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Bioplastics in Thailand

Perceptions Versus Reality and Future Directions for Southeast Asia

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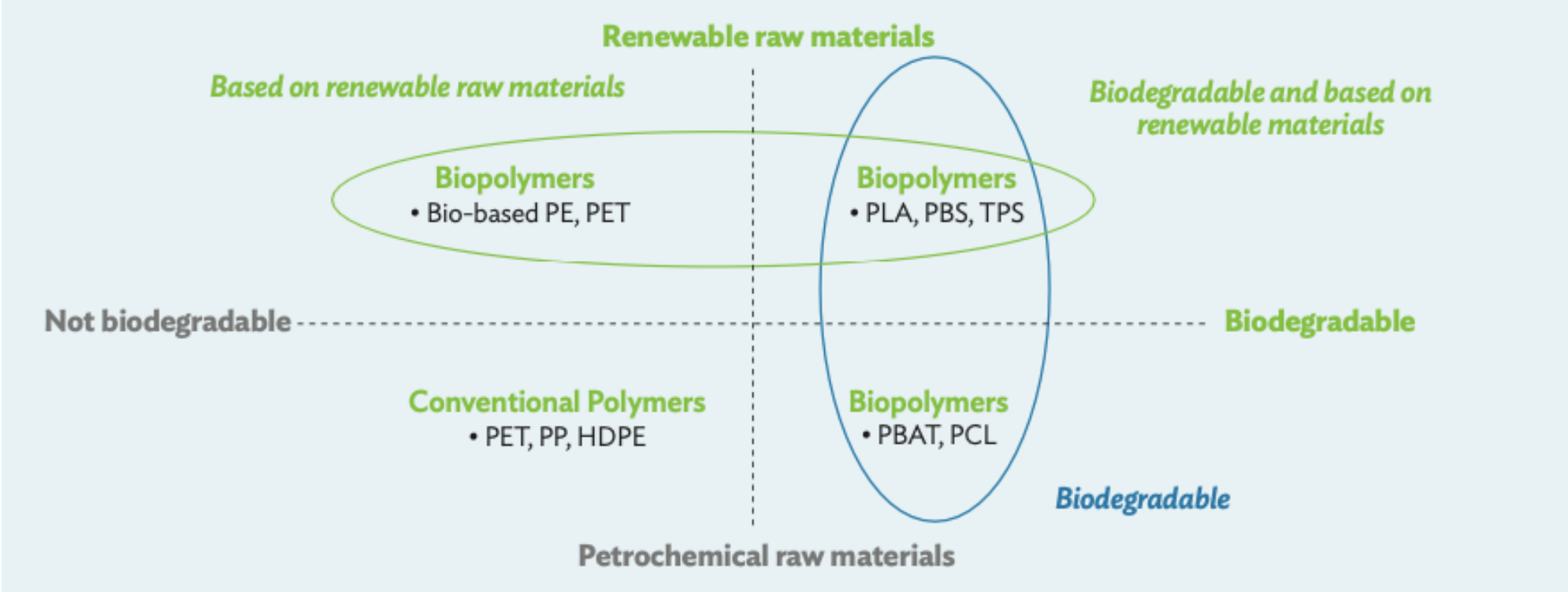
What are Bioplastics?

Bioplastics are plastic materials made of substances derived from biomass materials and/or can be broken down by microorganisms through processes that occur naturally in the environment or technologically enhanced natural processes.

How bioplastic products and materials are classified

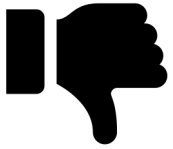


Perceptions of Bioplastics

"Bioplastics provide clear benefits in waste management and reduce greenhouse gas emissions."

"Bioplastics are just one of the green plastics and so they provide some benefits for society and can be an alternative to single-use plastics."

"Using bioplastics helps to increase the value of raw material agricultural products. They are high value products."



"Since bioplastic products are designed/engineered to be thrown in the certain settings/ environments, it has no value in the recycling market."

"Bioplastics are almost impossible to differentiate from petrochemical plastics as they look and feel identical and can contaminate recycling streams. Recyclers are not equipped with technology or knowledge to tell the difference."

"Bioplastics can in certain conditions be beneficial for the environment, but not at the current state of technology. Bioplastics might create another problem if we do not think carefully."

"The benefits of bioplastics for the environment also depends on the waste management pathway and how the recycling streams are being separated and how informed and trained the consumers and waste separators are. Could be bad for circularity."

Bioplastic Policies around the World

Promotion Policies

- Italy, Japan, the Netherlands, the Republic of Korea, and the United States
- Setting targets for a percent of bioplastics to be used in each country by a certain year.
- Encourage that bioplastics be composted, sorted, and recycled, go through anaerobic digestion, or incineration with energy recovery.

Bans on Bioplastics

- Australia, France, the People's Republic of China, and Taipei, China
- National Plastics Plan 2021 of Australia seeks to phase out problematic bioplastics that are not certified or are misleading regarding their ability to biodegrade.
- The French Agency for Food has recommended a home compostable plastics ban because complete degradation is less likely to take place at home composters and can release more contaminants into the environment.

Bioplastics Policies in Southeast Asia

Country	Policy
Cambodia	• Adopted a sub-decree that promotes biodegradable plastics and public plastic bag reduction through reusing plastic bags or using eco-friendly bags.
Indonesia	• Ministry of Industry of Indonesia enacted the Ministerial Regulation Number 55/2020 regarding Green Industry Standards for petrochemical plastic and bioplastic shopping bags.
Malaysia	• Established ecolabelling criteria for biodegradable and/or compostable plastic packaging materials. • Stimulates bio-based and biodegradable plastics production through tax breaks.
Philippines	• In 2013, the Caloocan City government enacted the Plastic and Polystyrene Regulation Ordinance that states that bags must be clearly marked as "oxo-biodegradable," "degradable," or "biodegradable" and printed with the Plastic Coding System emblem.
Thailand	• Board of Investment of Thailand currently offers a wide range of non-tax and tax incentives for activities related to the industry to support the manufacturing of eco-friendly chemicals and eco-friendly products.

Thailand Bioplastic Cost-Benefit Analysis Study

Objectives	• Measure the costs and benefits of bioplastics in Thailand versus petrochemical plastics and understand the key factors that drive the costs and benefits. • Identify policy and regulatory reforms, technology, and infrastructure that could improve the bioplastics value chain and how different stakeholders can contribute.
Supporting Organizations	• Government counterpart: Pollution Control Department of Thailand (PCD) • Industry partner: Thai Bioplastics Industry Association (TBIA)
Study outputs	• Life cycle environmental performance of bioplastics • Financial and economic analysis of bioplastics • Stakeholder engagement workshop • Bioplastics industry improvement strategy • Review of bioplastic industry and policies in ASEAN countries • ADB bioplastics policy brief
Bioplastics in Scope	**Bioplastic materials** 1. PLA (polylactic acid) 2. PBS (polybutylene succinate) 3. TPS (thermoplastic starch) 4. PHA (polyhydroxyalkanoate) 5. Bio-PE (bio-polyethylene) 6. Bio-PET (bio-polyethylene terephthalate) **Feedstocks** 1. Sugarcane 2. Cassava 3. Agri-waste (bagasse and rice husk)

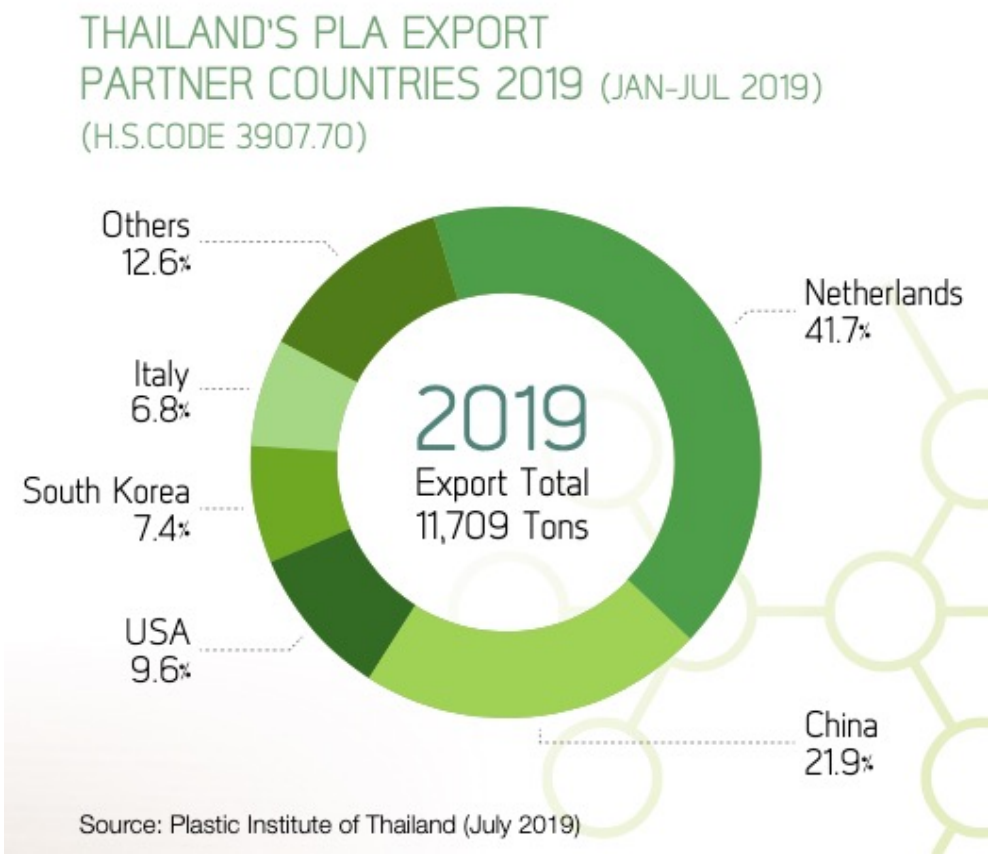
Thailand Bioplastic Industry Background

Ranking in Global Economy

- Thailand is the 2nd largest manufacturer of bioplastics in the world (USA #1), largest in Asia
- 90% of bioplastics (resins) are exported and 10% are consumed domestically
- Total current production: 95,000 tonnes/year
- Planned increase in production by an additional 75,000 tonnes/year (total of 170,000 tonnes/year, USA currently produces 150,000 tonnes/year)

Key Producers

- Total Corbion: PLA at 75,000 tonnes/year
- PTT MCC: PBS at 20,000 tonnes/year
- Feedstocks currently come from sugarcane and cassava, less than 1% of Thailand's sugarcane and cassava are used for bioplastics



Thai Bioplastic Stakeholders We Engaged

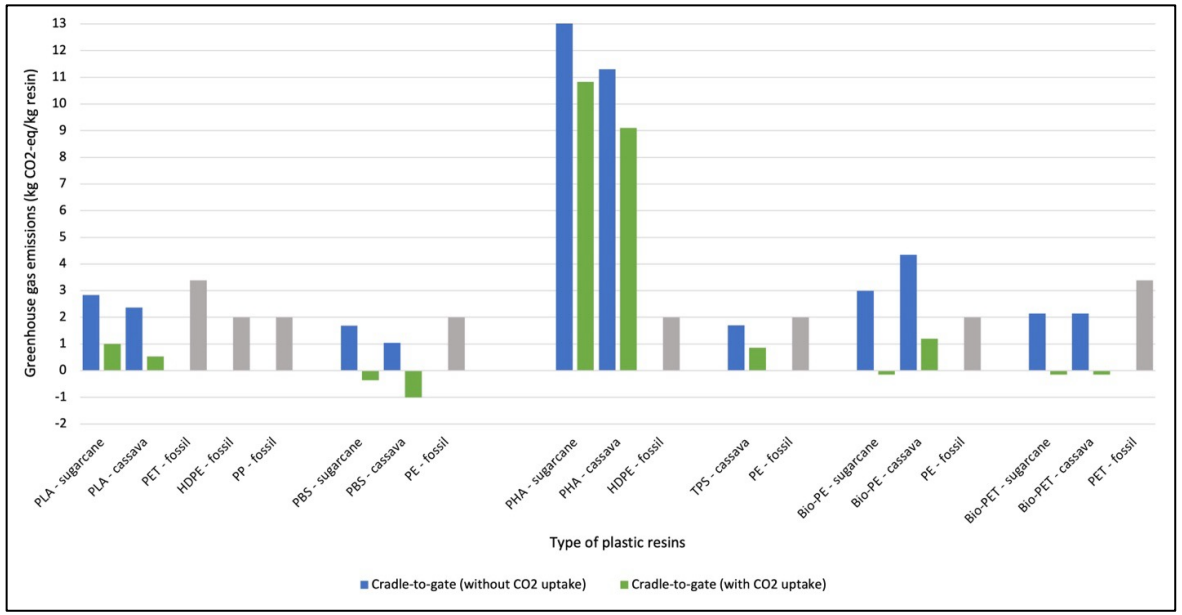
- Thailand Bioplastics Stakeholder Engagement Workshop in April 2023
- 60 participants, 70% from the private sector
- For the first time, brought together majority of Thailand bioplastics industry stakeholders in the same room for cross-cutting discussions

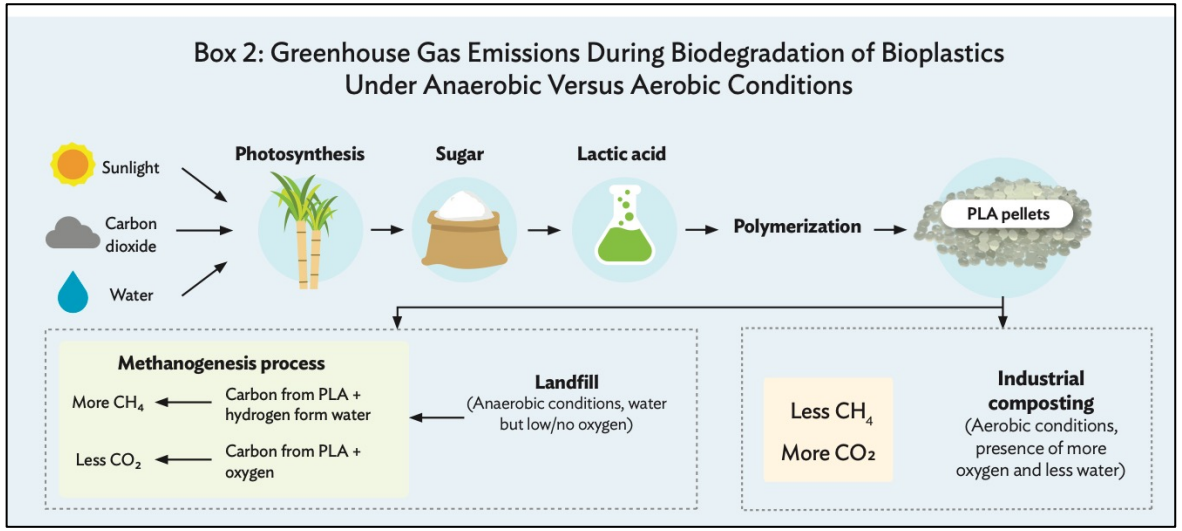
Thai Bioplastic Stakeholders We Engaged

Key Findings

Environmental Impacts

- Most bioplastics have lower greenhouse gas (GHG) emissions and fossil fuel use than petrochemical plastics, but have higher impacts to eutrophication, terrestrial acidification, particulate matter, water use, and agricultural land use.
- Farming and feedstock production activities for bioplastics made up a large share of the impacts to particulate matter, water use, and agricultural land use.
- Waste management of biodegradable bioplastics significantly influences the GHG emissions. GHG emissions during biodegradation can vary depending on how much carbon in the bioplastic resin is converted into carbon dioxide versus methane.
- Using agri-wastes can actually have a net increase in GHG emissions for bioplastics due to the higher energy demand of the conversion process (results based on data from lab-scale operations).





Financial Costs

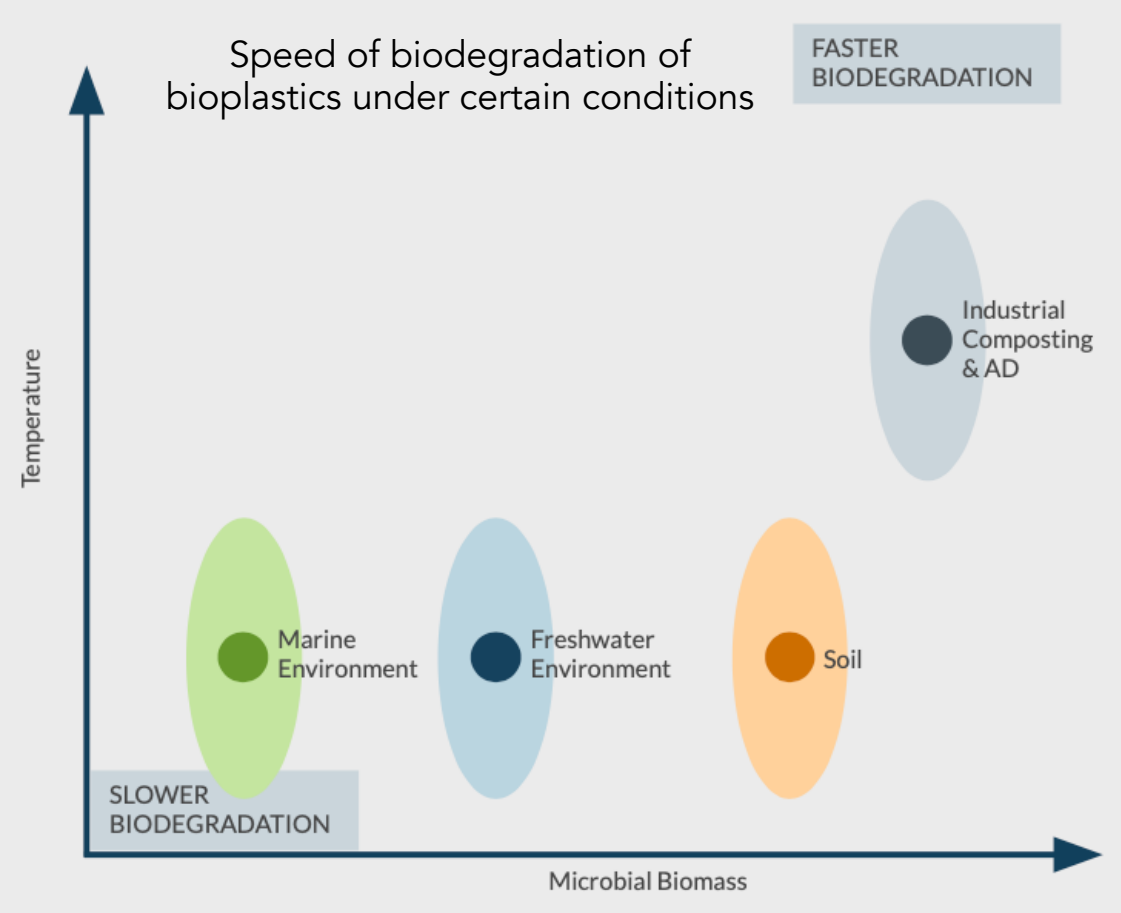
- **Resin costs:** Bioplastic resins are more expensive than petrochemical plastics (PET, PP, HDPE, LDPE prices range between USD0.40 – 0.60 per kg resin)
- **Profitability:** Bioplastics (PLA and PBS) can be a profitable investment that can recover investment costs within 10-12 years
- **Price fluctuations:** The prices of raw materials and resin sale prices for petrochemical plastics are affected by the oil and gas markets which are driven by supply and demand, cost of extraction and production, and political events and crises.
- **Domestic considerations:** If Thailand can control the prices of raw material inputs and manufacturing costs for domestic bioplastics production, this can help stabilize the financial performance in comparison to petrochemical plastics that is likely to be affected by factors outside of Thailand.

Bioplastic Resin	Price (USD/kg)
Bio-polyethylene (Bio-PE)	2
Bio-polyethylene terephthalate (Bio-PET)	2
Polybutylene succinate (PBS)	5
Polylactic acid (PLA)	3
Polyhydroxyalkanoate (PHA)	7
Thermoplastic starch (TPS)	2

Source: Thai Bioplastics Industry Association

Waste Management Aspects of Bioplastics

Biodegradation



Source: Circularity Concepts: Bioplastics and Alternative Materials, The Incubation Network and RRS

Mechanical Recycling

Challenges when mixing in biodegradable or compostable bioplastics in recycling streams

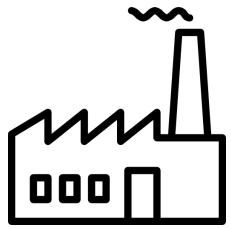
- Incompatible with traditional mechanical recycling technologies
- Higher loss rates of recyclable plastics due to contamination with compostable plastic
- Lower efficiency of the recycling facilities due to contamination of compostable plastic
- Mechanical properties of recycled polymers may be undermined by presence of biodegradable/compostable plastics in recycled streams

Looking Ahead

Actions to Improve Bioplastics

Feedstock production

- Contribute to agricultural sector reform
- Implement sustainable farming practices



Manufacturing

- Explore performance-based financial incentives for manufacturers
- Incentivize supply chain engagement
- Promote corporate clean energy in resin manufacturing facilities
- Improve agri-waste to bioplastic or biomaterial conversion technology

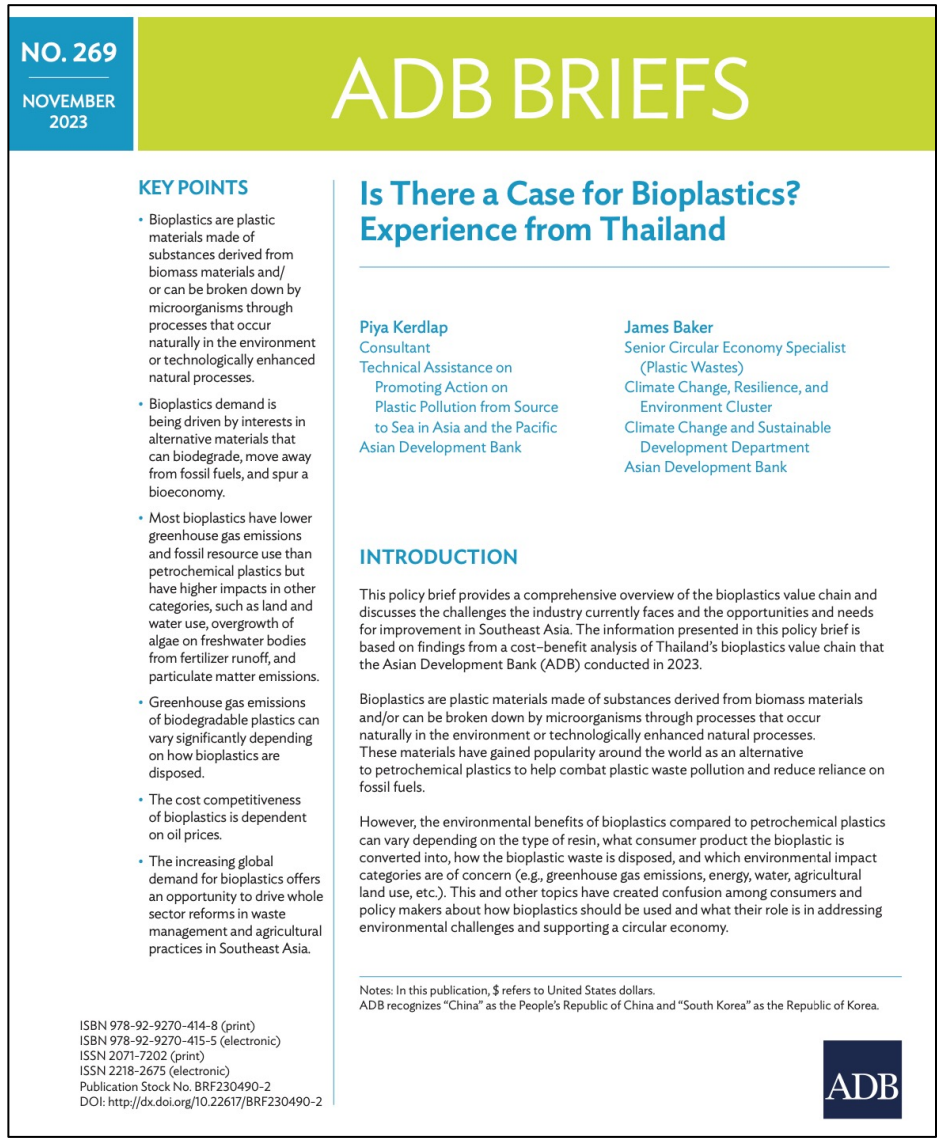
Consumption

- Identify applications of bioplastics that target specific problems

Waste management

- Investment in infrastructure to manage organic waste streams
- Institutional coordination in waste management
- Development of effective bioplastic labeling schemes

Learn More Through ADB's Policy Brief



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KEY POINTS

- Bioplastics are plastic materials made of substances derived from biomass materials and/or can be broken down by microorganisms through processes that occur naturally in the environment or technologically enhanced natural processes.
- Bioplastics demand is being driven by interests in alternative materials that can biodegrade, move away from fossil fuels, and spur a bioeconomy.
- Most bioplastics have lower greenhouse gas emissions and fossil resource use than petrochemical plastics but have higher impacts in other categories, such as land and water use, overgrowth of algae on freshwater bodies from fertilizer runoff, and particulate matter emissions.
- Greenhouse gas emissions of biodegradable plastics can vary significantly depending on how bioplastics are disposed.
- The cost competitiveness of bioplastics is dependent on oil prices.
- The increasing global demand for bioplastics offers an opportunity to drive whole sector reforms in waste management and agricultural practices in Southeast Asia.

Is There a Case for Bioplastics? Experience from Thailand

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INTRODUCTION

This policy brief provides a comprehensive overview of the bioplastics value chain and discusses the challenges the industry currently faces and the opportunities and needs for improvement in Southeast Asia. The information presented in this policy brief is based on findings from a cost–benefit analysis of Thailand's bioplastics value chain that the Asian Development Bank (ADB) conducted in 2023.

Bioplastics are plastic materials made of substances derived from biomass materials and/or can be broken down by microorganisms through processes that occur naturally in the environment or technologically enhanced natural processes. These materials have gained popularity around the world as an alternative to petrochemical plastics to help combat plastic waste pollution and reduce reliance on fossil fuels.

However, the environmental benefits of bioplastics compared to petrochemical plastics can vary depending on the type of resin, what consumer product the bioplastic is converted into, how the bioplastic waste is disposed, and which environmental impact categories are of concern (e.g., greenhouse gas emissions, energy, water, agricultural land use, etc.). This and other topics have created confusion among consumers and policy makers about how bioplastics should be used and what their role is in addressing environmental challenges and supporting a circular economy.

Notes: In this publication, $ refers to United States dollars.
ADB recognizes "China" as the People's Republic of China and "South Korea" as the Republic of Korea.

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ADB

- **Serves** as a guide for navigating the complex landscape of bioplastics in Southeast Asia
- **Gives** a 101 introduction to the different types of bioplastics.
- **Reviews** current state of bioplastic policies in Southeast Asia and other developed countries (promotions and bans).
- **Explains** life cycle environmental impacts of bioplastics in terms of greenhouse gas emissions and other areas.
- **Reviews** the waste management challenges of bioplastics in the context of Southeast Asia.
- **Provides** opportunities and needs in the bioplastic industry in Southeast Asia in terms of policies, improving environmental sustainability, and waste management and circularity.

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We would like to acknowledge the support of the Asian Development Bank, the Pollution Control Department of Thailand, and the Thai Bioplastics Industry Association in carrying out this important study.

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