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An Introduction to Bioplastics

2.4. Panel Discussion: Circular Plastics Economy and the Private Sector

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Managing Director

22 February 2024

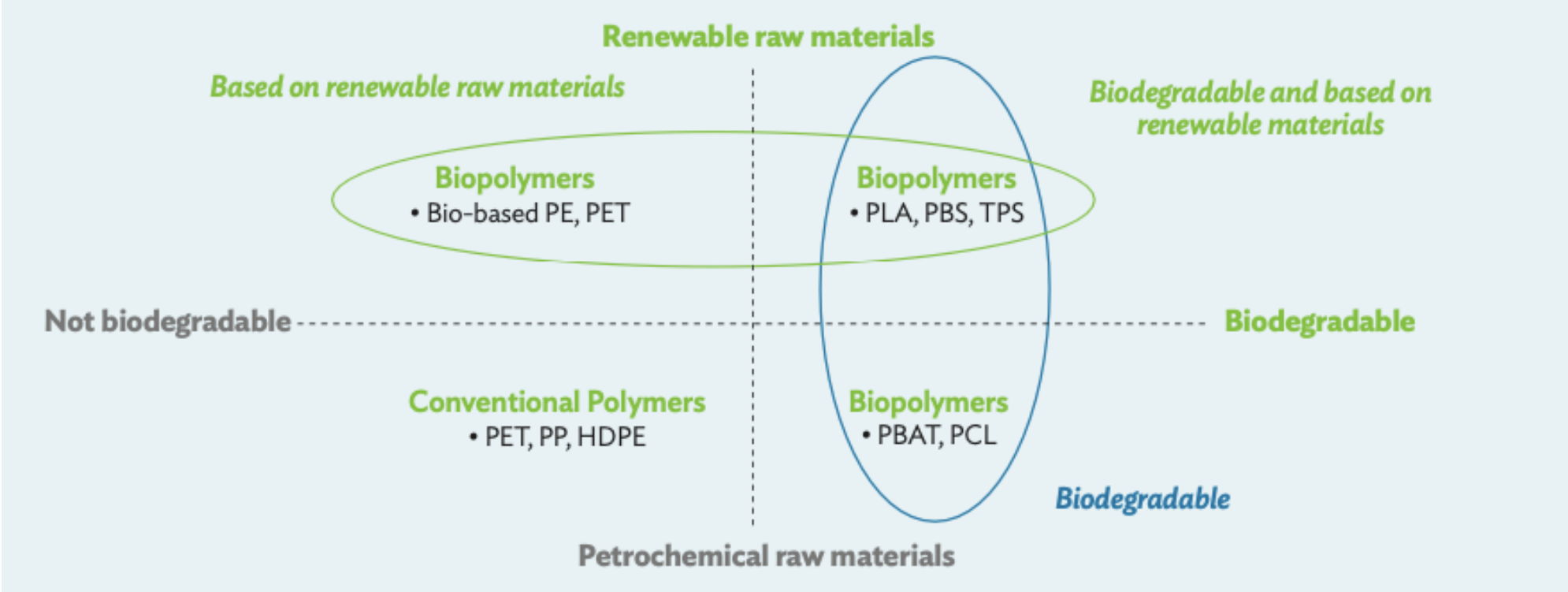
Getting in the Loop: Enabling Conditions for a Circular Economy

ADB Headquarters, Mandaluyong City, Philippines

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



Bioplastics Policies in Southeast Asia

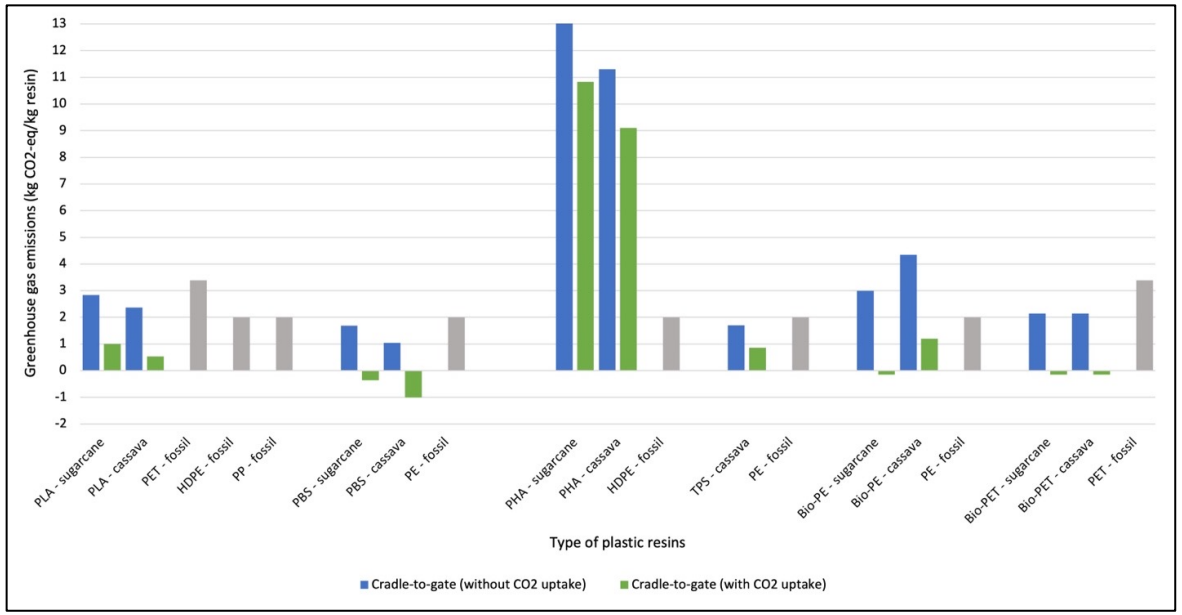
Country	Policy
Cambodia	• Adopted a sub-decree that promotes biodegradable plastics and public plastic bag reduction through reusing plastic bags or using eco-friendly bags.
Indonesia	• Ministry of Industry of Indonesia enacted the Ministerial Regulation Number 55/2020 regarding Green Industry Standards 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.

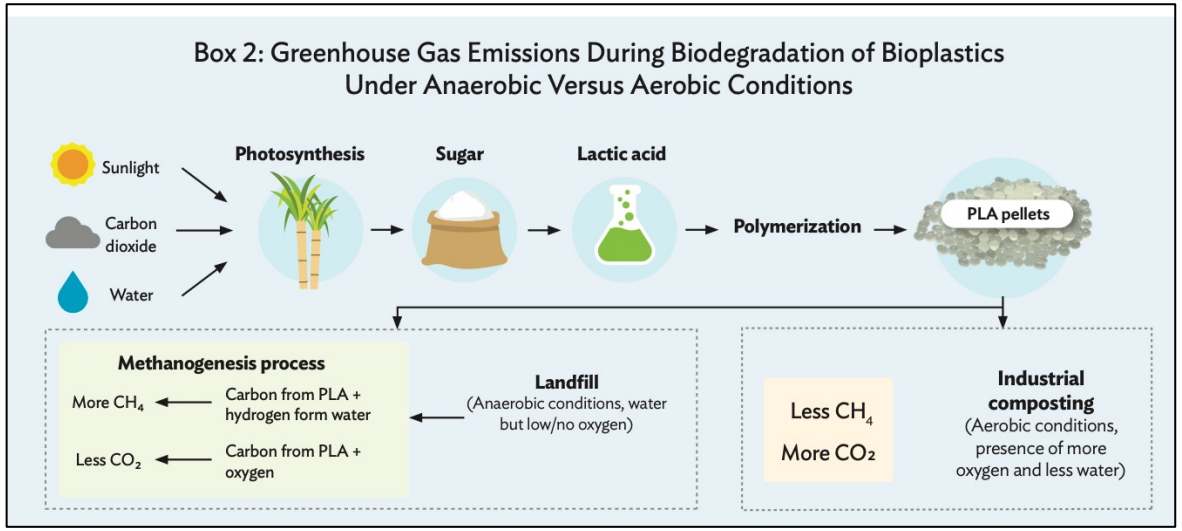
Thailand Bioplastic Cost-Benefit Analysis Study

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)

Environmental Impacts

- Most bioplastics have lower greenhouse gas (GHG) emissions and fossil fuel use than petrochemical plastics, but have higher 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 in. 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

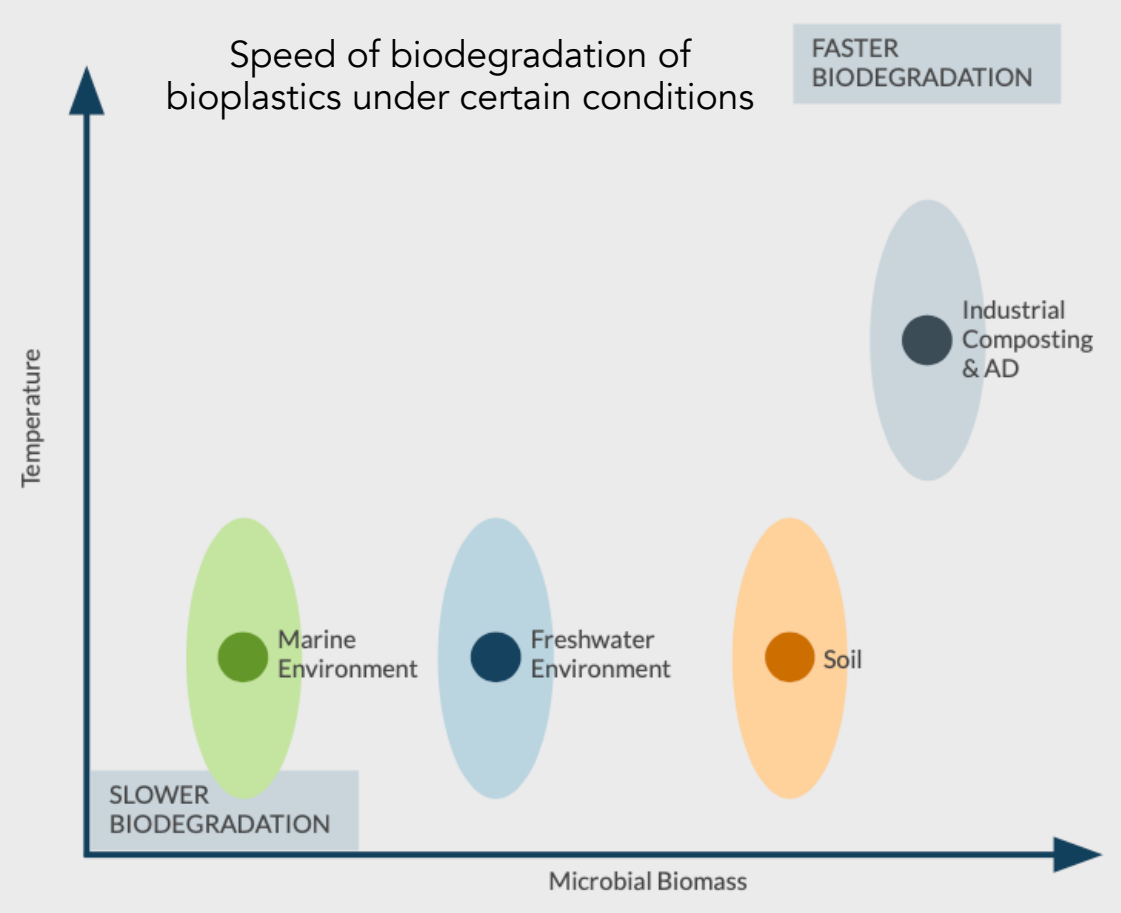
- **Resin costs:** Bioplastic resins are more expensive than petrochemical plastics (PET, PP, HDPE, LDPE prices range between USD0.40 – 0.60 per kg resin)
- **Profitability:** Bioplastics (PLA and PBS) can be a profitable investment that can recover investment costs within 10-12 years
- **Price fluctuations:** 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

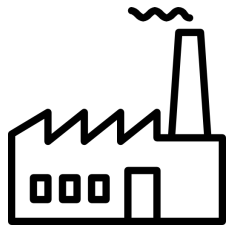
Challenges when mixing in biodegradable or compostable bioplastics in recycling streams

- 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

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
- Improving agri-waste to bioplastic or biomaterial conversion technology

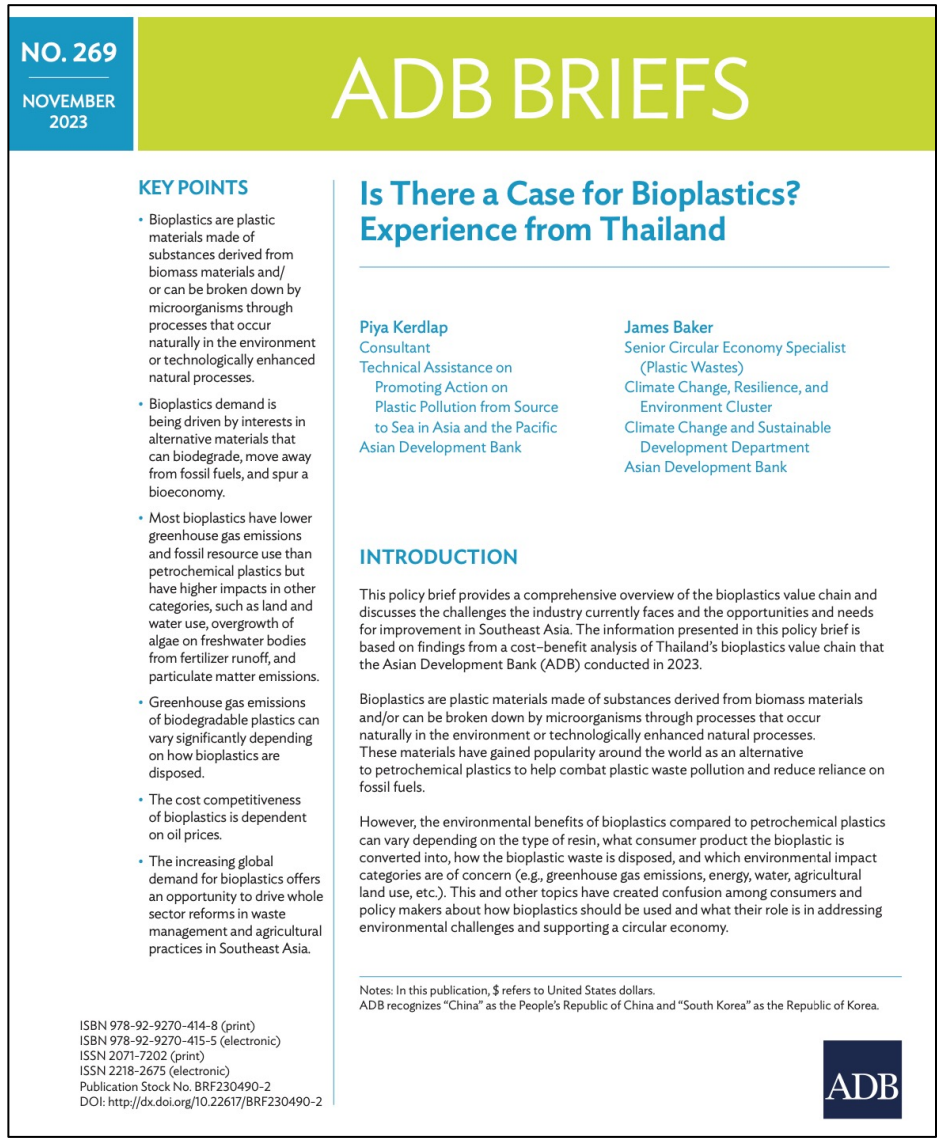
Consumption

- 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



NO. 269
NOVEMBER 2023

ADB BRIEFS

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.

ISBN 978-92-9270-414-8 (print)
ISBN 978-92-9270-415-5 (electronic)
ISSN 2071-7202 (print)
ISSN 2218-2675 (electronic)
Publication Stock No. BRF230490-2
DOI: http://dx.doi.org/10.22617/BRF230490-2

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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