

## **Thailand's Bioeconomy**

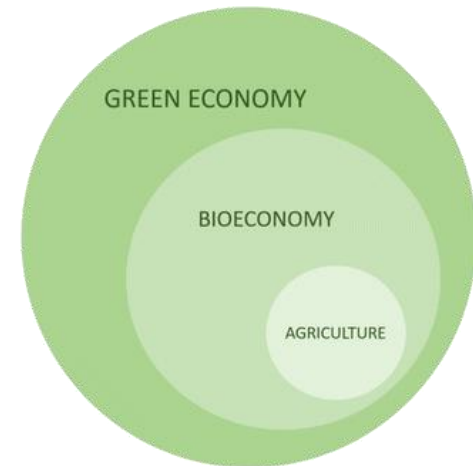
February 2019

# Trend Towards a Green Economy

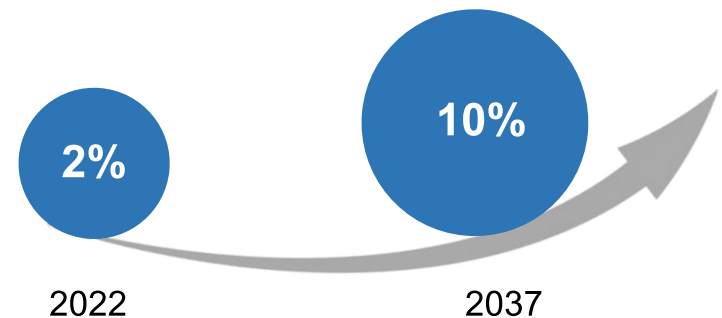
In response to the wide range of acute environmental challenges facing the world today, many governments have begun to focus their efforts on developing **bioeconomy industries**, i.e. **the production and conversion of renewable resources into alternative products such as food or energy sources**. This move is aimed at reducing their dependence on heavy industries and shifting resources towards more sustainable methods of production. With more than 50 countries officially pursuing policies related to the bioeconomy, especially in relation to the UN's Sustainable Development Goal (SDGs) and the 2030 Agenda, it looks certain that the industry will continue on its path of considerable growth.

In Thailand, this direction has resulted in the growth of a number of environmentally friendly sectors such as **biotechnology, bioenergy, biochemicals, and biopharmaceuticals**. With the abundance of necessary resources and availability of other supporting factors, Thailand is expected to play a leading role in the global bioeconomy for the foreseeable future.

## Green Economy Concept<sup>1</sup>



## Expected Contribution by Bioeconomy to Thailand's GDP<sup>2</sup>



# Thailand as a Natural Base for Production

## Abundance of Raw Materials

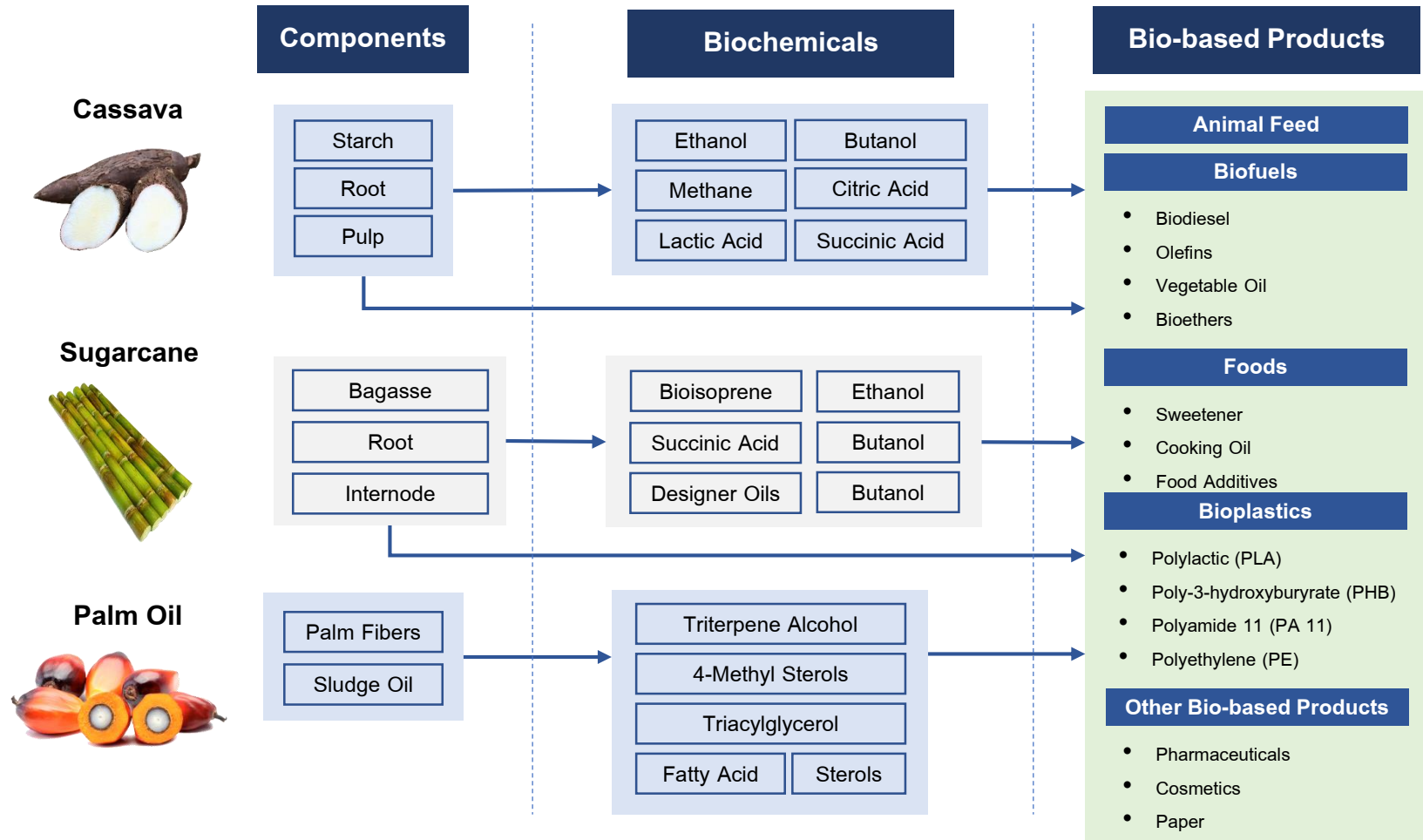
Reputed for its biodiversity and natural resources, it is estimated that Thailand hosts 8-10% of the world's microorganism species and approximately 8% of the world's plant species. Thailand is also well-known as a leading global supplier of raw agricultural products. The country is most famous for its large export volumes of rice, palm oil, sugarcane and cassava. It is estimated that Thailand produces 50% of the world's cassava, 9.4% of the world's sugar and 24.9% of the world's rice.

Products	World Ranking	2017 Export Value (Billion USD)	Share of World's Exports
Cassava	1 <sup>st</sup>	2.75	50%
Sugar	2 <sup>nd</sup>	2.6	9.4%
Rice	2 <sup>nd</sup>	5.2	24.9%
Palm Oil	9 <sup>th</sup>	0.216	0.6%

Source: World's Top Exports, Krungsri Research (2017)

# Home to an Abundance of Bio-based Materials

The raw materials abundant in Thailand are critical sources of bio-based energy and provide the foundation for the development of the bio—based products.



# Skilled Workforce

Each year, Thailand produces a significant number of graduates and post graduates who are equipped with the knowledge required to serve the needs of the bioeconomy. In 2017, there were 34,283 graduates and post graduates in science, 40,627 graduates and post graduates in engineering, and a further 26,169 graduates and post graduates in health and welfare studies<sup>1</sup>. According to the National Center for Genetic Engineering and Biotechnology (BIOTEC), there are currently more than 1,500 experts and researchers in biotechnology.

Many Thai universities offer undergraduate and graduate degree programs related to the development of the bioeconomy. For example, Mahidol University offers bachelor degrees in Biomedical Science, Bioresources and Environmental Biology, and Bioinnovation. They also offer a doctoral degree in Medical Biochemistry and Molecular Biology, Biomedical Sciences, and Biopharmaceutical Sciences. In addition, Chulalongkorn University also offers a master degree in Biotechnology and in Biomedical Engineering.

## The National Biotechnology Policy Framework 2012-2021<sup>2</sup>



## Develop human resources in 4 targeted groups



### Targeted group

### Community

### SMEs

### Large businesses

### R&D Community



### Human resources development measures

Increase biotechnology advocates, experts and leaders to promote locally viable technology

Link with universities and research institutes

Exchange research professionals between public and private sectors

Increase research professionals, develop their career paths and train professional research managers

# Thailand's Bioeconomy Policy

For decades, Thailand has directed significant government resources towards the development of its bioeconomy. One of the most significant milestones was the establishment of the National Center for Genetic Engineering and Biotechnology (BIOTEC) in 1983. Since then, a series of policies and initiatives have been formulated and implemented. For example, for 2004-2021, relevant organizations including the National Science Technology and Innovation Policy Office (STI) and the National Center for Genetic Engineering and Biotechnology (BIOTEC) have initiated the National Biotechnology Policy Framework, which aims to encourage innovation, boost overall competitiveness and generate greater productivity throughout the bioeconomy. Other subsequent policies include the 2012 Alternative Energy Development Plan, and since November 2015, the Thailand 4.0 model, which identifies the bioeconomy sector as a new growth engine.

It is believed that these initiatives will support Thailand's bioeconomy industries including **biotechnology**, **bioenergy**, **biochemical**, and **biopharmaceuticals** further still.

**1983**

**Establishment of BIOTEC**

**2004-2021**

**Thailand's National Biotechnology Framework**

**2008-2015**

**National Bioplastic Roadmap**

**2012-2036**

**Alternative Energy Development Plan**

**2015-NOW**

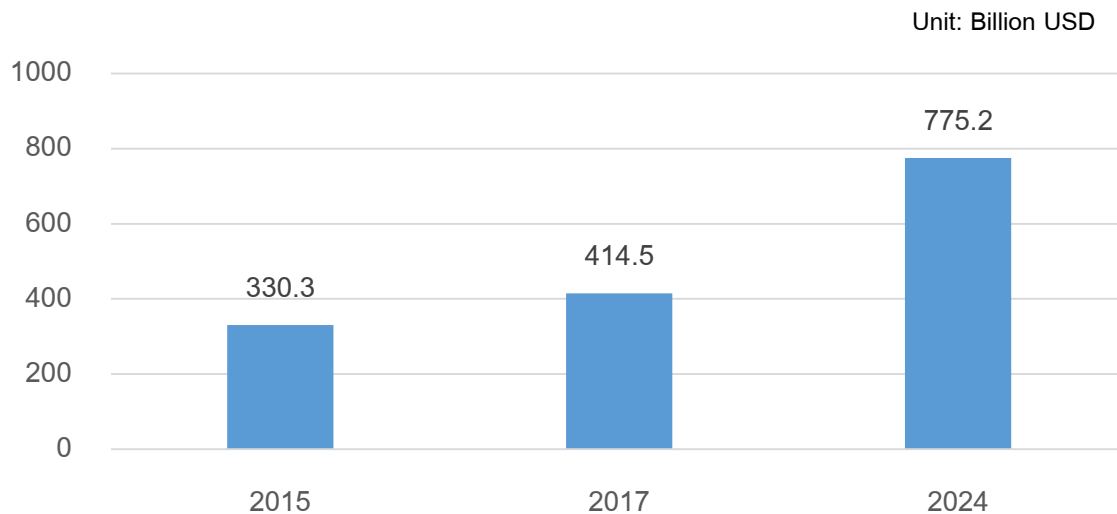
**Thailand 4.0 and the New S-Curve**

# Biotechnology

While the term “biotechnology” was originally coined approximately a century ago and it encompasses the utilization of a wide range of cellular and biomolecular processes, the advancement of science and technology as well as the demand for increasingly limited resources have given rise to a rapid growth of the industry in recent times. The rising need for agricultural and food products due to the growing population is another factor positively impacting the growth of the industry. More recently, the advancement of DNA sequencing, fermentation, and the rising demand for cures of chronic diseases have been attributed by Global Market Insights as further drivers of the expanding biotechnology industry in the years to come.

According to Global Market Insights, the global market of biotechnology, which include bioenergy, biochemical and biopharmaceuticals, among others, is expected to reach 775.2 billion USD by 2024.

**Global Market Value of the Biotechnology Market<sup>1</sup>**



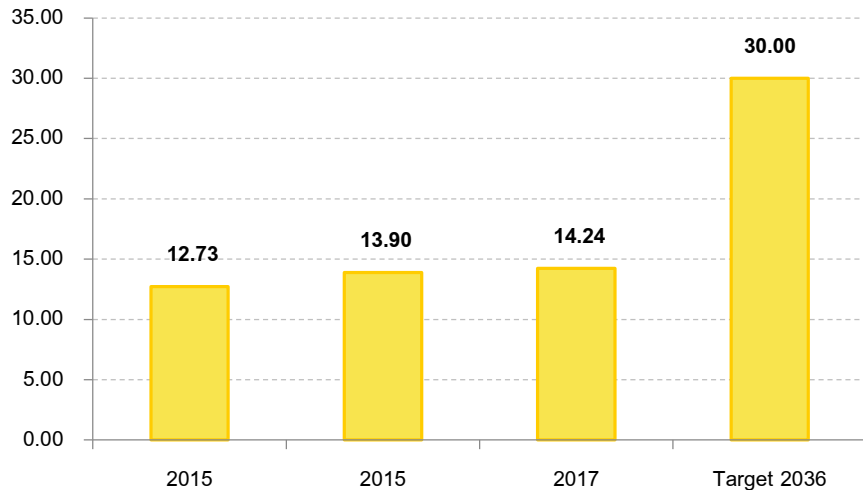


# Bioenergy

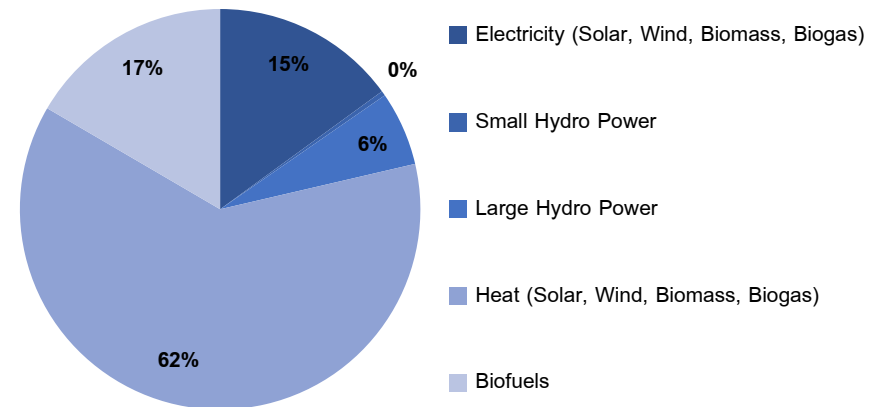
By 2036, or perhaps even earlier, Thailand will be facing the challenge of energy sustainability. As Thailand moves into upper-middle income status, and the population demographic begins to shift to a middle-class society, personal energy consumption is forecast to surge accordingly. Recent projections anticipate that consumption per person may rise tenfold to 131,000 ktoe. This makes renewable energy and bioenergy production an extremely important focus for Thailand in the years ahead.

In 2017, Thailand's renewable energy consumption was at 11,329 ktoe or 14.24% of the total consumption. Under the Alternative Energy Development Plan (2015-2036), by 2036 the renewable energy consumption is expected to increase to 30%.

Percentage of Alternative Energy



Share of 2017 Renewable Energy



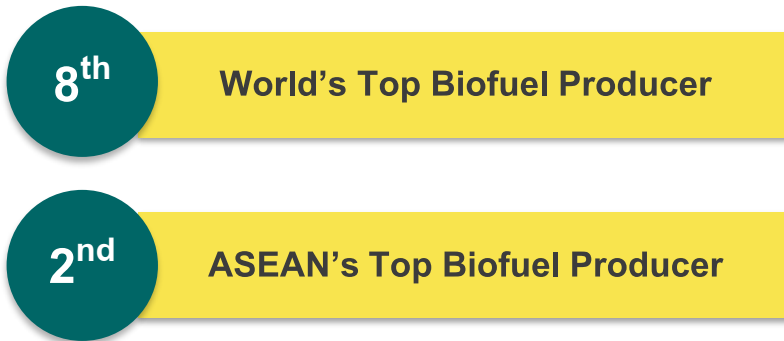


# Bioenergy

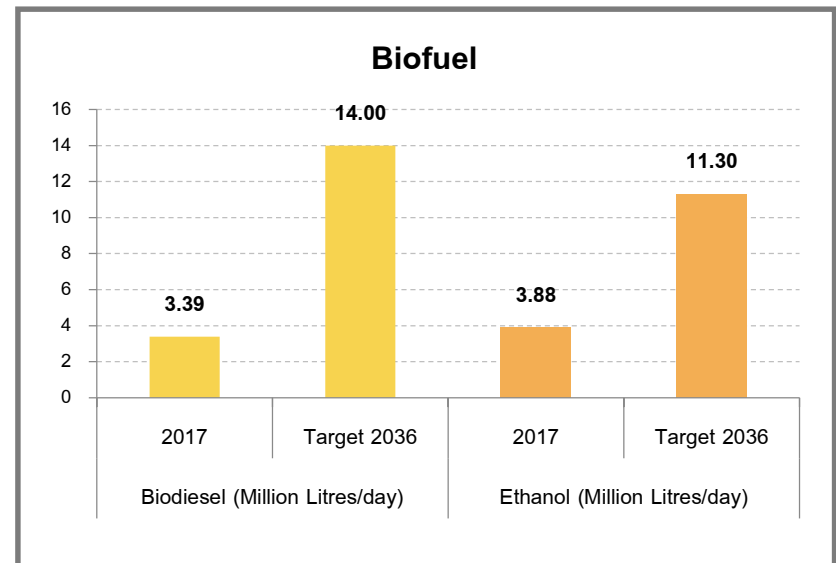
## Biofuels

Driven by the Alternative Energy Development Plan 2015 (AEDP 2015) and price subsidies via the State Oil Fund (SOF), biofuel production has experienced significant year-on-year growth. From 2017 to 2018, ethanol production was expected to increase by more than 7%, whilst biodiesel production was also expected to rise by an equally impressive 4%. In 2017 Thailand was ranked as ASEAN's second top biofuel producer, after only Indonesia.<sup>1</sup>

### Thailand Ranking as Biofuel Producer<sup>2</sup>



### Targets under Alternative Energy Development Plan<sup>3</sup>



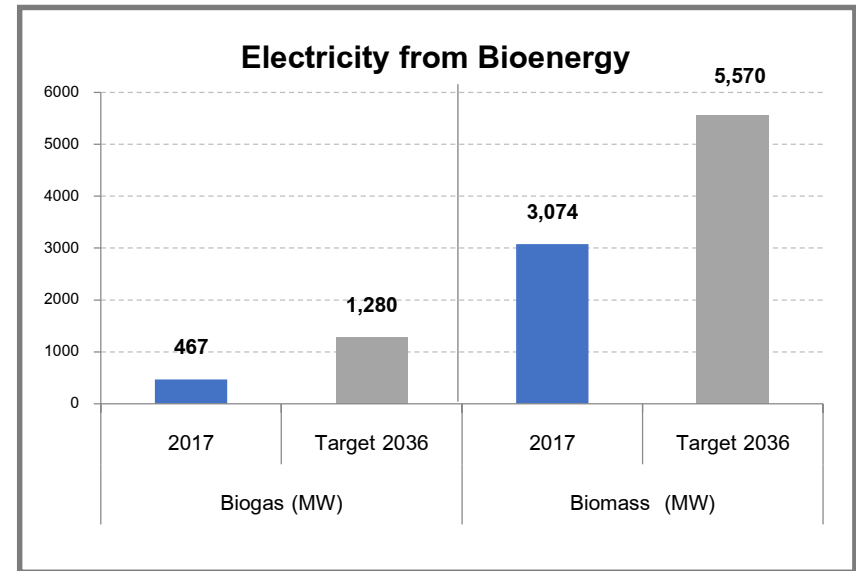
# Bioenergy

## Electricity from Bioenergy

As a preemptive measure to curb the high costs of electricity production, the Thai government implemented the Power Development Plan (2015-2036). This primarily focused upon generating significant growth in biogas and biomass energy. At the core of this plan is the desire for Thailand to be able to produce 20% of its own electricity from renewable sources by 2036.

In addition to alleviating domestic energy concerns, Thailand's growth in biomass also presents sizeable investment opportunities. Specifically, the production of wood pellets has generated significant domestic and international demands, with growth currently sitting at approximately 15% per year.<sup>1</sup>

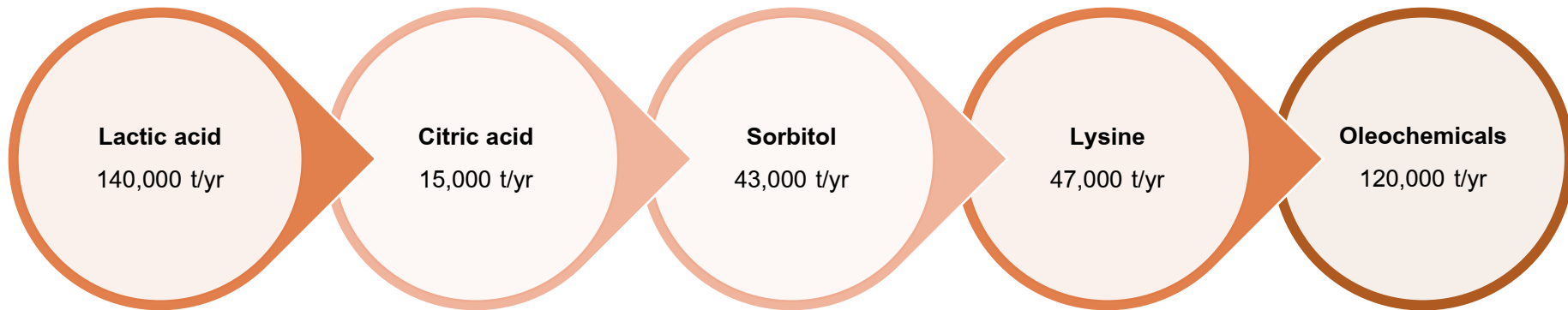
### Targets under Power Development Plan<sup>2</sup>



# Biochemicals

The biochemical industry remains one of the most important sectors for the Thai economy due to its ability to add significant value to raw agriculture products. For example, by converting sugarcane into polylactide (PLA), the product can increase its value by more than seven times. For two of Thailand's main exports, i.e. sugarcane and cassava, their value can be tripled or quadrupled respectively when converted to bioplastics. Under the new Thailand 4.0 development plan, the biofuels and biochemicals sector represents one of the five new "S-Curve" future industries that are expected to achieve a leap in development growth.

## Biochemical Production in Thailand<sup>1</sup>



# Biochemicals

## Bioplastics

The existence of the petrochemical industry creates a high potential for the Thai government to successfully develop its bioplastic industry in the future. It is estimated that approximately 90% of all domestically produced bioplastic products are exported from Thailand. Most of these exports make their way to Thailand's largest trading partners in Europe and Asia, including Japan, China, Taiwan and South Korea. Of the remaining bioplastics that have not been exported, only about 10% of the bioplastics are further processed domestically. Such low figures suggest that there is still considerable room for further development and expansion of supply chain facilities.

### Examples of Bioplastic Producers



**Product:** Bio-Degradable Bag



**Product:** Housewares, Furniture, Film, and Rigid Packaging



**Product:** Resin, Films, Fibers, and Dental Material



**Product:** Hot Stamping Foil, Flexible Air Conditioning Ducts, and Book Lamination



**Product:** Shopping Bags, Plastic Packaging, Plastic Bottles and Utensils,



**Product:** Nonwovens, Food Packaging, Durables, Apparel and Films



**Product:** Bottle, Films, Sheets and Extrusion Coating

# Biopharmaceuticals

In a desire to make Thailand one of the top 5 nations in Asia for biopharmaceutical production by 2036, the Ministry of Public Health has established a 20-year biopharmaceutical roadmap. This plan sets out a range of different milestones and short-term goals, with the first period of action set at five years. In the short-term, it is envisaged that Thai companies will be able to register nine biopharmaceutical / biosimilar products. By substituting these biosimilars for biologicals, it is expected to save Thai consumers approximately 7,500 million THB.

## Department of Medical Science's Biopharmaceutical Roadmap

Stage	Year	Goal
1	2017-2021	Full Production for Biopharmaceutical Product
2	2022-2026	Performance Improvement
3	2027-2031	International Recognition for Production and Quality Control of Biopharmaceutical Products
4	2032-2036	Top 5 Biopharmaceutical Production in Asia






**Final Goal: New Biopharmaceutical Products**



# Case Study

## Key Players

	<p>PTT MCC Biochem is a joint venture between PPT Global Chemical and Japan's Mitsubishi Chemical Corporation. It has successfully developed bio-based Polybutylene Succinate (Bio PBS), a breakthrough compostable plastic material derived from corn, cassava, and sugarcane, which has been used in a wide range of applications such as paper coating compounding, synthetic fiber, and flexible and barrier packaging. While being environmentally friendly, Bio PBS has the same level of seal strength as conventional petro-plastic.</p>
	<p>Founded in 1995 as a producer of polyethylene bags, Multibax has today become a world-renowned manufacturer of biodegradable plastic bags. Its flagship product, MBIO-2, is a biodegradable plastic bag that has been certified by international certifications bodies, and this guarantees that its quality meets the global standard. The company's production plants cover more than 30,000 square meters.</p>
	<p>Global Green Chemicals (GGC), formerly known as Thai Oleochemicals Company Limited, commenced its operations in 2005 and is now a leading producer of methyl ester, which is used as an important ingredient in biodiesel. Commonly known as B100, methyl ester is intended to be used as a replacement for petroleum diesel and is regarded as being more environmentally friendly. In 2017, GGC signed an MOU with KTIS Group to start the development of Nakhonswan Biocomplex, a dedicated area for development in the province.</p>

# Case Study 2

## Key Players



Siam Bioscience Company was founded via a partnership between the Crown Property Bureau Equity Company and Mahidol University. Upon formation, the primary aim of the partnership was to promote research and development, manufacturing, and commercialization of pharmaceutical and biopharmaceutical products. Siam Bioscience currently has two testing facilities that cover all forms of testing related to biopharmaceuticals. Since its inception, the company has successfully developed two life-saving drugs that are now available across the world. These drugs are:

- Erythropoietin Alfa - a biopharmaceutical that is used for treating anemia in patients with kidney failure; and
- Filgrastim - a biopharmaceutical that reduces the risk of infection among cancer patients that are undergoing chemotherapy.

As a company that has been successful in developing biopharmaceuticals to fight cancer and auto-immune diseases, Siam Bioscience Company has drawn a significant amount of attention and praise from the government.



BioNet-Asia is a leading vaccine company focusing on technological innovation and developing access to global markets. It is estimated that so far the company has supplied more than one billion individual vaccine doses worldwide. At its cutting-edge plant in Thailand, BioNet is developing unique expertise in genetic engineering, protein conjugation and vaccine formulation for diseases such as diphtheria, tetanus, pertussis, meningitis and Hepatitis B.



SGS has developed a wide range of services that draw upon a long-standing expertise in biopharmaceutical testing, clinical research, safety and quality control, and auditing. In addition, SGS provides a range of other specialist services including inspection, verification, and certification. SGS fulfills their clients' business needs via their headquarters in Bangkok, and via their regional offices in Rayong, Chonburi, Song Khla, Chiang Mai, and Nakorn Ratchasima.



# Supporting Facilities

## Pushing for the Development of the Bioeconomy

As government agencies came to further realize the importance of the industry, there was additional support offered in the form of education and research grants. Since the implementation of the Thailand 4.0 policy in 2015, the industry has also witnessed a spike in resources available for research & development and research hubs. This is primarily the result of the push within the Thailand 4.0 policy to encourage greater partnerships between the public sector, private sector, government agencies and educational institutions.

## Research Centers



Biochemical Engineering and Pilot Plant Research  
and Development Laboratory  
King Mongkut's University of Technology, Thonburi



MU-OU: CRC Collaborative Research  
Center for Bioscience and Biotechnology  
Faculty of Science, Mahidol University



Marine Biotechnology Laboratory  
Faculty of Science, Chulalongkorn University



National Biopharmaceutical Facility:

- Stated owned contract manufacturing facility for promotion of biopharmaceuticals
- Collaboration between BIOTEC and KMUTT

# Supporting Facilities

## Associations and Institutions



Department of Science Service (DSS)  
Operating under the auspices of the Ministry of Science and Technology, DSS has a mandate to conduct R&D and product testing through innovative technologies.



Plastics Institute of Thailand (PITH)  
Supports the Thai plastics industry and offers R&D and product testing for the industry.



National Innovation Agency (NIA)  
Advocates for R&D for innovative products whilst simultaneously providing strategic support to relevant companies.



Thailand Institute of Scientific and Technological Research (TISTR)  
Supports innovations in science and technology through R&D.



National Science and Technology Development Agency (NSTDA)  
The Agency supports R&D activities in five core areas including: food and agriculture, energy and environment, health and medicine, bioresources and the community, and manufacturing and service sectors.



The National Center for Genetic Engineering and Biotechnology (BIOTEC)  
Conducts policy research, outreach programs and training as aligned with Thailand's National Biotechnology Policy Framework.



Petroleum Institute of Thailand (PTIT)  
Promotes the Thai petroleum market through R&D activities that are related to the Thai petrochemical and petroleum industries.



Thailand Center of Excellence for Life Sciences (TCELS)  
Support life sciences R&D management and commercialization in Thailand and Oversea and empower of manpower in related sector

# Supporting Facilities

## Thailand Science Park



### TSP Fast Facts

**Area:** 80 Acres (200 Rais)

**Space:** (300,000 sq.m for whole project)

**National Research Centers:**

BIOTEC, MTEC, NECTEC, NANOTEC

### Current Status:

85 companies

2,700 R&D personnel

Thailand Science Park (TSP), where BIOTEC main campus is located, is the country's first science and technology park with the mission of promote innovation development and R&D activities in the private sector.

Located in Phatum Thani Province, the TSP offers:

**Fully-integrated R&D Environment**

**Attractive R&D Incentives**

**Comprehensive Facilities and Services**

# Investment Incentives from the BOI

## A Wide Range of Tax & Non-Tax Incentives

BOI offers a wide range of tax and non-tax incentives for eligible activities that target Thailand's national development objectives.

### Tax Incentives - Bioenergy

Group	Eligible Projects	Incentives	
		Corporate income tax exemption	Exemption of import duty*
A1	Manufacture of electricity or electricity and steam for garbage or refuse derived fuel	8 years (Without cap)	✓
A2	Manufacture of electricity or electricity and steam from renewable energy including solar energy, wind energy, biomass or biogas, etc. except from garbage or refuse derived fuel	8 years	✓

### Tax Incentives - Biofuels

Group	Eligible Projects	Incentives	
		Corporate income tax exemption	Exemption of import duty*
A2	<ul style="list-style-type: none"> <li>• Manufacture of fuel from agricultural products</li> <li>• Manufacture of fuel from agricultural scrap or garbage or waste</li> </ul>	8 years	✓
A3	Manufacture of biomass briquettes and pellets	5 years	✓

# Investment Incentives from the BOI

## Tax Incentives - Bioplastics

Group	Eligible Projects	Incentives	
		Corporate income tax exemption	Exemption of import duty*
A2	<ul style="list-style-type: none"> <li>Manufacture of eco-friendly chemicals, polymers or products from eco-friendly polymers or chemicals those are consolidated within the same activities as the manufacture of eco-friendly polymers or chemicals</li> </ul>	8 years	✓
A3	<ul style="list-style-type: none"> <li>Manufacture of products from eco-friendly polymers</li> </ul>	5 years	✓

## Tax Incentives - Biotechnology Research and Development

Group	Eligible Projects	Incentives	
		Corporate income tax exemption	Exemption of import duty*
A1	<ul style="list-style-type: none"> <li>Research and development activity and/or manufacturing, using biotechnology of                             <ul style="list-style-type: none"> <li>seed industry</li> <li>improvement of plants</li> <li>animals</li> <li>microorganisms using biotechnology</li> <li>biopharmaceutical agents using biotechnology</li> <li>diagnostic kits for health, agriculture, food and environment</li> <li>bio-molecule and bioactive substances using microorganisms, plant cells and animal cells</li> </ul> </li> <li>Manufacture of raw materials and/or essential materials for molecular biological research and development, experiments, testing or quality control services and/or production of biological substances</li> <li>Biological substance analysis and/or synthesis services and/or quality control services and/or product validation services</li> </ul>	8 years (Without Cap)	✓

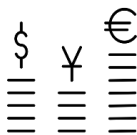
## Non-Tax Incentives



Permit to bring in expatriates



Permit to own land



Permit to take or remit foreign currency abroad