

Perspectives and challenges of bioeconomy sector development

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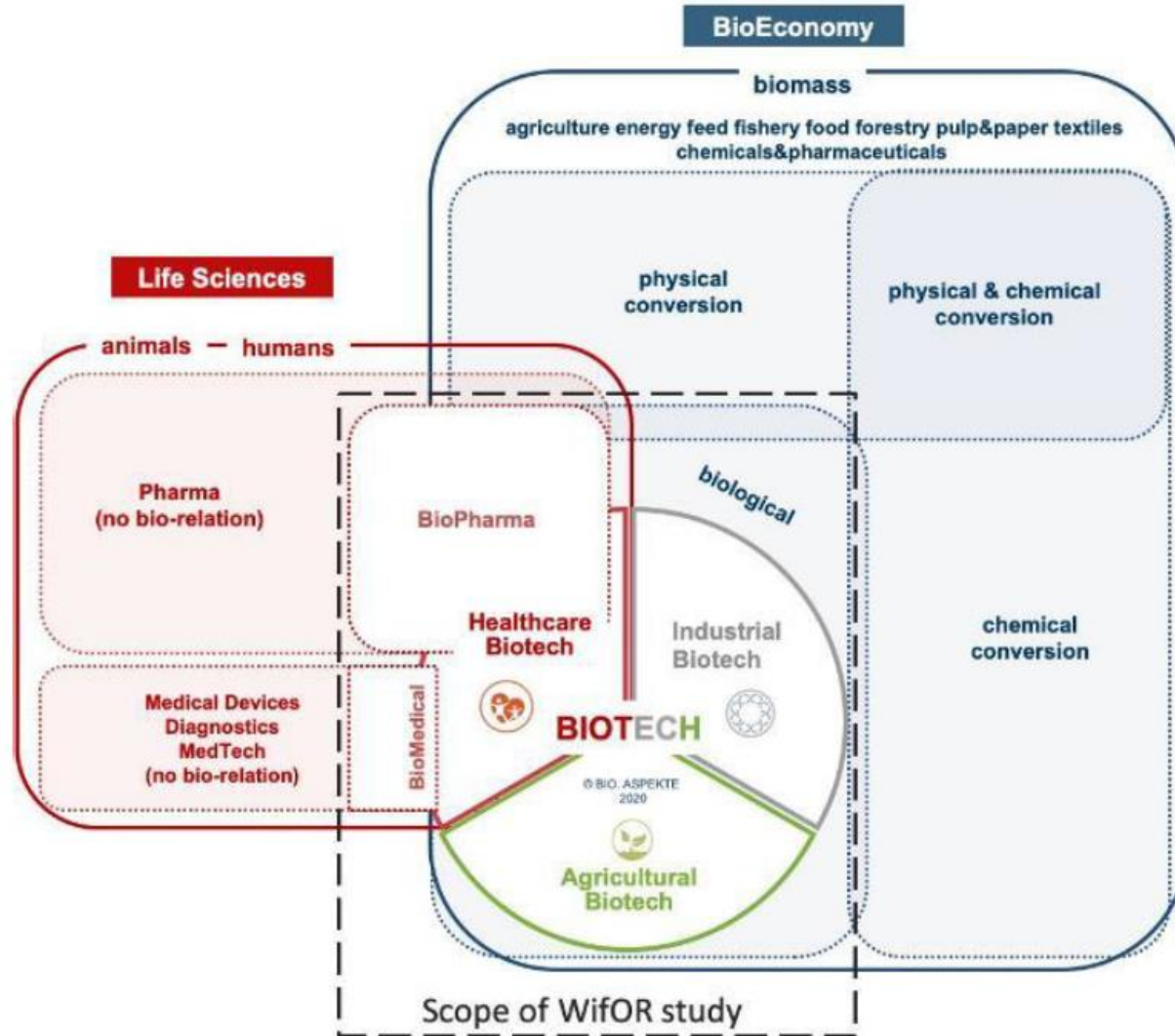
- Terminology
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Key terminology



- **Biotechnology** - the application of **life science and technology** to living organisms, as well as parts, products and models thereof, to alter living or non-living materials **for the production of knowledge, goods and services**
- **Life Sciences** – a branch of science (such as biology, medicine, biochemistry and more) that deals with living organisms and life processes
- **Bioeconomy** - covers **all sectors and systems** that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles.
- **Circular Economy** – **economic model of production and consumption**, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.

Biotech in Bioeconomy



Research report "Measuring the economic footprint of the biotechnology industry in Europe", December 2020

Main branches of biotechnology sector



RED

Healthcare biotechnology uses to create an advanced class of drugs, therapies, vaccines and diagnostic tools.

WHITE

Industrial biotechnology uses enzymes and microorganisms to make bio-based products in sectors such as chemicals, food and feed, detergents, papers and pulp, textiles and bioenergy.

GREEN

Agricultural Biotechnology encompasses environmental protection issues, modern plant breeding techniques, targeted biotechnological ways to improve plants with desirable characteristics.

BLUE

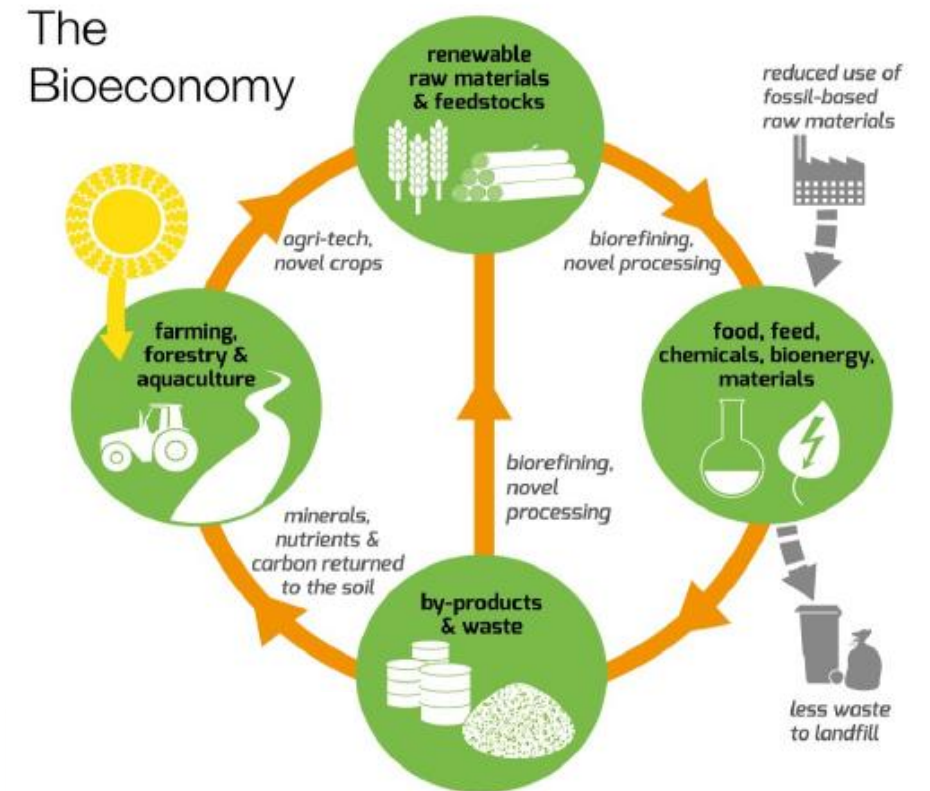
Marine biotechnology exploits the diversity found in marine environments, many of which have no equivalent on land, in ways which enable new materials to be realized.

More branches of Biotechnology exist, such as: yellow, grey, gold, brown, violet and black.

Bioeconomy

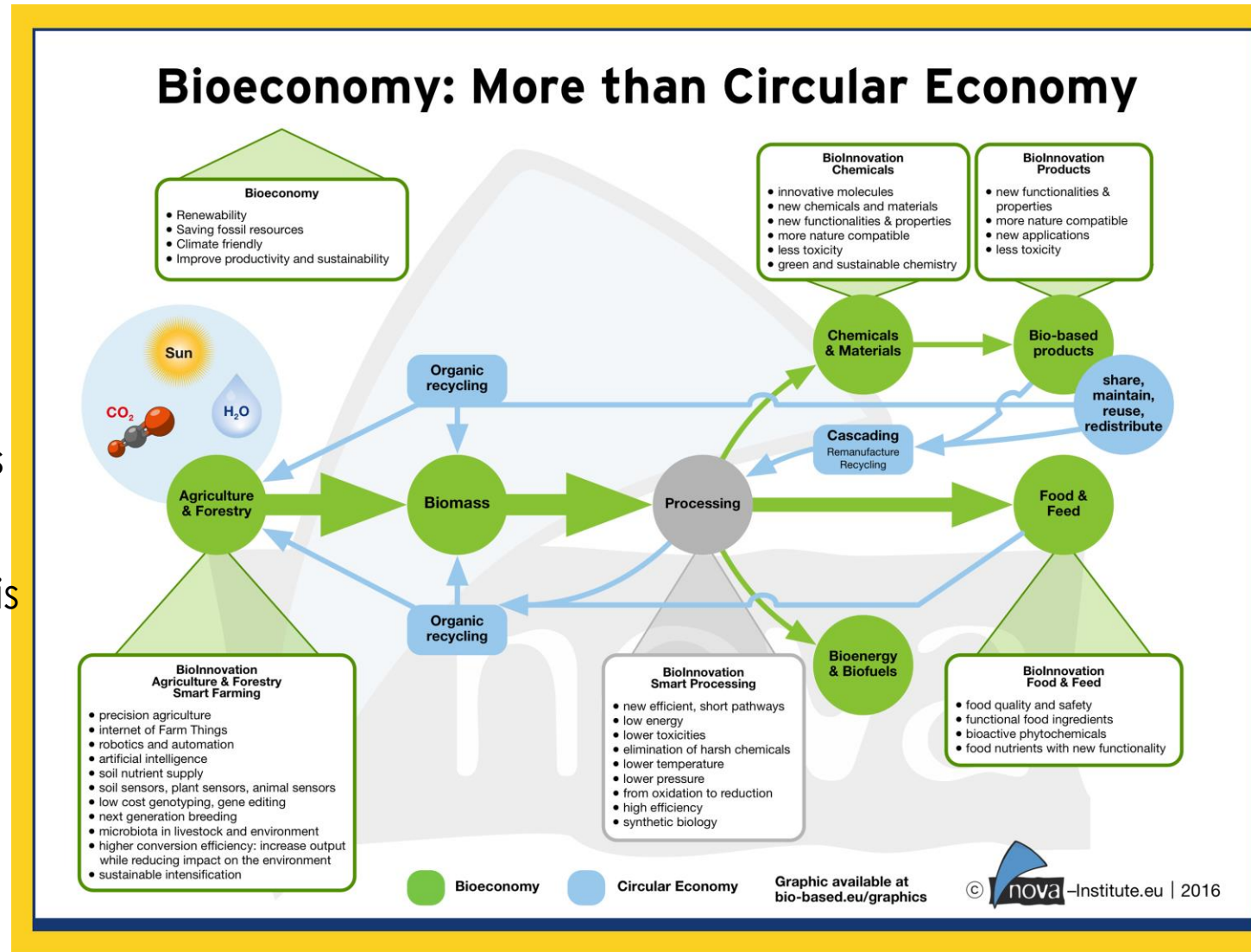


- The **bioeconomy** covers all sectors and systems that rely on biological resources their functions and principles.
- It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services
- To be successful, the European bioeconomy needs to have **sustainability and circularity** at its heart. This will drive *the renewal of our industries, the modernization of our primary production systems, the protection of the environment and will enhance biodiversity.*



Bioeconomy vs. Circular Economy

- **Circular and bioeconomy** policies have strong thematic links, both having, for example, food waste, biomass and bio-based products as areas of intervention.
- Circular economy policies are aiming at closing the loop of resources as much as possible
- The bioeconomy comprises any value chain that uses biomaterial and products from agricultural, aquatic or forestry sources as a starting point. Shifting from non-renewable resources to biomaterial is an important innovation aspect of the circular economy agenda. The bioeconomy and the circular economy are thus conceptually linked.



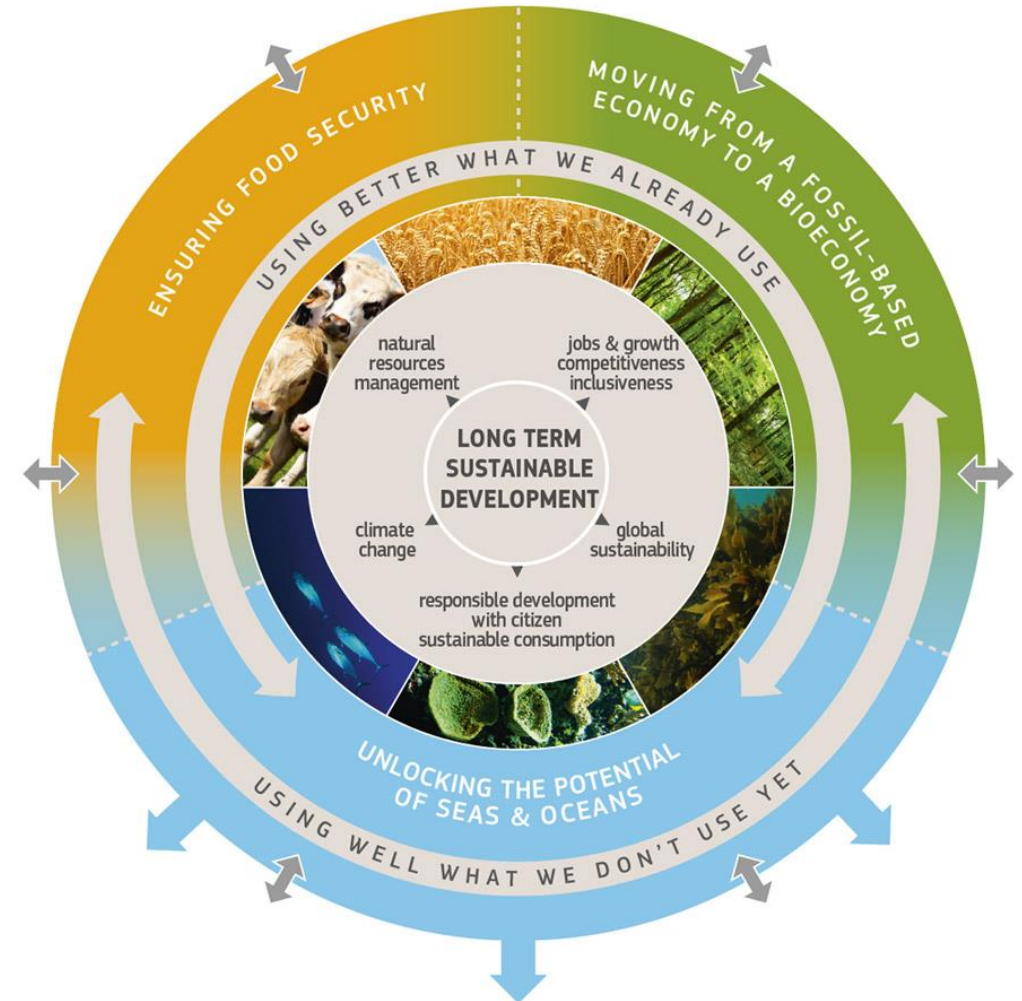
EU Bioeconomy strategy (updated 2018)



The 2018 update of the Bioeconomy Strategy proposes a three-tiered action plan to scale up the bio-based sectors, to spread it rapidly across the whole of Europe, and to understand the ecological boundaries of the bioeconomy.

5 GOALS:

- Ensure food and nutrition security
- Manage natural resources sustainably
- Reduce dependence on non-renewable, unsustainable resources
- Limit and adapt to climate change
- Strengthen European competitiveness and create jobs



Economic potential of Bioeconomy development



- Increased demand of biomass and bio-based products
Based on “Blue bioeconomy report” by EC Joint Research Center, collected data shows rapid increase in demand in the aquaculture sector (between 2004 and 2014 world production increased by 76%)
- Increased demand in renewable energy
EU imports energy resources for 1 billion Eur per day and could significantly benefit from bioenergy generated in the EU.
- Increased demand of sustainable products
9 of 10 Europeans (94%) states that environmental protection is important, 56% - highly important. 77% of Europeans are ready to pay more for environmentally friendly products. ([Source](#))

Bioeconomy in European Union



Source: Bioeconomy Report 2016, Joint Research Center, EC



- Strengthen and scale up the biobased sectors
- Deploy local bioeconomies rapidly across the whole of Europe
- Understand the ecological boundaries of the bioeconomy

EU and non-EU countries with a national bioeconomy

strategy: Austria, Finland, France, Germany, Ireland, Italy, Latvia, the Netherlands, Spain, Norway and United Kingdom

Bioeconomy in Lithuania



- Bioeconomy generated 4.7 billion Eur and accounted for 12.8% of Lithuania's GDP.
- Bioeconomy sector employs 234.400 people (17.6% of all working citizens) in Lithuanian (2015 data)
- In 2016 bioeconomy product export reached 9.9 billion Eur, 43.7% of all exports in Lithuania.
- In biomass production sectors Lithuanian ranks 6th among EU-28 countries and 1st in the fully biomass-based manufacturing sectors (according to GDP concentration)

Bioeconomy subsectors in Lithuania



Bioeconomy subsector	Contribution to GDP (2015)	Number of employees (2015)
Biomass production		
Agriculture (crops and livestock)	2.79%	105200
Forestry and logging	0.55%	13700
Fisheries and aquaculture	0.08%	1900
Fully biomass-based manufacturing		
Manufacture of food products, beverages and tobacco	4.05%	43000
Manufacture of wood and wood products	1.24%	21500
Manufacture of paper and paper products	0.49%	4800
Partly biomass-based manufacturing		
Manufacture of textiles, clothing and leather products	1.01%	21100
Manufacture of chemical products	0.14%	700
Manufacture of drugs and pharmaceuticals	0.37%	200
Manufacture of furniture and other products	2.08%	23300

Directions of Lithuanian bioeconomy breakthrough

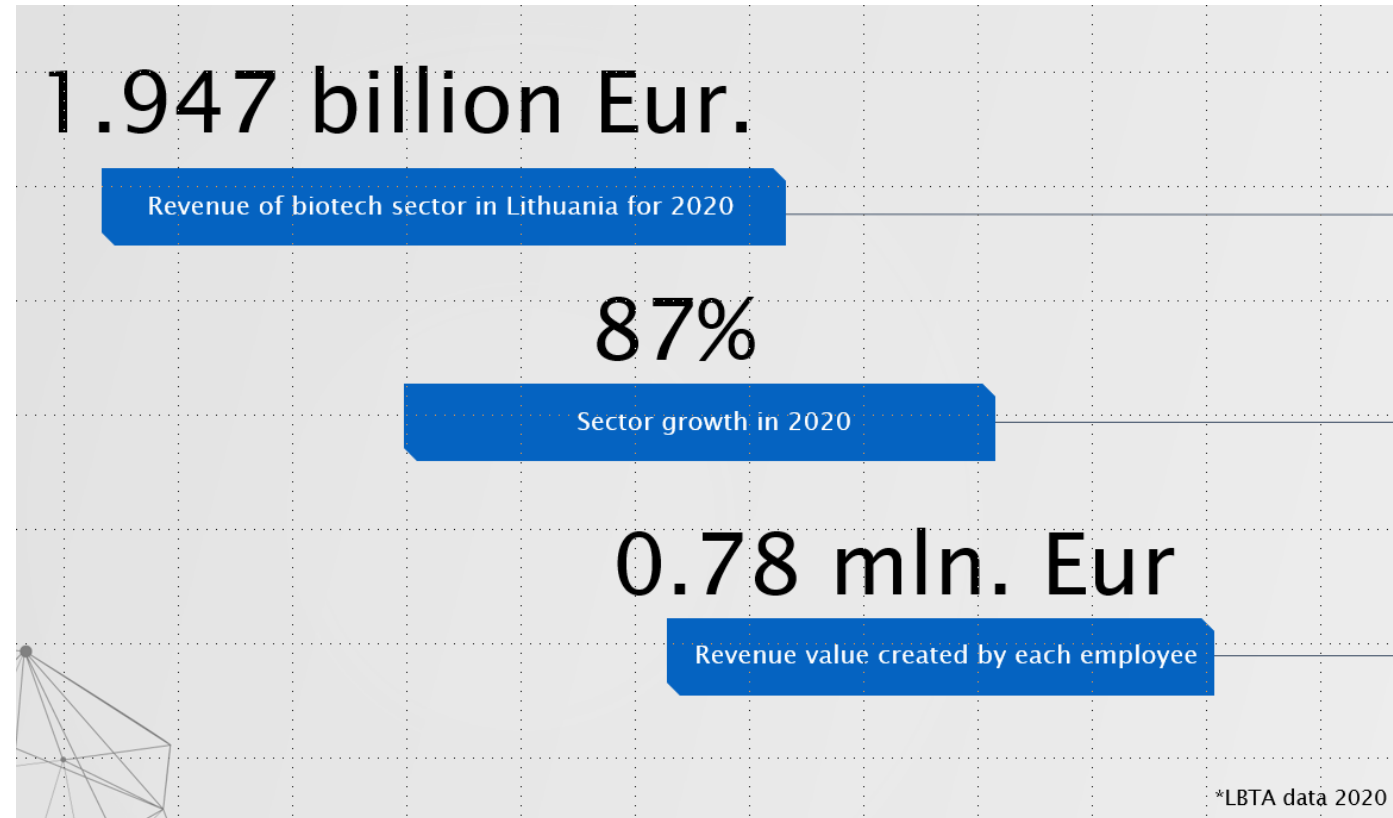


- Unlocking the potential of biomass value chains
- Ecological and functional foods
- Environmentally friendly products from the wood, textile and chemical industries made from raw materials of biological origin
- Introduction of industrial symbiosis and use of bio-based raw materials for the production of value-added products
- Use of biowaste generated in the biomass production and processing sectors for biogas and biofuel production
- Development and production of bioplastics and development of biodegradation solutions

Directions of Lithuanian bioeconomy breakthrough



- **Development of biotechnological tools and their application in bioindustry**
 - Molecular biology tools
 - Industrial enzymes
 - Microorganisms



Blue bioeconomy



- **Blue biotechnology** is the application of science and technology to living aquatic organisms for the production of knowledge, goods and services
- **Blue bioeconomy** incorporates any economic activity association with the use of renewable aquatic biological resources to make products:
 - Novel foods
 - Food additives
 - Animal feeds
 - Nutraceuticals
 - Pharmaceuticals
 - Cosmetics
 - Materials (clothes and construction materials)
 - Energy

Emerging technologies



- **Plan cell technology** - technologies that can transform plant science to address the challenges of new biology for human nutrition, environment and commercial uses.
- Plant cell cultures provide an attractive route to obtain highly valuable plant-derived products, such as flavours, fragrances, alkaloids, pigments and pharmaceuticals that are expensive to synthesise chemically and that naturally occur only at low concentrations. Plant cell cultures are a potential source for the production of high-value secondary metabolites.

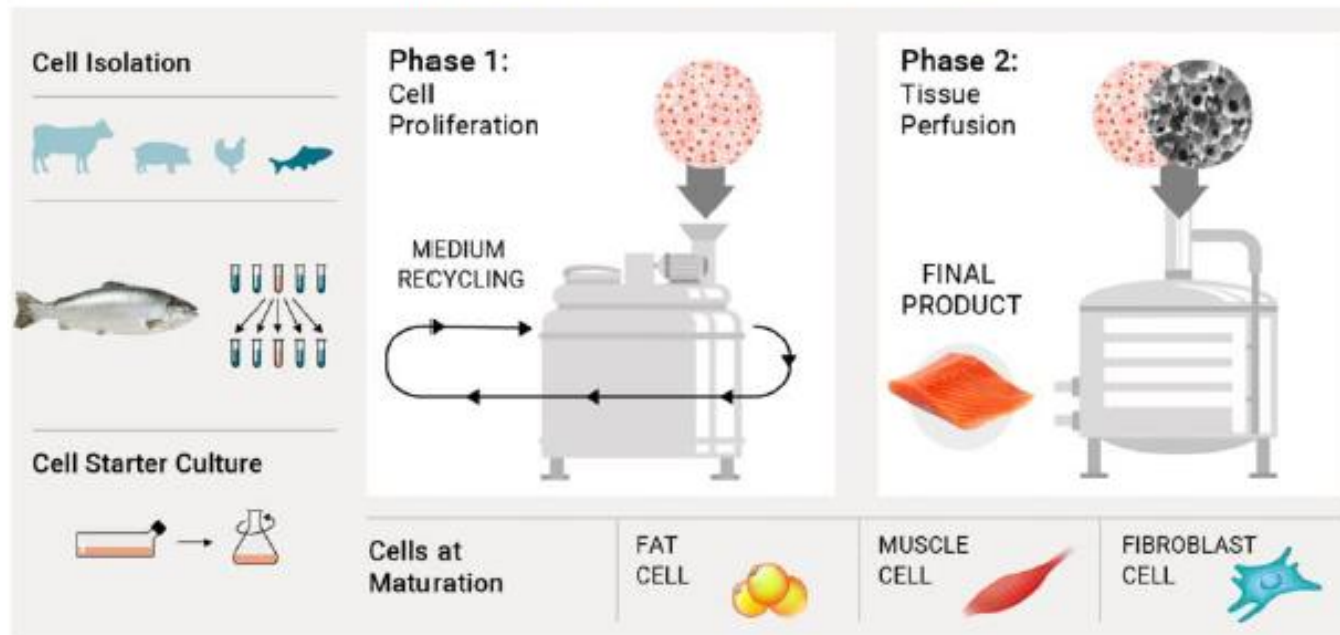
Industry	Products	Species	Manufacturer	Notes
Food	Anthocyanins	<i>Euphorbia milii</i>	Nippon Paint Co. Ltd, Osaka Japan	Textile dye
		<i>Aralia cordata</i>	Nippon Paint Co. Ltd, Osaka Japan	Coloring agents
	Arbutin	<i>Catharanthus roseus</i>	Mitsui Chemicals Inc., Tokio Japan	Pigments
	Betacyanin	<i>Beta vulgaris</i>	Nippon Shinyaku Co., Ltd	Pigments
	Carthamin	<i>Carthamus trincorius</i>	Kibun Foods Inc., Tokio Japan	Pigments
	Geraniol	<i>Geraminea spp.</i>	Mitsui chemicals., Inc	Essential Oils
	Ginseng	<i>Panax ginseng</i>	Nitto Denko Corporation, Osaka, Japan	Dietary supplements
		Wild ginseng from CMCs	Unhwa Biotech Corp., Jeonbuk, South Korea	Dietary supplements, cosmetic and medical products
Shikonin	<i>Lithospermum erythrorhizon</i>	Mitsui Chemicals., Inc	Red pigments	
Pharmaceuticals	Alginates	<i>Lessonia trabeculata</i>	Fraunhofer	Anticancer
		<i>Coptis japonica</i>	Mitsui Chemicals, Inc.	Anticancer
	Berberines	<i>Thalictrum minus</i>	Mitsui Chemicals, Inc.	Antibiotic Anti-inflammatory
		<i>Echinacea purpurea</i>	Diversa, Ahrensburg, Germany	Immunostimulant
	Echinacea polysaccharides	<i>Echinacea angustifolia</i>	Diversa, Ahrensburg, Germany	Anti-inflammatory
	Paclitaxel	<i>Taxus spp</i>	Phyton Biotech, Inc Germany	Anticancer World
		<i>Taxus spp</i>	Samyang Genex., Seoul, South Korea	Anticancer
Podophyllotoxin	<i>Podophyllum spp</i>	Nippon Oil, Tokio, Japan	Anticancer	
Rosamarinic acid	<i>Coleus blumei</i>	ANattemann & Cie. Gmbh, Cologne, Germany	Anti-inflammatory	
Scopolamine	<i>Duboisia spp</i>	Sumitomo Chemical Co., Ltd, Tokio, Japan	Anticancer World, also Used in treatment of motion sickness, nausea and intestinal cramping	

“[Blue Bioeconomy Report](#)” by EUMOFA 2020

Emerging technologies

- **Cellular mariculture** - focuses on the production of aquaculture products from cell cultures using a combination of biotechnology, tissue engineering, molecular biology, and synthetic biology to create and design new methods of producing proteins, fats, and tissues that would otherwise come from traditional agriculture.

Figure 3.10: Cell-based seafood production



Thank you for your attention!



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