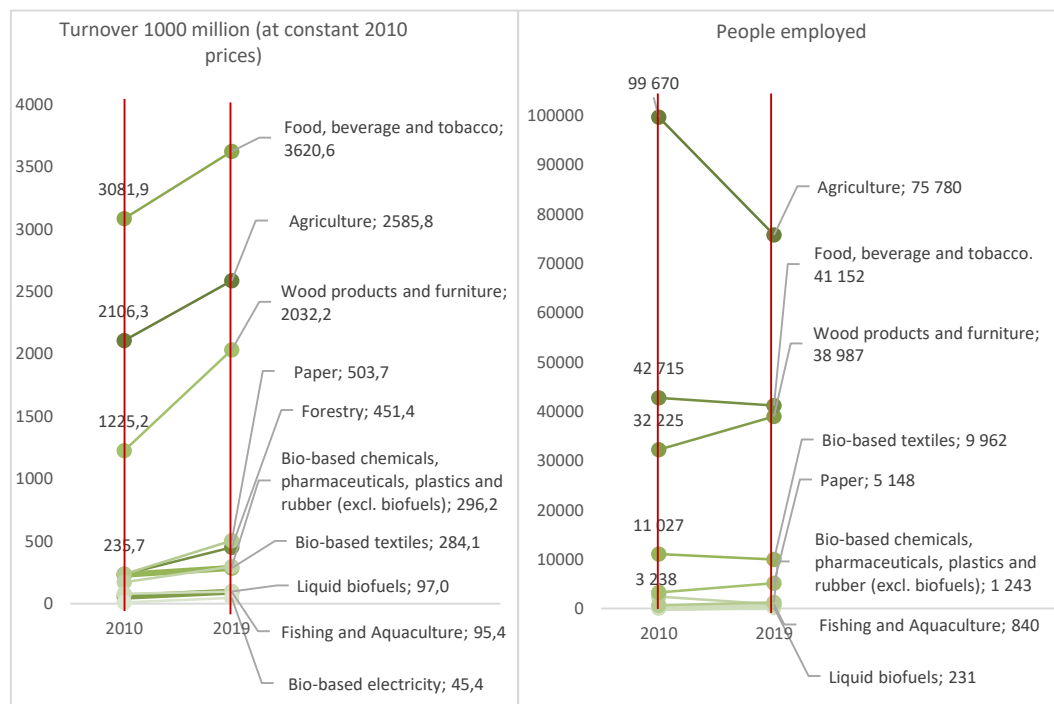


Figure 1: Current state of bioeconomy

1.2.3. Synergies among bioeconomy sectors

Synergies among different bioeconomy related sectors vary in Lithuania. The strongest synergies are observed among the following bioeconomy related sectors: agriculture and food products and beverages industries; agriculture and renewable energy sectors; agriculture and organic waste management sectors; forestry and wood and wood products sectors. Slightly less strong synergies may be noticeable among these Lithuanian sectors: wood and wood products and renewable energy sectors; agriculture and green care, nature tourism and recreation sectors; food products and beverages; organic waste management sectors; renewable energy and organic waste management sectors; renewable energy and forestry sectors. Synergies are detectable as very weak among these Lithuanian sectors: organic waste management and wood and wood products sectors; paper and paper products and rubber and plastic sectors, etc.

The main strengths of Lithuania's bioeconomy RDI are the life sciences industries such as developed R&D, rapid medium-term growth of business activity in R&D and growing SME participation in Horizon 2020, etc. However, there are a lot of weaknesses. Most of them are related to the lack of funding and high Lithuania's R&D dependence on European Structural

and Investment Funds, very low business RDI activity, etc. The main opportunities of Lithuania's bioeconomy related research and innovation are incompletely exploited high potential to produce biological resources and emerging consumer awareness and demand for bio-based products from bioeconomy, opportunities to benefit further from Horizon Europe, etc. Also, there are threats, such as the limited ability to finance innovations from national budget, the drain of talented and highly qualified employees from Lithuania, not existing national single strategy of bioeconomy development.

By nature, the bioeconomy encompasses many sectors and therefore offers a unique opportunity to achieve sustainable economic growth and to fully address interdependent societal challenges such as food security, lack of natural resources, dependence on fossil resources and climate change. In cross-sectoral policies, complex task interconnections can lead to disagreements, for example, on alternative uses of biomass. In other sectors, the rising demand for biological resources may interfere with food security, as well as raise environmental concerns. Priority is given to the consistency of the political framework and it is emphasised that only a strategic and comprehensive approach covering a wide range of policy areas is appropriate for multidimensional issues. The importance of better communication with the public is also emphasised.

1.2.4. Transformation pathways in the bioeconomy

Transformation processes can be triggered by the interaction of driving forces like increase of global population, rapid depletion of many resources, increase of environmental pressures and climate, change and technological innovation, or by political or social action. The bioeconomic transformation in Lithuania can proceed along few paths with different possible effects. Based on the assessment of experts, in the production of biofuels, wood fuel and wood waste for fuel are the main sources of primary energy in Lithuania since 2010. Firewood and wood waste in Lithuania are the main sources of renewable energy. Among the primary sectors in Lithuania, the biomass flows of the forestry sector can offer the most relevant potential for advanced energy use (biofuels, biogas, green electricity). Boosting primary sector productivity is very relevant transformation pathway in Lithuanian textiles, wearing apparel and leather sector and the manufacture of wood and wood products. New and more efficient biomass use is relevant transformation pathway in Lithuanian agriculture, the manufacture of food products and beverages, manufacture of textiles, wearing apparel and leather, manufacture of wood and wood products, pharmaceutical products sector, and sector of renewable energy. Low bulk / high-value applications are relevant transformation pathway in the majority of primary and manufacturing sectors in Lithuania. Valorisation of Ecosystem services is relevant pathway in all primary production and other bioeconomy related sectors (renewable energy, organic waste management, and green care, nature tourism and recreation). In Lithuania, the development of multifunctional ecosystem services must become the basis for agricultural development.

1.2.5. Key assets affecting the development of bioeconomy

The relevance of the assets that describe the qualitative aspects of bioeconomy potential / play key roles in the transition to the bioeconomy and their interactions are assessed in primary, manufacturing and other bioeconomy related sectors in Lithuania. Based on the assessment of experts, biomass availability is relevant asset in the sectors of agriculture and forestry. Biomass availability in Lithuania represents the most important and relevant asset for the development of bioeconomy. The efficiency of infrastructure/logistics is relevant asset in the sectors of agriculture, manufacture of wood and wood products, and renewable energy sector. The

presence of strong 'conventional' bioeconomy-related industries is a relevant asset in the manufacturing sector of wood and wood products. Slightly less relevant is this asset's role in the sectors of forestry, the manufacture of food products and beverages, the manufacture of pharmaceutical products, as well as in the sectors of construction and renewable energy in Lithuania. The level of business consolidation is the most relevant in the manufacture of pharmaceuticals in Lithuania. Slightly less relevant asset for the level of business consolidation is in the forestry sector, the manufacture of food products and beverages, the manufacture of wood and wood products, the manufacture of paper and paper products, the machinery and equipment sector, and the renewable energy sector. Emerging industrial initiatives that actively develop circular bioeconomy technological solutions and business models, for bio-based transformations are very relevant in the manufacture of pharmaceuticals and relevant in the sectors of agriculture, forestry, fisheries and aquaculture, the manufacture of food products and beverages, manufacture of wood and wood products, construction sector, renewable energy sector, and organic waste management sector. Policy commitment and availability of public funding for supporting bioeconomy-oriented projects is a relevant asset in agriculture and the manufacture of wood and wood products in Lithuania. The relevancy of the presence and engagement of national research & higher-education institutions are observed in all sectors in Lithuania. However, the relevancy of research engagement is more noticeable in the agriculture, and manufacturing sectors of food products and beverages, pharmaceuticals, and chemicals sectors. The presence of various actors engaged in innovation transfer, digitalisation and commercialization is more detectable in the sectors of the manufacture of textiles, wearing apparel and leather, chemicals and chemical products, and pharmaceuticals.

1.3. SWOT analysis of Lithuanian biological resources production and food sectors

The identified driving factors and barriers in the internal or external environment for each one of the promising bio-based niches/sectors are considered so that to populate the Strength, Weaknesses, Opportunities, and Threats (SWOT) matrix. To exploit such analysis for strategy formation all conceivable combinations of its external and internal SWOT factors set up a conceptual framework for situational analysis to build potential strategies to effectively and efficiently pursue the objectives. Finally, we can attribute priorities to the strategic directions for action. The main strengths, weaknesses, opportunities, and threats in the production of biological resources and manufacture of food in Lithuania are represented in the Table 1.

Table 1: **Main strengths, weaknesses, opportunities, and threats in the production of biological resources and manufacture of food in Lithuania**

STRENGTHS	WEAKNESSES
<ol style="list-style-type: none"> 1. High potential of biological resource extraction/production. 2. Rapid growth of biological materials consumption in the country's economy. 3. Forests, meadows, pasture and permanent grasslands – main GHG absorbent. 4. Organic farming and other environmentally and climate friendly farming methods. 5. Developed export of food products. 	<ol style="list-style-type: none"> 1. Unbalanced extraction / production of biological resources that does not meet domestic needs. 2. The bioenergy sector is developing rapidly but is still not modern and underdeveloped. 3. Agriculture is the main source of GHG emissions in the bioeconomy. 4. Soil degradation. 5. The trend of changes in the structure of cereals and permanent grasslands is unfavorable for ecosystems. 6. Irrational use of synthetic fertilizers, especially nitrogen fertilizers and plant protection products, excess nitrogen balance in soil. 7. Low level of application of the circularity principle, in particular for the production of higher value-added products from manure, slurry, other plant and animal waste. 8. Undeveloped economic cooperation and clustering in bioeconomy sectors.
OPPORTUNITIES	THREATS
<ol style="list-style-type: none"> 1. Growth of agriculture, fisheries and food, feed, biogas and biofuels consumption in the world. 2. Standard of living convergence among countries. 3. Enabling EU bioeconomy policy provisions. 4. Tight links between EU CAP 2021–2027 and bioeconomy. 5. Existing science institutions and science infrastructure for carrying out bioeconomy related projects. 6. Strengthening social partnerships in Lithuania's rural areas. 	<ol style="list-style-type: none"> 1. Global warming and other negative consequences of climate change. 2. Intensifying competition in the markets for bioeconomy products (as the center of gravity of the world economy shifts to Asia). 3. Decline in working age population in Lithuania (both in cities and rural areas). 4. Disturbances in training of specialists and skilled workers for bioeconomy sectors. 5. Low level of scientific research commercialization.

Source: Strategic Provisions of Lithuanian Bioeconomy, 2019

Taking into account the results of SWOT analysis in Lithuanian production of biological resources and food sectors, the following strategic directions of the intervention in this sector have been distinguished:

1. First direction

Strategically orientate the development of the biological resources production and food sectors. For this purpose, it is necessary to continuously guide the sectors on the basis of flexible partnership, public discussions and consultation of interested parties.

2. Second direction

Promote the creation of a competitive environment for business development. It is a direction that combines the efforts of the state government to create the most favourable environment for the biological resources production and the food business development under competitive conditions.

3. **Third direction**

Promote the production of biological resources and products with higher added value, the implementation of innovative technologies and business models, the prevention, reuse, recycling and use of biological waste. It is a direction that combines various financial and other support measures for farmers, forest users, and entrepreneurs, aimed at making the latter combine their private goals with public interests.

4. **Fourth direction**

Develop education, training and scientific research in the field of bioeconomy. Taking into account the fact that biotechnology and other innovations based on scientific achievements are of decisive importance in the further development, as well as competences and society's global understanding of the significance and principles of bioeconomy, state government incentive measures for the development of education, training and scientific research are allocated to a separate direction.

1.4. SWOT analysis of Lithuanian biogas sector

The main strengths, weaknesses, opportunities, and threats in the biogas sector of Lithuania are represented in the Table 2.

Table 2: **Main strengths, weaknesses, opportunities, and threats in the biogas sector of Lithuania**

STRENGTHS	WEAKNESSES
<ol style="list-style-type: none"> 1. High potential of sewage, agricultural, municipal, and industrial waste that is suitable for biogas production. 2. Acceleration of biogas production adoption in wastewater treatment plants, large pig farms. 3. Implementation of administrative instruments for the recognition of guarantees of origin for green gas (National Register of Guarantees of Origin for Gas Produced from RES; Accounting System for Fuels from Renewable Energy Sources). 4. Biogas production from plant waste, manure and slurry follows the principles of a circular economy and reduces GHG emissions. 5. The country's biogas production equipment industry is growing, providing biogas power plants and biogas purification (biomethane production) equipment to the market. 6. A Biopower Plants Development Cluster operates in the country, uniting business, agricultural sector companies, research, and study institutions for the development of biomethane production technologies and the dissemination of information in society. 	<ol style="list-style-type: none"> 1. In terms of biogas production capacity, Lithuania is lagging country in the EU. 2. No production of biogas on livestock farms, underdeveloped production of biogas from poultry manure. 3. Due to large investments, farmers and agricultural enterprises have no interest in adopting and developing biogas production. 4. Infrastructure for the supply of biogas to natural gas networks is underdeveloped. Produced biogas is used exclusively for producers' internal needs (electricity and heat production). 5. The collection and use of food waste from the population for biogas production is underdeveloped. 6. The conditions for receiving state support do not always meet the technical possibilities of efficient biogas production and the expectations of potential biogas producers. 7. The scepticism of local communities towards the construction of new biogas plants is still evident.
OPPORTUNITIES	THREATS
<ol style="list-style-type: none"> 1. The rise in the price of natural gas and other fossil fuels, as well as the increase in CO2 emissions, increase the economic attractiveness of biogas production and the development of the sector. 2. Large amounts of agricultural waste for the rapid development of biogas production. Possibility to produce biogas from biomass waste not used for food and feed (meadow grass, cereal straw, etc.). 3. EU (and Lithuanian) Green Deal policy and its strategic decisions on reduction of dependence on fossil fuels, development of RES, including biogas. 4. Grants and other financial support for the development of biogas production from EU and national funding sources. 5. Wider opportunities for the use of biogas (for the decarbonisation of the transport sector; trade in international markets, etc.). 6. EU (and Lithuanian) policy on food waste reduction and strategic decisions on its use in biogas production. 	<ol style="list-style-type: none"> 1. The declining scale of agriculture in the country, especially livestock farming, may adversely affect the potential of a raw material suitable for biogas production. 2. Limited opportunities to develop biomethane supply systems to natural gas supply networks (infrastructure). Limited number of suitable sites to connect biomethane production facilities. 3. Potentially increasing competition with other RES production methods, as well as biogas imports from other European countries. 4. Lack of opportunities for cooperation and community interaction in organizing the supply of biogas power plants with raw materials, developing local biogas use systems, collecting waste from the small farms prevailing in the country. 5. Threats to the establishment of stable and effective state support for the development of biogas production and consumption.

Taking into account the results of the SWOT analysis in Lithuanian biogas production sector, the following strategic directions for the intervention in this sector have been identified:

1. **First direction**

Provide state financial support for the investments of farmers, agricultural companies, and other companies in biogas power plants, biomethane purification and conversion into heat and electricity capacities. When providing investment support, it is appropriate to give priority to commercial biomethane production, as well as to biogas power plants cooperatively supplied with raw materials from surrounding small farms or integrated into local biogas utilization systems.

2. **Second direction**

Develop biomethane supply infrastructure by adapting natural gas networks for biomethane transmission, enabling biomethane producers to connect to the networks. Potential connections to natural gas networks and expanded biomethane sales opportunities must be inventoried and expanded.

3. **Third direction**

Provide state financial support to municipalities and communities to establish systems for food waste collection and use for biogas production. When providing support, it is appropriate to give priority to integrated biogas production systems that include the use of not only food but also biomass waste of other origins.

4. **Fourth direction**

Provide support for information dissemination, training, and consulting projects aimed at improving community awareness of the biogas benefits, its production technologies and local systems, environmental impact, and other important aspects of biogas production and consumption.

1.5. SWOT analysis of Lithuanian biofuels sector

The main strengths, weaknesses, opportunities, and threats in Lithuanian biofuels sector are represented in the Table 3.

Table 3: **Main strengths, weaknesses, opportunities, and threats in Lithuanian biofuels sector**

STRENGTHS	WEAKNESSES
<ol style="list-style-type: none"> 1. The great potential of the country's biological resources and its improving use for biomass extraction, especially in agriculture. 2. Long-standing traditions of grain and rapeseed cultivation, application of innovative technologies and increasing productivity. 3. Developed industry and acquired experience in the production of biofuels from agricultural raw materials (starchy and oilseed products that can be used for food and feed). 4. Implemented legal framework for biofuels production and consumption in line with EU legislation and methodology for biodiesel quality assessment. 5. The biofuels industry has the potential to meet the country's domestic needs for biofuels as an additive to fossil fuels and to increase their exports to European countries. 6. Technologies used in the production of biofuels from agricultural raw materials are based on the principles of a circular economy and are environmentally friendly. 7. High potential for waste and residues suitable for the production of advanced biofuels. 	<ol style="list-style-type: none"> 1. "Attachment" to the production of biofuels from agricultural raw materials. Relatively low investment in the production of advanced biofuels. 2. Biofuels production is export-oriented and poorly adapted to produce more advanced biofuels for the country's domestic needs. 3. The rapid increase in cereal production volumes, including for biofuels production, is inharmonious. 4. According to the market price, the competitiveness of Lithuanian biofuels in terms of fossil fuels and palm oil is low.
OPPORTUNITIES	THREATS
<ol style="list-style-type: none"> 1. EU and national legislation promotes the transition from agricultural feedstocks to the use of biowaste and residues in biofuels production by supporting advanced biofuels producers and research. 2. Increasing use of animal fats, used oils and cooking oils and other food waste, as well as algae in the production of advanced biofuels. 3. Rapid development of research into advanced biofuels feedstocks, production and use technologies. 4. International agreements, EU (and Lithuanian) strategic decisions on mitigation of climate change may lead to restrictions on the use of palm oil and other environmentally unfriendly biofuels. 5. Opportunities for local biofuels production to meet the decarbonisation targets for the transport sector set out in EU and national legislation. 6. Possibility to produce biofuels for aviation (Sustainable Aviation Fuels). 	<ol style="list-style-type: none"> 1. Ongoing and potential military conflicts, disruptions in supply chains, growing demand for food will lead to an increase in demand for and prices of agricultural raw materials, while limiting the production of biofuels from these raw materials. 2. Expensive and underdeveloped technologies for the production of biofuels from waste and residues may lead to sluggish investment growth in the production of advanced biofuels. 3. Underdeveloped logistics systems for waste collection and supply of required raw materials for the production of advanced fuels. 4. Indirect land use change (ILUC) for biofuels production, including wetlands and completely forested areas, is prohibited under EU law. 5. Rapid development of electric and hydrogen-powered transport under international agreements and EU strategic documents on climate change mitigation is expected.

Taking into account the results of the SWOT analysis in Lithuanian biofuels production sector, the following strategic directions of intervention in this sector have been identified:

1. First direction

Rapidly develop the production of advanced biofuels from biological wastes and residues, including animal fats, used oils and cooking oils and other food waste, as well as algae, and use in the transport sector. It is appropriate to provide financial support: i) for scientific research projects in the fields of advanced biofuels raw materials, production and use technologies; ii) to create and implement collection and logistics systems for biological waste and residues, including fats of animal origin, used oils and cooking oils and other food waste, as well as algae; iii) for investments in advanced biofuels production capacities.

2. Second direction

To improve the legal regulation of biofuels production and consumption as fuel. Legislation is appropriate to provide for the restriction of the use of palm oil and other environmentally unfriendly fuels.

2. Overall conclusions and outlook

A synthesis of the aforementioned sectoral strategic directions is necessary to develop overarching national bioeconomy appropriate strategic actions that can be summarized in 3 areas with regard to:

Market intervention actions:

- Promote the creation of a competitive environment for business development, also move from commodity to products with higher added value through implementation of innovative technologies and business models for prevention, reuse, recycling and use of biological waste;
- Provide financial support to businesses, municipalities and clusters for implementing scaling up of innovative technologies;
- Public investment in infrastructure (biomethane distribution network, district heating etc.).

Research, Innovation and education:

- National research agenda is a functional part of the BIOEAST macro-region's Strategic Research and Innovation Agenda (SRIA).
- The needs for actions to improve Lithuania's bioeconomy related research and innovation can be resumed in:
 - **Support (financial and nonfinancial):** plan the consistent funding for the research, based on medium and long-term strategic planning; provide better support for business innovation by upgrading competences of science, technology and innovation public sector policy makers; etc.
 - **Cooperation:** enhance integration with international innovation networks; promote the development of bioclusters; etc.
 - **Innovations:** implement the circular principles throughout the food supply chain; ensure sustainable agriculture activity in a circular way by using locally available and produced resources; etc.
 - **Knowledge transfer, education:** promote the development of bioeconomic hubs, networks to ensure learning from best practices; enhance understanding of bioeconomy at the business, scientific, governmental and consumer levels, better use the education system at all levels; etc.

Governance and Policy actions:

- set up a Bioeconomy Council to ensure long-term engagement at the national level to act as a catalyser for interministerial and interinstitutional coordination;
- enforce the relationship between the main sub-sectors of bioeconomy and niche sectors in frame of bioeconomy strategy or action plan;
- elaborate legal regulations to enable predictive environment in the bioeconomy.

