S&P Global
Commodity Insights

CI Consulting

Circular Economy

Biopolymers (Polylactic Acid)

Hormuzd R Karanjia
Executive Director, Chemicals Consulting
16th May 2025

Together, we are a strong combination of complementary powerhouses.

IHS Markit

+

S&P Global

Chemicals

- Every industry, from agriculture to energy to retail, relies on chemicals at some stage in the production process. To stay ahead, you need a deeper understanding of market volatility, regulatory pressures, supply-chain disruption and shifting end user demand.
- Our chemicals consultants have experience advising chemical producers, governments, financial institutions and technology providers operating at any point along the value chain, from commodity to specialty chemicals.

We can help you with

- Techno-economic and feasibility studies
- Plastics Circularity
- Market studies for commodity chemicals
- Transaction support
- Specialty chemicals studies
- Process technology

Source: S&P Global Commodity Insights

Why the interest in the Circular Economy?

Climate change is leading industrials to decarbonize portfolios	Energy players looking to diversify via chemicals.	Increasing ESG influence from investors, brand owners	As progress towards a circular economy accelerates, cost challenges emerge
Plastics as visible component with increasing **waste generation**	Refining growth increasingly dependent on petrochemicals	Petrochemical industry to align on disclosure and metrics	Low margin environment, without carbon valuation; expect the change to be policy driven

- Stakeholders along the value chain are driving a transformation of the plastic economy from linear to circular while commercially scaled technology, inadequate infrastructure and coordinated logistics all impede progress.
- Market volatility leads companies into reinvention
- Mismanaged plastics waste threatens the industry's "social license to operate."

Globally, approx. 9% of plastic waste is recycled while 22% is mismanaged

Source: S&P Global Commodity Insights
OECD.org

Pressure has picked up on the plastics industry to mitigate the negative impact of plastic consumption on the environment

Legislation & bilateral agreements				Tools			
Applications	Plastic types	Consumption /end of life	Trade	EPR	Bans	Plastic tax	Deposit-refund scheme

Focus on packaging

Recycling rate & recycled content

Target to 2025/30/40

- Legislation focused primarily on applications rather than type of plastics with aim to reduce either consumption into these applications or promote end of life and plastics circularity.
- Regulation centered around trade and plastics' waste trade that can be beneficial but also counterproductive to promote recycling.
- Tools have been set in place to support legislation such as bans on certain applications, deposit schemes (that improve collection/sorting and mechanical recycling), and EPR and plastic tax schemes that drive financing

Source: S&P Global Commodity Insights

Biodegradable polymers are mainly derived from bio-based feedstocks, which are themselves made from starches and sugars via fermentation and in some cases by processing natural oils

Non-Biodegradable,
Bio-Based Feedstock

PE(from bio-naphtha), PA11 (from castor oil), PA66 (from bio-based adipic acid)

Biodegradable &
Bio-Based Feedstock

Cellulose acetate & other cellulose products, Starch compounds, PLA (Polylactic Acid), PHAs, PBAT, PBS, PBSA

Bio-Based

Biodegradable

Conventional Polymers (petrochemical-based and non-biodegradable)

HDPE, LDPE, LLDPE, PP, PVC, PET, PA, PCPS, EPS, ABS, EVA/EVOH

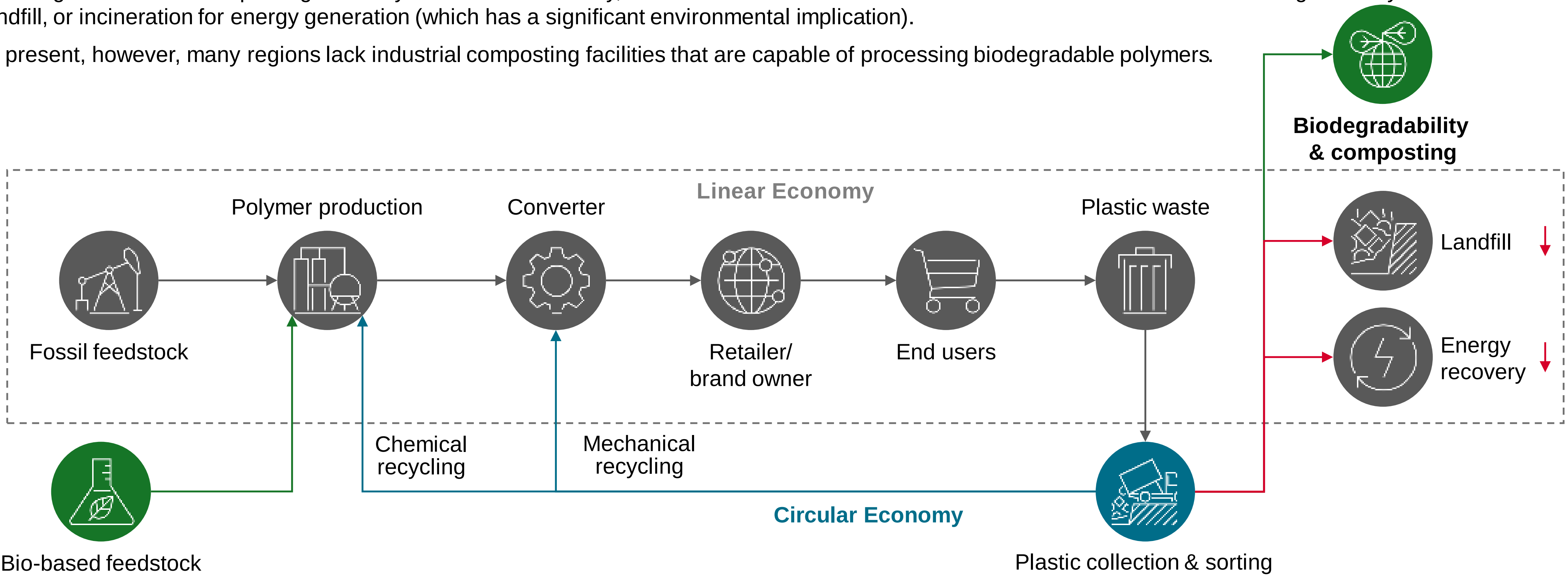
Biodegradable,
Petrochem. Feedstock

PVOH(Polyvinyl Alcohol), PCL(Polycaprolactone), PGA(Polyglycolic Acid)

Source: S&P Global Commodity Insights
PHAs (Polyhydroxyalkanoates); PBAT (Polybutylene Adipate Terephthalate); **PBSA (Polybutylene Succinate Adipate) -** properties of PBAT and PBS

Biodegradable plastics represent one aspect of the desirable "circular plastics economy", decreasing the volume of plastic that ends life in landfill or via incineration

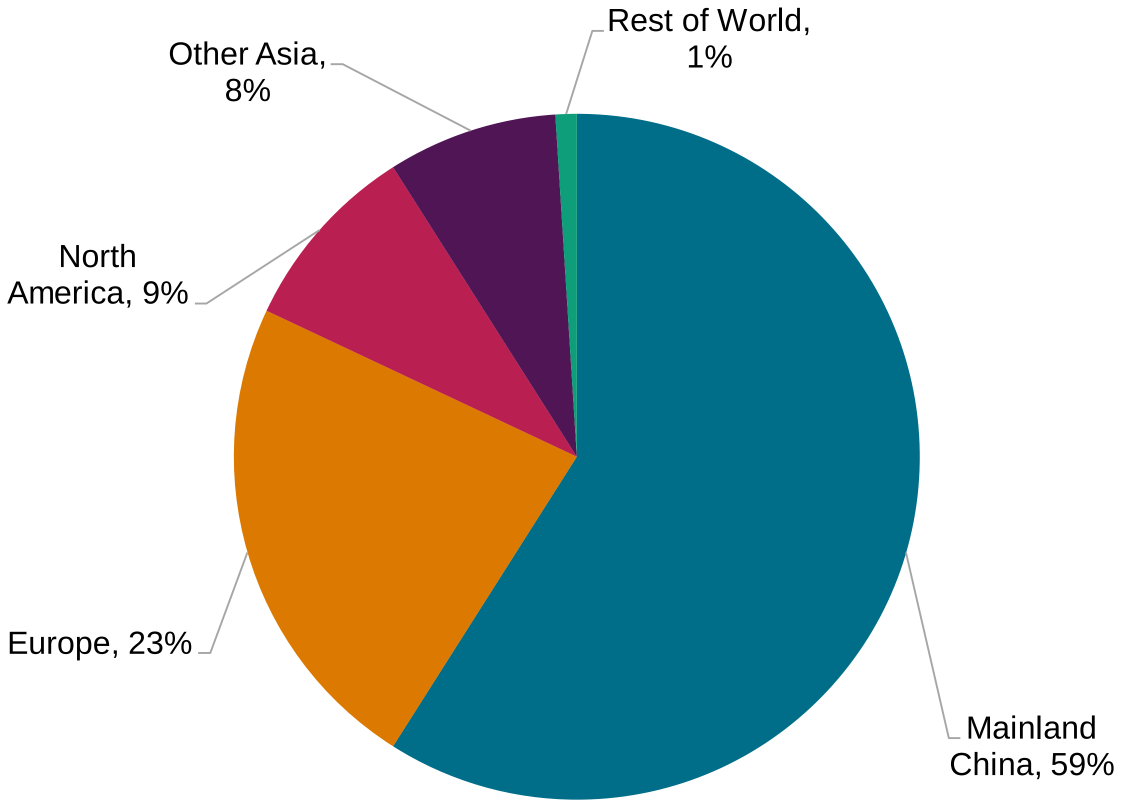
- Composting programs divert organic waste from landfill, thus reducing greenhouse gas emissions from landfill sites.
- Compostable packaging can be used in some closed loop systems, such as large sporting events, festivals or workplaces with catering facilities, where PLA based packaging can be distributed and have dedicated disposal and collection services.
- By being amenable to composting – usually in a dedicated facility, but sometimes under ambient conditions – the material avoids ending its life by unsustainable landfill, or incineration for energy generation (which has a significant environmental implication).
- At present, however, many regions lack industrial composting facilities that are capable of processing biodegradable polymers.



Source: S&P Global Commodity Insights

Biodegradable Polymer Market Size by Major Region

Global Biodegradable Polymer Demand by Region,2025



Total : 1.2 million metric tons

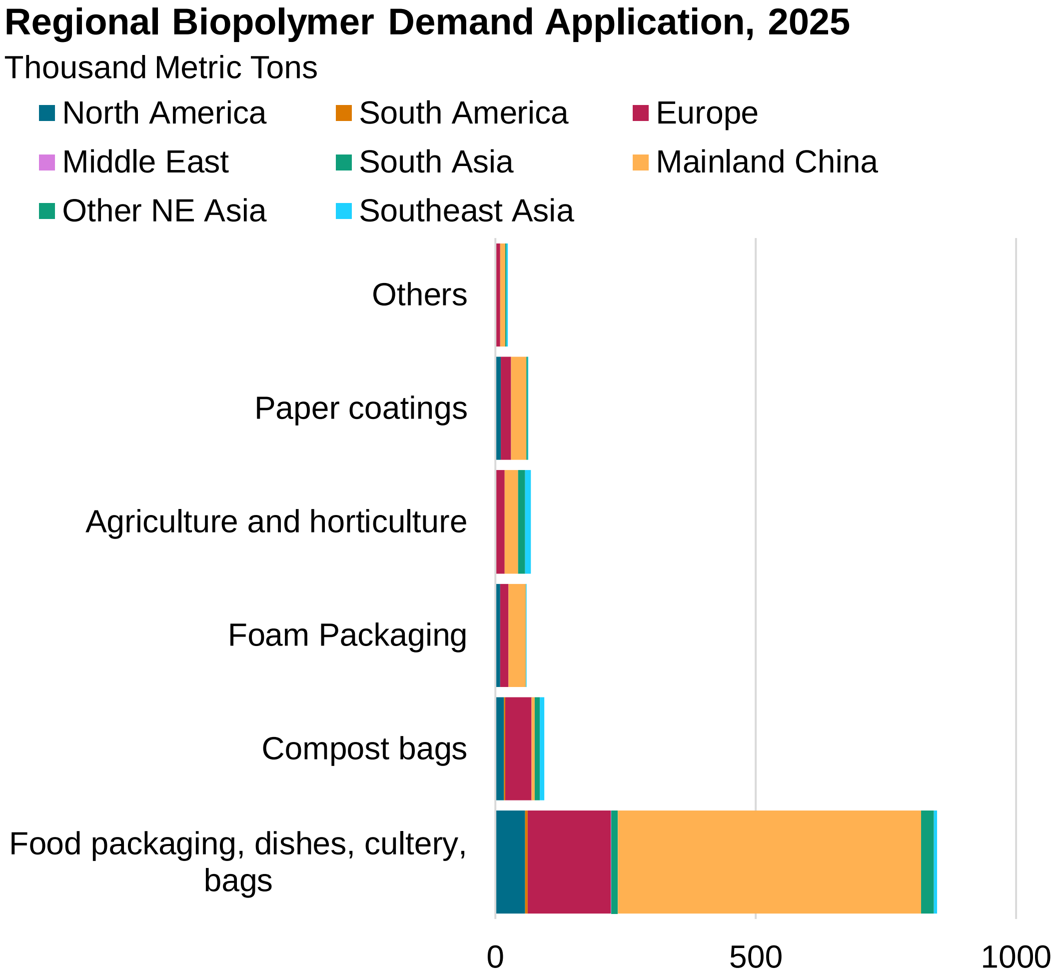
Data compiled March 2025
Source: S&P Global Commodity Insights.

Large disparity in the consumption & type/distribution of biodegradable polymers across different geographic regions

China, Europe and North America are major hubs for biodegradable polymers, with installed and upcoming capacity, and an above-GDP level of demand growth stimulated by legislation to lower the reliance on single-use, conventional plastics.

Legislation, combined with Central Government initiatives such as 'Made-in-China 2025', have encouraged biopolymer use and investment in mainland China.

Regional Variation in Biodegradable Polymer Use



The utilization of biodegradable plastics exhibits significant variation across different regions worldwide, influenced by local market demands and regulatory environments.

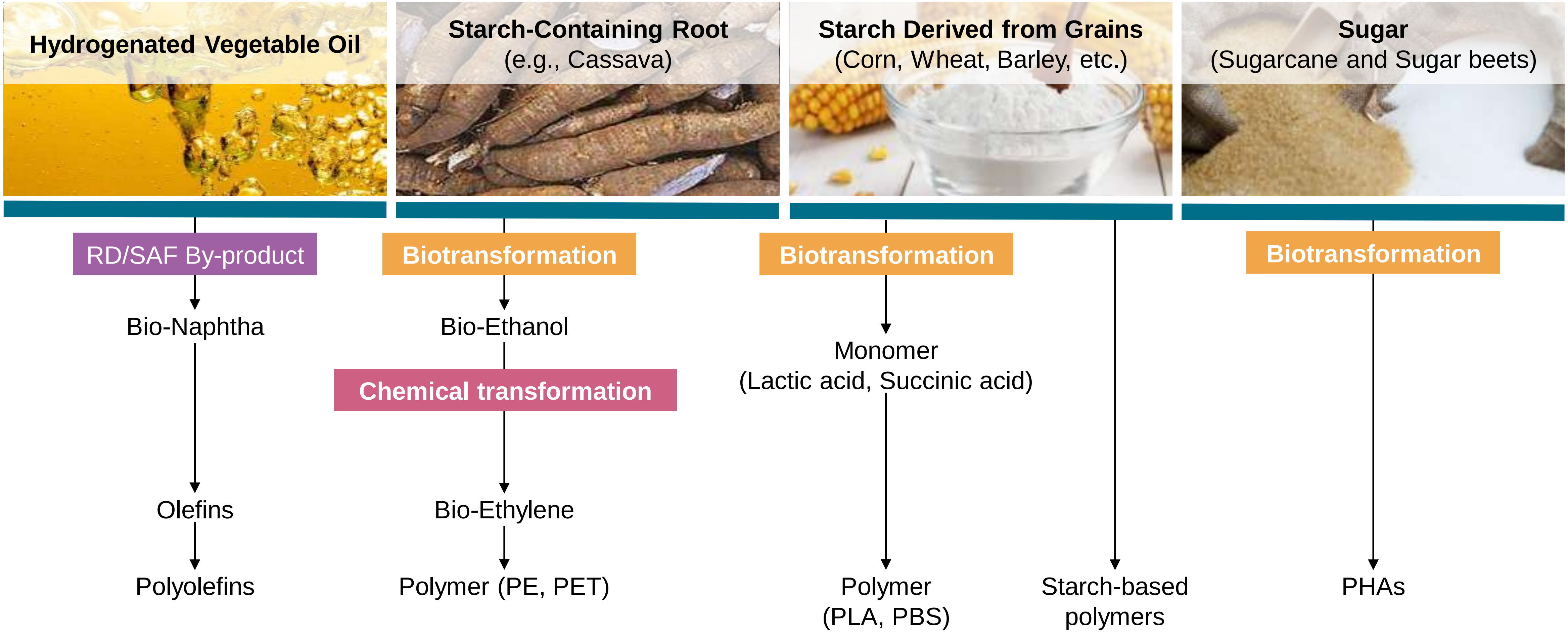
In Mainland China, the "**plastic ban"** has led to the replacement of **traditional plastic bags with biodegradable options**, such as PLA/starch/PBAT compounds, which are widely used in major cities.

Although traditional plastic straw consumption has decreased due to the "plastic ban," **the adoption of biodegradable alternatives like PLA straws** is still growing, particularly among small and medium-sized catering enterprises.

Overall, the demand for biodegradable polymers in these applications is driven by **regulatory changes and the need for sustainable solutions**.

Poly Lactic Acid - PLA

Natural substances offer routes to producing valuable chemical building blocks and intermediates, via chemical and bio-transformations, for producing bio-based polymers



Source: S&P Global Commodity Insights

Thailand – Bioplastics Hub Potential

Thailand's Role in Cassava and Sugar Production

Thailand is the leading global exporter of cassava, accounting for over 60% of the market, and is also the fifth largest producer of sugar. Both cassava and sugarcane, along with their waste byproducts, serve as significant sources of biomass that can be utilized to produce PLA and other bioplastics. Cassava ranks as the third-largest source of carbohydrates in tropical diets, following rice and maize, and is a vital staple for over 500 million people. Thailand holds the title of the largest exporter of cassava starch.

Tax Incentives and Investment in Thailand's Bioplastics Sector

Thailand offers various tax incentives for companies in the bioplastics sector, including corporate tax exemptions and up to eight-year tax holidays for environmentally friendly products like PLA. Businesses can also receive import duty exemptions on machinery. The country is attracting significant investments due to its abundant raw materials, existing value chain, and supportive government policies.

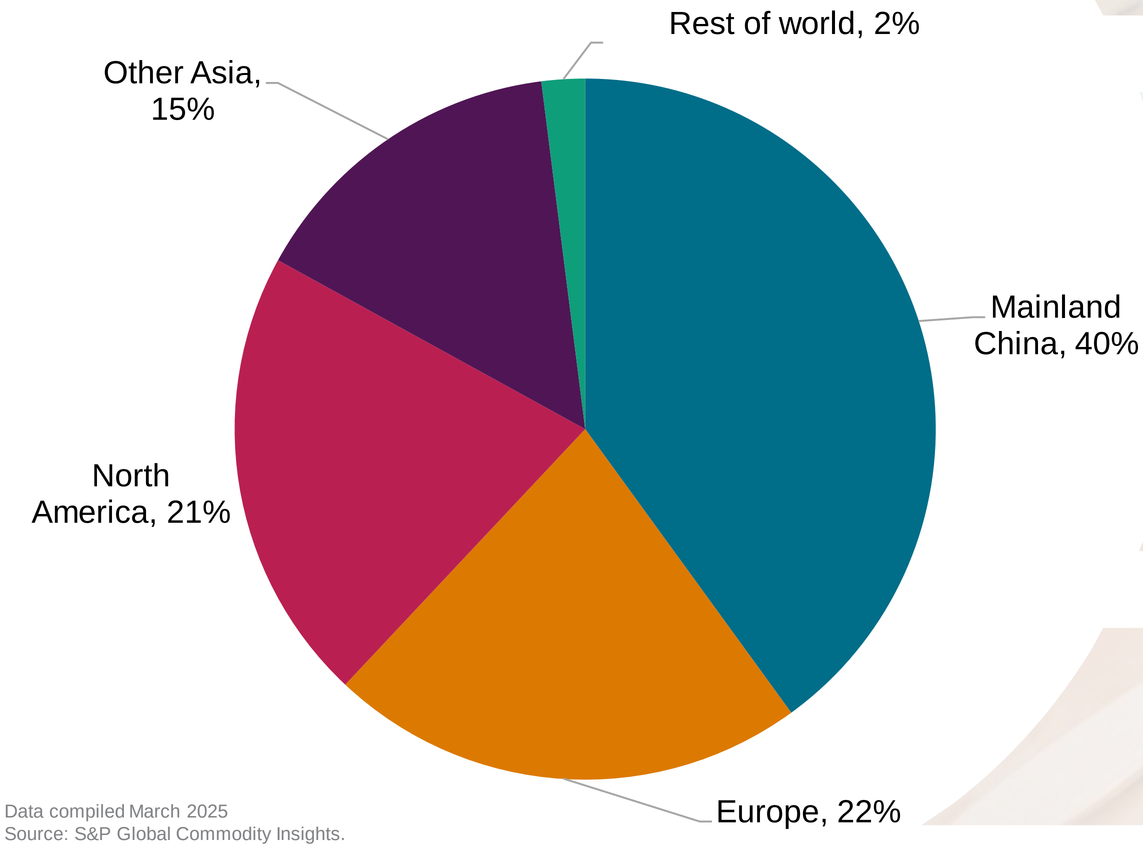
Strategic Advantages for Bioplastics Operations in Thailand

Businesses looking to establish bioplastics operations in Thailand will benefit from easy access to abundant biomass resources, which will become increasingly valuable as industry demand rises. The opening of the world's second-largest PLA plant (75,000 tons) by Total Corbion PLA (Thailand) Ltd., a joint venture between French energy group Total and Amsterdam-based biochemicals company Corbion, in September 2019 marked a significant step in the industry's development. NatureWorks' Ingeo™ startup is planned for 2025

Source: S&P Global Commodity Insights

Polylactic Acid Market Size by Major Region

Global Polylactic Acid Demand by Region, 2025



Data compiled March 2025
Source: S&P Global Commodity Insights.

The total global demand for PLA in 2025 is about 288,000 metric tons, with an expected compound annual growth rate (CAGR) of 9.1% from 2025 to 2030, reaching over 445,000 metric tons by 2030

This demand is primarily concentrated in three regions: North America (60,000 metric tons), Western Europe (60,000 metric tons), and Northeast Asia (149,000 metric tons), which together account for nearly 94% of global demand in 2025.

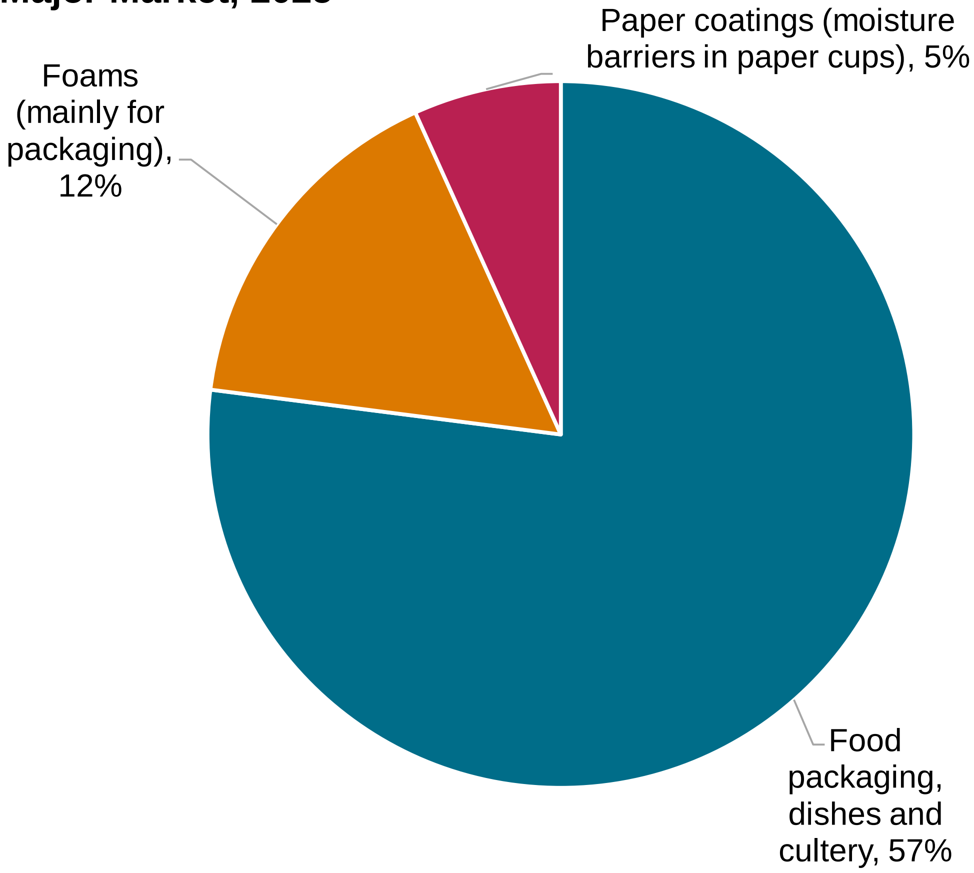
The growth of Polylactic Acid (PLA) is hindered by physical property limitations, such as lower heat and impact resistance. These issues are being mitigated by blending PLA with other polymers, exemplified by BASF's Ecovio® product line

The increase in consumption is largely driven by legislative measures and consumer preferences shifting towards more sustainable products.

Polylactic Acid Market Size by Application

Polylactic acid (PLA) is a biodegradable biopolymer derived from renewable resources, widely used across various industries due to its environmental benefits

Global Polylactic Acid Demand by Major Market, 2025



Data compiled March 2025
Source: S&P Global Commodity Insights.

Food Packaging, Dishes, and Cutlery (57%): PLA is popular in the food industry for packaging materials and disposable items, offering a sustainable alternative to conventional plastics due to its transparency, rigidity, and compostability.

Foams (12%): PLA foams are used mainly in packaging, providing cushioning and protection for items during shipping. They are also utilized in construction for insulation and in automotive applications for lightweight components.

Paper Coatings (5%): PLA serves as a moisture barrier in paper products like cups and containers, maintaining product integrity and offering compostable solutions in the food service industry.

Emerging Applications of Poly Lactic Acid

PLA cup, salad bowl, container, lid, drinking straws, coffee pods

PLA-lined hot cups and hot soup cup

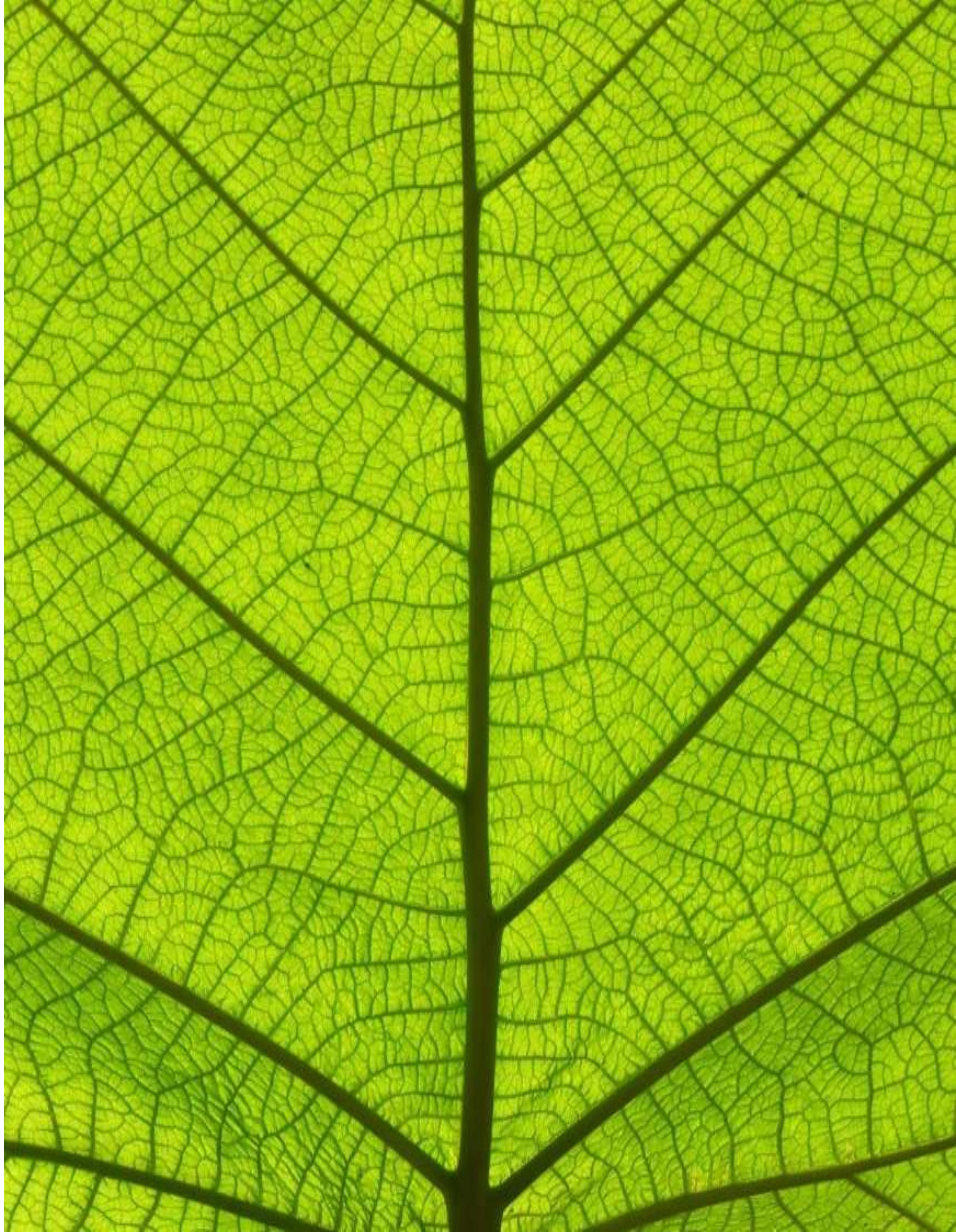
PLA foam clamshell, tray, ice cream box

Emerging Applications of Poly Lactic Acid

Compostable PLA carrier bag, vegetable packing bag, bin bag

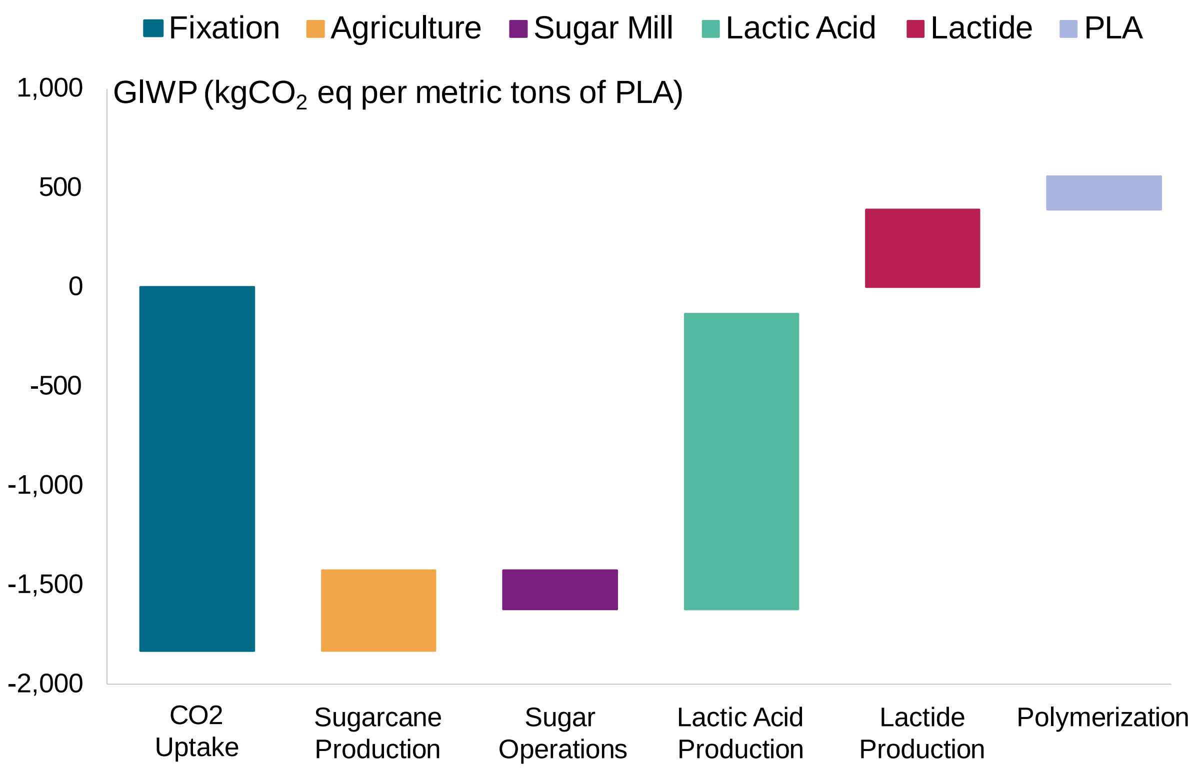
PLA-based agriculture mulching film

Carbon Footprint – Poly Lactic Acid - PLA



Carbon Footprint Considerations – Taking PLA as an Example

PLA Carbon Footprint



Data compiled December 2023
Source: Journal of Polymers and the Environment, https://doi.org/10.1007/s10924-019-01525-9

Major producers of biodegradable plastics have published their LCAs, some in the academic literature.

Some include CO_2 fixation by the crop in much the same way as seen with biofuels using the GREET® model (Greenhouse gases, Regulated Emissions, and Energy use in Technologies).

This approach to PLA LCA analysis results in a carbon footprint of 500 kgCO_2 eq per metric ton of PLA produced.

Ongoing process improvements, access to renewable energy, etc., can further lower this figure.

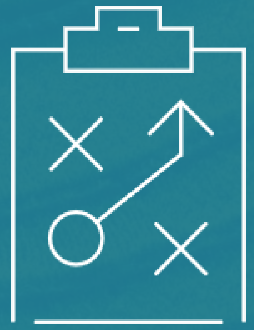
However, the lactic acid step is the major emitter as the chemistry generates CO_2. In future this could be captured for sequestration or even feedstock use.

Strategic considerations for biodegradable polymers must account for their currently minimal share in overall plastic consumption and the competing circular plastic economy

Biodegradable polymers account for only a small share of the global plastics market

Legislative pressure continues to drive demand, but feedstock availability may act as a barrier

Competition from plastics recycling could limit the potential of biodegradable polymers



Disclaimer

S&P Global Commodity Insights is a business division of S&P Global Inc. ("SPGCI"). The reports, data, and information referenced in this document ("Deliverables") are the copyrighted property of SPGCI and represent data, research, opinions, or viewpoints of SPGCI. SPGCI prepared the Deliverables using reasonable skill and care in accordance with normal industry practice. The Deliverables speak to the original publication date of the Deliverables. The information and opinions expressed in the Deliverables are subject to change without notice and SPGCI has no duty or responsibility to update the Deliverables (unless SPGCI has expressly agreed to update the Deliverables). Forecasts are inherently uncertain because of events or combinations of events that cannot reasonably be foreseen including the actions of government, individuals, third parties and competitors. The Deliverables are from sources considered by SPGCI (in its professional opinion) to be reliable, but SPGCI does not assume responsibility for the accuracy or completeness thereof, nor is their accuracy or completeness or the opinions and analyses based upon them warranted.

To the extent permitted by law, SPGCI shall not be liable for any errors or omissions or any loss, damage, or expense incurred by reliance on the Deliverables or any statement contained therein, or resulting from any omission. THE DELIVERABLES ARE PROVIDED "AS IS" AND TO THE MAXIMUM EXTENT ALLOWED BY LAW, NEITHER SPGCI, ITS AFFILIATES NOR ANY THIRD-PARTY PROVIDERS MAKES ANY REPRESENTATION, WARRANTY, CONDITION, OR UNDERTAKING, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, RELATING TO THE DELIVERABLES OR THE RESULTS OBTAINED IN USING THEM; INCLUDING: A) THEIR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE; OR B) THEIR CONTINUITY, ACCURACY, TIMELINESS OR COMPLETENESS. The Deliverables are supplied without obligation and on the understanding that any recipient who acts upon the Deliverables or otherwise changes its position in reliance thereon does so entirely at its own risk.

The Deliverables should not be construed as financial, investment, legal, or tax advice or any advice regarding any recipient's corporate or legal structure, assets or, liabilities, financial capital or debt structure, current or potential credit rating or advice directed at improving any recipient's creditworthiness nor should they be regarded as an offer, recommendation, or as a solicitation of an offer to buy, sell or otherwise deal in any investment or securities or make any other investment decisions. The Deliverables should not be relied on in making any investment or other decision and should not in any way serve as a substitute for other enquiries or procedures which may be appropriate. Nothing in the Deliverables constitutes a solicitation by SPGCI or its Affiliates of the purchase or sale of any loans, securities or investments. The Deliverables do not constitute legal advice and SPGCI did not act in the capacity of lawyers under any jurisdiction in the preparation of Deliverables. SPGCI is not a registered lobbyist and cannot advocate on anyone's behalf to government officials regarding specific policies.

S&P Global Inc. also has the following divisions: S&P Dow Jones Indices, S&P Global Market Intelligence, S&P Global Mobility, and S&P Global Ratings, each of which provides different products and services. S&P Global keeps the activities of its business divisions separate from each other in order to preserve the independence and objectivity of their activities. SPGCI publishes commodity information, including price assessments and indices and maintains clear structural and operational separation between SPGCI's price assessment activities and the other activities carried out by SPGCI and the other business divisions of S&P Global Inc. to safeguard the quality, independence and integrity of its price assessments and indices and ensure they are free from any actual or perceived conflicts of interest. The Deliverables should not be construed or regarded as a recommendation of any specific price assessment or benchmark.

No portion of the Deliverables may be modified, reproduced, reused, or otherwise distributed in any form without the prior written consent of SPGCI (to be granted or withheld in SPGCI's absolute discretion).

Unless SPGCI has expressly agreed otherwise, the Deliverables are not works-made-for-hire and SPGCI shall own all right, title, and interest in and to the Deliverables, including all intellectual property rights which subsist in the Deliverables. Use of the Deliverables is subject to any licence terms and restrictions agreed between SPGCI and the commissioning Client. The SPGCI name(s) and logo(s) and other trademarks appearing in the Deliverables are the property of S&P Global Inc., or their respective owners.

Contacts

Hormuzd R Karanjia (Singapore)
Executive Director- Chemical Consulting
Hormuzd.Karanjia@spglobal.com
+65 91158492