LANCANG-MEKONG COOPERATION SPECIAL FUND

MASCI
Management System Certification Institute (Thailand)

CIRCULAR ECONOMY CAPABILITY BUILDING IN THE LANCANG-MEKONG REGION PROJECT

DESK RESEARCH: CE PRODUCT VERIFICATION FOR PLASTICS PACKAGING IN SUPPLY CHAINS

Project Title: Circular Economy (CE) Capability Building in the Lancang-Mekong Region: Product Verification of Plastics Packaging in Supply Chains

Duration: 1 Year (December 2022 – November 2023)

Implementing Agency: Management System Certification Institute (Thailand) (MASCI), Ministry of Industry, Thailand

Acknowledgement

The research team would like to express my gratitude and appreciation to Lancang-Mekong Cooperation Special Fund (LMCF) our their finances and for providing necessary guidance concerning projects framework and implementation.

We sincerely appreciate the Management System Certification Institute (MASCI) for your efforts in professional coordinating among institutions. The project task could be executed successfully according to the timeline.

We are also grateful to Office of Industrial Economics (OIE), Plastic Institute of Thailand for provision of expertise, and technical support in the implementation. With their superior knowledge and experience, the research team can successfully accomplish high quality outputs and outcomes.

Nevertheless, we express our gratitude toward the National Institute of Development Administration (NIDA) for their fully support in facilities and experts in the field which help us in completion of this project.

Research team

CONTENTS

FIGURES

FIGURES (CONT.)

FIGURES (CONT.)

FIGURES (CONT.)

TABLES

CHAPTER 1

GLOBAL PLASTICS INDUSTRY AND PLASTICS PACKAGING OVERVIEW

Chapter 1

1. Global Plastics Industry and Plastics Packaging Overview

1.1 Global Plastics Resin Situation

During 2017–2021, the world's import-export value of plastic resins has grown at an average rate of +7.03% and +9.43% per year. However, it can be observed that the global plastic resin trade has continuously contracted since 2019 and 2020, which was a period when the COVID-19 virus spread across many regions of the world. This has resulted in a slowdown in the plastic processing and manufacturing industries, including the transportation of goods in some areas. In 2021, it was found that the value of global import-export of plastic resins had expanded from 2020, reflecting the recovery of the trade and plastic processing and manufacturing industries after the pandemic situation subsided.

As for the direction of the world's plastic resin trade in 2022, it was found that the import-export value was at 364.361 billion USD and 370.800 billion USD, respectively. Compared to the same period in 2021, the import-export value has contracted and decreased by -0.27% YoY and -1.54% YoY, respectively. This contraction of the import-export value of plastic resins in 2022 is partly due to the impact of the COVID-19 pandemic situation in China, which has put pressure on market confidence and reduced the volume of orders in the destination market.

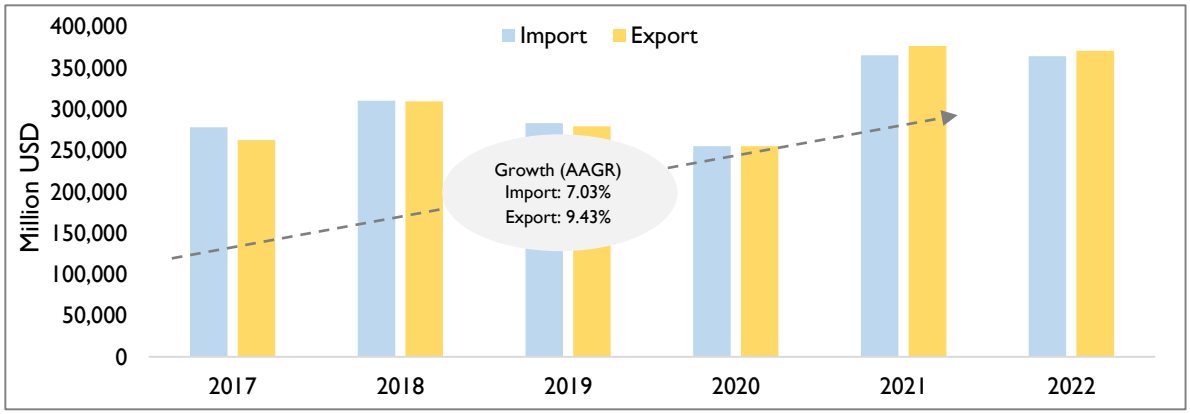


Figure 1-1 Global Plastic Resin Import-Export Value 2017-2022

sourse: Plastics Institute of Thailand (n.d.)

Overall changes in global plastic resin imports in 2022 reveal that the value of plastic resin imports has contracted compared to the previous year, with a decrease of -968.74 million US dollars or a YoY growth rate of -0.27%. When examining the proportion of plastic resin imports by key destination countries in 2022, it is found that China has the highest plastic resin imports in the world. This is because China produces over 100 million tons of plastic raw materials annually and consumes over 30 million tons of plastic products, with the proportion of imports accounting for approximately 15%, or equivalent to 56,171 million US dollars. The value of China's plastic resin imports has decreased by -

8.1% compared to the previous year, reflecting the direction of raw material prices, including the impact of COVID-19 measures to control the spread of the virus within the country, which resulted in economic activities being stalled. The second and third highest proportions of plastic resin imports are Germany and the United States, which account for 7% of the world's total plastic resin imports. The value of plastic resin imports from both countries has grown by +4.3% and +10.2% YoY, respectively.

In terms of the overall value of global plastic resin exports in 2022, which amounted to 370,800 million US dollars, there has been a contraction of -1.54% YoY. When considering the proportion of plastic resin exports by the top 10 exporting countries, it is found that the country with the highest proportion of global plastic resin exports is the United States, followed by Germany, and France, respectively. The value of plastic resin exports from the United States has decreased by -1.73% YoY, while those from Germany and France have increased by +1.41% and -1.81% YoY, respectively.

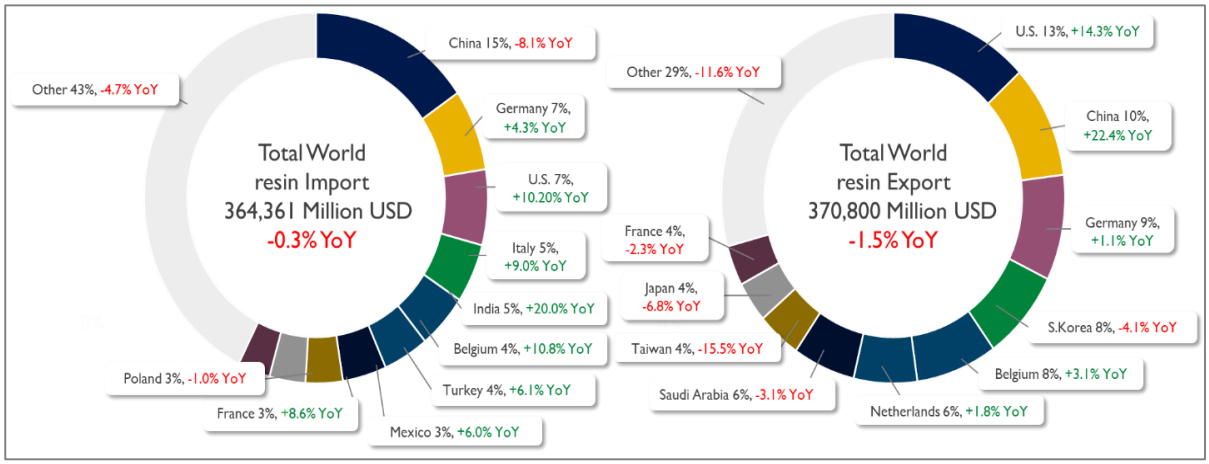


Figure 1-2 The World's Top 10 Countries with the Highest Import and Export of Plastic Resin (By Value) in 2022

source: Plastics Institute of Thailand (n.d.)

The overall picture of the plastic industry's supply chain found that China is the largest importer of plastic resin in the world. This is because China is the largest producer and exporter of industrial products in the world, leading to a large number of plastic resin imports from foreign countries each year. As for the export of plastic resin, the United States is the world's largest exporter, partly due to being the world's largest crude oil producer. Additionally, the United States is also a leader in manufacturing technology in the world.

1.2 Global Plastics Product Situation

In the past, from 2017 to 2021, the global plastic product trade, both import and export, has shown a continuous growth trend with an average annual growth

rate of +7.08% and +8.32%, respectively. Although many countries around the world were impacted by the COVID-19 pandemic from late 2019 to 2020, the overall plastic product trade was relatively less affected compared to products in other industries, due to increased demand for plastic components in the medical equipment sector during that period. Additionally, the expansion of online ordering and food delivery businesses has contributed to the increased consumption of plastic products. Furthermore, the shift in consumer behavior towards the new normal has resulted in higher demand for plastic products. In 2021, as the severity of the COVID-19 pandemic decreased and many countries eased their domestic control measures, the tourism and service sectors began to recover, leading to significant growth in the import and export of plastic products.

In 2022, the global value of plastic product imports and exports was recorded at 348,233 million US dollars and 398,353 million US dollars, respectively, compared to the previous years. It's further found that in 2022, world imports of plastic products contracted by -0.86% YoY, but exports of plastic products grew by +0.74% YoY.

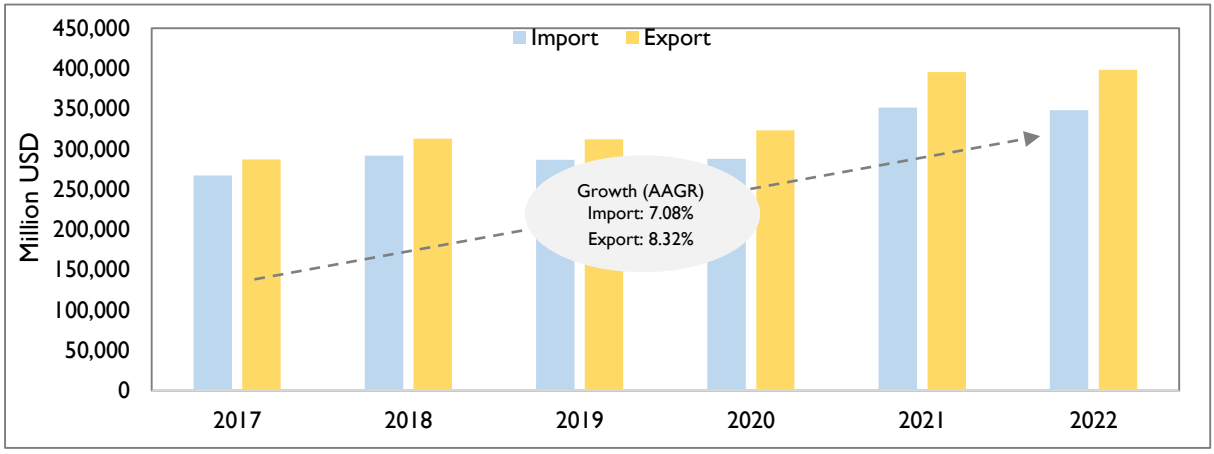


Figure 1-3 Global Plastics Product Import-Export Value 2017-2022

Source: Plastics Institute of Thailand (n.d.)

Considering the ranking of countries with the highest value of imported plastic products in the world's top 5 in 2022, it was found that the ranking of leading plastic product importing countries remained similar to that in 2021. In 2022, the United States remained the country with the highest value of imported plastic products, ranking first in the world. This is because it is the largest consumer goods market in the world, and there is also a trend of expansion due to the improvement of the pandemic situation after the spread of COVID-19. The value of plastic product imports accounted for 17% of the world's total plastic product imports, or a value of $58.347 billion USD. The value of plastic product imports from the United States increased by +6.7% YoY. The second-ranked country is Germany, which accounts for 8% of the world's total plastic product imports, or a value of $26.982 billion USD. The value of plastic product imports from Germany decreased by -1.9% YoY. The countries with the highest proportion of plastic product imports in the 3rd to 5th ranks

are China, France, and Mexico, respectively. Their proportion of plastic product imports accounts for 5% of the world's total plastic product imports.

For plastic products exporting countries, which are important products in the top 5 of the world in 2022, it was found that China is the country with the highest value of plastic product exports in the world, ranked number 1 due to being a producer for export. Therefore, there has been a stable increase in exports, with a value of approximately 107,589 million US dollars, or 1 out of 4 of the total value of plastic product exports in the world. The value of China's plastic product exports in 2022 has expanded by more than +6.1% YoY. The second country in the ranking for exporting plastic products is Germany, which accounts for 11% of the total value of plastic product exports in the world, but has decreased by -4.0% YoY. The following countries in the ranking for exporting plastic products are the United States (9%), Italy (4%), and Poland (4%), respectively.

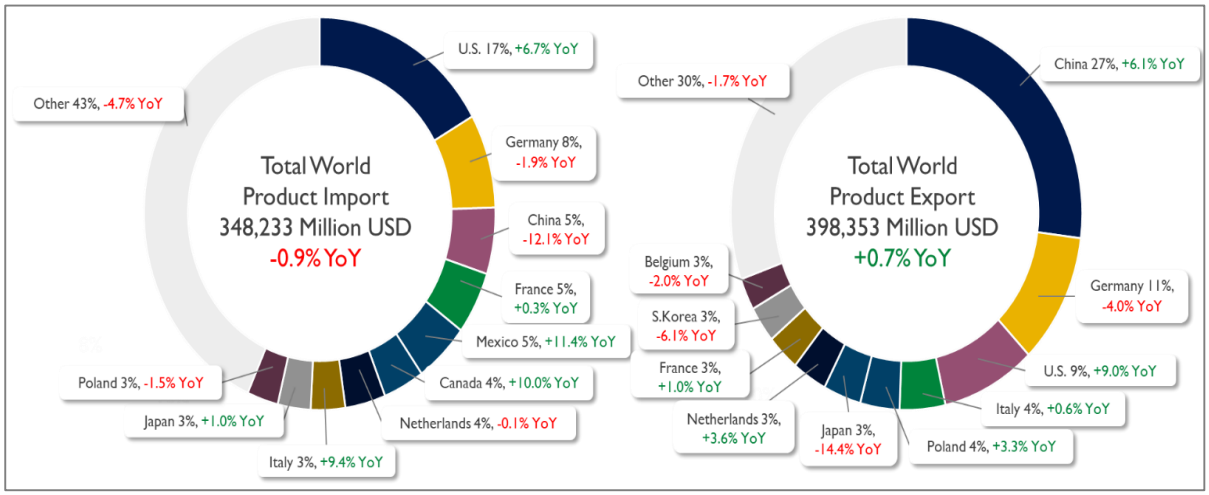


Figure 1-4 The World's Top 10 Plastic Product Import and Export Countries In 2022

Source: Plastics Institute of Thailand (n.d.)

In terms of plastic product imports, the United States has the highest imports in the world due to being the largest consumer market in the world. As an open market with high purchasing power and high living standards, the US has a high demand for plastic products from other countries to meet the needs of its consumers. On the other hand, China is the largest exporter of plastic products in the world due to being a major producer for export. This is the result of many years of development and continuous improvement of China's plastic product industry.

1.3 Thailand Plastics Product Situation

Following depressed conditions in 2020, domestic sales and export volume of plastic products are projected to rise by an average of 2.0-3.0%per year over 2021-2023.This will be helped by the anticipated recovery in the Thai and global

economies, especially downstream industries, including packaging, electrical appliances, construction, auto parts, and medical devices which collectively account for almost 80%of domestic consumption of plastic products. However, there are lingering challenges for the industry over the next 3 years. These include uncertainty over the direction of crude oil prices(aprimary input in the production of plastic resins), rising labor costs, and concerns over the environmental impacts of plastics at home and abroad that are discouraging the consumption of single-use plastic items (Aphinya Khanunthong Krungsri Research, 2022).

Plastics are produced from hydrocarbons, most commonly from chemicals originating from crude oil distillation or natural gas separation processes. These initial processes yield products that are then separated into their component chemicals, including ethylene,propylene, styrene, phenol and acrylonitrile, which comprise the major inputs in the production of a range of plastic resins. There are different types of plastic resins, distinguished by properties such as ductility and heat-tolerance. And depending on demand from downstream industries, these resins may be molded and shaped into finished goods for use in a large range of applications. Recently, there has been growing interest to manufacture plastics from renewable resources, including from polylactic acid (PLA)derived from corn, sugarcane or cassava. While plastics produced from PLA are biodegradable, it is possible to use them in many applications that are identical to those of traditional oil-based plastics (Aphinya Khanunthong Krungsri Research, 2022).

In 2019, the plastics industry accounted for 6.1%of Thai GDP, playing an important role in linking between the petrochemicals sector which supplies upstream inputs, with end-user industries (especially packaging, construction, auto assembly, electronics and electrical appliances, and medical equipment), and for which the plastics industry provides finished and semi-finished products (Aphinya Khanunthong Krungsri Research, 2022).

Manufacturing plastic products involves melting and molding plastic resins, cooling the molded plastic, and final processing to produce the desired finished goods.Dyes and plasticizers may be added to change the color and characteristics of the goods and to make them more suitable for their intended use, for example by raising pH tolerance values to make them more resistant to fire or ultra-violet radiation, or by increasing their flexibility. There are many different ways to moldplastics but deciding on which technique to use depends on the final application. The main methods are: blow molding,which is suitable to produce bottles to package water, oil and shampoo; injection molding,which is normally used to produce kitchenware, toys and electronic parts, auto parts, and electrical appliances; compression molding,which is generally used to produce plates, bowls, cups and kitchenware made from melamine; and extrusion molding, which is used to manufacture plastic bags and sacks, and PVC water pipes. Asurvey by the Plastics Institute of Thailand in 2019 reveals 35-40% of Thai plastics producers use injection molding, followed films and blow molding1/. Given the range of physical and mechanical properties displayed by different plastics (e.g., weight, moldability, flexibility, and gas-and water-permeability), these haveassumed an extremely important role as upstream inputs into a large number of industries, with special plastics solving the problems unique to those downstream industries. For example, auto parts manufacturers use plastics to reduce the weight of components and so,

increase fuel efficiency, producers of construction materials use plastic products that are durable and resistant to chemicals, and the medical equipment industry uses plastics to add value to products (Figure 1-5) (Aphinya Khanunthong Krungsri Research, 2022).

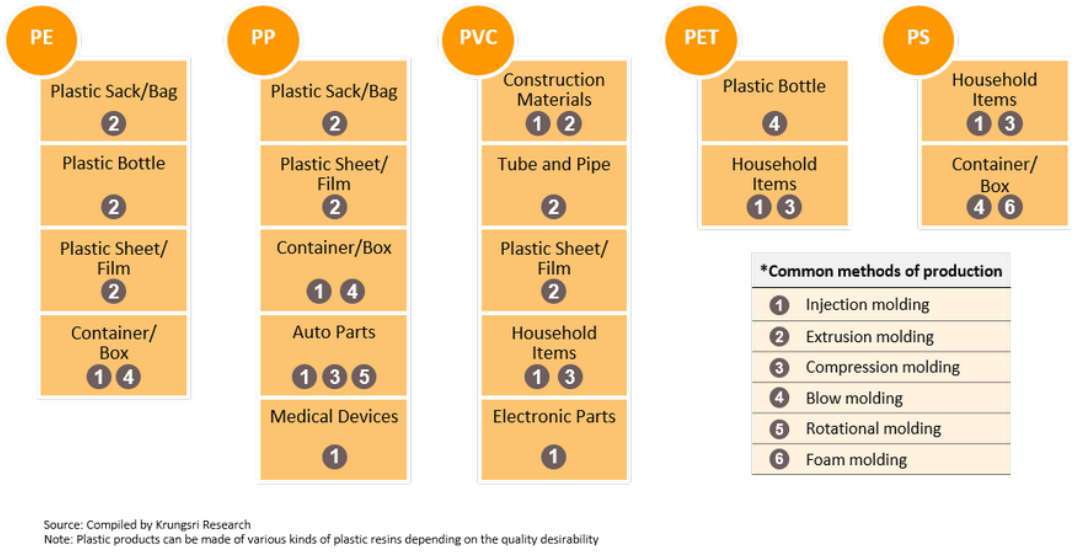


Figure 1-5 Common Products of Plastic Resins
Source: Aphinya Khanunthong Krungsri Research (2022)

In 2019, 368 million tonnes of plastic were produced globally, a 2.5% increase from 2018 (PlasticsEurope, n.d. quoted by Aphinya Khanunthong Krungsri Research, 2022). Asia is the principal producing-area, accounting for 51% of the world total (Figure 1-6), with regional production led by China which produces 31% of all plastics manufactured globally. China is the world's biggest importer of resins and the 3rd biggest importer of plastic products. After Asia, come North America (NAFTA region, led by the United States) which produces 19% of the global total, and Europe with 16%, led by Germany. In the downstream industries, the packaging industry is the biggest plastics consumer at 36% of global output, followed by construction (16%) and textiles (14%) (Figure 1-7) (Aphinya Khanunthong Krungsri Research, 2022).

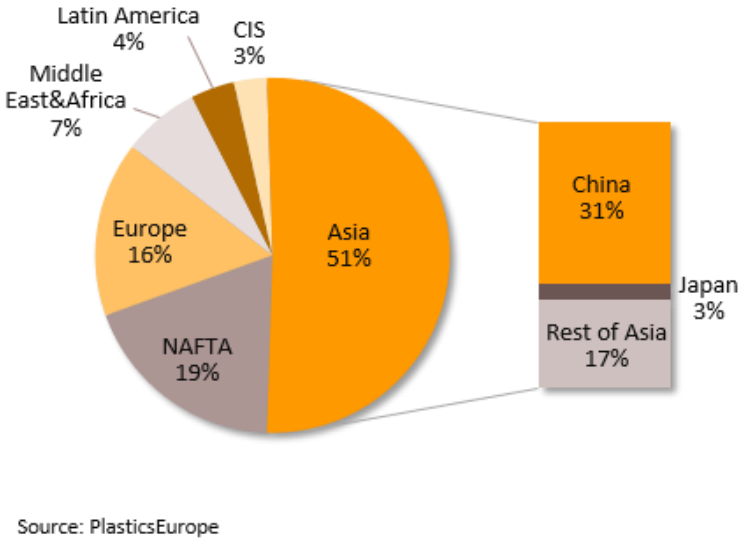


Figure 1-6 Global Plastic Production Shares in 2019
Source: Aphinya Khanunthong Krungsri Research (2022)

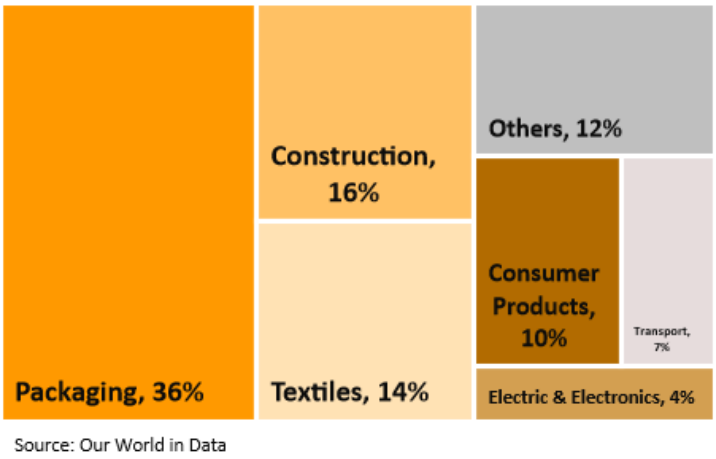
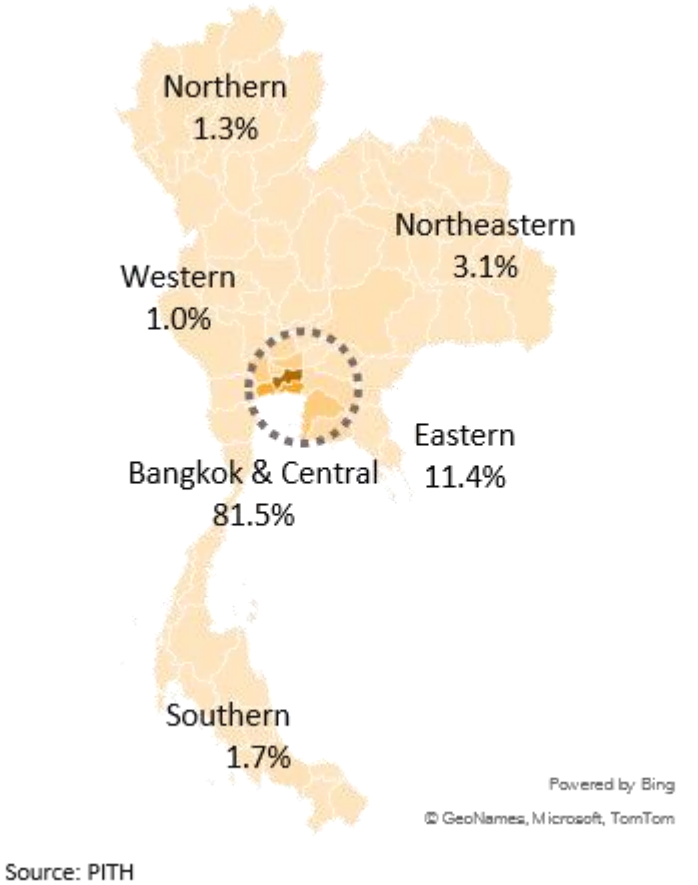


Figure 1-7 Global Shares of Plastics Production by End-use Section in 2015
Source: Aphinya Khanunthong Krungsri Research (2022)

Thailand occupies an important place in the global plastics industry. The domestic industry generates around THB 1.0 trillion annually. The industry benefits from a domestic petrochemicals industry that is both sizeable and highly-efficient compared to its competitors in the ASEAN zone. And because plastic resins sit downstream from the petrochemicals industry, this helps to increase the competitiveness of Thai manufacturers. Major Thai players are also skilled in the research & development of new products to accommodate constantly shifting market demands. In addition, by producing a wide range of resins (in both quality and price), Thai companies can support the activities of a large number of different industries. In 2019, Thai manufacturers produced 9.0 million tonnes of plastics, while the country imported just 2.2 million tonnes. 56% of output is consumed by export markets

(Thailand is the world's 11th biggest exporter of plastics and the 2nd biggest in the ASEAN zone after Singapore), with the remaining 44% used to manufacture products for domestic industries, most notably for players in auto assembly, electronics and electrical appliances, and construction. Therefore, Thai plastics converters are embedded in comprehensive supply chains that stretch from upstream raw materials (i.e., domestic producers of natural gas products), through intermediate goods (i.e., petrochemical players manufacturing plastic resins), to a large number of downstream industries (Aphinya Khanunthong Krungsri Research, 2022).

There are currently more than 2,800 plastics converters active in Thailand, comprising 87% SMEs and 13% large players. The large number of SMEs is because of low entry barriers to the market given relatively small up-front investment costs. In addition, production utilizes only low to mid-level technology, and because of this, most of the output is commodity-grade products. As a result, competition is fairly stiff and margins are narrow. Most players that are active domestically are Thai companies (83.5%), 7.5% is controlled by Japanese, and 1.2% by the Chinese. In terms of geographical distribution, the majority of operations (81.5%) are clustered in the central region, especially in the Bangkok Metropolitan Region, Samut Prakan and Samut Sakhon, followed by the east (11.4%) and the northeast (3.1%) (Figure 1-8) (Aphinya Khanunthong Krungsri Research, 2022).



Source: PITH

Figure 1-8 Location of Plastic Producers in Thailand
Source: Aphinya Khanunthong Krungsri Research (2022)

The domestic market consumes 80% of the output of Thai plastics converters. This is split into two primary segments: (i) end-consumer market, which meets consumer demand directly through the production of goods such as kitchenware, bags and straws; and (ii) suppliers to the end-user industries which comprise the five major markets – packaging, electronics & electrical appliances, construction, auto parts, and medical devices & supplies. The remaining 20% is exported, but much of this is low-value commodity-grade products including packaging (most important export segment) and cellular and non-cellular films. The main export markets in 2019 were the ASEAN zone (30.7% of all exports by value), Japan (19.2%) and the US (12.5%). Imports include plastic packaging (16% of all imports), non-cellular films (14.4%) and self-adhesive films (10.3%). The major sources of imports in 2019 were China (36.3% of all imports by value), Japan (21.6%) and the ASEAN region (14.7%) (Figure 1-9) (Aphinya Khanunthong Krungsri Research, 2022).

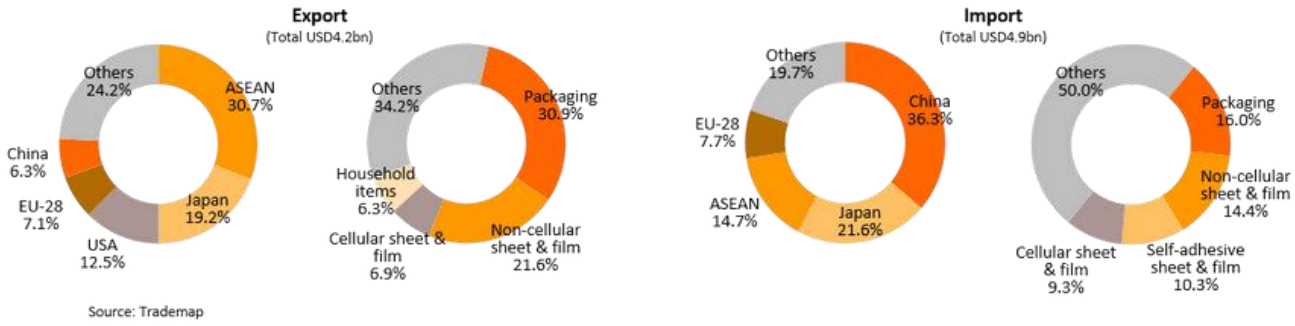
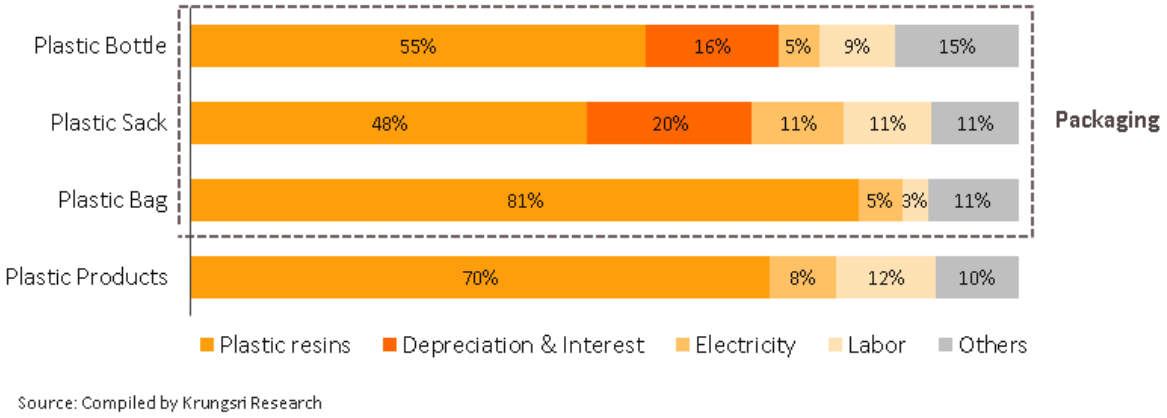


Figure 1-9 Trade Share of Plastic Products Values in 2019 (HS 3916-3926)
Source: Aphinya Khanunthong Krungsri Research (2022)

Generally, raw materials (i.e., plastic resins) account for around 70% of production costs, with another 10-15% coming from labor, 8% from energy and 7-12% attributable to other costs. In plastic packaging, (most important product category) the primary expense is for resins (50-80% of production costs). Total energy and labor costs will depend on the type of inputs used and the products manufactured; for plastic packaging that requires the utilization of more advanced production technology and more expensive machinery, depreciation and interest costs will be relatively high (Figure 1-10). Overall, the industry's cost structure implies fluctuating crude oil and natural gas prices can have substantial influence on manufacturers' costs and competitiveness (Aphinya Khanunthong Krungsri Research, 2022).



Source: Compiled by Krungsri Research

Figure 1-10 Cost Structure for Plastic Production
Source: Aphinya Khanunthong Krungsri Research (2022)

References

Aphinya Khanunthong. (2022). Industry Outlook 2021-2023: Plastics. Retrieved from https://www.krungsri.com/en/research/industry/industry-outlook/Petrochemicals/Plastics/IO/io-plastics-21

Plastics Institute of Thailand. (n.d.). IHS Markit estimated data by Plastics Market Intelligent Center.

CHAPTER 2

PLASTICS INDUSTRY AND PLASTICS PACKAGING TRADING SITUATION

Chapter 2

2. Plastic Industry and Plastics Packaging Trading Situation

2.1 Global Trading Situation

In the past, from 2017 to 2021, the global trade value of plastic packaging for both imports and exports has shown a continuous growth trend, with an average annual growth rate of +6.14% and +7.28% respectively. Although from late 2019 to 2020, many countries around the world were impacted by the COVID-19 pandemic, the overall trade of plastic packaging was relatively less affected compared to products in other groups. This is because plastic packaging is a product that is closely related to consumers' daily lives, especially during the COVID-19 pandemic outbreak, plastic packaging and disposable plastic products have become products with increasing usage due to consumers' concerns about health and hygiene, and the growth of e-commerce businesses has also led to an improvement in transportation packaging. In 2021, as the severity of the COVID-19 pandemic situation decreased and many countries relaxed their own measures to control the outbreak, the tourism and service industries began to recover, resulting in a significant increase in the import-export value of plastic packaging.

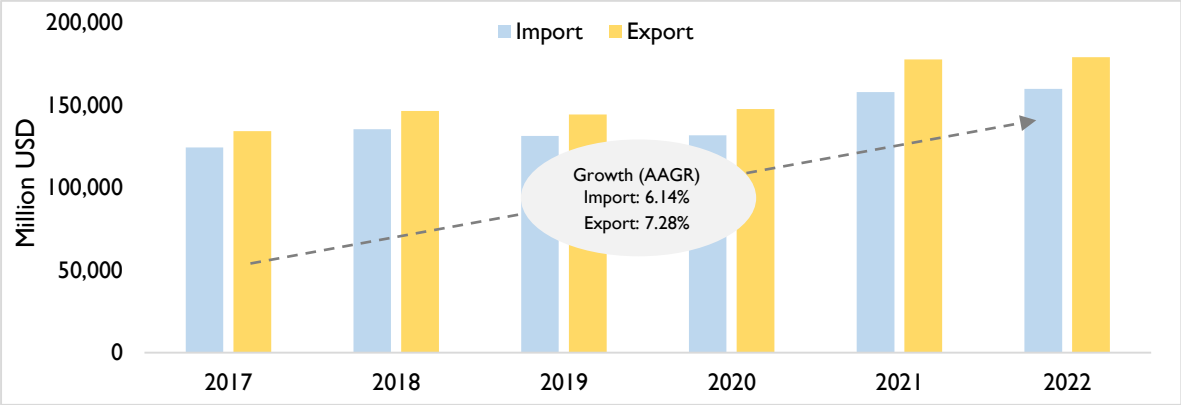


Figure 2-1 Global Plastic Packaging Imports and Exports Value from 2017 to 2022

Source: Plastics Institute of Thailand (n.d.)

For global plastic packaging imports and exports in 2022, it was found that the values were $159.796 billion and $178.992 billion, respectively. Compared to the same period in the previous year, the value of global plastic packaging imports and exports in 2022 expanded by +1.21% YoY and +0.71% YoY, respectively. This trend is due to the global economic recovery and the countries' trading partners recovering from the COVID-19 pandemic, as well as the shift towards work from home, online shopping, health consciousness, using products for health, and increased home food delivery, resulting in a greater demand for packaging. Therefore, the growth trend of the plastic packaging trade is expected to continue.

2.2 Asia

2.2.1 Review of China's Plastics Industry

China Plastic Resin Trade Situation (HS Code: 3901-3915)

- **China import-export plastic resin value in 2017-2022**

The overview of China's plastic trade shows that the value of China's plastic imports has increased significantly, especially during the period of 2017–2021, with an average annual growth rate of 4.25%. In 2021, China's total plastic imports were approximately 61,149 million US dollars, which increased from around 8,703.99 million US dollars in the previous year. Meanwhile, the overall value of China's plastic exports has also increased, from 15,031.44 million US dollars in 2017 to 29,830.67 million US dollars in 2021, with an average annual growth rate of 18.69%.

For 2022, China's plastic exports were valued at 36,505.11 million US dollars, which represents a 22.37% YoY increase from the previous year, while plastic imports were valued at 56,170.87 million US dollars, representing an 8.14% YoY decrease from the previous year.

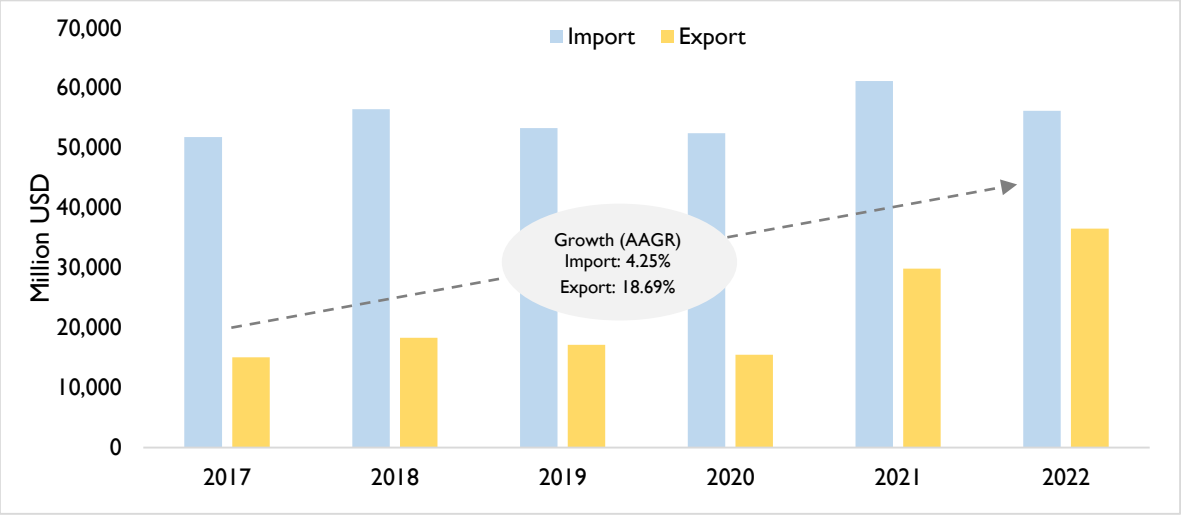
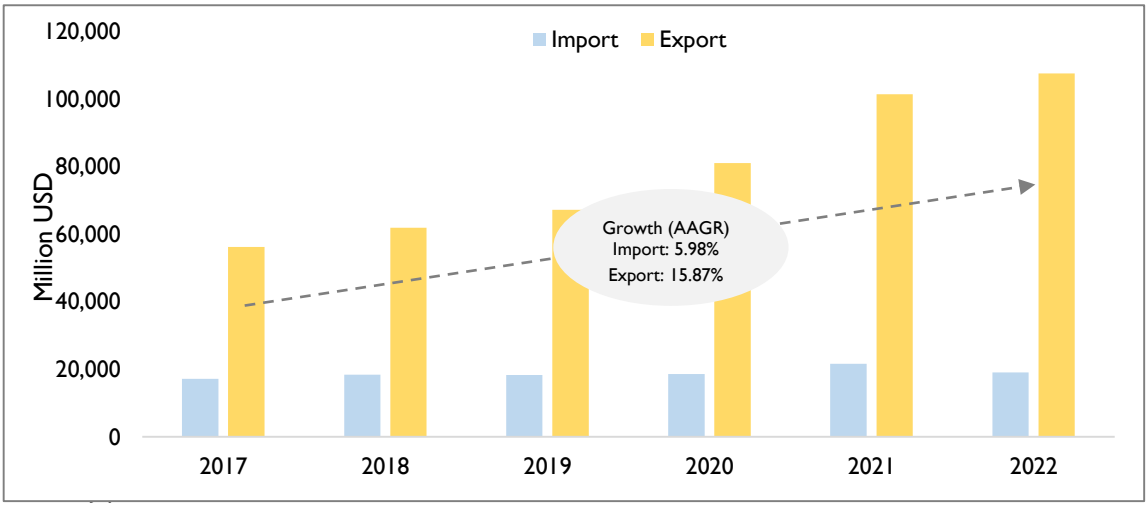


Figure 2-2 China import-export plastic resin value in 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Important plastic resin imports and exports trading partners of China in 2021**

For the key destination markets of China's plastic product imports and exports, it was found that in 2022, India was the main trading partner for China's plastic resin exports, with a market value proportion of 8.44% compared to the overall export value, followed by Vietnam, South Korea, Russia, and the United States in descending order. On the other hand, for China's plastic product imports in 2022, South Korea was the main trading partner in the import sector with a market value proportion of 18.02%, followed by Taiwan, the United States, Japan, and Saudi Arabia in descending order.



Note: Million US Dollars (MUSD)

Figure 2-3 Important plastic resin imports and exports trading partners of China in 2022

Source: Plastics Institute of Thailand (n.d.)

China Plastic Products Trade Situation

- **China Import-Export Plastic Products in 2017–2022 (HS Code: 3916-3926)**

An overview of the plastic products trade in China shows that in the import sector, the value of plastic product imports has increased significantly, particularly during the period from 2017 to 2021, with an average annual growth rate of 5.98%. The value21, China's total value of plastic product imports was approximately USD 21.69 billion, an increase of about USD 3.03 billion from the previous year. On the other hand, the value of plastic product exports from China has also increased significantly, from USD 56.28 billion in 2017 to USD 101.43 billion in 2021, with an average annual growth rate of 15.87%

For the value of plastic product exports from China in 2022, it was found to be USD 107.59 billion, with a 6.07% YoY increase from the previous year. Meanwhile, in the import sector, the value of plastic product imports into China in 2022 was found to be USD 19.06 billion, a 12.14% YoY decrease from the previous year.

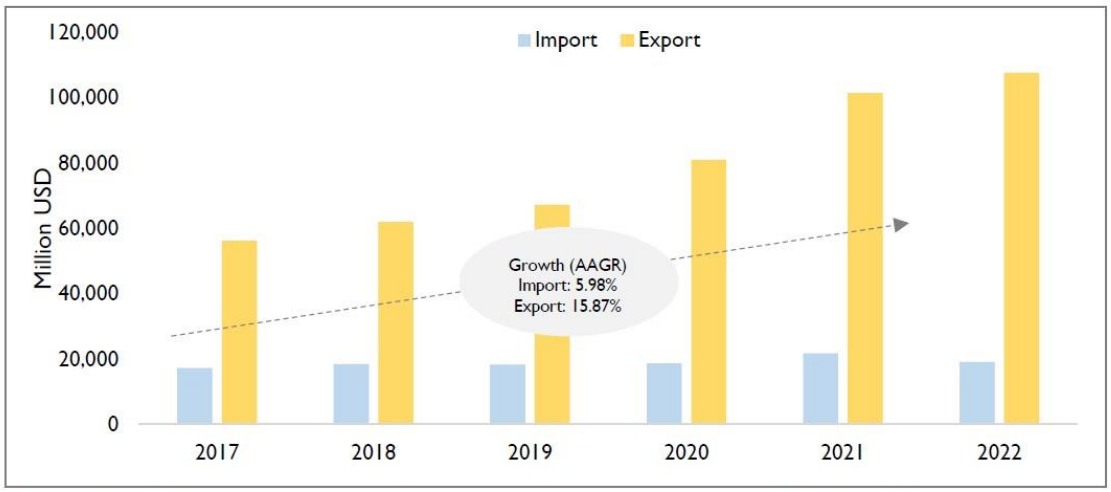
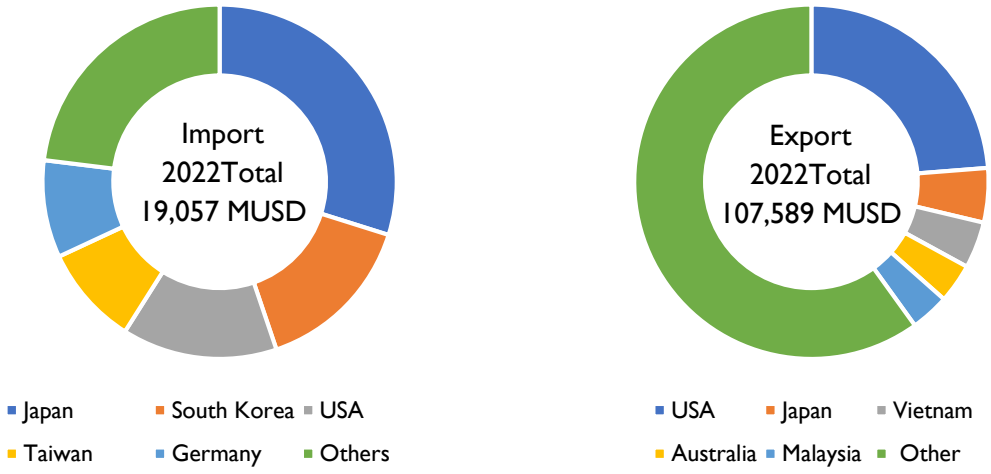


Figure 2-4 China Import-export value of plastic products in 2017–2022

Source: Plastics Institute of Thailand (n.d.)

- **Important plastic products imports and exports trading partners of China in 2022**

According to data, the United States was the top trading partner for China's major export markets in 2022, accounting for 23.75% of the total export value, followed by Japan, Vietnam, Australia, and Malaysia. On the other hand, for China's plastic product imports in 2022, the top trading partner was Japan, accounting for 29.86% of the total import value, followed by South Korea, the United States, Taiwan, and Germany, respectively.

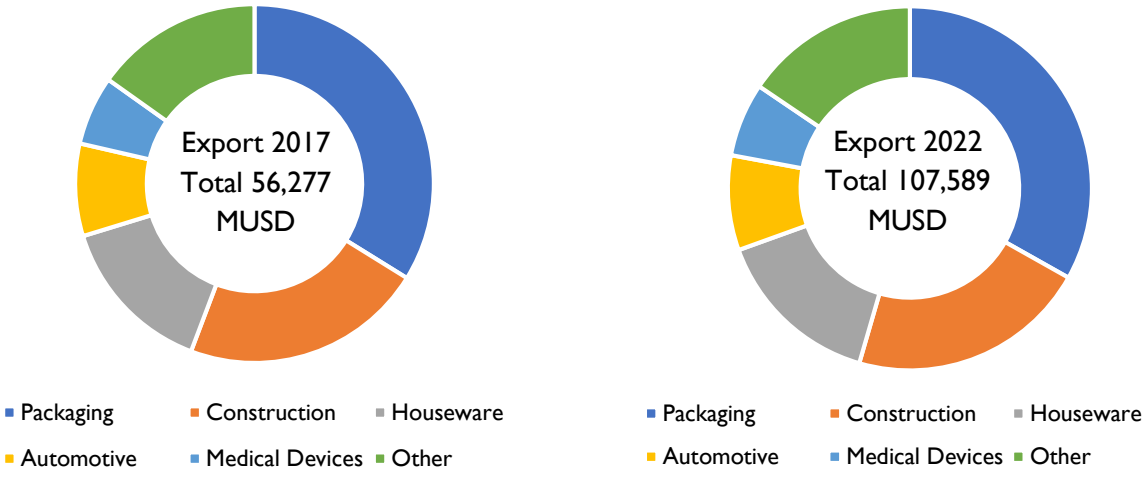


Note: Million US Dollars (MUSD)

Figure 2-5 Important plastic products imports and exports trading partners of China in 2022

Source: Plastics Institute of Thailand (n.d.)

- **China's plastic product import - export by industrial sector**

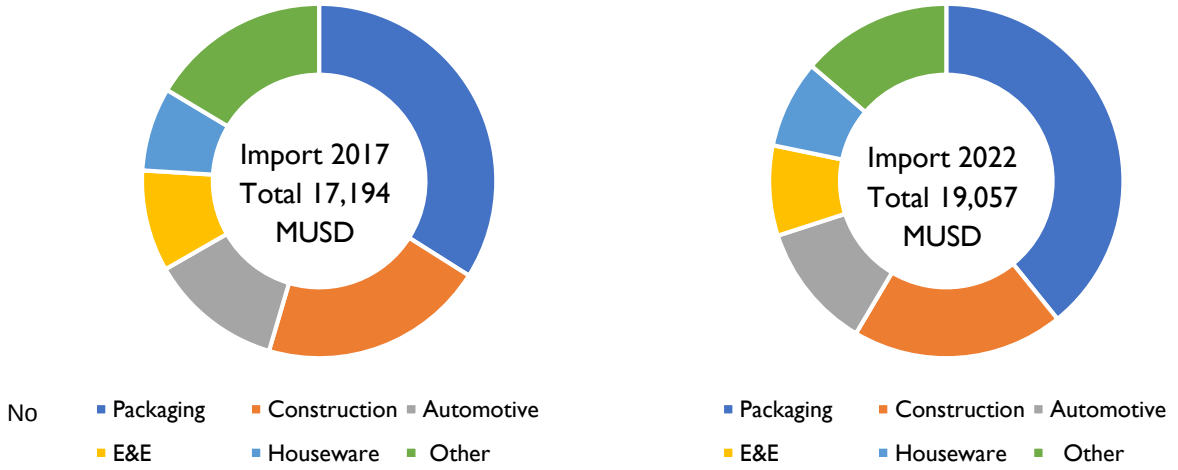


Note: Million US Dollars (MUSD)

Figure 2-6 China's plastic product export proportion by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

Considering the proportion of China's plastic product exports by industry group in 2017, it was found that China exported the most plastic products in the packaging industry group, accounting for 33.83% of the total value of plastic product exports from China. The next highest groups were construction material components, household appliance components, automotive parts, and medical equipment components, in that order. However, in 2022, it was found that China exported the most plastic products in the packaging industry group, accounting for 33.16% of the total value of plastic product exports from China. The next highest groups were construction material components, household appliance components, automotive parts, and medical equipment components, in that order.



Note: Million US Dollars (MUSD)

Figure 2-7 China's plastic product import proportion by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports from China by industry group in 2017, it was found that China imported the most plastic products in the packaging group, accounting for 37.90% of the total value of plastic product imports in China. This was followed by the automotive parts industry group, construction material components industry group, electrical and electronic equipment components industry group, and household appliance components industry group, respectively. However, in 2022, it was found that China imported the most plastic products in the packaging group, accounting for 37.13% of the total value of plastic product imports in China. This was followed by the automotive parts industry group, construction material components industry group, electrical and electronic equipment components industry group, and household appliance components industry group, respectively.

Summary of China's plastics industry and trading situation

Based on trade data for plastic pellets from China over the past five years, it was found that China has an increasing demand for plastic pellets within the country due to the expansion of its industrial sector. This is reflected in the increased volume of plastic pellet imports, as China continues to require plastic products as raw materials for various industries. This has a positive impact on plastic pellet exporters, including Thailand, as it is expected that the value of China's plastic pellet imports will continue to increase in the future, in line with the rising price of crude oil as well as the expanding export sector.

Regarding plastic product manufacturing, China is a country with great potential in the plastic industry, particularly in downstream industries. They produce plastic products to meet the diverse needs of various industries. China's plastics industry has developed rapidly with many new technologies and is considered one of the main industries that generate revenue for the country compared to other industries.

2.2.2 Review of Japan's Plastics Industry

Japan Plastic Resin Trade Situation (HS Code: 3901-3915)

- **Japan import-export plastic resin value**

Overview of Japan's plastic trade reveals that in the import sector, the value of Japan's plastic imports has increased significantly, especially during the period of 2017-2021, with an average annual growth rate of 3.52%. In 2021, Japan's total plastic imports were approximately 6.898 billion US dollars, up from the previous year's import value of approximately 1.612.86 billion US dollars. On the other hand, in the export sector, Japan's total plastic exports increased from 12.017.05 billion US dollars in 2017 to 14.124.44 billion US dollars in 2021, or an average annual growth rate of 4.12%.

For plastic exports in 2022, the value was 13.164.83 billion US dollars, with a decrease of 6.79% YoY from the previous year. In contrast, the value of plastic imports in 2022 was 7.663.84 billion US dollars, which increased by 11.09% YoY from the previous year.

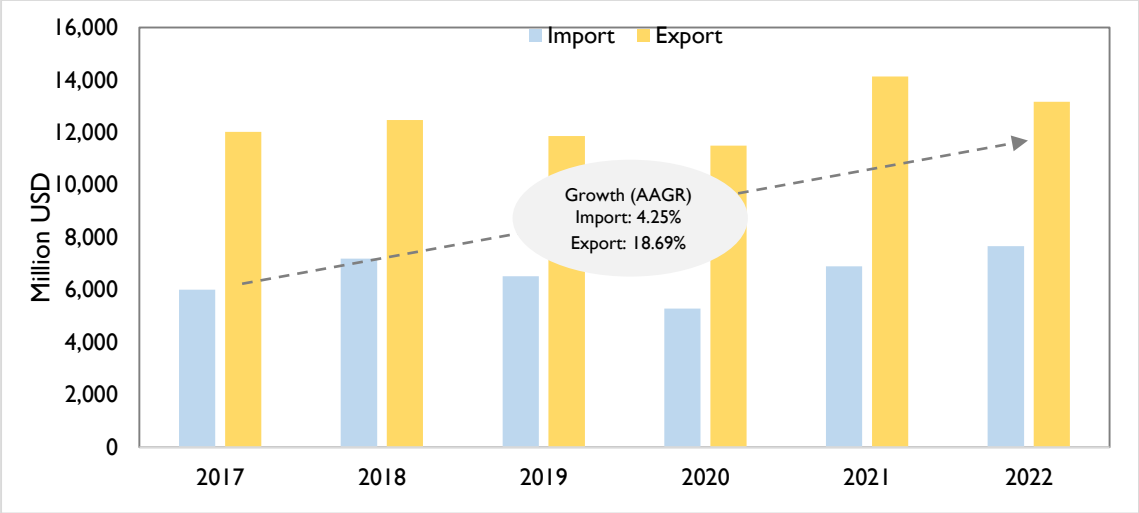
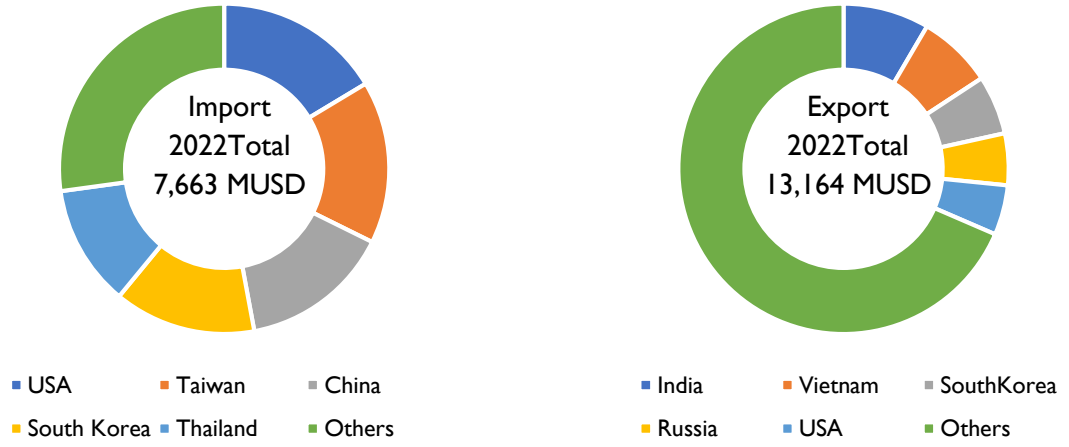


Figure 2-8 Japan import-export plastic resin value in 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Important plastic resin imports and exports trading partners of Japan in 2022**

For the important target market segment of importing and exporting plastic products from Japan, it was found that in 2022, the main trading partner for Japan's plastic pellets in the export sector was China, with a market value share of 32.18%, followed by the United States, India, Taiwan, and South Korea in descending order. Meanwhile, in the import sector in 2022, the main trading partners for Japan were the United States, with a market value share of 16.38%, followed by Taiwan, China, South Korea, and Thailand in descending order.



Note: Million US Dollars (MUSD)

Figure 2-9 Important plastic resin imports and exports trading partners of Japan in 2022

Source: Plastics Institute of Thailand (n.d.)

Japan Plastic Products Trade Situation

- **Japan Import-Export Plastic Products in 2017–2022 (HS Code: 3916-3926)**

Overview of Japan's plastic product trade shows that in the import sector, the value of Japan's plastic product imports has increased significantly, especially during the period of 2017-2021, with an average growth rate of 3.65% per year. In 2021, Japan's total value of plastic product imports was approximately 10,447.75 million US dollars, increasing by about 758.87 million US dollars from the previous year. Meanwhile, in the export sector, the total value of Japan's plastic product exports increased from 13,135.39 million US dollars in 2017 to 16,198.24 million US dollars in 2021, with an average growth rate of 5.38% per year during the period of 2017-2021.

As for the value of Japan's plastic product exports in 2022, it was found to be 13,860.63 million US dollars, which is a decrease of 14.43% YoY from the previous year. On the other hand, in 2022, the value of Japan's plastic product imports was found to be 10,553.81 million US dollars, increasing by 1.02% YoY from the previous year.

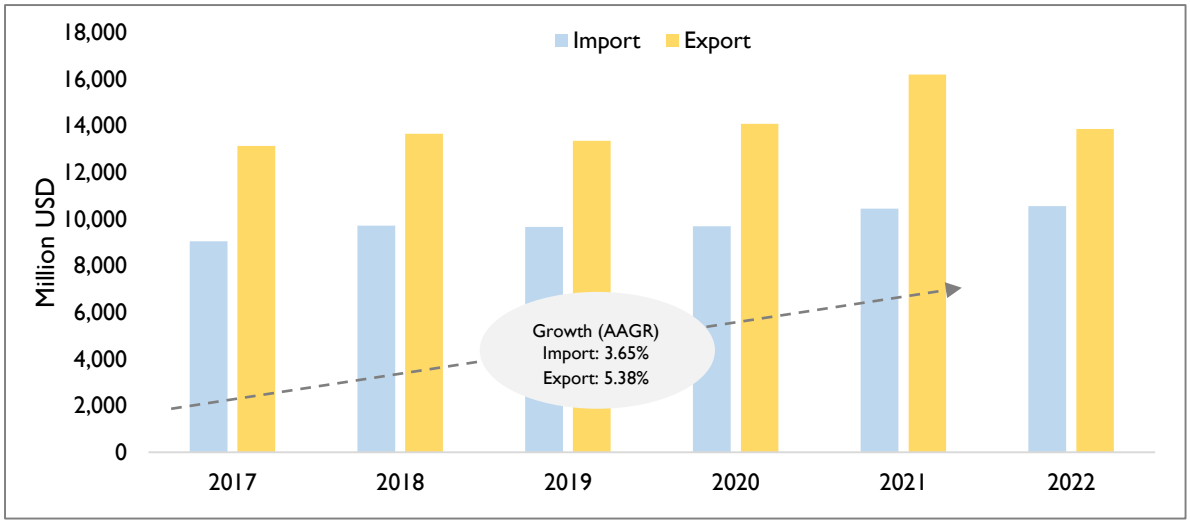
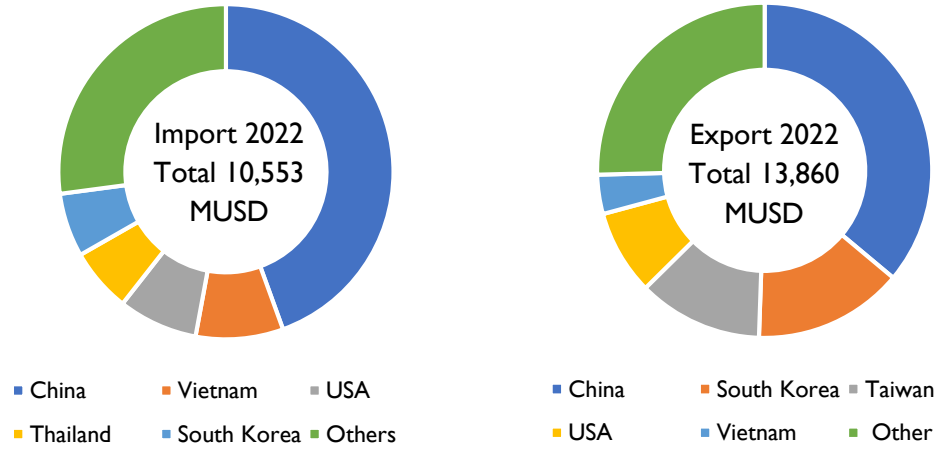


Figure 2-10 Japan import-export value of plastic products in 2017–2022
Source: I Plastics Institute of Thailand (n.d.)

- **Important plastic products imports and exports trading partners of Japan in 2022**

For the key target market segment of importing and exporting plastic products from Japan, it was found that in 2022, the main trading partner for Japan's plastic products in the export sector was China, accounting for 36.08% of the market value compared to the overall export value, followed by South Korea, Taiwan, the United States, and Vietnam, respectively. Meanwhile, in the import sector in 2022, the main trading partners for Japan were China, accounting for 44.47% of the import value, followed by Vietnam, the United States, Thailand, and South Korea, respectively.

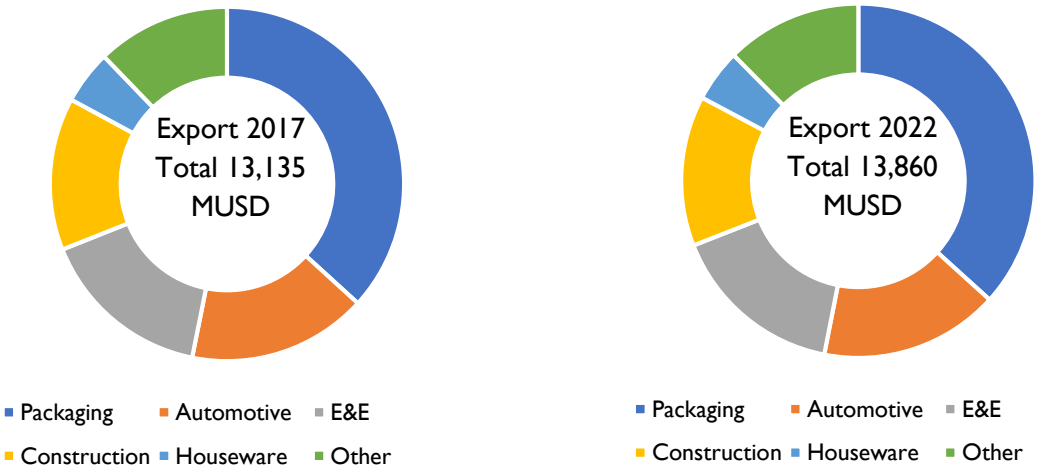


Note: Million US Dollars (MUSD)

Figure 2-11 Important plastic products imports and exports trading partners of Japan in 2022

Source: Plastics Institute of Thailand (n.d.)

- **Japan's plastic product import - export by industrial sector**

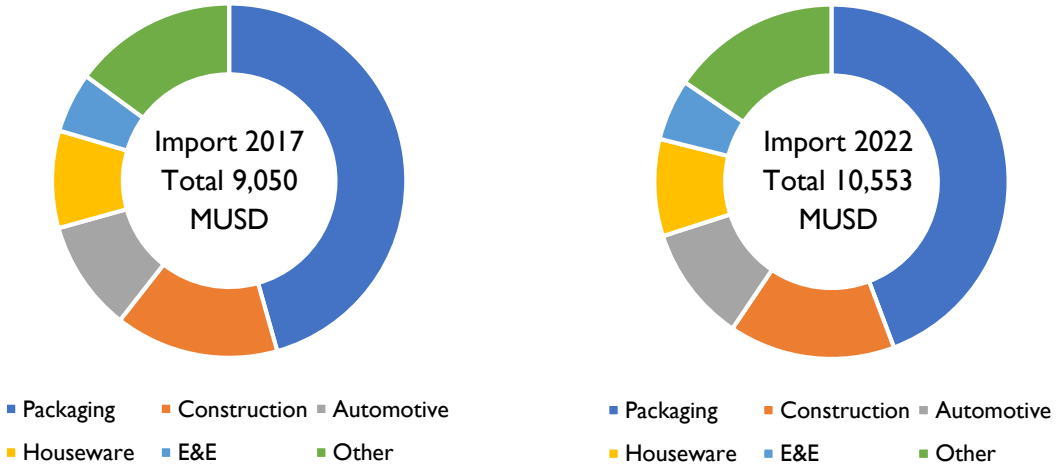


Note: Million US Dollars (MUSD)

Figure 2-12 Japan's plastic product export proportion by industrial sector

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of Japan's plastic product exports by industry group in 2017, it was found that Japan exported the most plastic products in the packaging industry group, accounting for 36.76% of the total value of plastic product exports from Japan. This was followed by the automotive parts industry group, the electrical and electronic components industry group, the construction materials industry group, and the household appliance industry group, respectively. In contrast, in 2022, it was found that Japan exported the most plastic products in the packaging industry group, accounting for 36.72% of the total value of plastic product exports from Japan. This was followed by the automotive parts industry group, the electrical and electronic components industry group, the construction materials industry group, and the household appliance industry group, respectively.



Note: Million US Dollars (MUSD)

Figure 2-13 Japan's plastic product import proportion by industrial sector

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports from Japan in 2017, separated by industry groups, it was found that Japan imported the most plastic products in the plastic packaging group, accounting for 45.62 percent of the total value of plastic product imports in Japan. Following that were the construction material component group, industrial automotive component group, household appliance group, and electric and electronic appliance component group, respectively. In 2022, it was found that Japan imported the most plastic products in the plastic packaging group, accounting for 44.26 percent of the total value of plastic product imports in Japan. This was followed by the construction material component group, industrial automotive component group, household appliance group, and electric and electronic appliance component group, respectively.

Summary of Japan's plastics industry and trading situation

From the information on Japan's plastic trade over the past five years, it was found that Japan has increased its plastic imports to support domestic consumption, although there has been some contraction, particularly during the 2019-2020 COVID-19 pandemic. As the situation improved, demand started to recover. Meanwhile, exports contracted during the pandemic in 2019-2020, but increased in 2021, as did imports. However, the global economic crisis and higher oil prices affected Japan's plastic industry, reflected in the decline in export value in 2022.

In terms of plastic processing and production, Japan is another country with potential in the end-of-life plastic industry in Asia, second only to China. Plastic products are produced to meet the needs of various end-use industries, such as the production of electrical appliances and automobiles, which are important industries generating income for Japan. Specifically, the plastic packaging industry is significant due to Japan's high single-use plastic waste per capita, ranking second highest in the world. Therefore, Japan has a strong interest in producing and

consuming environmentally friendly products. The government has implemented policies to reduce the use of petroleum-based plastics.

2.2.3 Review of South Korea's Plastics Industry

South Korea Plastic Resin Trade Situation (HS Code: 3901-3915)

- **South Korea import-export plastic resin value**

Overview of South Korea's Plastic Trade: It has been found that in the import sector, the value of plastic imports of South Korea has increased significantly, especially during the period of 2017-2021, with an average growth rate of 4.47% per year. In 2021, South Korea's total plastic imports were approximately $6,088.68 million, an increase of about $1,457.71 million from the previous year. In the export sector, South Korea's total plastic exports have increased from $21,288.31 million in 2017 to $30,520.32 million in 2021, with an average growth rate of 9.42% per year during the period of 2017-2021.

As for the value of South Korea's plastic exports in 2022, it was found to be $29,263.64 million, with a YoY decrease of 4.12% from the previous year. In the import sector, the value of South Korea's plastic imports in 2022 was $6,111.21 million, which increased by 0.37% YoY from the previous year.

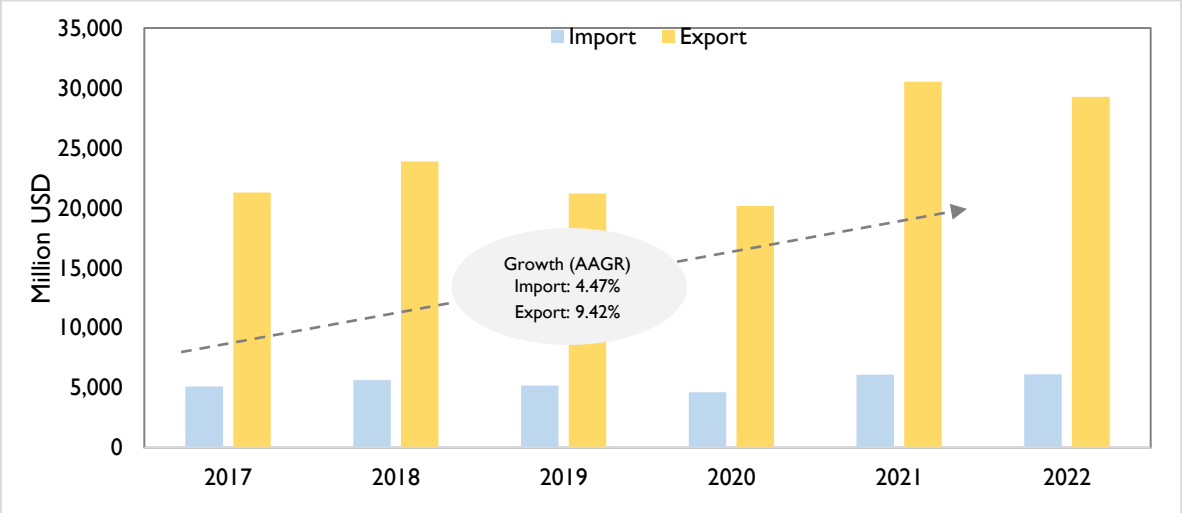
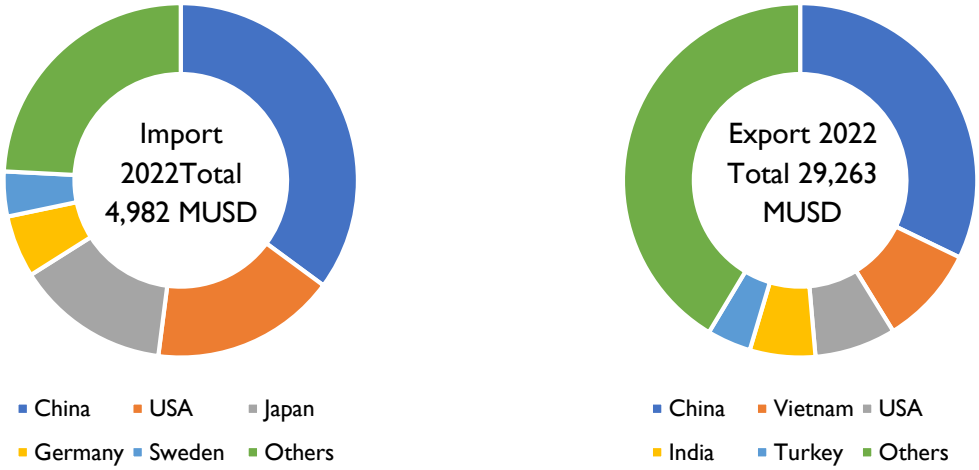


Figure 2-14 South Korea import-export plastic resin value 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Important plastic resin imports and exports trading partners of South Korea in 2022**

For the important target market of importing and exporting plastic pellets from South Korea, it was found that in 2022, the main trading partner for South Korea's plastic pellets in the export sector was China, with a market value proportion of 32.16%, compared to the total export value. Following that, the next countries in order were Vietnam, the United States, India, and Turkey, respectively. As for the import sector in 2022, the main trading partners for South Korea were China with a market value proportion of 35.10%, followed by the United States, Japan, Germany, and Sweden, respectively.



Note: Million US Dollars (MUSD)

Figure 2-15 Important plastic resin imports and exports trading partners of South Korea in 2022

Source: Plastics Institute of Thailand (n.d.)

South Korea Plastic Products Trade Situation

- **South Korea Import-Export Plastic Products in 2017–2022 (HS Code: 3916-3926)**

Overview of South Korea's plastic product trade reveals that in the import sector, the value of plastic product imports to South Korea has increased significantly, especially during the period of 2017-2021, with an average annual growth rate of 7.78%. In 2021, the country imported plastic products worth approximately 8,087.27 million US dollars, an increase of approximately 1,233.77 million US dollars from the previous year. Meanwhile, in the export sector, the overall value of plastic product exports from South Korea has increased, from 10,169.73 million US dollars in 2017 to 12,673.76 million US dollars in 2021, representing an average annual growth rate of -1.90%.

As for the value of plastic product exports from South Korea in 2022, it was found to be 11,894.44 million US dollars, representing a decrease of 6.15% YoY from the previous year. In the import sector, the value of plastic product imports to South Korea in 2022 was found to be 7,703.88 million US dollars, representing a decrease of 4.74% YoY from the previous year.

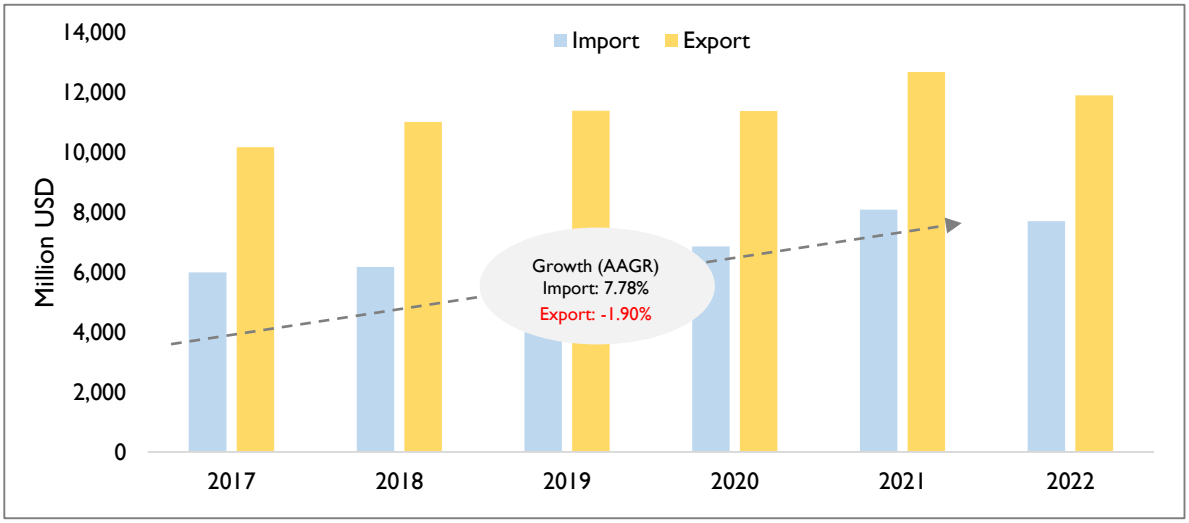
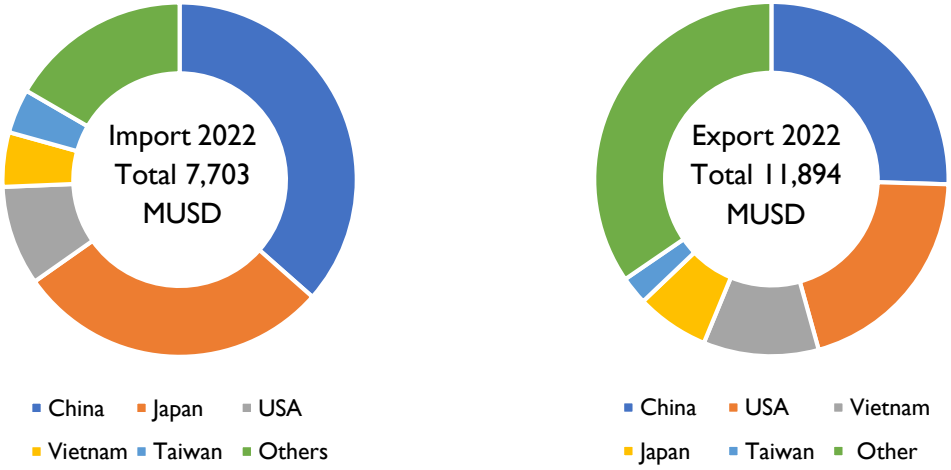


Figure 2-16 South Korea Import-export value of plastic products in 2017–2022

Source: Plastics Institute of Thailand (n.d.)

- **Important plastic products imports and exports trading partners of Japan in 2022**

For the important target market segment of importing and exporting plastic products from South Korea, it was found that in the year 2022, the main trading partner for South Korean plastic products in the export sector was China, accounting for 25.47% of the market value, followed by the United States, Vietnam, Japan, and Taiwan in that order. Meanwhile, the main trading partner for South Korean plastic products in the import sector in 2022 was China, accounting for 36.51% of the market value, followed by Japan, the United States, Vietnam, and Taiwan, in order.

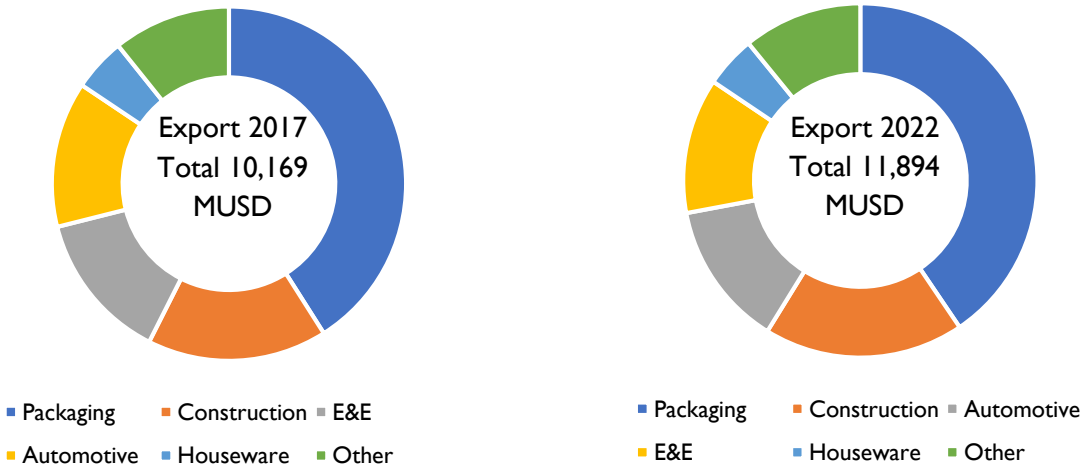


Note: Million US Dollars (MUSD)

Figure 2-17 Important plastic products imports and exports trading partners of South Korea in 2022

Source: Plastics Institute of Thailand (n.d.)

- **South Korea's plastic product import - export by industrial sector**



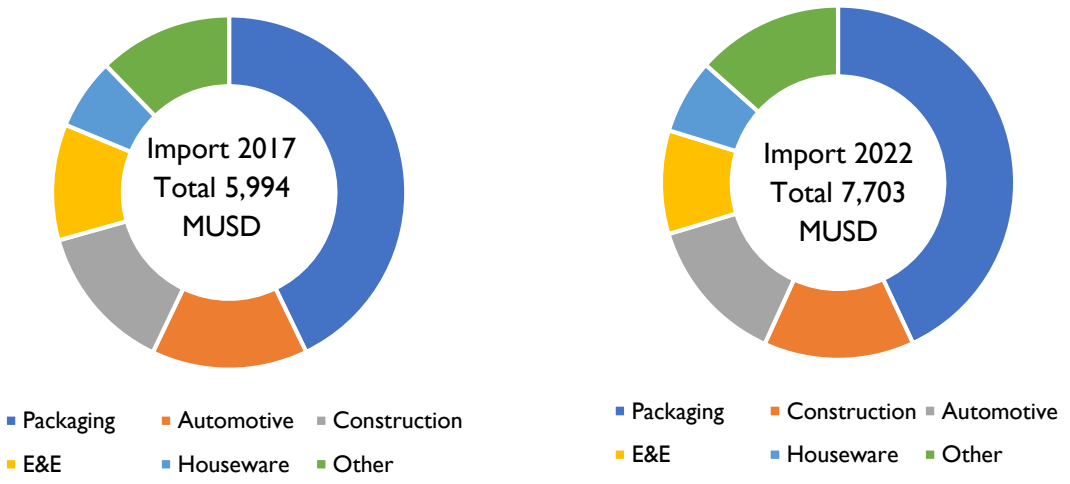
Note: Million US Dollars (MUSD)

Figure 2-18 South Korea's plastic product export proportion by industrial sector

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of South Korea's plastic product exports by industry group in 2017, it was found that South Korea exported the highest

proportion of plastic packaging products, accounting for 41.00% of the total value of plastic product exports from South Korea. This was followed by the group of construction material components, the group of electronic and electrical appliance components, the group of automotive components, and the group of household appliance components, respectively. Meanwhile, in 2022, it was found that South Korea exported the highest proportion of plastic packaging products, accounting for 40.53% of the total value of plastic product exports from South Korea. This was followed by the group of construction material components, the group of automotive components, the group of electronic and electrical appliance components, and the group of household appliance components, respectively.



Note: Million US Dollars (MUSD)

Figure 2-19 South Korea's plastic product import proportion by industrial sector

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports from South Korea by industry group in 2017, it was found that South Korea imported the most plastic products in the packaging group, accounting for 42.83% of the total value of plastic product imports. This was followed by the automotive parts group, construction material group, electrical and electronic parts group, and household appliance group, respectively. In contrast, in 2022, it was found that South Korea imported the most plastic products in the packaging group, accounting for 43.05% of the total value of plastic product imports, followed by the construction material group, automotive parts group, electrical and electronic parts group, and household appliance group, respectively.

Summary of South Korea's plastics industry and trading situation

From the trade data of plastic pellets in South Korea in the past 5 years, it was found that South Korea has a balanced trade in the upstream plastic industry products. South Korea has important export markets for plastic pellets, such as China, Vietnam, and the United States, although it contracted somewhat during 2019-2020 due to the COVID-19 pandemic, but it has gradually recovered as the situation improves.

In terms of product processing and manufacturing, South Korea is a country with great potential in the downstream plastic industry. There are productions of plastic products to meet the demands of various industries, such as the electronics industry, automobile industry, etc., which generates income for the country compared to other industries. This is reflected in the export figures of plastic products over the past 5 years, which have continued to grow despite the impact of the COVID-19 pandemic on the trade sector, with China, the United States, and Vietnam being the main trading partners.

2.3 CLMVT Countries

2.3.1 Review of Cambodia's Plastics Industry

Cambodia's plastic resin trading situation (HS Code: 3901-3915)

- **Plastic resin import-export value of Cambodia**

Overview of plastic trade in Cambodia: It was found that in the import sector, the value of plastic imports to Cambodia has increased significantly, especially during the period of 2017-2021, with an average annual growth rate of 31.66%. In 2021, Cambodia imported plastic resins worth approximately 358 million US dollars, up from around 129 million US dollars in the previous year. In the export sector, the overall value of plastic resin exports from Cambodia during the period of 2017-2021 decreased from 8.43 million US dollars in 2017 to 7.43 million US dollars in 2021, or an average annual growth rate of -3.10%.

For the value of plastic resin exports in Cambodia in 2022, it was found to be 10.33 million US dollars, with an increase of 38.92% YoY from the previous year. As for plastic resin imports in Cambodia in 2022, the value was found to be 335.34 million US dollars, with a decrease of 6.36% YoY from the previous year

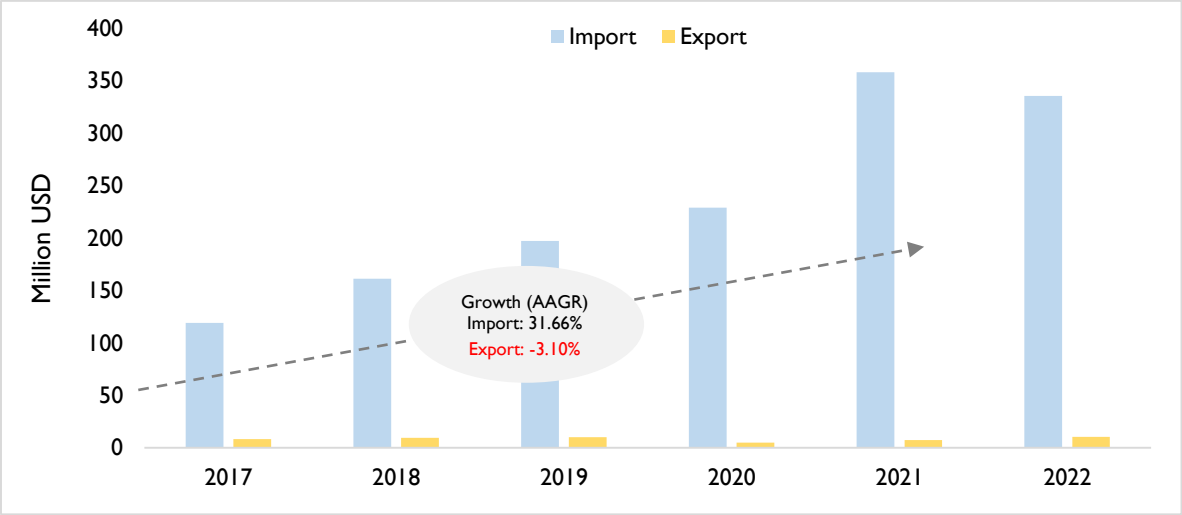
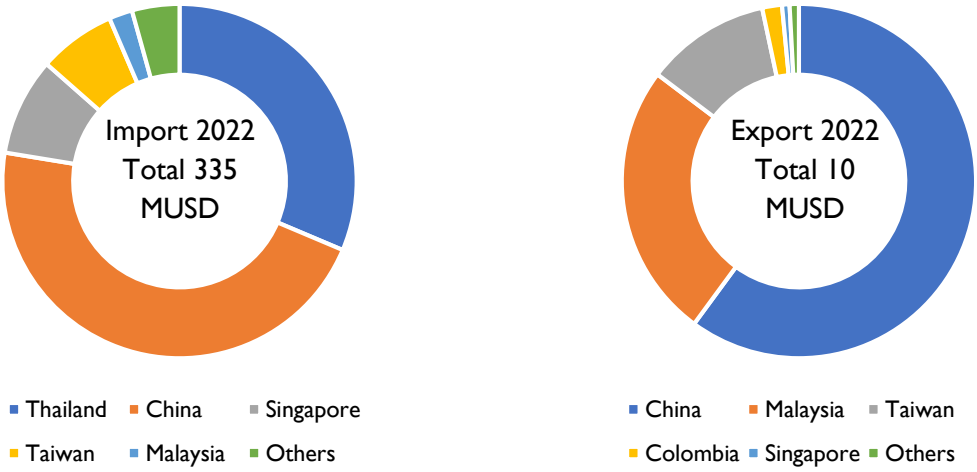


Figure 2-20 Plastic resin import-export value of Cambodia 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Cambodia's plastic resin trading partner country in 2021**

For the important destination market segment of importing and exporting plastic products from Cambodia, it was found that in 2022, the main trading partner for Cambodia's plastic resins in the export sector was China, with a market value proportion of 60.08% compared to the total export value. Following that were Malaysia, Taiwan, Colombia, and Singapore in descending order. Meanwhile, in the import sector in 2022, the main trading partner for Cambodia was Thailand, with a market value proportion of 31.36%, followed by China, Singapore, Taiwan, and Malaysia in descending order.



Note: Million US Dollars (MUSD)

Figure 2-21 Cambodia's plastic resin trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

Cambodia's plastic product trading situation

- **Plastic product import-export value of Cambodia 2017-2022 (HS Code: 3916-3926)**

Overview of Cambodia's plastic product trade reveals that there has been a significant increase in the value of plastic product imports, particularly during the period of 2017-2021, with an average annual growth rate of 24.52%. In 2021, the total value of plastic product imports in Cambodia was approximately 767.13 million US dollars, which increased from around 203 million US dollars in the previous year. On the other hand, the overall value of plastic product exports in Cambodia also increased significantly from 142.93 million US dollars in 2017 to 522.56 million US dollars in 2021, with an average annual growth rate of 38.28%.

Regarding plastic product exports in 2022, it was found that the total value reached 551.57 million US dollars, which increased by 5.55% YoY from the previous year. Meanwhile, plastic product imports in 2022 reached a total value of 956.52 million US dollars, which increased by 24.69% YoY from the previous year.

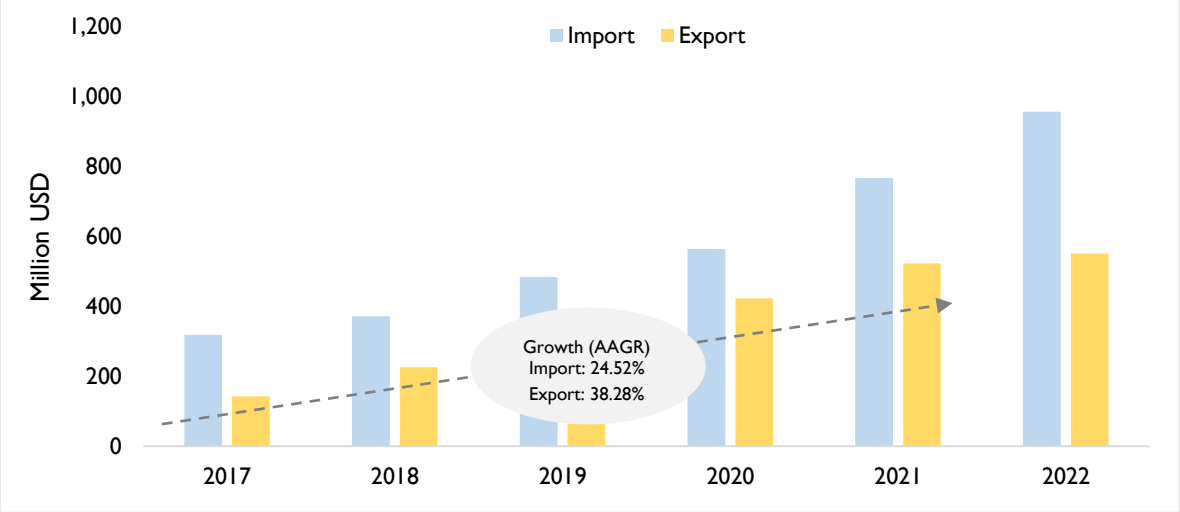
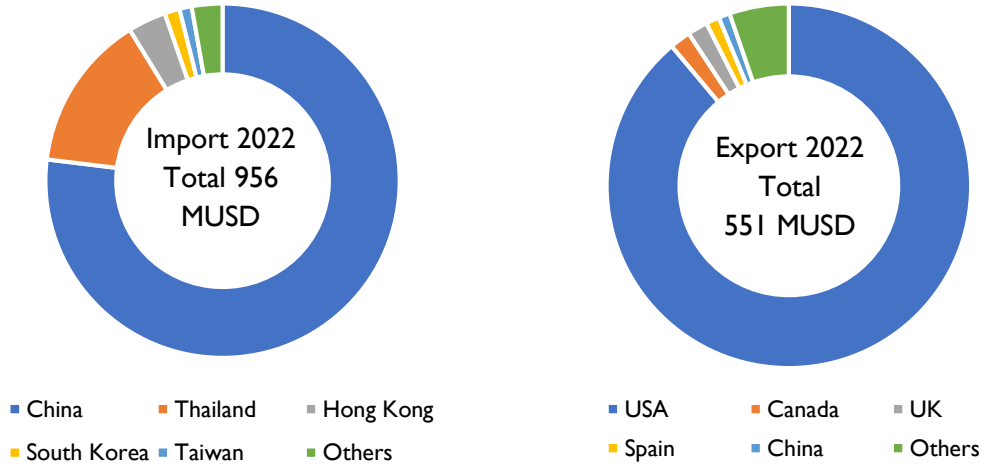


Figure 2-22 Plastic Product import-export value of Cambodia 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Cambodia's plastic product trading partner country in 2022**

For the important destination market segment of Cambodia's import-export of plastic products, it was found that in 2022, the main trading partner for Cambodia's plastic products in the export sector was the United States, accounting for 88.89% of the market value compared to the total export value. The second largest trading partners were Canada, the UK, Spain, and China, in that order. As for the import sector in 2022, the main trading partner for Cambodia's import was China, accounting for 76.92% of the import value, followed by Thailand, Hong Kong, South Korea, and Taiwan, in that order.

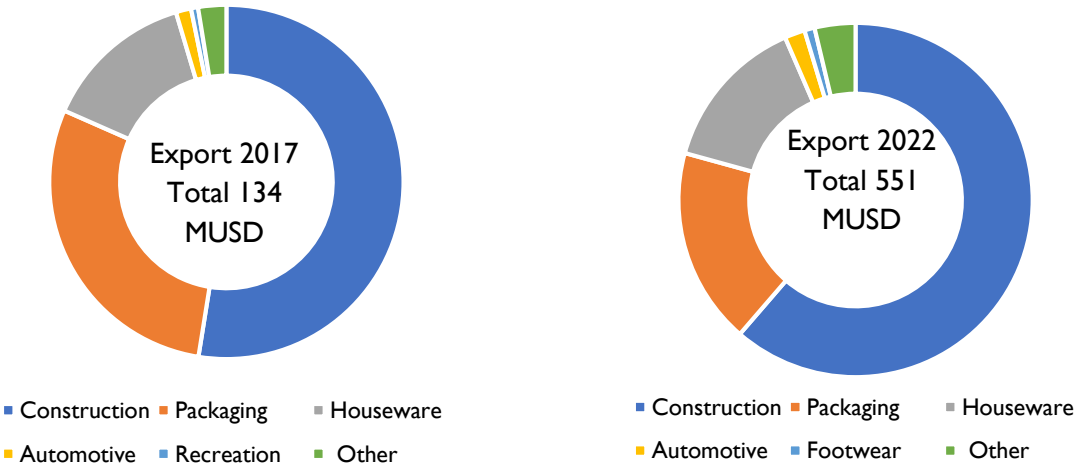


Note: Million US Dollars (MUSD)

Figure 2-23 Cambodia's Plastic Product trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

- **Cambodia's plastic product export by industrial sector in 2022**



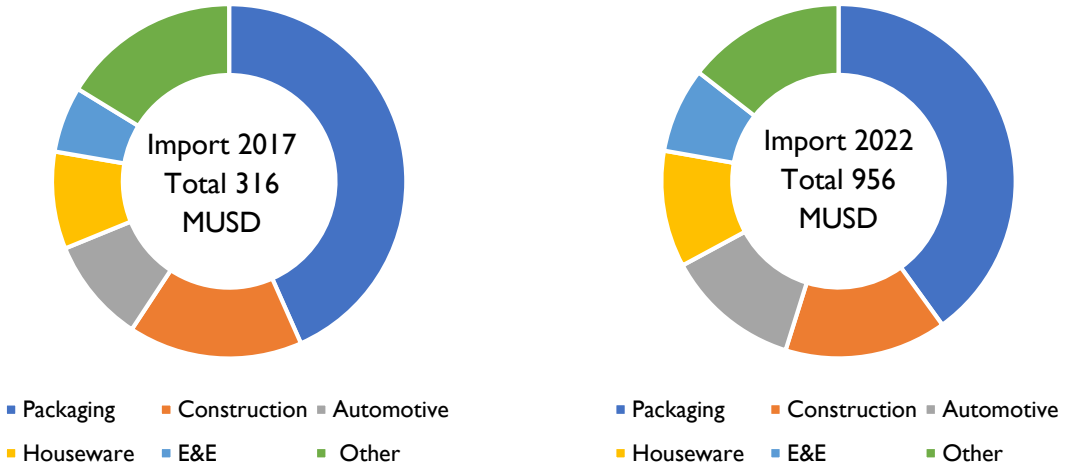
Note: Million US Dollars (MUSD)

Figure 2-24 Market share of Cambodia's plastics product export by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic products exported by Cambodia in 2017, broken down by industry group, it was found that Cambodia exported the most plastic products in the construction materials group, accounting for 52.53 percent of the total value of plastic product exports from Cambodia. Following this were the plastic packaging group, household appliances group, automotive components group, and toys and fashion accessories group, respectively. However, in the past

year of 2022, it was found that Cambodia exported the most plastic products in the construction materials group, accounting for 61.33 percent of the total value of plastic product exports from Cambodia. Following this were the plastic packaging group, household appliances group, automotive components group, and shoe group, respectively.



Note: Million US Dollars (MUSD)

Figure 2-25 Market share of Cambodia's plastics product import by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic products imported by Cambodia in 2017, broken down by industry group, it was found that Cambodia imported the most plastic products in the plastic packaging group, accounting for 43.36 percent of the total value of plastic product imports to Cambodia. Following this were the construction materials group, automotive components group, household appliances group, and electrical and electronic appliances group, respectively. However, in the past year of 2022, it was found that Cambodia imported the most plastic products in the plastic packaging group, accounting for 40.04 percent of the total value of plastic product imports to Cambodia. Following this were the construction materials group, automotive components group, household appliances group, and electrical and electronic appliances group, respectively.

Summary of Cambodia's plastics industry and trading situation

From studying the data on the trading situation of plastic products in Cambodia's plastic industry, it was found that Cambodia still heavily relies on importing raw materials from foreign countries to meet the needs of its domestic production sector. This shows that Cambodia still has limitations in the production of plastic resins in the country. The main countries that are important trading partners in importing plastic resins to Cambodia are mostly countries in the Asia and ASEAN regions, such as Thailand, China, Singapore, and Taiwan. In addition, from the

statistics on the quantity of plastic resin imports into Cambodia over the past 5 years, it was found that the quantity has continuously increased, reflecting the significant expansion of the downstream industry to produce plastic products to meet the demand of the target market.

In terms of the downstream plastic industry, as mentioned above, although Cambodia has a significant number of plastic resins in the country due to the expansion of the downstream product processing industry, in terms of trading plastic products, Cambodia still lacks balance in the continuous trade of plastic products for 5 years. This reflects that the production of plastic products in Cambodia is mainly aimed at meeting the needs of the downstream industry. The majority of plastic products that are used domestically are packaging, industrial components, construction materials, etc.

2.3.2 Review of Laos's Plastics Industry

Laos's plastic resin trading situation (HS Code: 3901-3915)

- **Plastic resin import-export value of Laos**

Overview of plastic trade in Laos reveals that in the import sector, the value of plastic pellets imported by Laos has increased significantly, especially during the period of 2017-2021, with an average growth rate of 11.55% per year. In 2021, the total value of plastic pellet imports in Laos was around 58.42 million US dollars, an increase of approximately 9.01 million US dollars from the previous year. On the other hand, in the export sector, the overall value of plastic pellet exports in Laos has also increased significantly during the period of 2017-2021, from 1.37 million US dollars in 2017 to 58.42 million US dollars in 2021, with an average growth rate of 105.99% per year.

For the value of plastic pellet exports in Laos in 2022, it was found to be 18.93 million US dollars, with a YoY decrease of 23.21% from the previous year. Meanwhile, in the import sector, the value of plastic pellets imported by Laos in 2022 was found to be 71.35 million US dollars, with a YoY increase of 22.14% from the previous year.

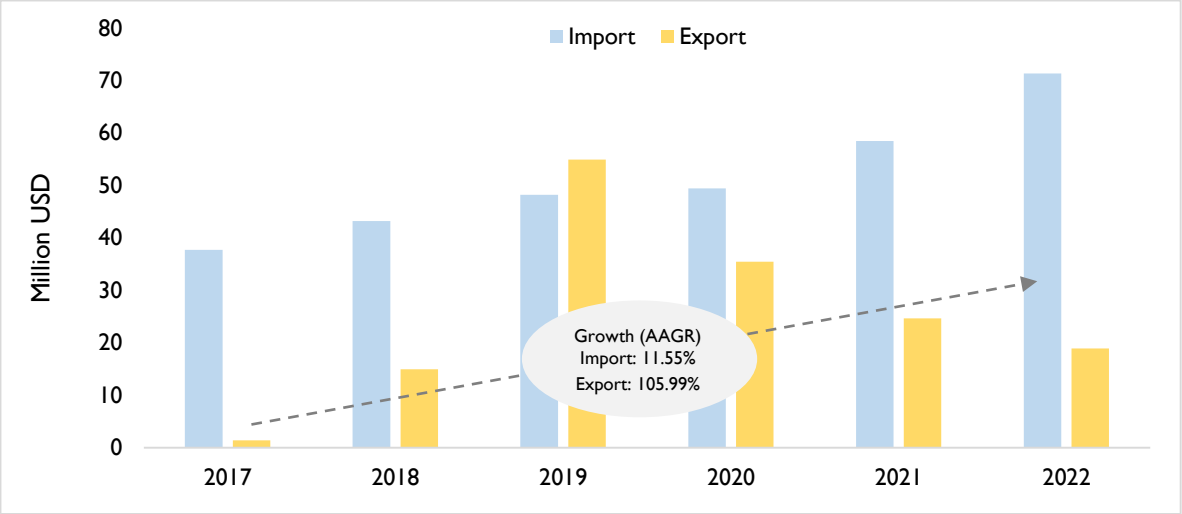
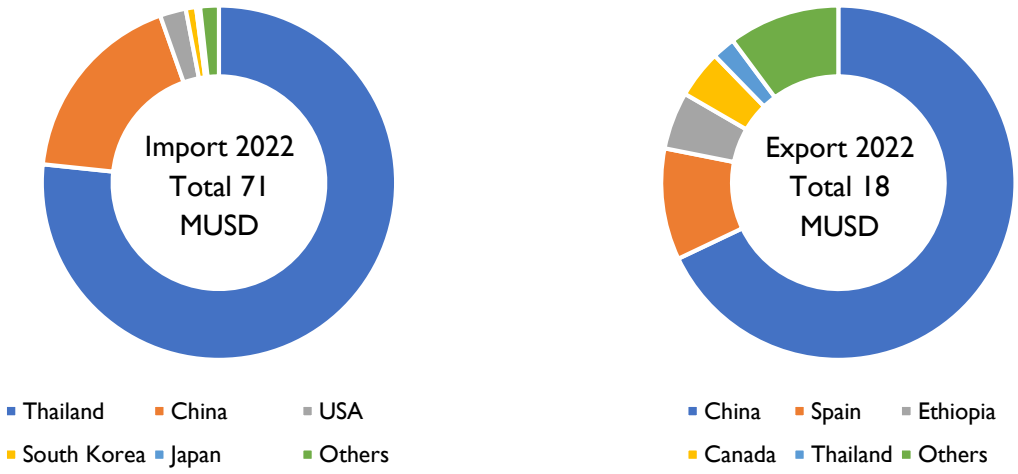


Figure 2-26 Plastic resin import-export value of Laos 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Laos's plastic resin trading partner country in 2022**

For the important destination market segment of Laos' plastic product imports and exports, it was found that in 2022, the main trading partner for Laos' plastic pellets in the export sector was China, accounting for 67.94 percent of the market value, followed by Spain, Italy, Canada, and Thailand, respectively. Meanwhile, in the import sector in 2022, the main trading partners for Laos were Thailand, accounting for 76.66 percent of the import value, followed by China, the United States, South Korea, and Japan, respectively.



Note: Million US Dollars (MUSD)

Figure 2-27 Laos's plastic resin trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

Laos's plastic product trading situation

- **Plastic product import-export value of Laos 2017-2022 (HS Code: 3916-3926)**

Overview of plastic product trade in Laos: It was found that in the import sector, the value of plastic product imports into Laos has increased significantly, especially during the period of 2017-2021, with an average annual growth rate of 10.04%. In 2021, Laos had a total import value of plastic products of approximately 162.72 million US dollars, which increased from around 21.43 million US dollars in the previous year. However, in the export sector, the overall value of plastic product exports from Laos decreased from 3.65 million US dollars in 2017 to 3.46 million US dollars in 2021, with an average annual growth rate of -1.35%.

As for the value of plastic product exports from Laos in 2022, it was found to be at 4.78 million US dollars, which increased by 38.07% YoY from the previous year. Meanwhile, in the import sector, the value of plastic product imports into Laos in 2022 was found to be at 207.78 million US dollars, which increased by 27.69% YoY from the previous year.

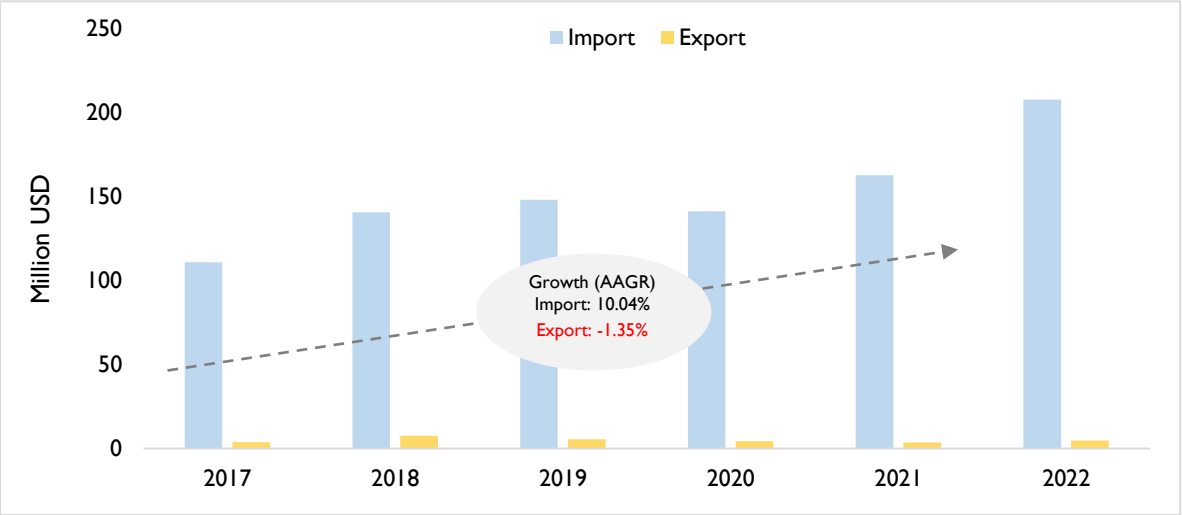
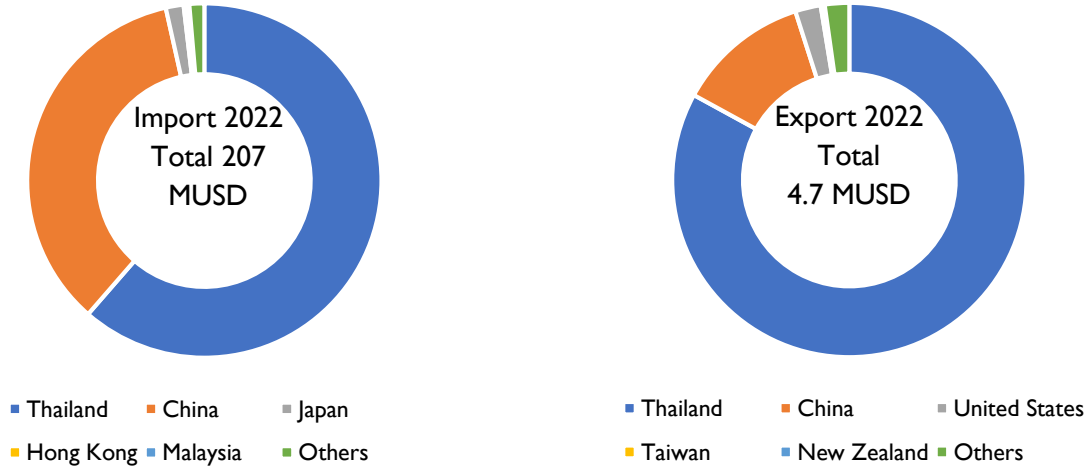


Figure 2-28 Plastic Product import-export value of Laos 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Laos's plastic product trading partner country in 2021**

For the important destination market segment of Laos' import-export of plastic products, it was found that in 2022, the main trading partner for Laos' plastic products in the export sector was Thailand, with a market value proportion of 82.96% compared to the overall export value, followed by China, the Dominican Republic, Taiwan, and New Zealand, respectively. Meanwhile, in the import sector in 2022, the main trading partner for Laos was Thailand, with a market value proportion of 61.40%, followed by China, Japan, Hong Kong, and Malaysia, respectively.

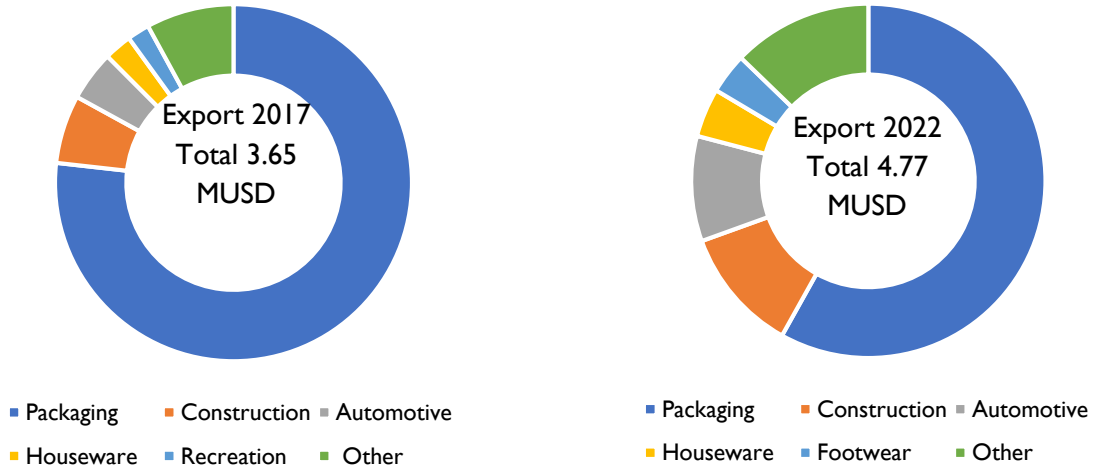


Note: Million US Dollars (MUSD)

Figure 2-29 Laos's plastic Product trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

- **Laos's plastic product export by industrial sector in 2022**



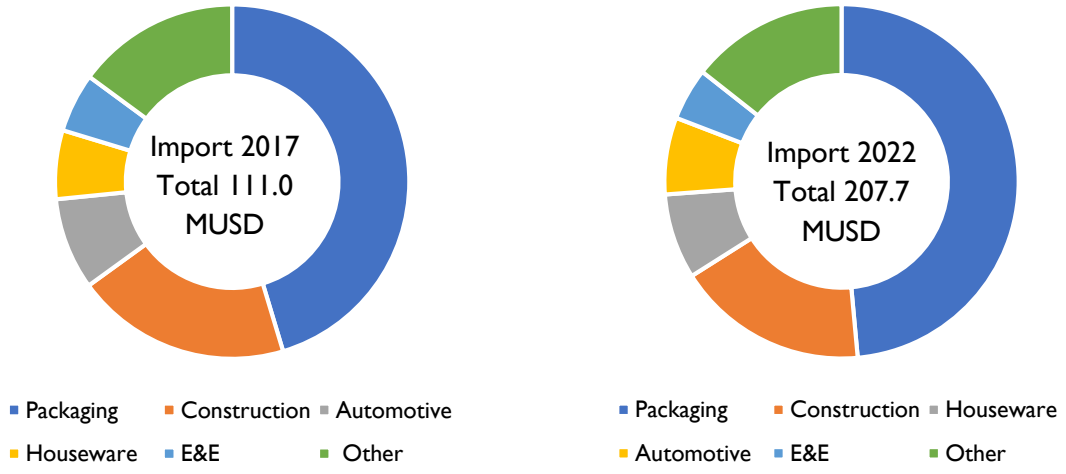
Note: Million US Dollars (MUSD)

Figure 2-30 Market share of Laos's plastics product export by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product exports from Laos in 2017 divided by industry groups, it was found that the largest proportion of plastic product exports from Laos was in the plastic packaging group, accounting for 76.78% of the total value of plastic product exports from Laos, followed by the construction

materials group, automotive parts group, household appliances group, and toys and fashion accessories group, respectively. In contrast, in 2022, the largest proportion of plastic product exports from Laos was still in the plastic packaging group, accounting for 58.10% of the total value of plastic product exports from Laos, followed by the construction materials group, automotive parts group, household appliances group, and footwear group, respectively.



Note: Million US Dollars (MUSD)

Figure 2-31 Market share of Laos's plastics product import by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports into Laos, separated by industrial groups, in 2017, it was found that Laos imported the most plastic products in the packaging group, accounting for 45.36 percent of the total value of plastic product imports in the country. The following groups ranked lower: construction material components, automotive industry components, household appliance components, and electronic and electrical appliance components, respectively. In 2022, it was found that Laos still imported the most plastic products in the packaging group, accounting for 48.54 percent of the total value of plastic product imports in the country. The following groups ranked lower: construction material components, household appliance components, automotive industry components, and electronic and electrical appliance components, respectively.

Summary of Laos's plastics industry and trading situation

From studying the statistics of plastic industry trade in Laos, it was found that in the upstream plastic industry, Laos still heavily relies on importing plastic pellets from foreign countries compared to exporting. Over the past five years, Laos has continuously relied on importing plastic pellets, indicating that the plastic pellet and petrochemical production industry in the country is not yet very strong compared to Thailand. While the export of plastic pellets from Laos has increased in some years, it is expected that this is due to the re-export by entrepreneurs in the country.

As for the downstream plastic industry, it was found that Laos has the potential to produce plastic products in the packaging, construction parts, and automotive industries to meet the production needs of the destination industries in Thailand, which is the important automobile and industrial product base of Asia. However, the overall trade of plastic products in Laos shows that the country still heavily relies on importing plastic products from foreign countries, resulting in continuous trade imbalances in the plastic product sector. This shows that Laos still has limitations in producing plastic products in the country as much as it should be.

2.3.3 Review of Myanmar's Plastics Industry

Myanmar's plastic resin trading situation (HS Code: 3901-3915)

- **Plastic resin import-export value of Myanmar**

Overview of plastic trade in Myanmar reveals that in the import sector, the value of plastic imports has increased significantly, especially during the period of 2017-2021, with an average annual growth rate of 6.05%. In 2021, Myanmar imported plastic pellets with a total value of approximately 421 million US dollars, which decreased by about 9.64 million US dollars from the previous year. On the other hand, in the export sector, Myanmar's overall value of plastic pellet exports has increased from 3.16 million US dollars in 2017 to 12.00 million US dollars in 2021, with an average annual growth rate of 39.57%.

Regarding the value of plastic pellet exports in Myanmar in 2022, it was found to be at 17.43 million US dollars, which increased by 45.22% year-over-year (YoY) from the previous year. Meanwhile, in the import sector of plastic pellets in Myanmar in 2022, the value of plastic imports was approximately 520.74 million US dollars, which increased by 23.83% YoY from the previous year.

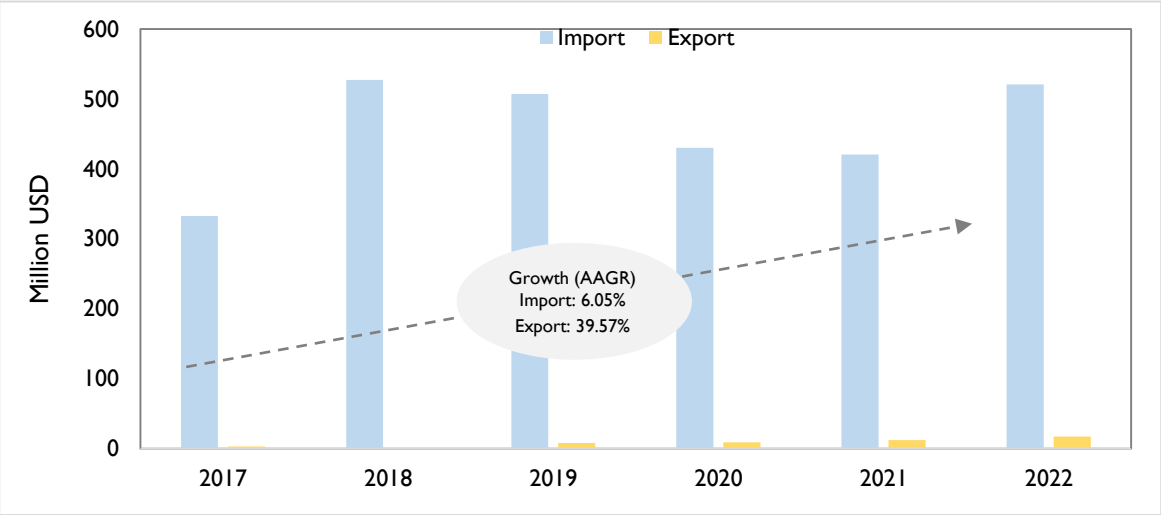
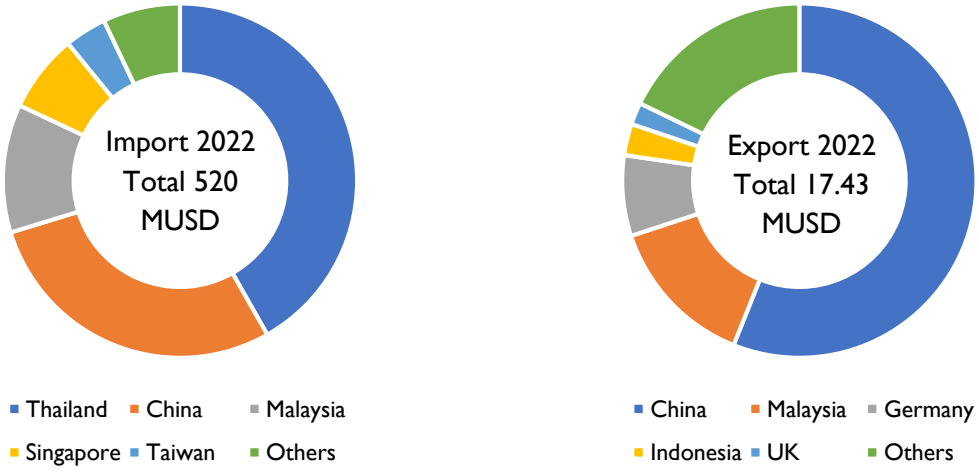


Figure 2-32 Plastic resin import-export value of Myanmar 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Myanmar's plastic resin trading partner country in 2022**

For the important destination market segment of importing and exporting plastic products from Myanmar, it was found that in 2022, the main trading partner for Myanmar's plastic pellets in the export sector was China, with a market value share of 56.05% compared to the overall export value, followed by Malaysia, Germany, Indonesia, and the United Kingdom, respectively. Meanwhile, in the import sector in 2022, the main trading partners for Myanmar were Thailand, with an import value share of 41.79%, followed by China, Malaysia, Singapore, and Taiwan, respectively.



Note: Million US Dollars (MUSD)

Figure 2-33 Myanmar's plastic resin trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

Myanmar's plastic product trading situation

- **Plastic product import-export value of Myanmar 2017-2022 (HS Code: 3916-3926)**

Overview of plastic product trade in Myanmar found that in the import sector, the value of plastic product imports has increased significantly, particularly in the period of 2017-2021, with an average annual growth rate of 4.98%. In 2021, Myanmar had a total plastic product import value of approximately 528.42 million US dollars, which decreased by about 4.80 million US dollars compared to the previous year. In the export sector, overall plastic product exports from Myanmar increased significantly, from a value of 40.49 million US dollars in 2017 to 93.01 million US dollars in 2021, or an average annual growth rate of 23.11%.

As for the value of plastic product exports from Myanmar in 2022, it was found to be 81.72 million US dollars, with a YoY decrease of 12.14% from the previous year. Meanwhile, in the import sector of plastic products in Myanmar in 2022, the value of imports was 686.15 million US dollars, with a YoY increase of 29.85% from the previous year.

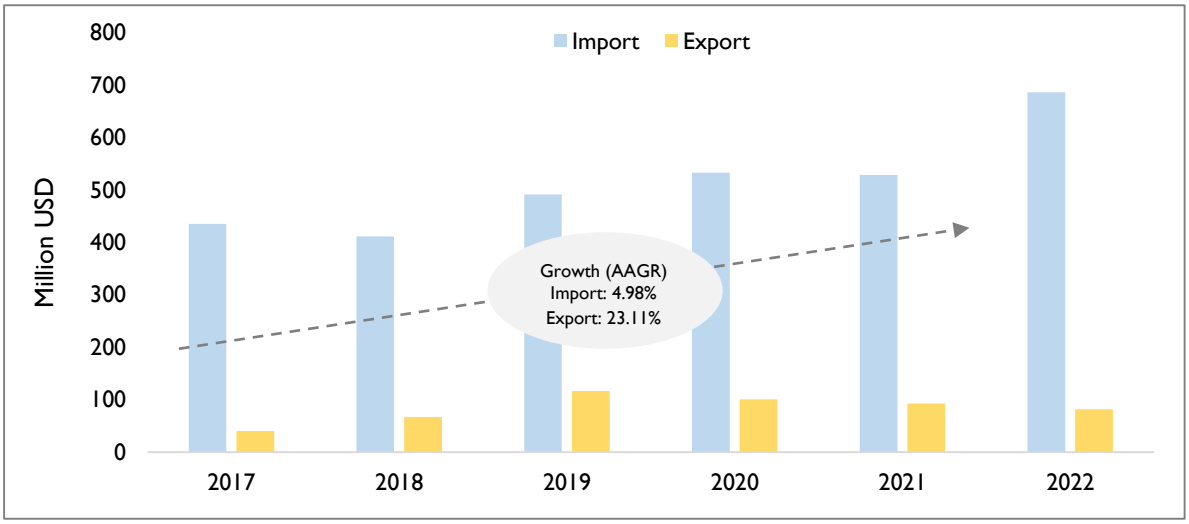
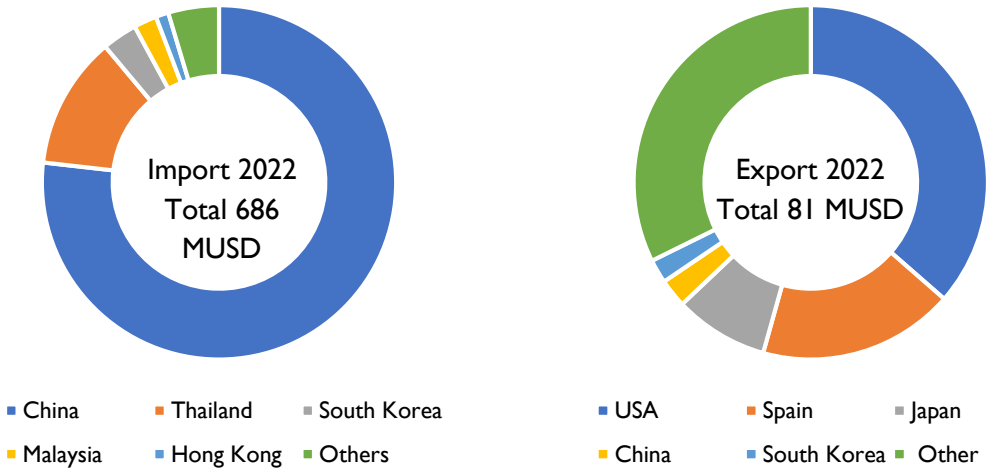


Figure 2-34 Plastic Product import-export value of Myanmar 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Myanmar's plastic product trading partner country in 2021**

For the important destination market segment of importing and exporting plastic products from Myanmar, it was found that in 2022, the main trading partner for Myanmar's plastic products in the export sector was the United States, with a market value proportion of 36.43% compared to the overall export value. The following countries were Spain, Japan, China, and South Korea respectively. In terms of imports in 2022, the main trading partners for Myanmar were China with a proportion of 76.80% of import value, followed by Thailand, South Korea, Malaysia, and Hong Kong respectively.

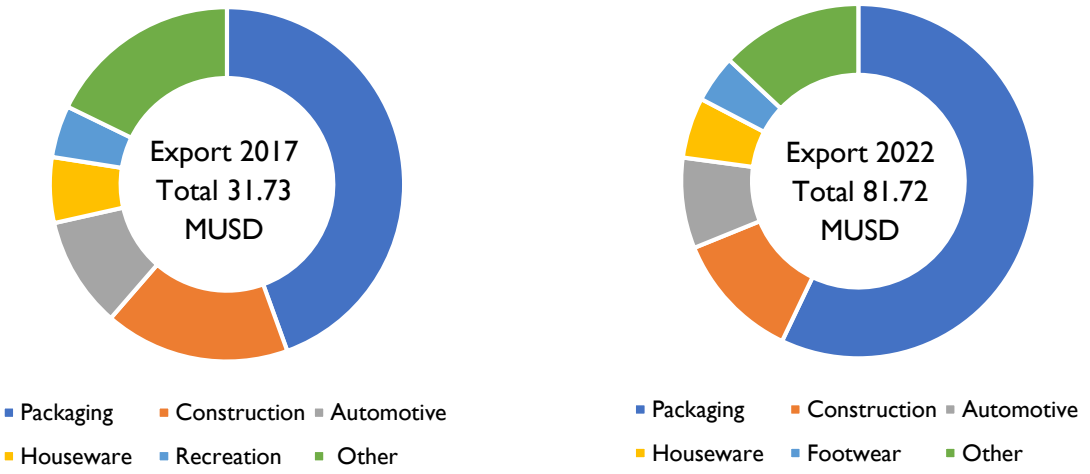


Note: Million US Dollars (MUSD)

Figure 2-35 Myanmar's Plastic Product trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

- **Myanmar's plastic product export by industrial sector in 2022**

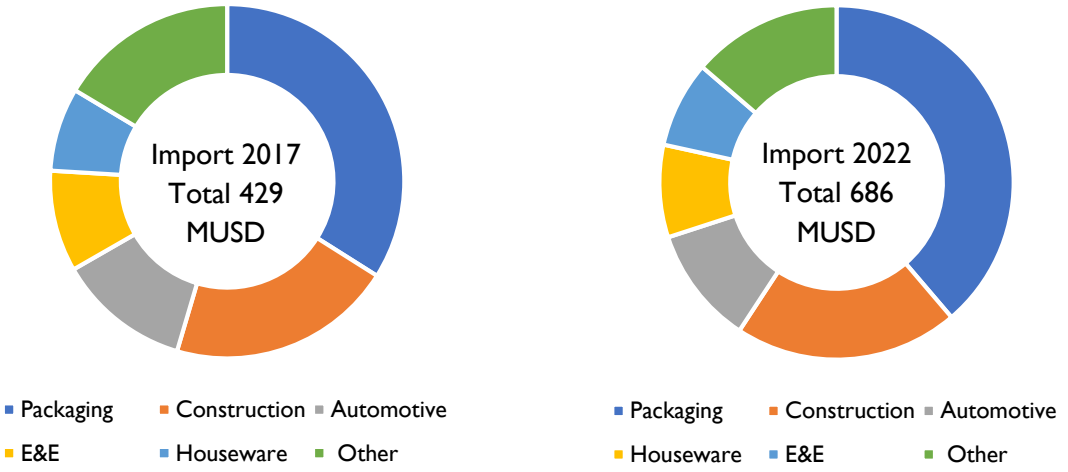


Note: Million US Dollars (MUSD)

Figure 2-36 Market share of Myanmar's plastics product export by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product exports from Myanmar classified by industry groups in 2017, it was found that Myanmar had the highest proportion of plastic packaging exports, accounting for 44.47% of the total value of plastic product exports from Myanmar. This was followed by the construction materials group, automotive parts group, household appliance group, and electronics and electrical parts group, in that order. In contrast, in 2022, it was found that Myanmar had the highest proportion of plastic packaging exports, accounting for 57.08% of the total value of plastic product exports from Myanmar. This was followed by the construction materials group, automotive parts group, household appliance group, and footwear group, in that order.



Note: Million US Dollars (MUSD)

Figure 2-37 Market share of Myanmar's plastics product import by industrial sector in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports by industry group in 2017, it was found that for Malaysia, the group with the highest imports of plastic products was packaging, accounting for 33.96% of the total value of plastic product imports. This was followed by the construction materials group, automotive parts group, electrical and electronic parts group, and household appliance group, in that order. In contrast, in 2022, it was found that the packaging group remained the industry group with the highest imports of plastic products, accounting for 38.76% of the total value of plastic product imports for Malaysia. The other groups, in descending order of import value, were construction materials, automotive parts, household appliances, and electrical and electronic parts.

Summary of Myanmar's plastics industry and trading situation

For an overview of the plastic industry in Myanmar, specifically in the upstream industry, it was found that Myanmar imports plastic pellets mainly from China and Thailand to meet the demand for domestic production. This reflects the limitations of Myanmar's plastic industry in terms of producing raw plastic materials to meet the needs of the industry, similar to Cambodia. As a result, Myanmar has had a continuous trade deficit in plastic pellet products over the past five years.

In the downstream industry, or the plastic product manufacturing industry in Myanmar, it was found that Myanmar serves as a production base for industrial products such as plastic packaging, construction materials, as well as automotive components for both domestic and foreign industries. However, it is expected that the plastic product manufacturing in Myanmar will be based on meeting the demands of the local downstream industry. This is reflected in the relatively small proportion of Myanmar's plastic product exports and the continuous trade deficit in the past five years. Most of the plastic products produced in Myanmar are exported to large, industrialized countries with well-established brands such as the United States, Spain, and Japan.

2.3.4 Review of Vietnam's Plastics Industry

Vietnam's plastic resin trading situation (HS Code: 3901-3915)

- **Plastic resin import-export value of Vietnam**

Overview of plastic trade in Vietnam reveals that in the import sector, the value of plastic imports by Vietnam has increased significantly, especially during the period of 2017-2021, with an average growth rate of 14.43% per year. In 2021, Vietnam's total plastic imports were approximately USD 11.689 billion, an increase of approximately USD 3.243 billion from the previous year. In the export sector, Vietnam's overall plastic exports increased significantly from USD 633 million in 2017 to USD 2.118 billion in 2021, with an average growth rate of 35.23% per year during the period of 2017-2021.

For the value of plastic exports in Vietnam in 2022, it was found to be USD 2.301 billion, with exports increasing by 8.63% YoY from the previous year. Meanwhile, in the import sector, Thailand's plastic imports in 2022 were found to be USD 12.064 billion, increasing by 3.21% YoY from the previous year.

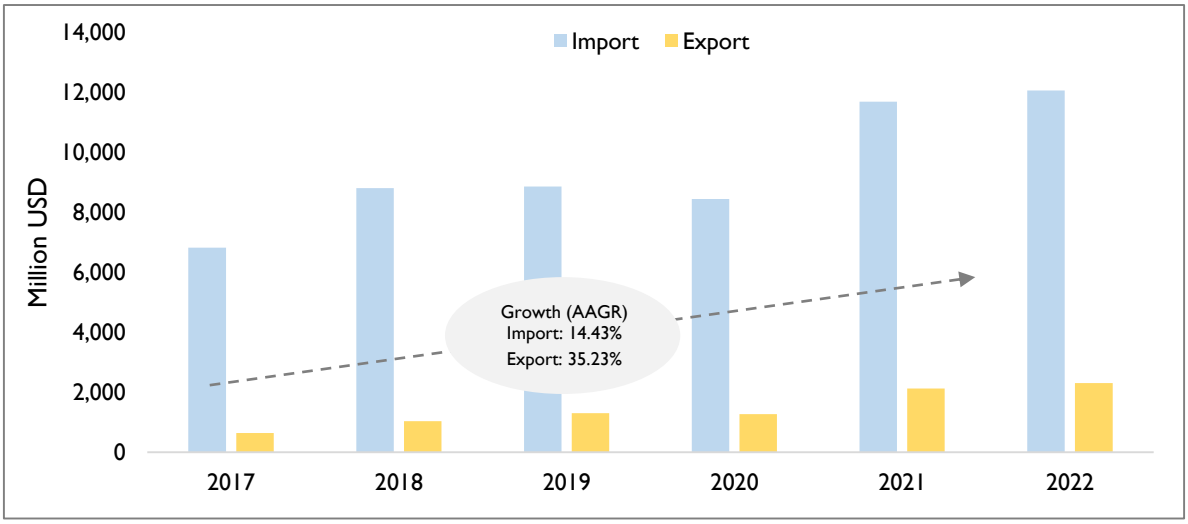
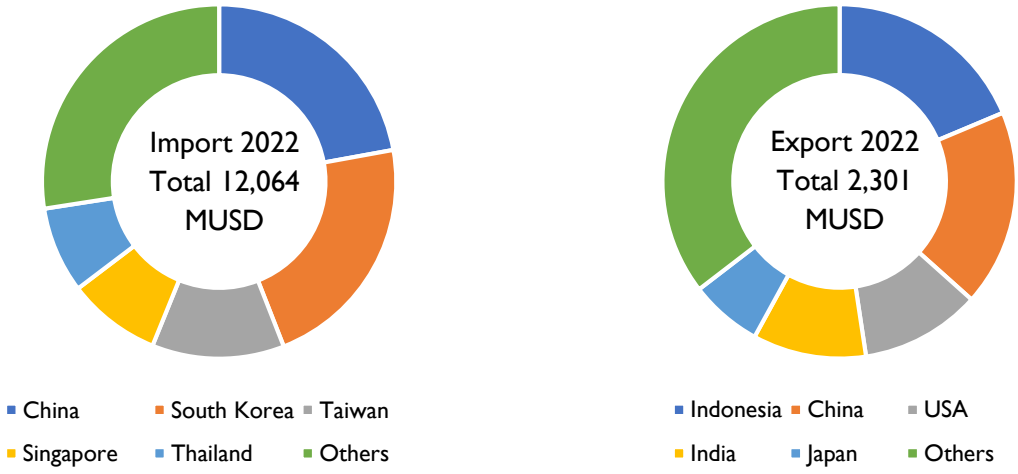


Figure 2-38 Plastic resin import-export value of Vietnam 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Vietnam's plastic resin trading partner country in 2022**

For the important destination market segment of Vietnam's plastic imports and exports, it was found that in 2022, the main trading partner for Vietnam's plastic pellets in the export sector was Indonesia, with a market value proportion of 18.67% compared to the overall export value, followed by China, the United States, India, and Japan in that order. Meanwhile, in the import sector in 2022, the main trading partner for Vietnam's imports was China, with a market value proportion of 22.14%, followed by South Korea, Taiwan, Singapore, and Thailand in that order.



Note: Million US Dollars (MUSD)

Figure 2-39 Vietnam's plastic resin trading partner country 2022

Source: Plastics Institute of Thailand (n.d.)

Vietnam's plastic product trading situation

- **Plastic product import-export value of Vietnam 2017-2022 (HS Code: 3916-3926)**

An overview of Vietnam's plastic product trade shows that the value of plastic product imports to Vietnam has increased significantly, especially during the period from 2017-2021, with an average annual growth rate of 15.19%. In 2021, the total value of plastic product imports to Vietnam was approximately 8,045.22 million US dollars, an increase of around 1,180 million US dollars from the previous year. On the other hand, the total value of plastic product exports from Vietnam has also increased significantly from 3,227.42 million US dollars in 2017 to 6,180.70 million US dollars in 2021, with an average annual growth rate of 17.64%.

An overview of Vietnam's plastic product trade shows that the value of plastic product imports to Vietnam has increased significantly, especially during the period from 2017-2021, with an average annual growth rate of 15.19%. In 2021, the total value of plastic product imports to Vietnam was approximately 8,045.22 million US dollars, an increase of around 1,180 million US dollars from the previous year. On the other hand, the total value of plastic product exports from Vietnam has also

increased significantly from 3,227.42 million US dollars in 2017 to 6,180.70 million US dollars in 2021, with an average annual growth rate of 17.64%.

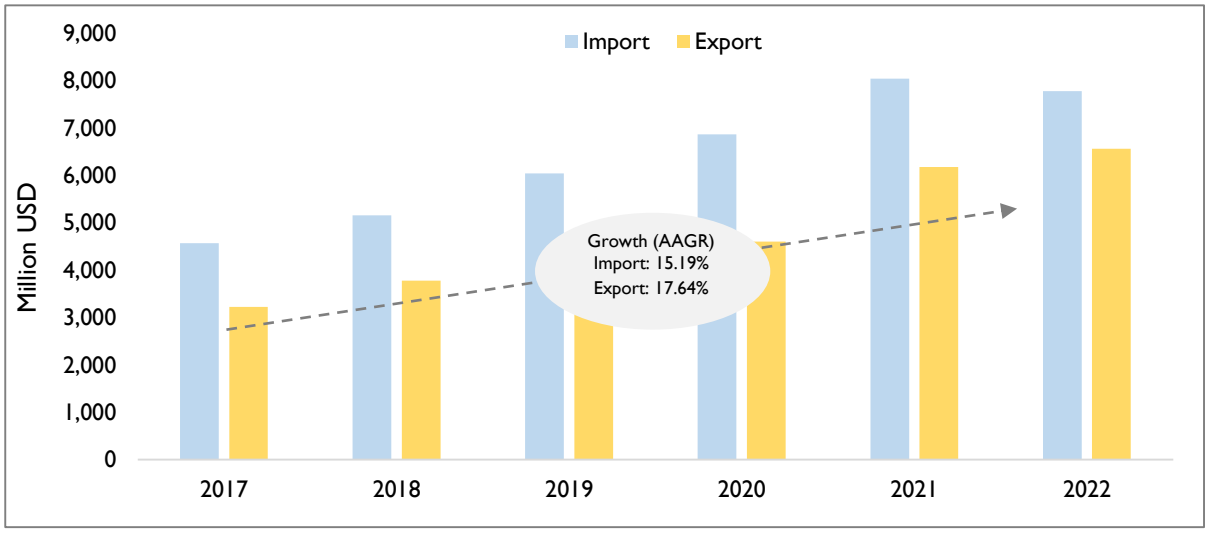
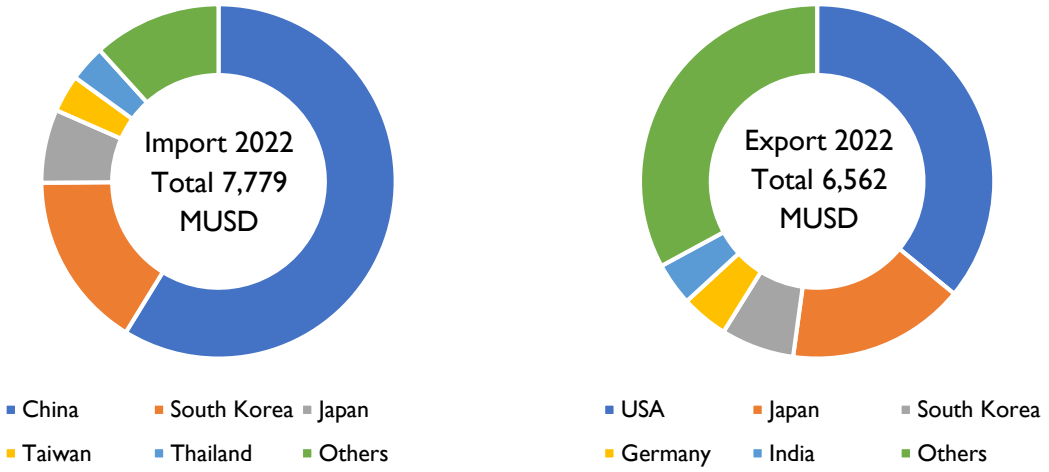


Figure 2-40 Plastic Product import-export value of Vietnam 2017-2022

Source: Plastics Institute of Thailand (n.d.)

- **Vietnam's plastic product trading partner country in 2022**

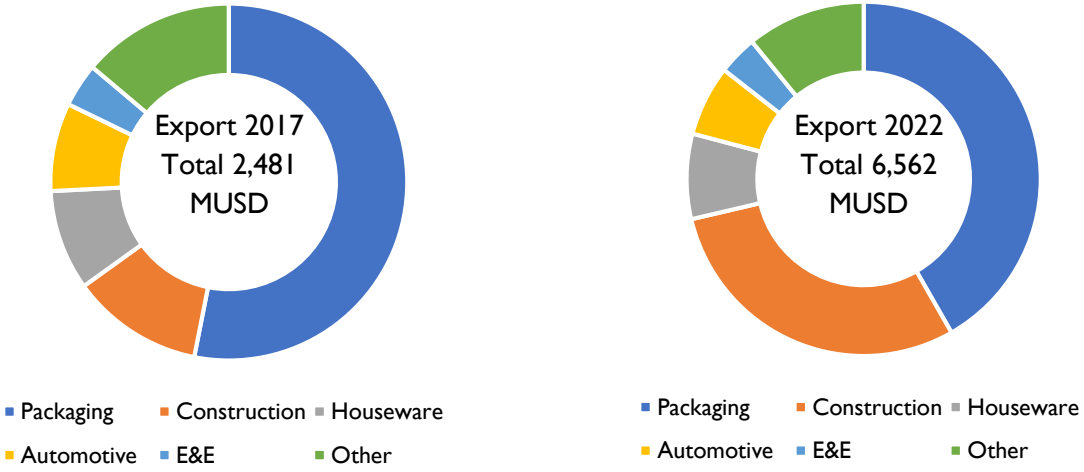
For the important destination market segment of importing and exporting plastic products from Vietnam, it was found that in 2022, the main trading partner for Vietnam's plastic products in the export sector was the United States, with a market value proportion of 37.98% compared to the total export value. The following countries in order were Japan, South Korea, Germany, and India. Meanwhile, in the import sector in 2022, the main trading partners for Vietnam's imports were China, with a market value proportion of 58.72%, followed by South Korea, Japan, Taiwan, and Thailand.



Note: Million US Dollars (MUSD)

Figure 2-41 Vietnam's import - export plastic product trading partner country in 2022
Source: Plastics Institute of Thailand (n.d.)

Vietnam's plastic product export by industrial sector in 2022

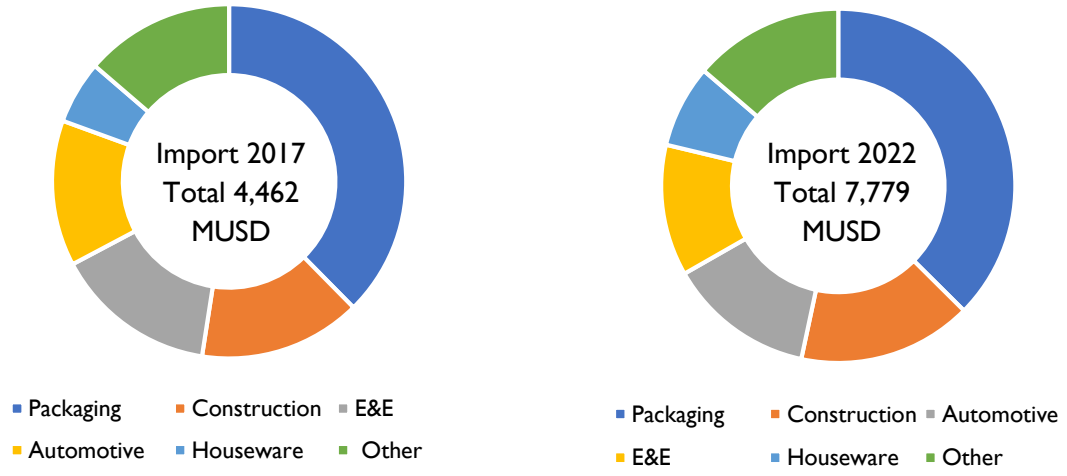


Note: Million US Dollars (MUSD)

Figure 2-42 Market share of Vietnam's plastics product export by industrial sector in 2022
Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of Vietnam's plastic product exports by industry group in 2017, it was found that Vietnam had the highest proportion of plastic packaging product exports, accounting for 53.11% of the total value of plastic product exports. This was followed by the construction material component group, household appliance group, automotive parts group, and electrical and electronic

components group, in that order. In contrast, in 2022, it was found that Vietnam's plastic product exports in the plastic packaging product group were still the highest, accounting for 41.74% of the total value of plastic product exports, followed by the construction material component group, household appliance group, automotive parts group, and electrical and electronic components group, in that order.



Note: Million US Dollars (MUSD)

Figure 2-43 Market share of Vietnam's plastics product import by industrial sector in 2022
Source: Plastics Institute of Thailand (n.d.)

When considering the proportion of plastic product imports into Vietnam divided by industrial groups in 2017, it was found that Vietnam imported the most plastic products in the packaging group, accounting for 37.61% of the total value of plastic product imports. This was followed by the construction material component group, electrical and electronic component group, automotive component group, and household appliance group, in that order. However, in the past year of 2022, it was found that Vietnam imported the most plastic products in the packaging group, accounting for 37.44% of the total value of plastic product imports. This was followed by the construction material component group, automotive component group, electrical and electronic component group, and household appliance group, in that order.

Summary of Vietnam's plastics industry and trading situation

From the trade data of plastic pellets in Vietnam over the past 5 years, it was found that Vietnam has an increasing demand for plastic pellets within the country, reflecting the expansion of the domestic plastic industry. This is evidenced by the increased volume of plastic pellet imports, especially during the period of 2018-2021, while the volume of exports is relatively low. This has resulted in a trade deficit for Vietnam in the plastic pellet product group. Vietnam mainly imports plastic pellets from its trading partners, mostly located in the Asian region.

In terms of plastic product processing, Vietnam is a country with potential in the downstream plastic industry. Plastic products are produced to meet the needs of various industries such as the electronics industry, automotive industry, etc. The plastic industry in Vietnam is considered a supportive industry, rather than a primary industry that generates revenue for the country, compared to other industries. However, Vietnam still has advantages that help promote the expansion of the plastic industry within the country, such as lower labor costs compared to other competitors, readiness in plastic product processing, and geographical advantages that can promote transportation and logistics.

2.3.5 Review of Thailand's Plastics Industry

Thailand's plastic resin trading situation (HS Code: 3901-3915)

- **Plastic resin import-export value of Thailand**

Overview of Thailand's plastic pellet trade found that in the import sector, the value of Thailand's plastic pellet imports has increased significantly, particularly in the period from 2017 to 2021, with an average growth rate of 6.05% per year. In 2021, Thailand's overall value of plastic pellet imports was approximately 5,376.89 million US dollars, increasing from around 1,486.19 million US dollars in the previous year. In the export sector, Thailand's overall value of plastic pellet exports has also increased significantly from 2017 to 2021, from 8,642.76 million US dollars in 2017 to 11,059.08 million US dollars in 2021, or an average growth rate of 6.36% per year.

As for the value of Thailand's plastic pellet exports in 2022, it was found to be 10,564.04 million US dollars, with a reduction in export performance of 4.48% YoY compared to the previous year. In contrast, the value of Thailand's plastic pellet imports in 2022 was 5,561.07 million US dollars, showing an increase of 3.43% YoY compared to the previous year.

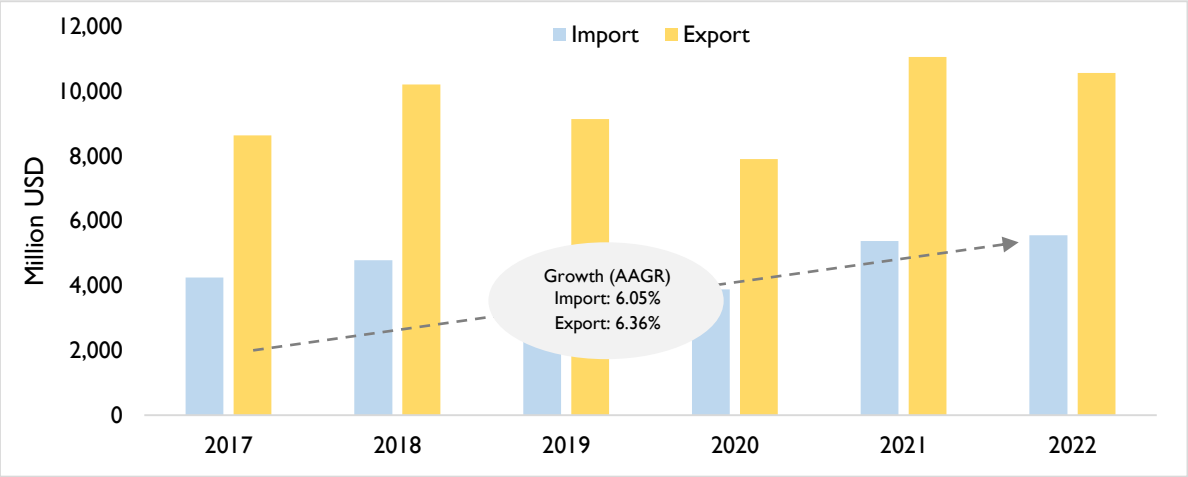
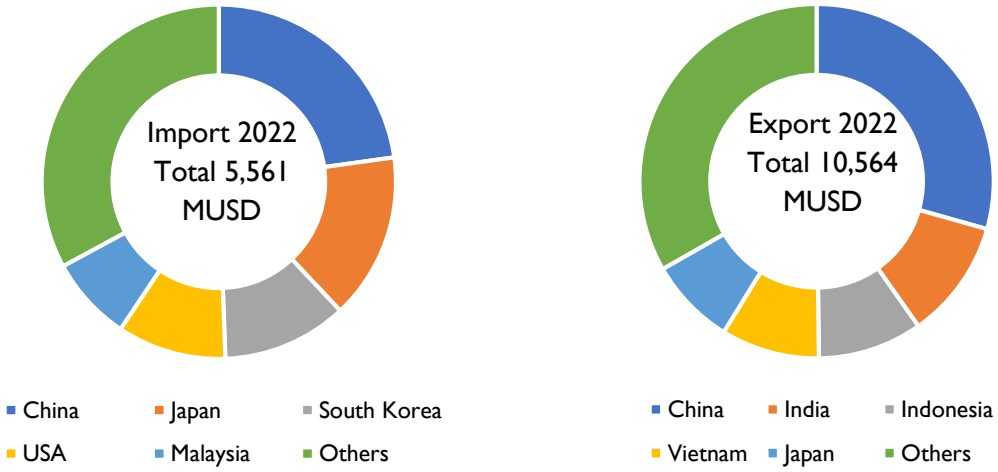


Figure 2-44 Plastic resin import-export value of Thailand 2017-2022

Source: Thai Customs Source (n.d.)

- **Thailand's plastic resin trading partner country in 2022**

For the important destination market segment of Thailand's import-export of plastic products, it was found that in 2022, the main trading partner for Thailand's plastic pellets in the export sector was China, with a market value proportion of 29.36% compared to the overall export value, followed by India, Indonesia, Vietnam, and Japan in order. Meanwhile, in the import sector in 2022, the main trading partners for Thailand were China with a market value proportion of 22.80%, followed by Japan, South Korea, the United States, and Malaysia in order.



Note: Million US Dollars (MUSD)

Figure 2-45 Thailand's plastic resin trading partner country 2022
Source: Thai Customs Source (n.d.)

Thailand's plastic product trading situation

- **Plastic product import-export value of Thailand 2017-2022 (HS Code: 3916-3926)**

Overview of Thailand's Plastic Product Trade: It has been found that the value of plastic product imports to Thailand has increased, particularly during the period of 2017-2021, with an average annual growth rate of 4.88%. In 2021, the total value of plastic product imports to Thailand was approximately 5,374.50 million US dollars, which increased by approximately 675.79 million US dollars from the previous year. On the other hand, the overall value of plastic product exports from Thailand has also increased, from 3,933.60 million US dollars in 2017 to 4,410.60 million US dollars in 2021, with an average annual growth rate of 2.90%.

In 2022, the value of plastic product exports from Thailand was 4,545 million US dollars, with an increase of 3.05% YoY from the previous year. Meanwhile, the value of plastic product imports to Thailand in 2022 was 5,365.12 million US dollars, with a decrease of 0.18% YoY from the previous year.

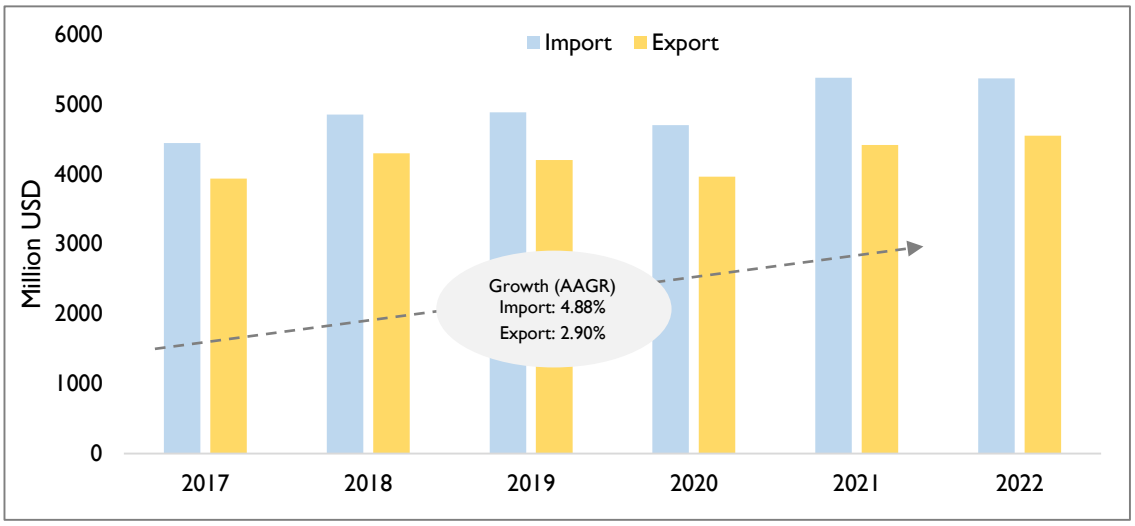
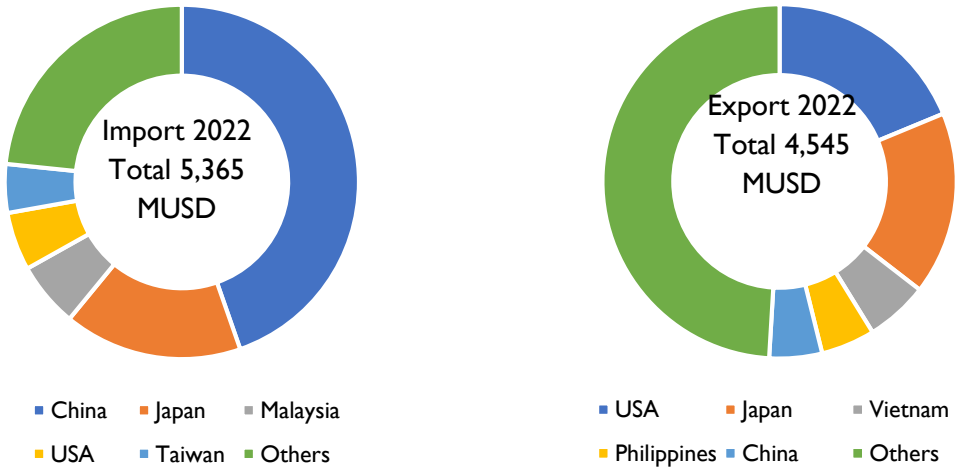


Figure 2-46 Plastic Product import-export value of Thailand 2017-2022
Source: Thai Customs Source (n.d.)

- **Thailand's plastic product trading partner country in 2022**

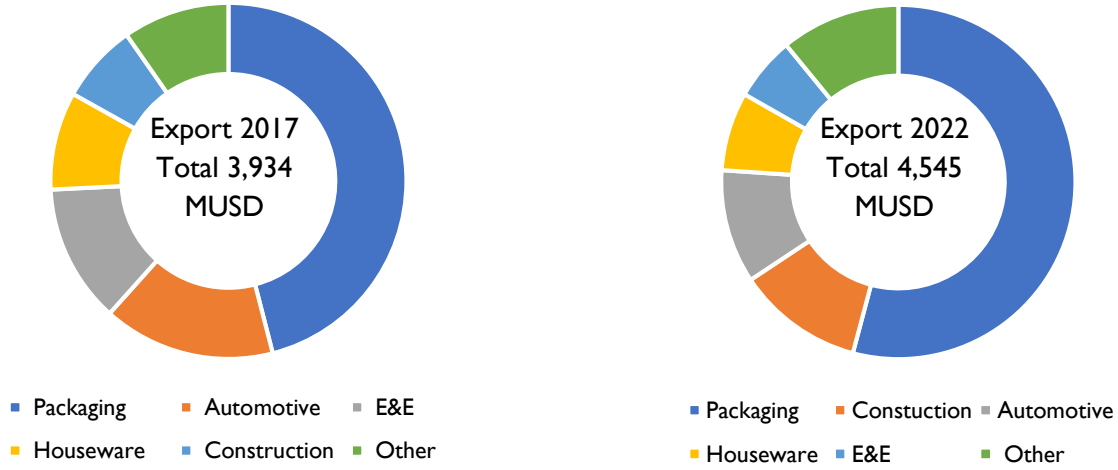
For the important destination markets of Thai plastic product imports and exports, it was found that in 2022, the main trading partner for Thai plastic products in the export sector was Japan, with a market value share of 17.62%, compared to the overall export value. The next top countries were the United States, Vietnam, China, and Indonesia, respectively. On the other hand, in the import sector in 2021, the main trading partner for Thailand was China, with a market value share of 41.90%, followed by Japan, Malaysia, Taiwan, and Vietnam, respectively.



Note: Million US Dollars (MUSD)

Figure 2-47 Thailand's plastic product trading partner country in 2022
Source: Thai Customs Source (n.d.)

- **Thailand's plastic product export by industrial sector in 2022**

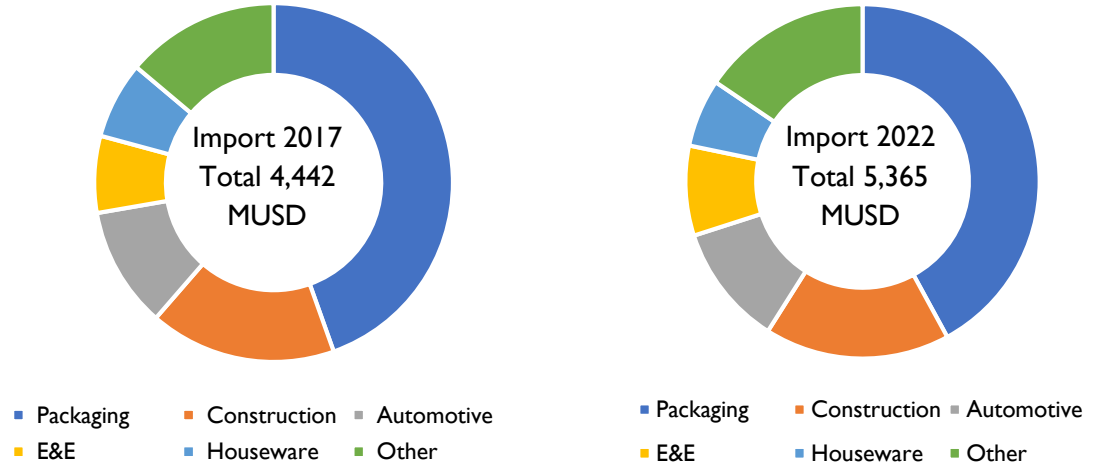


Note: Million US Dollars (MUSD)

Figure 2-48 Market share of Thailand's plastics product export by industrial sector in 2022
Source: Thai Customs Source (n.d.)

When considering the proportion of Thailand's plastic product exports by industry group in 2017, it was found that Thailand had the highest proportion of plastic product exports in the plastic packaging group, accounting for 46.00 percent of Thailand's total plastic product exports. This was followed by the automotive parts industry group, the electrical and electronics parts group, and household appliances group, in that order. In contrast, in the past year of 2022, it was found that Thailand

had the highest proportion of plastic product exports in the plastic packaging group, accounting for 54.14 percent of Thailand's total plastic product exports. This was followed by the construction material parts group, the automotive parts industry group, the household appliances group, and the electrical and electronics parts group, in that order.



Note: Million US Dollars (MUSD)

Figure 2-49 Market share of Thailand's plastics product import by industrial sector in 2022
Source: Thai Customs Source (n.d.)

When considering the proportion of Thailand's plastic product imports in 2017, separated by industry groups, it was found that Thailand imported the most plastic products in the plastic packaging group, accounting for 43.70 percent of the total value of plastic product imports in Thailand. This was followed by the construction material component group, automotive industry component group, and electrical and electronics component group, respectively. In the past year, 2022, it was found that Thailand imported the most plastic products in the plastic packaging group, accounting for 42.06 percent of the total value of plastic product imports in Thailand. This was followed by the construction material component group, automotive industry component group, and electrical and electronics component group, respectively.

Summary of Thailand's plastics industry and trading situation

From an overview of Thailand's plastic industry, it is found that Thailand is a country with a strong upstream plastic industry, being a key producer of plastic pellets in the ASEAN and Asia-Pacific region. Looking at the data on plastic pellet exports from Thailand in the past 5 years, it can be seen that there is a trend of increasing plastic pellet exports from Thailand. This trend has not been significantly impacted by the COVID-19 pandemic that began in early 2020 and continued into 2021, and Thailand has maintained a balanced trade in plastic pellets, especially in early 2022 when plastic pellet prices increased due to the expansion of crude oil

prices and the weak Thai baht. The main trading partners for Thailand's plastic pellet imports and exports are countries in the ASEAN and Asia-Pacific region, such as China, Japan, South Korea, Indonesia, and Malaysia.

In terms of trade in plastic products, Thailand has had a trade deficit in this category over the past 5 years, as Thailand has had to import certain types of plastic products to meet market and industrial demand in the country, especially for specialized packaging, construction components, and automotive parts. However, efforts have been made to increase local production and reduce the need for imports in these areas, and Thailand has made progress in developing its downstream plastic industry, particularly in the production of plastic finished products for export.

2.4 Summary of Global Trading Situation

Summary of plastic product import – export value proportion in 2022

Currency: USD

Country	Plastics Product	Plastics Packaging	% Share
World	468,978.7	178,992.7	38%
China	107,589.4	35,679.5	33%
Japan	13,860.6	5,089.2	37%
South Korea	11,894	4,820.8	41%
Vietnam	7,232.4	2,738.8	38%
Thailand	4,545.0	2,460.7	54%
Singapore	2,652.6	977.8	37%
Cambodia	556.2	99.0	18%
Myanmar	85.9	46.7	54%
Lao	4.8	2.8	58%

Figure 2-50 Plastic product export value proportion in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the overall global export of plastic products, it is found that China is the country that exports the most plastic products, with an export value of 107,589.4 million US dollars, accounting for 22% of the total value of plastic product exports worldwide. This is because China is a major exporter of plastic products and has increasingly incorporated technology into its manufacturing sector, producing a variety of products. However, if the proportion of plastic packaging exports is compared to the export of plastic products, it is found that Laos, Thailand, and Vietnam have exported plastic packaging, accounting for 58% and 54% of the total value of plastic product exports, respectively. It is expected that the packaging industry is a key industry that creates value for the country and is also a group of products that continues to have an increasing market demand trend.

Currency: USD

Country	Plastics Product	Plastics Packaging	% Share
World	414,379.2	159,796.3	39%
China	19,057.7	7,075.5	37%
Japan	10,553.8	4,671.3	44%
Vietnam	7,916.5	2,912.3	37%
South Korea	7,704	3,316.4	43%
Thailand	5,365.1	2,256.5	42%
Singapore	3,520.6	1,396.7	40%
Cambodia	960.1	383.0	40%
Myanmar	688.6	265.9	39%
Lao	209	100.9	48%

Figure 2-51 Plastic product import value proportion in 2022

Source: Plastics Institute of Thailand (n.d.)

When considering the overall import of plastic products in the world, it is found that China is the country with the highest import of plastic products, as well as in the export sector. However, it is second to the United States and Germany. China's imports of plastic products are worth more than 19,057.7 million US dollars or about 4% of the total value of plastic product imports worldwide. This is because China is a large country and has a huge consumer market, so plastic products are imported to meet the demand in the market and the industry. However, when considering the proportion of plastic packaging imports compared to plastic product imports, it is found that Laos, Japan, and South Korea have imported plastic packaging products accounting for 48%, 44%, and 43% of the total value of plastic product imports, respectively. It is expected that the packaging industry is a group of products that have high consumer demand. Due to the COVID-19 pandemic, consumers mostly engage in private activities such as working from home, eating at home, shopping online, etc. Therefore, this is a supporting factor in increasing the demand for packaging products, including the economy in countries that gradually recover from tourism and private consumption. This allows the plastic packaging industry associated with food and beverages to continue to grow continuously.

Global Plastic Packaging Market by Application

In 2021, the food and beverage application segment dominated the market and accounted for more than 51.5% of the industry's revenue. During the forecast period, the segment is anticipated to grow significantly. Changing consumer lifestyles and food preferences have resulted in the expansion of the packaging and processed food manufacturing industry, which is likely to increase demand for plastic packaging. Additionally, rising utilization of alcoholic and non-alcoholic beverages, particularly among the young, is anticipated to contribute to the industry's expansion.

Due to its convenience, single-serving packaging for consumption goods has experienced significant growth in recent years. Increasing consumer focus on health

and well-being, heightened awareness of waterborne diseases, and rising purchasing power have accelerated the global demand for packaged drinking water, which is anticipated to have a positive effect on them.

During the forecast period, the personal and domestic care application segment is anticipated to see a revenue CAGR of over 4.4%. Increasing consumer awareness of sanitation and hygiene has resulted in significant growth for this industry. In addition, rising consumer interest in plant-based or clean label cosmetics is anticipated to play a significant role in the growth of this segment during the forecast period.

Population aging in Europe and North America is anticipated to increase demand for pharmaceutical products, thereby boosting the market. In addition, the growing production of generic pharmaceuticals is expected to increase demand for plastic packaging in the pharmaceutical application segment.

Additionally, an increase in the utilization of shipping containers and import/export activities has fueled the growth of the industrial packaging segment. Liners for shipping containers are predominantly employed for the mass transportation of goods and commodities. However, stringent regulations and policies to limit the consumption of non-biodegradable packaging may impede the development of the industrial packaging segment over the forecast period.

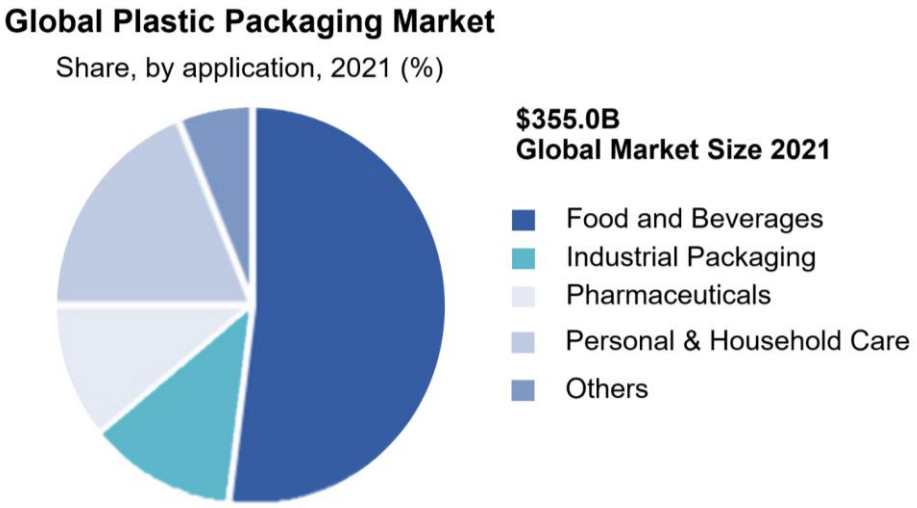


Figure 2-52 Global Plastic Packaging Market by Application 2021

Source: Grand View Research (n.d.)

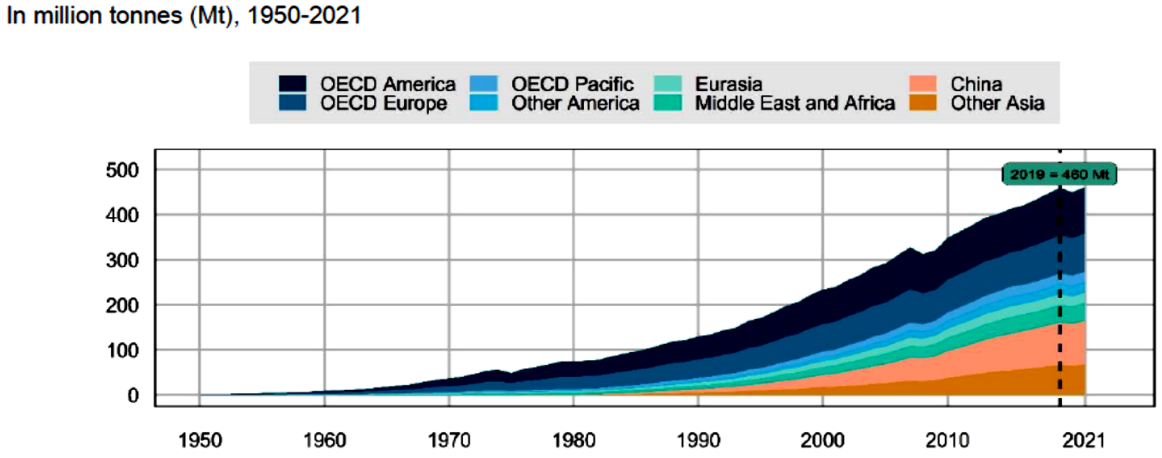
During the period from 2022 to 2029, the introduction of innovative packaging solutions such as active packaging, modified atmosphere, consumable, and bioplastic packaging will provide market participants with lucrative opportunities. In addition, awareness of waterborne diseases will contribute to the future expansion of the plastic packaging market.

The Global Use of Plastics

Growing populations and rising per capita incomes have seen the global use of plastics, including additives and fibres, reach 460 Mt in 2019 (Figure 2-53). The used volumes of these synthetic polymers have been increasing constantly and increased more rapidly than any other commodity, including steel, aluminium and cement (IEA, 2018).

In 2020, the COVID-19 pandemic had significant impacts on plastics use. On the one hand, there was a rapid increase in demand for personal protective equipment (such as face masks), a shift from restaurant eating to take-away and a shift from in-store shopping to online retail. On the other, plastics use in industry and commercial sectors declined as firms faced lockdowns. On balance, plastics use declined in 2020 but rebounded largely in 2021.

While plastics are produced and consumed everywhere, there are important regional variations when it comes to total volumes of plastics demand. Two-thirds of current use is concentrated in OECD countries and the People's Republic of China (hereafter China) (Figure 2-53) China represents around 20% of global plastics demand, the United States represents approximately 18%, OECD Europe represents about 18% and the rest of the OECD countries represent around 9%. However, the relative importance of each region's plastics use has been changing, mirroring the economic dynamics of regions and countries. For instance, the share of the OECD in global consumption has been declining steadily – from 87% in 1980 to 46% in 2019. As COVID-19 was a worldwide pandemic, this share has been more or less stable since 2019. However, relatively fast economic recovery in the United States and China may have increased their share somewhat in 2021.



Note: See Annex A for the detailed regional breakdown of the OECD ENV-Linkages regions.

Figure 2-53 Global plastics use has quadrupled in 30 years, mainly driven by emerging economies.
Source: OECD (2022)

The majority of plastics in use today are virgin plastics, made from crude oil or gas. Due to the fossil-based feedstock and the high energy consumption during refining, most greenhouse gas (GHG) emissions from plastics can be attributed to the production stage. Biobased plastics are a rather small group of plastics with similar characteristics to fossil-based plastics, but are derived from biomass. Together fossil-based and biobased

plastics can be referred to as primary plastics. Plastics made from recycled material are called secondary plastics. Secondary plastics contribute less to GHG emissions than primary plastics, but only accounted for 6% of global plastics use in 2019.

The variety of different polymers that can be produced accounts for the versatility of plastics (Table 2-1). Figure 2-54 provides an overview of the most commonly used polymers and their applications. Different polymers have differing properties. For example, thermoplastics can be remoulded after heating, while thermosets are irreversibly hardened. Elastomers have elastic properties and fibres can be made of various polymers but are defined by their shape. Biobased plastics are made of biomass as feedstock instead of fossil fuels. In addition, polymers are usually mixed or "compounded" with a wide range of additives to further customise and improve the performance of plastics. Some of the most important functions of additives are to prevent aging, colour the plastic, make rigid material flexible, work as a lubricant, improve the impact resistance, reduce flammability and generate foam as a blowing agent.

Table 2-1 The large range of polymers allows for a multitude of plastics applications

Polymer	Abbreviation	Examples of use
Polypropylene	PP	Food packaging, automotive parts
Low-density polyethylene	LDPE	Reusable bags, food packaging film
High-density polyethylene	HDPE	Toys, shampoo bottles, pipes
Polyvinylchloride	PVC	Window frames, floor covering, pipes, cable insulation
Polystyrene	PS	Food packaging, insulation, electronic equipment
Polyethylene terephthalate	PET	Beverage bottles
Polyurethane	PUR	Insulation, mattresses
ABS, elastomers, biobased plastics, PBT, PC, PMMA, PTFE, …	Other	Tyres, packaging, electronics, automotive, …
Fibres made of different polymers	Fibres	Textile applications but also in many other sectors

Note: ABS stands for Acrylonitrile butadiene styrene, PBT for Polybutylene terephthalate, PC for Polycarbonates, PMMA for Poly (methyl methacrylate) (also known as plexiglas) and PFTE for Polytetrafluoroethylene.

Source: OECD (2022)

Together, packaging, construction and transportation applications account for more than 60% of total plastics use. The other main applications of plastics use include textiles, household consumer products and non-household or institutional products, electronics, machinery and tyres (Figure 2-54).

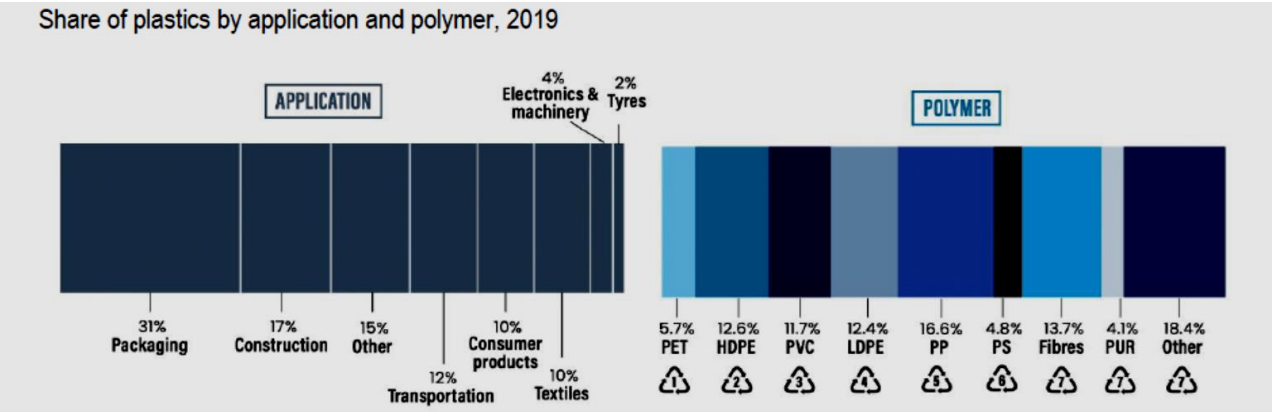


Figure 2-54 Global plastics use by application and polymer
Source: OECD (2022)

Normalised indicators, such as plastic intensity relative to GDP and plastic use per capita, allow for a comparison of plastics use across regions (Table 2-2). Regional plastics use per capita varies greatly: an inhabitant of the United States uses 255 kg of new plastics every year on average, while the average person in Sub-Saharan Africa uses less than one tenth of that amount. In contrast, the range of plastics intensity relative to GDP across the world is smaller, ranging between 2.5 and 4.5 tonnes per million USD (t/M$). OECD plastic intensity reaches 3.7 tonnes per million USD, while non-OECD countries reach 3.4 tonnes. This correlation is also found in plastics use per capita, whose OECD level is 156 kg per capita, compared to 39 kg per capita for non-OECD countries. The only outlier in this table is Sub-Saharan Africa, which has the lowest plastics use per capita (16 kg/cap), but the highest plastic intensity (4.5 t/USD M). This high intensity reflects the very low level of GDP per capita of Sub-Saharan Africa in 2019 (about five times lower than Middle East and North Africa and twice lower than India).

Table 2-2 GDP is a key driver of global plastics use

2019

			Plastics use per capita (kg/cap)	Plastics intensity relative to GDP (t/M$ in PPP)
World			60.1	3.5
OECD			155.8	3.7
Non-OECD			39.3	3.4
OECD	OECD America	USA	255.2	4.3
		Canada	202.2	4.3
		Other OECD America	65.4	3.6
	OECD Europe	OECD EU countries	152.9	3.6
		OECD non-EU countries	124.3	3.5
	OECD Pacific	OECD Asia	102.4	2.6
		OECD Oceania	143.9	3.1
Non-OECD	Other America	Latin America	50.9	3.5
	Eurasia	Other EU	103.0	4.1
		Other Eurasia	66.7	3.7
	Middle East and Africa	Middle East & North Africa	47.1	2.5
		Other Africa	15.9	4.5
	Other Asia	China	69.0	3.7
		India	22.1	2.7
		Other non-OECD Asia	31.7	3.2

Source: OECD (2022)

The current plastics lifecycle (far from circulalar)

Population growth and higher incomes have driven up global plastics production, which has doubled, soaring from 234 million tonnes (Mt) in 2000 to 460 Mt in 2019. In this same period, the growth of plastics volumes outpaced economic growth by almost 40%. While COVID-19 temporarily curtailed this growth, it is likely to rebound once again, though with a slight shift in use and waste trends.

Global annual plastic waste has more than doubled, from 156 Mt in 2000 to 353 Mt in 2019. Almost two thirds of all plastic waste comes from applications with lifespans of less than five years: packaging (40%), consumer products (12%) and textiles (11%). Only 55 Mt of this waste was collected for recycling, but 22 Mt ended up as a recycling residue that needed further disposal. Ultimately, 9% of plastic waste was recycled, 19% was incinerated and almost 50% went to sanitary landfills.

The remaining 22% was disposed of in uncontrolled dumpsites, burned in open pits or leaked to the environment.

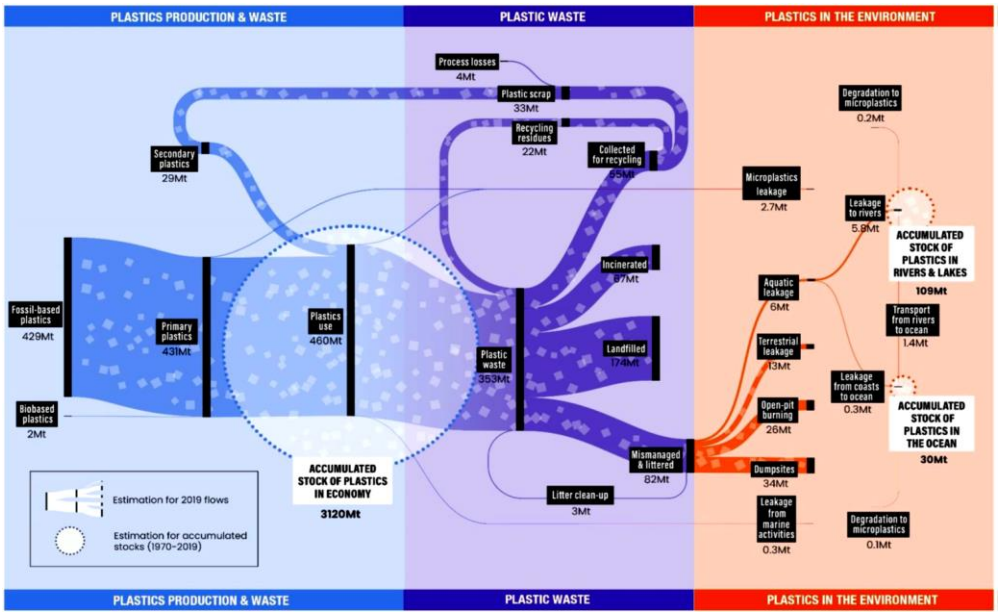


Figure 2-55 Only 33 million tonnes (Mt), or 9% of the 353 Mt of plastic waste, was recycled in 2019
Source: OECD (2022)

Plastic waste generation

The generation of plastic waste is strongly related to how plastics are used. The overall average lifespan of a plastic product is almost ten years, though this depends on its use (Figure 2-55). Packaging has an extremely short average lifespan while plastic applications in the construction sector may be in use for several decades. Therefore, packaging waste constitutes a large share (42%) of total plastic waste generated.

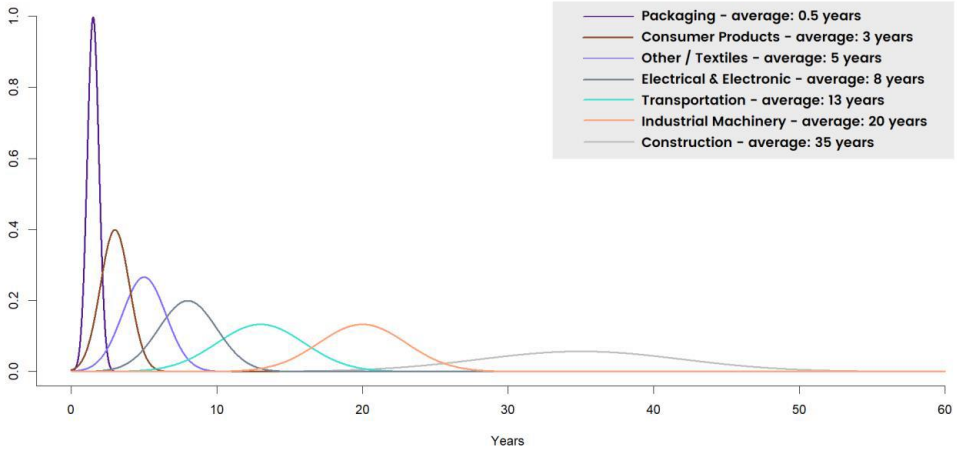


Figure 2-56 Average plastic product lifespans range from six months to 35 years
Source: Geyer, Jambeck and Law (2017)

The global generation of plastic waste can be estimated from the amount of plastics used in previous decades, the international trade of plastics and plastic products, as well as the average lifespan of plastics applications. According to the OECD Global Plastics Outlook Database, the plastic waste generated in 2019 amounted to 353 Mt.

At the waste stage, the ease of recycling and the potential mobility when lost to the environment are influenced by polymer type, dimensional shape, object size, additive mix, and the items and materials appended in assembly. Figure 5 highlights that the applications and polymers present in the waste stage are different than in the consumption stage. The predominance of PP, LDPE and HDPE has become even greater in the waste stage because they are often used for packaging applications with short lifetimes. Similarly, since PET is mainly used for packaging, it will become waste rapidly after its initial use. By contrast, PVC and PUR are mainly used for applications with long lifecycles. They will only enter the waste stage many years later. These long lifecycles, combined with significant growth rates of use, result in a relatively lower presence in plastic waste than in plastics use of those polymers. Conversely, the polymers with long life cycles account for a relatively high share of the stock of plastics that is present in the economy.

The OECD Global Plastics Outlook Database indicates that the OECD generates almost half of all plastic waste: the United States accounts for 21%, OECD Europe 19% and the remaining OECD countries 9%. Outside the OECD, China produces 19% of global plastic waste, India 5% and the rest of the world 27%.

In terms of waste per capita, there are stark differences across the world (Table 2-3). The United States had the largest plastic waste footprint in 2019, at 221 kg per capita, while OECD Europe had 114 kg plastic waste per capita. Japan and Korea's plastic waste generation is relatively low for industrialised countries, averaging 69 kg per capita. Finally, China generated 47 kg of plastic waste per inhabitant in 2019, while India generated only 14 kg per inhabitant.

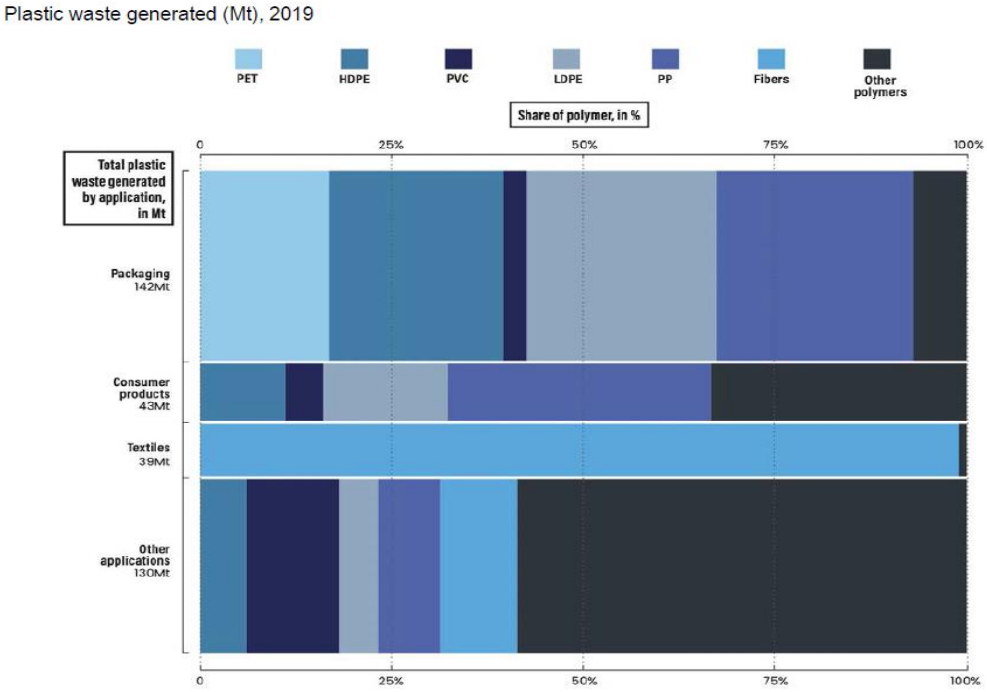


Figure 2-57 Almost two-thirds of plastic waste comes from relatively short-lived products such as packaging, consumer products and textiles
Source: OECD (2022)

Table 2-3 Per capita plastic waste generation differs strongly across the world

Kg/cap, 2019

			Plastic waste per capita (kg/cap)
OECD	OECD America	USA	220.5
		Canada	177.9
		Other OECD America	57.9
	OECD Europe	OECD EU countries	121.6
		OECD non-EU countries	94.4
	OECD Pacific	OECD Asia	68.9
		OECD Oceania	62.1
Non-OECD	Other America	Latin America	43.4
	Eurasia	Other EU	75.5
		Other Eurasia	53.0
	Middle East and Africa	Middle East & North Africa	37.6
		Other Africa	14.5
	Other Asia	China	46.6
		India	14.0
		Other non-OECD Asia	21.4

Source: OECD (2022)

Plastic waste management varies across the world

The end-of-life fate of plastics depends on the local waste management capacities and regulations. The OECD Global Plastics Outlook Database contains five different waste handling categories (recycling, incineration, landfilling, mismanaged waste and littered waste). In Figure 2-58, the category “collected for recycling” refers to plastic waste that is collected in order to recycle and that will, after processing, produce secondary plastics. “Incineration” refers to incineration in a

state-of-the-art industrial facility. The third approach to manage plastics in a safe way is sanitary “landfilling”. Unfortunately, plastic waste is often improperly managed. The treatment category “mismanaged waste” aims at quantifying the end-of-life plastics generated in areas where state-of-the-art waste collection or treatment facilities are not in place. The plastic waste is either not collected, collected but disposed of in dumpsites, or collected for disposing in the environment, for example dumped directly into seas or open waters. Finally, “littered waste” differs from mismanaged waste because littering behaviour is not necessarily correlated to the provision of basic waste collection and disposal infrastructure. The category refers both to littering (i.e. when users discard packaging or other products into the environment), and to fly-tipping (i.e. plastic waste generators who consciously circumvent legislation to discard larger volumes of, for example, construction waste into the environment). Litter can either be collected via street sweepings and other clean-up actions or be left uncollected and leak into the environment. There are also biodegradable plastics that can be composted at the waste stage (European Bioplastics, 2019).

In most cases, differences in waste management capacities are related to regulations, geographical and demographic characteristics and other variables. In low-income countries, economic growth can outpace improvements in collection and disposal capacity, leading to increased volumes of mismanaged waste. By contrast, low-income countries typically have low labour costs that make collection and high-quality sorting of recyclables by manual labour economically feasible. Therefore, countries may encounter different waste management challenges depending on the stages of their economic development trajectory (Figure 2-58).

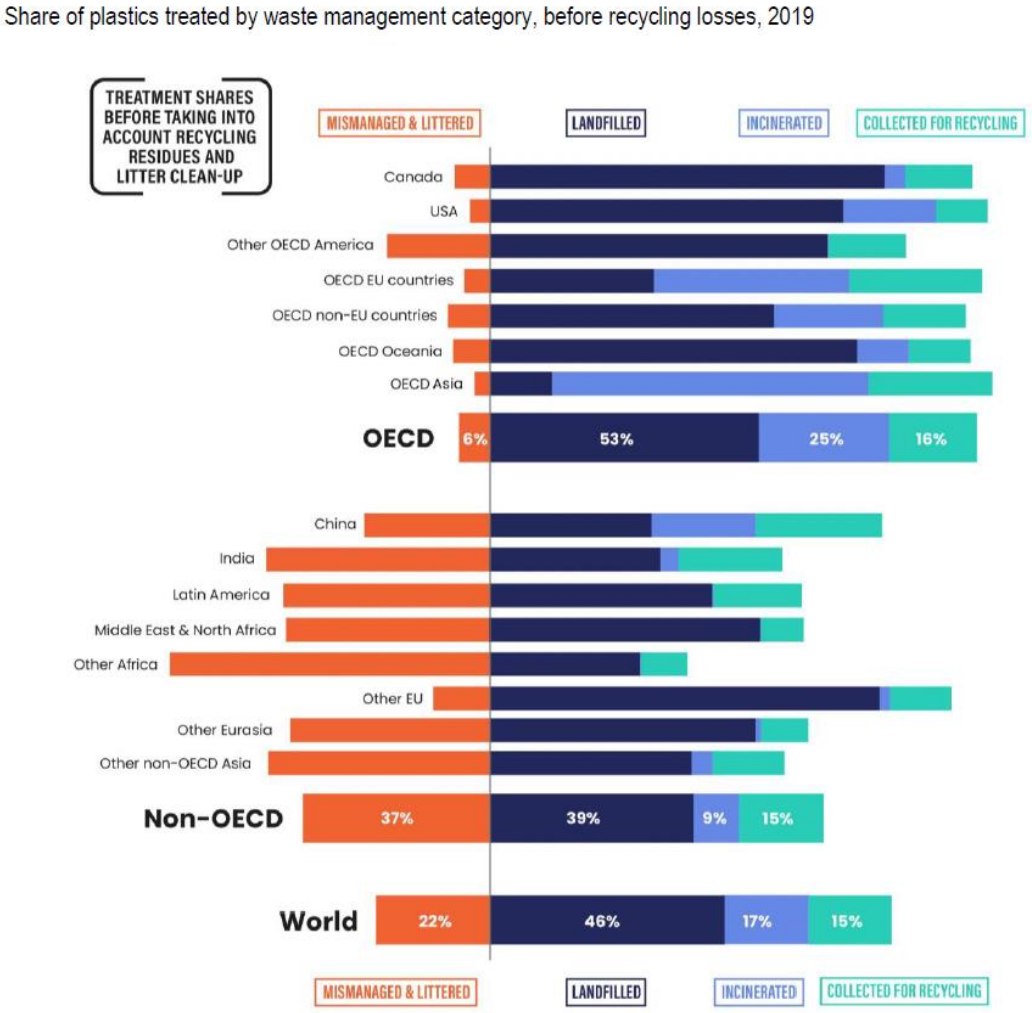


Figure 2-58 More plastic waste is mismanaged than collected for recycling
Source: OECD (2022)

Globally, 15% or 55 Mt of plastic waste were collected for recycling in 2019.7 EU countries, as well as China, India, Japan and Korea have above-average recycling rates. Key drivers of recycling in Europe, Japan and Korea are extensive separate collection facilities and extended producer responsibility (EPR) schemes that put the onus to recycle on producers of plastic products and packaging. In other parts of the world, the informal economy is the main driver of recycling, incentivised by the value of some of the plastics.

The underlying regional economic drivers not only determine the volumes of plastic waste collected for recycling – they also affect the process losses from recycling (Figure 2-58). Globally, almost 40% of plastics collected for recycling, or close to 22 Mt, are lost during recycling and end up being incinerated, landfilled or mismanaged. In particular, when formal waste collection is funded by government and free to users, it typically contains large amounts of un-recyclable plastics and non-plastics which need to be removed. These are counted as recycling losses. By contrast, in informal waste systems, waste pickers selectively target high-value plastics at the point of collection, reducing the mass lost when they are cleaned and

sorted to get the maximum price. Therefore, there are important regional differences in recycling both in terms of volumes as well as in practices used.

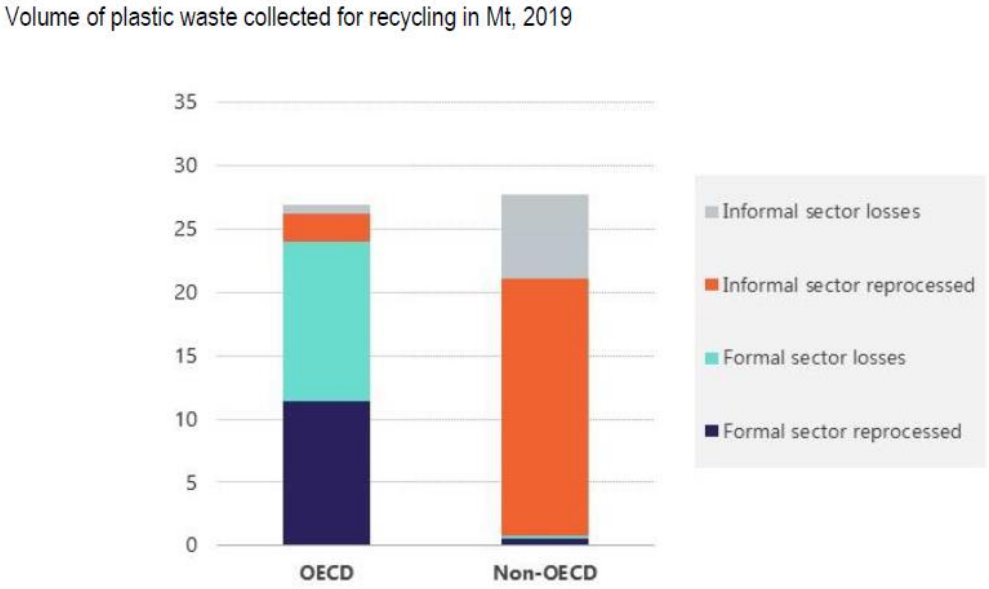


Figure 2-59 Formal and informal recycling volumes and losses differ across regions
Source: OECD (2022)

Globally in 2019, 60 Mt of generated plastic waste, 6 Mt of plastic recycling residues and 1 Mt of collected litter were incinerated in industrial facilities, while 162 Mt of generated waste, 11 Mt of residues and 1 Mt of collected litter were disposed of in sanitary landfills. Whether plastic waste, especially municipal solid waste (MSW), is incinerated or landfilled depends on historic infrastructure, regulation, local population density and costs. Since sanitary landfilling requires large amounts of land, densely urbanized countries and regions such as Japan and Western Europe rely heavily on incineration. However, because well-controlled incineration is almost three times more expensive than landfilling, countries and cities with more space have kept sanitary landfilling as their prime disposal method.

For many emerging economies, lack of technical capacities, poor governance and insufficient financial resources at the municipal level are major bottlenecks in improving waste management practices. Mismanaged waste is a wide category that includes waste that has not been collected and is therefore “self-managed” by those who generate it – and who usually resort to dumping it on land, in rivers and lakes or burning it in open uncontrolled fires. Mismanaged waste can also include waste that has been collected but which is then subsequently deposited in dumpsites that do not have sufficient controls to prevent its interaction with the natural environment or human receptors. These practices mainly occur in developing countries, but they are also present in more mature economies.

Globally, approximately 79 Mt (73 Mt of waste and 5 Mt of recycling residues and 1 Mt of collected litter) are mismanaged annually. Around 43% of that amount (34 Mt) is estimated to be captured in the inner part of dumpsites where degradation and interaction with the environment is close to zero. One-third (26 Mt) is burned in open, uncontrolled fires. This is mainly done by households who have to manage their waste in the absence of waste collection services, but can also be done at

dumpsites where waste is combusted deliberately to reduce volume or to recover valuable metals. It can also be burned due to accidental and spontaneous fires. The remainder is considered to be lost to terrestrial and aquatic environments. More specifically, the University of Leeds estimates that around 10% of mismanaged waste is dumped directly onto land when there is no formal waste collection, while other important leakage pathways are waste directly dumped into aquatic environments, dumped recycling residues, losses from dumpsites and losses during collection and transport.

Littered waste is a specific category of improper waste handling that unfortunately is still a problem throughout the world, even in mature economies. The amount of littered waste was more than 4 Mt globally in 2019. An estimated 3 Mt of this litter was collected via street sweeping and other actions for disposal in an industrial incinerator or a landfill; around 1 Mt was collected but then burned in open pits or sent to dumpsites; and 1 Mt remained uncollected and is likely to have been lost to the environment. However, as has been pointed out in Boucher et al. (2020), uncollected litter is exceptionally difficult to measure.

Plastic Packaging in Southeast Asia and China

- Preventing waste from entering the ocean through Southeast Asa and China is key to addressing the global plastic emergency

Plastic pollution has become a global crisis. Every year, on average 8 million tonnes of plastic enters our oceans.1 If current trends continue, the volume of plastic waste is on course to quadruple between 2010 and 2050 – meaning that, by weight, the ocean could contain more plastic than fish.2 This vast quantity will stay in the environment for hundreds of years, gradually decomposing into countless tiny particles known as microplastics. This has serious consequences for marine life, with more than 800 species directly threatened by marine debris.

Around 80% of the plastic in our oceans originates on land, with a significant proportion entering the sea via rivers.4 And while marine plastics have captured the headlines, plastic waste on land is also a major problem – from despoiling the visual environment, to toxic pollutants leaching into soil and water, to air pollution caused by incineration. Carbon emissions associated with plastic, from production to burning, reached 860 million tonnes in 20195– greater than the annual emissions of Thailand, Vietnam and the Philippines combined.

Preventing plastic waste from entering nature requires both upstream and downstream solutions – from eliminating unnecessary plastic use and using more recycled and recyclable materials, to setting up and operating effective waste management systems. Packaging is the dominant user of plastic, and accounts for about half of the world's plastic waste.6 In the present briefing, we focus on the specific challenge of managing plastic packaging waste in Southeast Asia and China. While plastic pollution is a global problem, studies show that around 60% of marine plastic debris enters the ocean from just five countries: China, Indonesia, Thailand, Vietnam and the Philippines.7 Tackling plastic waste in this region – from both domestic consumption and imported waste – is a top priority.

This briefing introduces the findings of a study commissioned by WWF from GVM, a German consultancy firm that specializes in the packaging market. It looks at the volume of plastic packaging placed on the market in China, Indonesia, Malaysia, the Philippines, Thailand and Vietnam. Obtaining reliable data is hard, and these figures should not be

treated as definitive; rather, they are our best estimates of the make-up of the plastic packaging market in these countries, based on the information available. As well as showing the scale of the challenge, the report gives an idea of the funds that could be raised if these countries introduced extended producer responsibility (EPR) schemes – under which companies that place plastic packaging on the market cover the costs of its proper management, from collection and sorting to recycling and disposal. We also include recommendations for companies and policy-makers to address the plastic challenge.

The Waste Management Challenge

- Inadequate waste management systems are the primary cause of plastic pollution in Southeast Asia and China

Plastic ends up in the environment because of inadequate systems for collecting and treating waste, particularly in the developing world. In low-income countries, 93% of waste is dumped somewhere in the environment, compared to just 4% in industrialized countries.

Waste collection rates in developing countries are often below 50%.9 Single-use plastics and packaging for consumer goods are driving the increase in plastic pollution. Globally, 36% of plastic is used for packaging – and almost a third of it (32%) leaks into the environment. Just 14% is recycled in some way, with only 2% achieving “closed loop” recycling or circularity (where it can be continually recycled into similar products).

In Southeast Asia and China, rapid economic growth has led to an immense increase in the use of plastic, especially for packaging consumer goods. Unfortunately, waste management systems in the region have not kept pace. In China and Thailand, for example, only around half the waste is collected, while in Malaysia and the Philippines, just 15% is safely disposed of.11 Segregation of waste is rare, and very little municipal waste is recycled. When recycling does happen, it usually depends on the informal sector, private enterprises or community initiatives. These countries often lack resources for effective waste services, even though solid waste management makes up a higher share of municipal expenditure on average, at 19% in low-income countries and 11% in middle-income countries, compared to just 4% in high-income countries.

With the volume of plastic packaging in Southeast Asia continuing to increase, there is an urgent need to put in place effective systems for collecting, sorting, recycling and disposing of waste. As well as being the most effective way of preventing plastic from leaking into the environment, this presents economic opportunities: in Germany, for example, 270,000 people work in the waste management and secondary materials sector.13 Shifting to more efficient, circular business models can also provide a competitive advantage, for example through reduced materials costs and improved brand perception. But setting up the necessary infrastructure requires significant investment, and ongoing financial resources are needed to operate an effective waste management system.

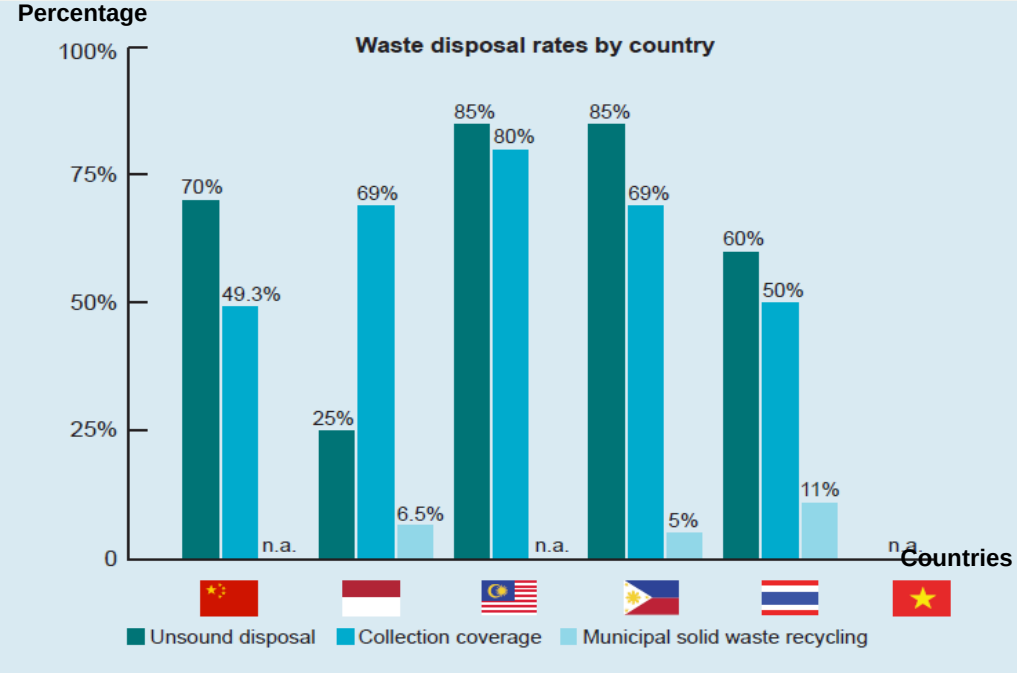


Figure 2-60 Waste disposal rates by country
Source: Jurgen Freund / WWF International (2020)

Plastic Packaging Consumption

Our study focuses on household consumption of plastic packaging, as this is the plastic most likely to end up in the oceans. In Germany, household plastic packaging makes up about two-thirds of the total, though this proportion is thought to be higher in Southeast Asian countries with a smaller manufacturing sector. The data includes plastic packaging consumption among private households, small businesses and other end users such as schools, hospitals and government buildings, but not retail/ wholesale or industry.

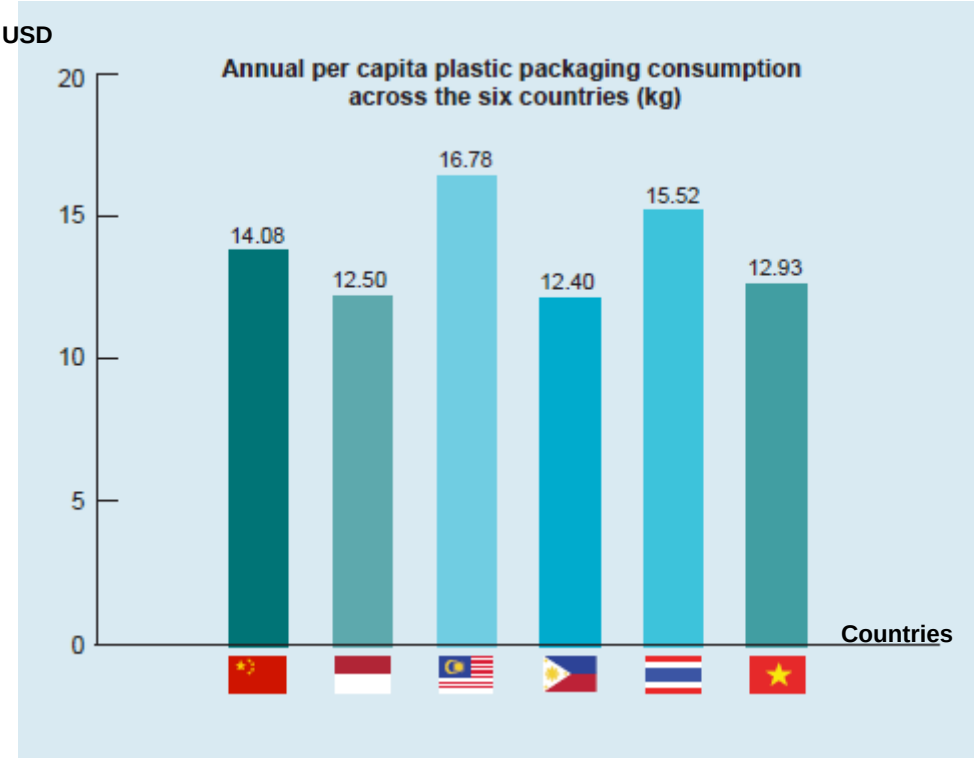


Figure 2-61 Annual per capital plastic packaging consumption
Source: WWF (2020)

Table 2-4 Total estimated annual household plastic packaging consumption in the six countries analysed.

Total estimated annual household plastic packaging consumption (in 1,000 tonnes)	PET bottles	Other plastic bottles	Plastic film and bags	Plastic cups, cans other containers	Other plastic packaging	Total plastic packaging
Beverage	7,296	50	367	79	785	**8,576**
Food	105	247	2,553	3,004	1,387	**7,297**
Detergent cleaning agents and personal care	183	749	110	358	515	**1,916**
Other	10	303	4,983	1,709	2,327	**9,332**
Total	**7,594**	**1,350**	**8,013**	**5,150**	**5,015**	**27,122**

Source: WWF (2020)

Extended Producer Responsibility

- Ensuring that companies take responsibility for the full life-cycle impacts of their plastic products and packaging can strengthen waste management, reduce pollution, and drive smarter design and materials use

When waste management systems cannot take the strain of plastic packaging, leakage into the environment is the result. One effective solution is the concept of extended producer responsibility (EPR). Essentially, this means that those who place packaged goods (as well as products such as electrical appliances and batteries) on the market bear the cost of their collection, treatment, recycling and disposal. More than 30 countries, mainly in Europe but also including Japan and South Korea, have implemented EPR programmes, and around 400 schemes exist worldwide.14

In practice, rather than each company individually taking responsibility for the waste it produces, EPR schemes are usually managed by a collective system operator, sometimes known as a producer responsibility organization (PRO). Companies pay a fee to this organization for the packaging they introduce onto the market, and the PRO is then responsible for organizing collection and further processing of the packaging waste, as well as for communicating with consumers. The system operator will usually contract out waste management services to third parties, potentially including those in the informal sector such as waste pickers. PROs may be private companies, not-for-profit organizations or public sector agencies; some EPR schemes involve more than one competing operator.

EPR schemes can help address the shortfall in financial resources for waste management that leads to plastic pollution. Introducing mandatory EPR policies, rather than relying on voluntary action by individual companies, provides a level playing field for business as well as creating economies of scale. EPR schemes also help reduce plastic consumption by incentivizing producers to design more resourceefficient products with lower environmental impacts.

On a positive note, several countries in Southeast Asia have taken first steps toward implementing EPR schemes. To date, however, these mostly concern e-waste rather than packaging.

Shared Responsibility

- Governments and companies in Southeast Asia and China need to work together to solve the plastic crisis

Improving waste management for plastic packaging in Southeast Asia and China is vital for stemming the tide of marine plastic pollution – and, in the longer term, for moving towards a sustainable circular economy. EPR schemes play a crucial role in addressing this problem by providing an ongoing source of financing for collecting and processing waste, as well as encouraging companies to adopt eco-design practices and educating consumers.

- Governments should
  - Set national targets for waste collection, segregation and recycling, and invest in national/regional waste management infrastructure.
  - Create a coherent and transparent EPR framework within national legislation that takes account of local characteristics, such as the role of the informal sector, while promoting a global treaty against plastic pollution on an international level.

- Monitor companies' plastic use and enforce EPR legislation, creating a level playing field for all companies.

- Companies should
  - Reduce unnecessary use of plastics and transparently disclose the amount of plastic packaging they are putting on the market, e.g. via WWF's ReSource platform (resource-plastic.com) or joining the national PACT initiative.
  - Take responsibility for products' end-of-life impacts, from the design and choice of materials through to collection, sorting, recycling and disposal.
  - Support the creation of EPR schemes, and work with governments and other partners to improve waste management systems and raise consumer awareness.
- Consumers should
  - Call on companies to demonstrate leadership by reducing dependency on single-use and unnecessary plastics, taking responsibility for the end-of-life impact of their packaging, and investing in environmentally sound alternatives.
  - Reduce consumption of unnecessary plastics and select reusable or recyclable packaging – and do reuse or recycle it.
  - Ask government representatives for better waste management infrastructure and eco-design, and show support for the creation of EPR schemes.

References

Boucher, J. et al. (2020). The marine plastic footprint, IUCN, International Union for Conservation of Nature, http://dx.doi.org/10.2305/IUCN.CH.2020.01.en.

European Bioplastics. (2019). Bioplastics market data 2019 - Global production capacities of bioplastics 2019-2024.

European Commission. (2019). Single-use plastics. From https://environment.ec.europa.eu/topics/plastics/single-use-plastics_en

European Commission. (2022). EU rules on packaging and packaging waste, including design and waste management. From https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste_en

Geyer, R., J. Jambeck and K. Law. (2017). "Production, use, and fate of all plastics ever made", Science Advances, Vol. 3/7, p. e1700782, http://dx.doi.org/10.1126/sciadv.1700782

WWF. (2016). Plastic Packaging in Southeast Asia and China. Retrieved from https://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_plastic_packaging_in_se_asia_2020_v8_0214_final_.pdf

IEA. (2018). The future of petrochemicals: Towards more sustainable plastics and fertilisers,International Energy Agency, Paris, https://dx.doi.org/10.1787/9789264307414-en

Jurgen Freund / WWF Internationa. (2020). lPLASTIC PACKAGING IN SOUTHEAST ASIA AND CHINA Report

OECD. (2022). Global Plastics Outlook, https://www.oecd.org/environment/plastics/

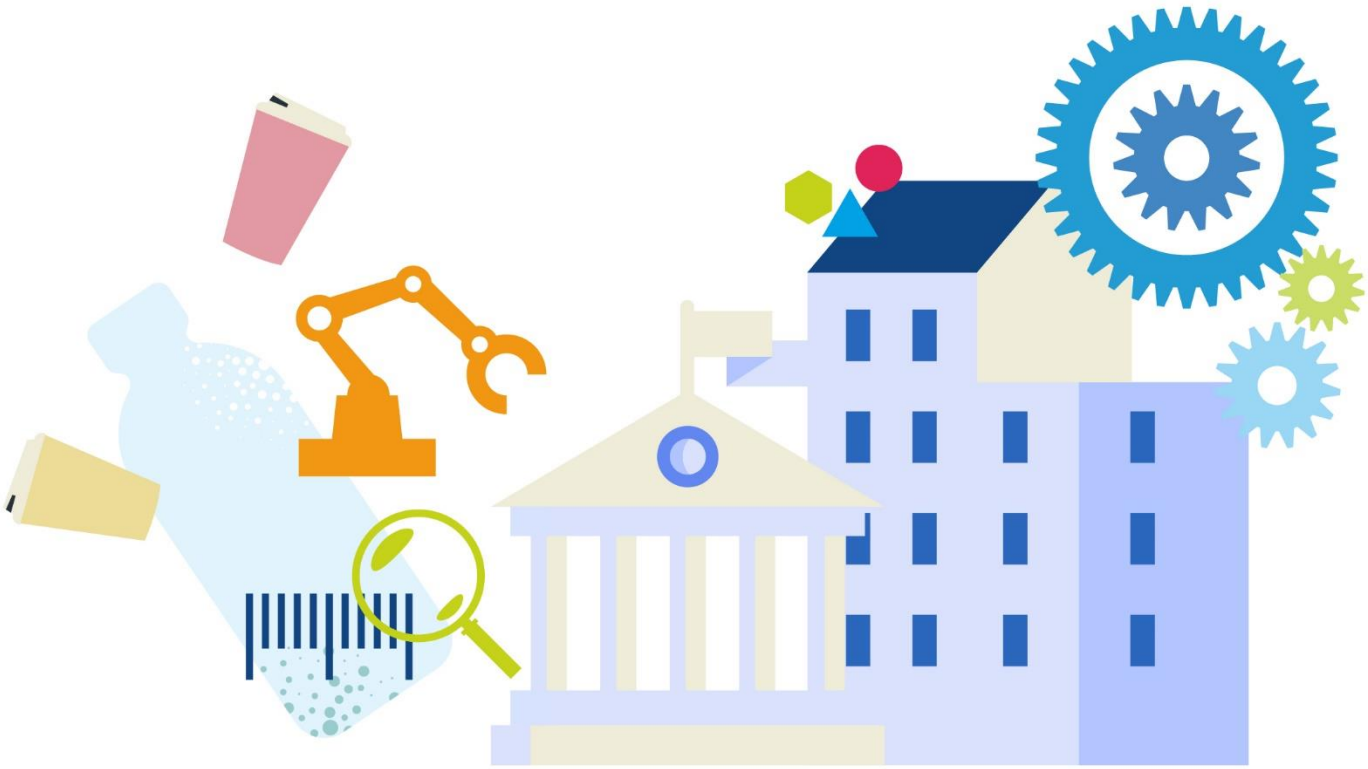
Pollution Control Department.

Thai Customs Source. (n.d.) Remark: HS Code: 3901-3915

Grand View Research. (n.d.). Retrieved from www.grandviewrsearch.com

CHAPTER 3

LAWS & REGULATIONS AND POLICIES RELATED TO PLASTICS PACKAGING



Chapter 3

3. Laws & Regulations and Policies related to Plastics Packaging

3.1 Overviews of global plastics packaging

While the packaging is often necessary to protect products, everyone in the industry is looking for ways to reduce waste and overpackaging. This goal is complemented by efforts to make packaging more sustainable with renewable and recyclable materials. The quest for sustainability unites big brands with responsible consumers and – regulators around the world.

In recent years, governments have responded to public concerns by devising rules that seek to tackle packaging waste – single-use plastics in particular – and improve recycling and waste management systems. Many of these new norms will become effective in the next years, creating a worldwide regulative trend that can help promote more sustainable packaging. Here's a quick look into what various countries is currently doing to reduce packaging waste and how this affects companies and consumers.

France aims to phase out single-use plastic

France has set the goal to recycle 100% of plastics by 2025 and phase out single-use plastics by 2040. Plastic packaging for nearly all fruit and vegetables will be prohibited from January 2022. In addition, publications can no longer be wrapped in plastic for shipping, fast-food restaurants can no longer have plastic toys and public spaces must provide water fountains to reduce the use of plastic bottles. Plastic straws, cups, and cutlery, and styrofoam takeaway boxes have already been banned in 2021. Any business that sells cross-border to consumers in France needs to register its packaging with a French recycling scheme. Under the French packaging law, companies pay less for their recyclable packaging.

China elevates its plastics restriction to ban

The "plastics restriction" policy introduced by China in 2007 as part of efforts to tackle pollution was upgraded to a "plastics ban" in 2021.

All single-use plastic products such as non-degradable plastic bags, disposable plastic straws, disposable plastic tableware, and ultra-thin plastic shopping bags will be prohibited in the country. A five-year roadmap is laid out to restrict the use of plastic products such as shopping bags, straws, and utensils by 2020, 2022, and 2025, respectively. In addition, the fast-food industries, e-commerce, and express delivery companies are required to recycle packaging materials and reduce their usage under a revised law that came into effect in September 2020.

New York becomes third US state to enforce plastic bag ban

New York's statewide ban on single-use plastic bags has been enforced since October 2020. From January 2022, no covered food service provider or store will be allowed to sell, offer for sale, or distribute disposable food service containers that contain expanded polystyrene foam in New York.

However, alternatives are allowed as long as they do not contain polystyrene foam. The authorities encourage the use of reusable, recyclable, and compostable items, source reduction, and items made using recycled content where possible.

India taking steps to promote biodegradable alternatives

A ban on single-use plastics announced by the Indian central government will take effect in July 2022. In addition, plastic packaging waste must be collected and managed in an environmentally sustainable way through the Extended Producer Responsibility of the Producer, Importer, and Brand owner (PIBO).

At the same time, the authorities have promoted biodegradable alternatives to plastics. Many food vendors, restaurant chains and local businesses have already started using biodegradable tableware and switching plastic bags to cloth or paper alternatives.

Italy's new mandatory environmental labeling is coming into effect

Italy is one of the first EU countries to oblige manufacturers to inform consumers about their packaging's material composition and end of life. The purpose of this mandatory environmental labeling is to facilitate the collection, reuse, and recycling of packaging. Producers and suppliers have until June 30th, 2022, to comply.

Meanwhile, Italy's plastic packaging tax is now expected to come into effect in January 2023. The tax was first introduced in 2020 but has been delayed due to the Covid-19 pandemic. It is aimed at single-use plastics, such as bottles, bags, and food containers made of polyethylene, tetra packs, packaging made from expanded polystyrene, rolls of bubble wrap plastic, and plastic caps. The tax will affect a wide range of businesses, including Italian manufacturers, purchasers, and sellers of plastic items as well as importers of goods from non-EU countries. However, recycled plastics and compostable biodegradable plastics are set to be exempt.

Australia sets ambitious packaging targets for 2025

Australia aims to phase out single-use plastics and reach ambitious recycling goals under the 2025 National Packaging Targets. These require that all packaging must be 100% reusable, recyclable, or compostable, 70% of plastic packaging is recycled or composted, and 50% of average recycled content is included in the packaging. These targets will be applied to all packaging that is made, used, and sold in Australia.

6 out of 8 Australian states and territories will phase out various types of single-use plastics by 2022 and 2023.

3.2 Asia

3.2.1 China

China National Light Industry Council released the "Guideline for Classification and Label Standard of Biodegradable Plastic Products", which make the further explanation of the concept and definition of biodegradable plastic and make specific requirements for the biodegradable plastic label in five aspects, the scope, the definition, and classification of products, the measurement methods for degradation performance, the requirements of the label, and the styles and standards of the label.

- **Guideline for Classification and Label Standard of Biodegradable Plastic Products**

The main purpose of the Guideline for Classification and Label Standard of Biodegradable Plastic Products is to explain the concept and definition of biodegradable plastic and make specific requirements for the biodegradable plastic label in five aspects, the scope, the definition and classification of products, the measurement methods for degradation performance, the requirements of the label, and the styles and standards of the label. This guideline requires that enterprises that produces or sales relevant products or use relevant products such as retailers or restaurants should implement the national policies and measures for combating plastic pollution, and enhanced the management of labeling and procurement for relevant products based on the requirements of the guideline.

3.2.2 Japan

In Japan, more than 9 million ton of plastic waste was generated in 2017. More than 50% of plastic waste was treated by incineration with power generation and heat recovery, refuse-derived fuel and auxiliary fuels in cement kilns, while material recycling accounted for only 23% (Japan PWMI, 2019). In Japan, “Resource circulation strategy for plastics” was developed to reduce the use of single-use plastics and promote the development and use of substitutes for petroleum-based plastics in 2018. The specific goals with timelines include the cumulative 25% reduction of single-use plastics generation by 2030, reusable and recyclable design for all containers and packaging/products by 2025, 60% recycling rate of plastic containers and packaging by 2030, 100% effective use of used plastics by 2035 including circular economy measures, doubling use of recycled materials by 2030, and maximum introduction (2 million tons) of biomass plastics by 2030(Japan MOE, 2019)

- **The Containers and Packaging Recycling Law (CPRL)**

The Containers and Packaging Recycling Law (CPRL) focus on subsidize recycling for municipalities, provide municipalities with recyclers and increases the volume of plastic waste recycling in municipalities. In this law, Manufacturers have to been assigned the responsibility of recycling these containers and wrapping in accordance with the volume that they manufacture or sell, a government-designated organization, operates recycling business on behalf of the specified business entities that pay "recycling fees" to the Japan Containers and Packaging Recycling Association [JCPRA].

3.2.3 South Korea

- **The Act on the Promotion of Saving and Recycling of Resources (the “Resource Recycling Act”)**

1.Article 9-2 (Improvement, etc. of Quality and Structure of Packing Materials) The Minister of Environment shall determine and publicly notify standards

for improvement, etc. of the quality and structure of packing materials, to ease the recycling of such materials, and producers obligated to recycle under Article 16 (1) shall comply with such standards.

2. In addition, a ban will be imposed on PVC plastics and colored PET bottles, which have an extremely negative impact on the recycling process. However, if such packaging does not have substitutes available on the market or are closely related to people's diet and medicines, they will be exempt from the ban. Colored PET bottles will be banned only for mineral water and drinks.

3.3 CLMVT Countries

3.3.1 Cambodia

Food producers, processors and packers have to compliance with all food technical regulations, minimum food requirements, including safety, labelling, packaging, advertising and hygiene. Wholesalers and distributors must also meet similar requirements, emphasizing storage and transport.

- **Royal Kram No.NS/RKM/0622/006**

The purpose of this standard is to protect consumer health; addresses local and international trade; and brings the country into line with global standards and suggest food producers, processors and packers must now ensure compliance with all food technical regulations, minimum food requirements, including safety, labelling, packaging, advertising and hygiene.

- **Environmental Guidelines on Solid Waste Management in Kingdom of Cambodia (2006)**

The purpose of the Environmental Guidelines on Solid Waste Management in Kingdom of Cambodia (2006) is to make goals and purposes of the environmental guidelines on solid waste management to ensure the protection of the public health, environment and the conservation of biodiversity by avoiding polluting by solid waste. This guideline applies to all activities related to discarding, storage, collection, transport, recycling, treatment, composting and disposal of all kinds of solid waste. This guideline was created by ministry of Environment of Cambodia and the COMPED-Cambodian Education and waste management organization.

3.3.2 Laos

Laos has to implement further regulations on plastic waste management and also has to specify, enforce and monitor the already implemented laws and regulations.

In February 2019 the Government of Lao approved a National Green Growth Strategy 2030 aimed at strengthening the balance between economic expansion, environmental protection, and social development to ensure the maintenance of high, stable, sustained, and durable economic growth. National Green Growth has the target to Improve living standards, create jobs and income-generating activities, be inclusive and reduce poverty; achieve sustainable use of resources; reduce vulnerability to natural disasters and global economic uncertainties; and decrease

emissions, pollution, and waste. National Green Growth focuses on developing the industrial sector and promoting manufacturing industries (e.g., food and beverage), and implementing financial mechanisms to help entrepreneurs utilize material-saving technologies, including recycling.

3.3.3 Myanmar

Now Myanmar doesn't have specific law about plastics packaging law. Myanmar only has Notification No.8/2022 concerning the announcement of the labelling requirements for prepacked foodstuff from The National Food Law, Myanmar Food and Drugs Authorities of the Ministry of Health. The notification provides the labelling requirements for prepacked foodstuffs to be in line with international and regional standards.

3.3.4 Vietnam

The Ministry of Health of The Socialist Republic of Vietnam announced technical standards/Regulations including QCVN 12-1:2011/BYT 'Plastics' to provide specifications and requirements for plastic packaging in Vietnam.

The Vietnamese government established Decree No. 08/2022/ND-CP Detailing several Articles of Law on Environmental Protection 2020 (hereinafter "the Decree"), which came into effect on the same day. Article 64 of Chapter 5 "Waste Management" of the Decree stipulates regulations for plastic products. Specifically, a roadmap for control of the manufacture and import of single-use plastic products has been set out.

Decree No. 08/2022/ND-CP Detailing a Number of Articles of Law on Environmental Protection 2020. This decree focuses on regulations for plastic products. Specifically, a roadmap for control of the manufacture and import of single-use plastic products.

In decree no. 08/2022/ND-CP, After January 1, 2026, the manufacture and import of poorly degradable plastic bags of 50cm x 50cm or smaller and 50μm thick or less shall be prohibited. However, this excludes cases where the bags are intended for export or packaging of other goods.

- Business entities that manufacture or import single-use plastic products and/or poorly degradable plastic packaging materials shall implement the recycling and treatment obligation under the Extended Producer Responsibility (EPR)
- After December 31, 2030, the manufacture and import of the following products shall be prohibited:
- Single-use plastic products (excluding Vietnam Green Label certified products)
- Poorly degradable plastic packaging materials (including poorly degradable plastic bags, and plastic foam containers for food packing)
- Products containing microplastics.

3.3.5 Thailand

- **Announcement of the Ministry of Public Health, No. 435, B.E. 2565 (2022) on the quality or standard of plastic containers**

The purpose of this standard is to update the notification of the Ministry of Public Health regarding quality or standards of plastic containers, create requirements for the use of recycled plastic (Recycled Plastic) in the production of packaging and create quality requirements for food contact (food contact grade) of containers made from recycled plastic where the raw material is polyethylene terephthalate (Polyethylene terephthalate; PET). This standard created by Food and Drug Administration (Thai
FDA), Ministry of Public Health

In this announcement, they create a definition of recycled plastic food container. In the notification, “Container made from recycled plastic” is defined as a container made from recycled plastic which has a recycling process as follows:

1. Primary recycling: pre-consumer scrap means the in-house processing of plastic parts or scrap which is left over from the food container manufacturing process to be recycled by parts. Such plastic or plastic scraps must have never been in contact with food before.
2. Secondary recycling: physical reprocessing mechanical recycling means the physical processing of plastic food containers, including mechanical methods such as grinding, washing, and chemically treating the plastic and then melting it into plastic pellets to be used as containers. However, these processes must not alter the structure of the polymer.
3. Tertiary recycling: chemical reprocessing means the processing of plastic containers that have been used to contain food back to their original form by using chemical processes.

In this announcement also create the requirements for plastic food container as follows:

1. Containers made of recycled plastics with polyethylene terephthalate (PET) food contact grade raw material.
2. Containers made of recycled plastic pellets that have undergone a process that can effectively remove contaminants must submit a safety assessment report from the Safety Assessment Unit as announced by the Food and Drug Administration or be made of recycled plastic pellets that are certified according to industrial product standards.

- **Notification No.92/2528 (1985) Regulation (mandatory standard) for Food manufacturer about Quality standards for food packaging.**

The purpose of this standard is to create regulation (mandatory standard) for Food manufacturer about Quality standards for food packaging [General requirements, Chemical safety requirements] and to described meaning of plastic packaging Ministry of Industry - Thai Industrial Standards Institute (TISI) has

authority for food packaging, manufacturer control, food packaging standard and labeling. The purpose of this standard is to

- **TIS 655 Part 1-2553 (2010) Plastic utensils for the food part 1 Polyethylene, Polypropylene, Polystyrene, Poly (Ethylene Terephthalate), Poly (Vinyl Alcohol), and Poly (Methyl Pentane)**

This industrial product standard Covers plastic containers and utensils that touch food. of single, composite, single or multi-layer materials for use in the preparation, storage or consumption of food including container components that come in contact with food, such as lids, dividers, or lids for pouring There are both single-use and reusable. This standard does not cover Plastic containers and/or utensils for food that have already been announced as industrial production standards.

Each type of plastic container is classified according to the type of plastic used to make it. (Only the floor that touches food) is 6 types as follows.

1. Polyethylene (polyethylene): PE
2. Polypropylene (polypropylene): PP
3. Polystyrene (polystyrene): PS
4. Polyethylene Terephthalate (polyethylene terephthalate): PET
5. Polyvinyl alcohol (poly (vinyl alcohol)): PVAL
6. Polymethyl pentene: PMP

- **TIS 655 Part 2-2554 (2011) Plastic utensils for the food part 2 poly (Vinyl Chloride) polycarbonate polyamide and poly (Methyl methacrylate)**

This industrial product standard Covers plastic containers and utensils that touch food. of single, composite, single or multi-layer materials for use in the preparation, storage or consumption of food including parts of containers that come into contact with food, such as lids, dividers or lids for pouring There are both single-use and reusable.

Each type of plastic container is classified according to the type of plastic used to make it. (Only the floor that touches food) is divided into 4 types as follows.

1. Polyvinyl chloride (poly (vinyl chloride)): PVC
2. Polycarbonate (polycarbonate): PC
3. Polyamide (polyamide): PA
4. Poly (methyl methacrylate): PMMA

- **TIS 655 Part 3-2554 (2011) Plastic utensils for the food part 3 acrylonitrile-butadiene-styrene and styrene-acrylonitrile**

This industrial product standard Covers plastic containers and utensils that come into contact with food made of acrylonitrile-butadiene-styrene. and styrene-acrylonitrile for use in preparing, storing, or consuming food, including parts of containers that come into contact with food such as lids, dividers, or pouring lids.

There are two types of plastic containers:

1. Acrylonitrile-butadiene-styrene (acrylonitrile – butadiene – styrene): ABS
2. Styrene-acrylonitrile (styrene-acrylonitrile): SAN

- **TIS 1136-2559 (2016) Stretch cling film for food.**

1. This standard specifies types, sizes and tolerances, materials, and characteristics that require packaging. marks and labels Sampling and judging criteria and stretch film testing.
2. These standards cover only polyvinyl chloride and polyethylene food stretch film. But does not include stretch film used in automatic machines.

Stretch film for food wrapping refers to a plastic film that can be stretched and strapped to wrap and stick together.

- **TIS 2493 Part 1-2554 (2011) Plastic food containers for microwave oven part 1 for reheating**

This industrial product standard Covered plastic containers include lids. that have direct contact with food heated in a microwave oven and must withstand a temperature of not less than 100 degrees Celsius, which in this standard will be called a "plastic container."

- **TIS 2493 Part 2-2556 (2013) Plastic food containers for microwave Part 2 for single reheating**

This industrial product standard Covers plastic containers, lids, and other components. food contact Temperature resistant at least 100°C Made for single use from single or multi-ply materials. For use in microwave ovens.

Plastic containers are classified according to the type of plastic used to make them. (Only the floor that touches food) is divided into 3 types as follows.

1. Polypropylene (polypropylene): PP
2. Polyethylene Terephthalate (poly (ethylene terephthalate)): PET
3. Polystyrene (polystyrene): PS

- **TIS 2921-2562 (2019) Melamine - Formaldehyde urea – Formaldehyde**

These standards cover plastic containers and utensils that contact with food made from formaldehyde-polymerized thermoset plastics with a specific focus. safety, hereinafter referred to as "Containers and Utensils".

References

BPF. (n.d.). Chemical Recycling 101. Retrieved from https://www.bpf.co.uk/plastipedia/chemical-recycling-101.aspx

Gausas, L., Kristensen, S. K., Sun, H., Ahrens, A., Donslund, B. S., Lindhardt, A. T., & Skrydstrup, T. (2021). Catalytic Hydrogenation of Polyurethanes to Base Chemicals: From Model Systems to Commercial and End-of-Life Polyurethane Materials. JACS Au, 1(4), 517–524. https://doi.org/10.1021/jacsau.1c00050

MTEC.(n.d.). High Quality Para Rubber Sheet Drying Industry. Retrieved from http://www.mtec.or.th/th/special/biodegradable_plastic/plastic_recycle.html

CHAPTER 4

CIRCULAR ECONOMY (CE) CONCEPT AND IMPLEMENTATION

Chapter 4

This chapter provides an overview of circular economy (CE) concept and implementation from various continent in the world. At the end of the chapter provides a summary of CE status quo and target of plastic packaging waste management.

4. Circular Economy (CE) Concept and Implementation

4.1 European Union

EU has started to ban single use-plastics since 2021. Approximately, ten product categories have been banned which are 1) Cotton bud sticks 2) Cutlery, plates, straws and stirrers 3) Balloons and sticks for balloons 4) Food containers 5) Cups for beverages 6) Beverage containers 7) Cigarette butts 8) Plastic bags 9) Packets and wrappers 10) Wet wipes and sanitary items (see Figure 4-1)(European Commission, 2018a).

Figure 4-1 EU bans single use-plastics

Source: Phys.org (2023)

Besides, the ban policies, The EU aims to transition to a circular economy by moving away from the linear “take-make-use-dispose” model. In a circular economy, the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized (European Commission, 2018b).

To accelerate the EU’s transition to a circular economy, the European Commission adopted the new circular economy action plan in March 2020. plastic

packaging recycling of 50% by 2025 and of 55% by 2030 European Commission (2018c).

In addition, the European has the EuCertPlast Certification, a European wide certification program, for companies that recycle post-consumer plastic waste (EuCertPlast, 2018).

It seems that EU has been very active on reducing single-use plastic consumption and moving forward CE. According to Figure 4-2, Germany set to reach 63% recycling plastic packaging by 2022. In United Kingdom, A range of polluting single-use plastics will be banned from October 2023 following the Government's consultation.

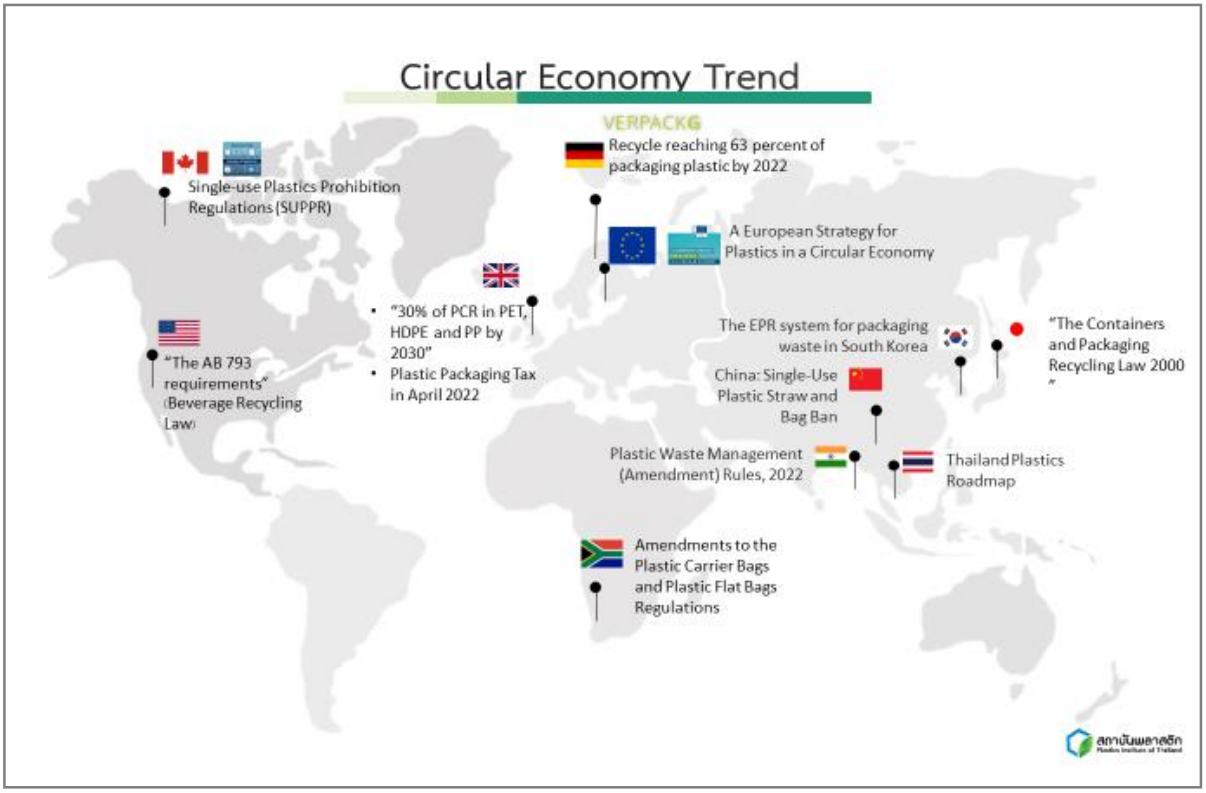


Figure 4-2 Global Circular Economy Trend

Source: Plastics Institute of Thailand (n.d)

4.4.1 France

Phase out single-use plastics

France has set the goal to recycle 100% of plastics by 2025 and phase out single-use plastics by 2040. Plastic packaging for nearly all fruit and vegetables has been prohibited since January 2022. In addition, publications can no longer be wrapped in plastic for shipping, fast-food restaurants can no longer have plastic toys,

and public spaces must provide water fountains to reduce the use of plastic bottles. Plastic straws, cups and cutlery, and Styrofoam takeaway boxes have already been banned in 2021.

Any business that sells cross-border to consumers in France needs to register its packaging with a French recycling scheme. Under the French packaging law, companies pay less for their recyclable packaging (World Economic Forum, 2021).

4.1.2 Italy

Italy's new mandatory environmental labeling is coming into effect

Italy is one of the first EU countries to oblige manufacturers to inform consumers about their packaging's material composition and end-of-life. The purpose of this mandatory environmental labeling is to facilitate the collection, reuse, and recycling of packaging. Producers and suppliers have to comply, started in June 30th, 2022 (Janne Suokas, 2022)

Meanwhile, Italy's plastic packaging tax is now expected to come into effect in January 2023. The tax was first introduced in 2020 but has been delayed due to the Covid-19 pandemic. It is aimed at single-use plastics, such as bottles, bags, and food containers made of polyethylene, tetra packs, packaging made from expanded polystyrene, rolls of bubble wrap plastic, and plastic caps. The tax will affect a wide range of businesses, including Italian manufacturers, purchasers, and sellers of plastic items as well as importers of goods from non-EU countries. Recyclable plastics and compostable/biodegradable plastics are tax exemption. (Jessica Krahl, 2022).

4.1.3 The Netherlands

Single-use plastic ban

The country bans single-use plastic and free plastic carrier bags. Municipalities are responsible for the collection of plastic packaging waste in the Netherlands. Plastic packaging waste from households has been collected separately since 2008. The plastic packaging materials are usually collected alongside metal packaging and beverage cartons (PMD). In the Netherlands plastic packaging waste collection differs per municipality. Depending on what they choose, municipalities can use source separation or post seperation. If waste is post separated, plastic packaging is collected via residual waste and then offered to sorting centers that separate it into different waste streams. Around 90% of municipalities in the Netherlands uses source separation, the rest use post separation or a mix of both systems (KIDV) .

The Dutch Ministry of Infrastructure and Water Management has reached an agreement with the sector on the introduction of a deposit on small plastic bottles by 2021. For PET bottles that are 0,75 liters or larger the Dutch government has already introduced a deposit-refund system (European commission, 2021).

The number of municipalities in the Netherlands that use a Pay as You Throw (PAYT) System is rising. The way in which systems are implemented differs considerably between municipalities.

Plastic packaging in the Netherlands is sorted according to DKR standards. These standards describe the material, indicate the minimum purity of the material, determine the maximum contamination and specify the delivery method. Within the specifications applied in the Netherlands, PET falls under DKR standard 328-1, PE under standard 329, PP under standard 324, films under standard 310 and mixed plastic under standard 350 (Government information for entrepreneurs, 2023)

Despite the efforts made with regard to collecting, sorting and recycling packaging waste, new raw materials will have to flow into the packaging chain in order to safeguard the quality of the material and compensate for the loss of material in the chain. For a growing number of the new raw materials, steps are being taken towards a circular economy, e.g. by making use of biobased materials.

4.1.4 Australia

Ambitious packaging targets for 2025

Australia aims to phase out single-use plastics and reach ambitious recycling goals under the 2025 National Packaging Targets. It requires all packaging 100% reusable, recyclable, or compostable, 70% of plastic packaging is recycled or composted, and 50% of average recycled content is included in the packaging. These targets will be applied to all packaging that is made, used, and sold in Australia. 6 out of 8 Australian states and territories will phase out various types of single-use plastics by 2022 and 2023 (APCO, 2023).

4.2 Canada

In 2021, the Canadian government drafted the single-use plastics prohibition regulation (SUPPR). SUPPR aims to prohibit the manufacture, import, and sale of six categories of single-use plastics, including checkout bags, cutlery, and ring carriers (see Figure 4.3). The implementation of these measures is not yet in place. Canada set a target to make zero plastic waste by 2030 and help reduce greenhouse gas emissions. The Regulations prohibit the manufacture, import, and sale of 6 categories of single-use plastics such as Checkout bags, Cutlery, Foodservice ware, Ring carriers, Stir sticks, and Straws (Government of Canada ,2023).

Figure 4-3 Single-use Plastics Prohibition Regulations (SUPPR) in Canada

Source: Government of Canada (2023)

4.3 Private Sectors

Nestle

Nestle is committed to designing 100% plastic packaging for recycling. By 2025 and expect that more than 95% of it will be. Now, 85.8% of our total packaging is already recyclable or reusable. Out of this, 81.9% of our plastic packaging is designed for recycling in dedicated recycling facilities (Nestlé News, 2023)

Nestle is on track to reduce our use of virgin plastics in packaging by one-third by 2025 and is pioneering alternative packaging materials to facilitate recycling. Nestle has already achieved a reduction of 10.5% as of year-end 2022. Packaging plays an important role in safely delivering high-quality food and drinks to consumers, and in reducing food loss and waste.

So, by 2025 Nestlé will:

1. Make 100% of its packaging recyclable or reusable
2. Reduce its use of virgin plastic by one-third

Coca Cola

In 2018, The Coca-Cola Company (TCCC) declared its vision to work towards a "world without waste" by launching a global initiative under this name to dramatically reduce the environmental impact of packaging. In January of that year, the Coca-Cola system in Japan announced its commitment to 2030 Packaging Vision" in which it laid out a set of environmental targets that align with TCCC's global initiative. Furthermore, to accelerate the progress of this global initiative, the roadmap set in "2030

Packaging Vision" has been renewed in July 2019 with shorter timelines aimed at achieving the targets earlier than the original due dates.

Based on this global initiative, the Coca-Cola system in Japan is undertaking activities built on the three pillars of "Design, Collect, and Partner" to resolve the problem of waste originating from packaging.

Target of 2030 Packaging Vision Roadmap

- 50% by 2022
  By 2022, we will achieve at least 50% use of sustainable materials made from recycled PET plastic through "Bottle to Bottle*" and bio-based PET plastic.*In bottle-to-bottle recycling, used PET bottles are collected and processed for recycling before being remade into PET bottles for use as packaging for beverages.
- 100% by 2025
  By 2025, sustainable materials will be used in PET bottles of all products being sold in Japan.
- 100% by 2030
  By 2030, the proportion of sustainable materials will be made 100% to aim for the complete implementation of packaging not using fossil fuels.
- 35% by 2030
  By 2030, the amount of PET plastic used in each product will be reduced by 35% (compared to 2004).

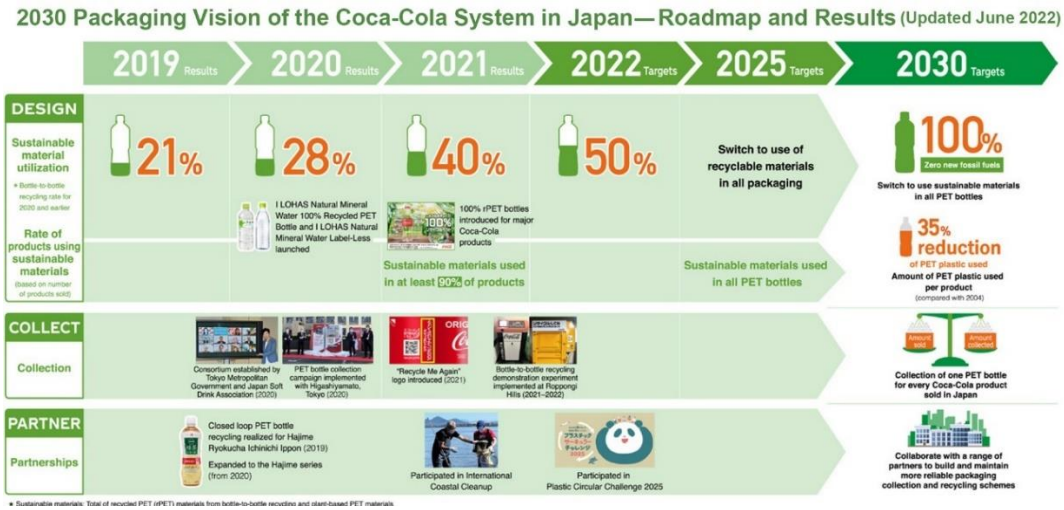


Figure 4-4 2030 Packaging Vision of the Coca-Cola System in Japan

Source: Coca-Cola Bottlers Japan Inc. (n.d.)

4.4 Asia

4.4.1 China

Guideline for classification and label standard of Biodegradable Plastic

China National Light Industry Council released the “Guideline for Classification and Label Standard of Biodegradable Plastic Products”, which make the further explanation of the concept and definition of biodegradable plastic and make specific requirements for the biodegradable plastic label in five aspects, the scope, the definition, and classification of products, the measurement methods for degradation performance, the requirements of the label, and the styles and standards of the label.

The Guideline for Classification and Label Standard of Biodegradable Plastic Products aim to the explanation of the concept and definition of biodegradable plastic and make specific requirements for the biodegradable plastic label in five aspects, the scope, the definition and classification of products, the measurement methods for degradation performance, the requirements of the label, and the styles and standards of the label. The Guideline for Classification and Label Standard of Biodegradable Plastic Products mainly focuses on requires that enterprises that produce or sell the relevant products or use the relevant products such as retailers or restaurants should implement the national policies and measures for combating plastic pollution and enhanced the management of labeling and procurement for relevant products based on the requirements of the guideline. This guideline was implemented in 2020 by The China National Light Industry Council, the China General Chamber of Commerce, and the China Plastics Processing Industry Association (CHEN Yang, 2020).

General guidelines for the evaluation of plastic products’ easy-to-collect & easy-to-recycle design” (T/CRRA 0302-2020)

General guidelines for the evaluation of plastic products’ easy-to-collect & easy-to-recycle design” (T/CRRA 0302-2020) are used for defines evaluation indicators for plastic products’ easy-to-collect & easy-to-recycle design, mainly focusing on the standard specifies the evaluation index system and evaluation methods for easy-to-collect & easy-to-recycle design and applies to the guidance and evaluation process of easy-to-collect & easy-to-recycle design of plastic products. This General guideline for the evaluation of plastic products’ easy-to-collect & easy-to-recycle design” (T/CRRA 0302-2020) was implemented in February 1, 2021, by China National Resource Recycling Association (CRRA) (CHEN Yang, 2020).

4.4.2 Japan

The Containers and Packaging Recycling Law (CPRL)

In Japan, more than 9 million tons of plastic waste were generated in 2017. More than 50% of plastic waste was treated by incineration with power generation and heat recovery, refuse-derived fuel, and auxiliary fuels in cement kilns, while the

material recycling accounted for only 23% (Japan PWMI, 2019). In Japan, “Resource circulation strategy for plastics” was developed to reduce the use of single-use plastics and promote the development and use of substitutes for petroleum-based plastics in 2018. The specific goals with timelines include the cumulative 25% reduction of single-use plastics generation by 2030, reusable and recyclable design for all containers and packaging/products by 2025, 60% recycling rate of plastic containers and packaging by 2030, 100% effective use of used plastics by 2035 including circular economy measures, doubling use of recycled materials by 2030, and maximum introduction (2 million tons) of biomass plastics by 2030 (Japan MOE, 2019)

Japan established the Containers and Packaging Recycling Law (CPRL). The CPRL law aims to subsidize recycling for municipalities, providing municipalities with recyclers and increasing the volume of plastic waste recycling in municipalities. The CPRL mainly focus on the Manufacturers that have been assigned the responsibility of recycling these containers and wrapping in accordance with the volume that they manufacture or sell and a government-designated organization, operates recycling business on behalf of the specified business entities that pay "recycling fees" to the Japan Containers and Packaging Recycling Association [JCPRA].

The Containers and Packaging Recycling Law (CPRL) was implemented in 1995 by The Japan Containers and Packaging Recycling Association

4.4.3 South Korea

The EPR system for packaging waste in South Korea

South Korea established the EPR system for packaging waste in South Korea for make zero plastic waste by 2030 and help reduce greenhouse gas emissions. This EPR system focuses on the manufacture, import, and sale of 6 categories of single-use plastics such as PET bottles, cutlery, foamed synthetic resin (EPS, PSP, exc.), other synthetic resin (container/ tray) other synthetic resin (film/sheet) and metal cans, glass bottles, carton packs.

The Producers should annually collect and recycle their assigned quantities corresponding to the recycling mandatory rate notified by the Korea MOE based on the 5-year long-term recycling target rate. Producers can fulfill their obligations by joining Korea Packaging Recycling Cooperative, a producer responsibility organization (PRO).

The EPR system for packaging waste in South Korea was implemented in 2003 by the government of Korea (ref).

4.4.4 India

Taking steps to promote biodegradable alternatives

A ban on single-use plastics announced by the Indian central government will take effect in July 2022. In addition, plastic packaging waste must be collected and

managed in an environmentally sustainable way through the EPR of the Producer, Importer, and Brand Owner (PIBO).

At the same time, the authorities have promoted biodegradable alternatives to plastics. Many food vendors, restaurant chains, and local businesses have already started using biodegradable tableware and switching from plastic bags to cloth or paper alternatives (Azadi Ka Amrit Mahotsav, 2022).

4.5 CLMVT countries

4.5.1 Cambodia

Cambodia has three main policies about the circular economy that use in country.

First is the National Environment Strategy and Action Plan (NESAP) 2016-2023 developed in accordance with the Constitution and 1996 Law on Environmental Protection and Natural Resource Management. It is aligned to Rectangular Strategy Phase III (RSIII), which reaffirms the RGC's mission and commitment to sustainable development and poverty reduction responding to the people's will and changing contexts of national and international developments. The Strategy has a clear focus on waste (solid, liquid, and chemical).

Second is Sub decree on Urban solid waste management is Tasks sub-national administrative units with the responsibility of preparing annual waste management action and budget plans, coordinating waste service provision with the private sector, determining appropriate fees for waste services, generating source revenue through the collection of service fees, and accessing financial resources from central authorities inter alia.

Third is Law on environmental protection and natural resources. The law designates that the Ministry of Environment is tasked with formulating policies towards waste management and pollution control (ADB, 2018).

4.5.2 Laos

Laos encouraging and promoting domestic and foreign investors to make investment in waste-related business activities in order to reuse the wastes or to use them as raw materials for producing various items so as to create economic value, jobs and income generating activities for the peoples as well as to decrease the use of new natural resources. According to the statistical data, a person in Vientiane Capital has produced waste, on average, of 237 kgs per year; about 70% of this waste can be reused. Most of this waste consists of papers, plastics, glasses, and metals. At present, only 10% of this waste is collected for reuse. These statistical data indicate that reuse of waste is an opportunity for investment to create jobs and income generating activities for the peoples (Japan International Cooperation Agency, n.d.). Ref ไม่น่าจะตรงกับที่เขียนคะ

The Ministry of Industry and Commerce, Lao PDR published the "Decision on the list of prohibited goods for importation or exportation No. 0848 / MOIC" in the Gazette on 17 September 2021. The Decision broadens Article 11 of the Decree on

Goods for Importation and Exportation, No. 114 / Gov, dated 06-Apr-2011. The decision became effective 15 days after the announcement in the Gazette.

The prohibited list of the goods for importation or exportation refers to the prohibited goods for either import or export in order to protect the national security; social order; ethics; culture; lives and health of the people, animal or plants; to protect the national heritage; natural resources or to comply with the international conventions. The decision lists prohibited goods for import and export respectively as follows.

The goods within the above list are prohibited to import or export for commercial purposes though they might be permitted by the government for the purposes of research and development, national security, or other benefits for the country (UMEYAMA Kenichi, 2021).

4.5.3 Myanmar

The Mandalay City in Myanmar banned the manufacture, import, trading and distribution of HDPE (High-density Polyethylene) plastic bags in some municipalities in 2009 (OECD, n.d.).

The Yangon City Development Committee (YCDC) of Myanmar officially announced to ban businesses from manufacturing, importing, trading, or distributing high-density polyethylene (HDPE) plastic bags for environmental reasons. Yangon also attempted not to allow the production, storage and sales of non-biodegradable waste such as polyethylene bags and ropes in April 22, 2011 (Towards Osaka Blue Ocean Vision, 2021).

4.5.4 Vietnam

Vietnam is facing diverse environmental issues due to its rapid economic growth and industrialization. The “Resolution No. 35/NQ-CP on a number of urgent issues in environmental protection”, which was promulgated in 2013, has identified seven issues as the country’s challenges as listed below. As seen in items 1 and 4 of the list, water pollution has been recognized as a major problem in Vietnam. Air pollution has also become a concern in large cities due to the sharp increase of automobiles and motorcycles. Awareness about soil pollution has also raised in recent years. As mentioned later, the country’s “Law on Environmental Protection of 2014” also refers to soil pollution control.

On October 28, 2020, the Ministry of Natural Resources and Environment of Vietnam issued the “Decision 2395/QD-BTNMT of the Ministry of Natural Resources and Environment (hereinafter referred to as this decision) to implement the ‘Prime Minister Directive 33/CT-TTg on strengthening management, reuse, recycling, treatment, and reduction of plastic waste’ and the ‘Prime Minister Decision 1746/QD-TTg of on introducing national action plan for management of marine plastic waste’”. The purpose of this decision is to embody and effectively implement the goals set by

2020 Directive 33/CT-TTg and Decision 1746/QD-TTg and the measures to achieve the goals.

Vietnam's Prime Minister approved Decision No. 1746/QD-TTg, which promulgated the National Action Plan for Management of Marine Plastic Litter by 2030. This plan set targets for reducing marine plastic waste by 50 percent by 2025, and by 75 percent by 2030, as well as eliminating single-use plastics (SUPs) from coastal tourism destinations and marine protected areas by 2030.

In addition, the Law on Environmental Protection 2020, which became effective on January 1, 2022, has introduced "pay as you throw" policies; it requires the segregation of wastes; and it sets out the legal basis for extended producer responsibility (EPR) schemes. Vietnam has also set targets for phasing-out SUPs. On January 1, 2026, production (for domestic consumption), as well as imports of non-biodegradable plastic bags will be banned. In addition, the decree directs Provincial People's Committees (PPCs) to restrict the distribution and use of SUPs in shopping centers, supermarkets, hotels, and tourism areas, starting in 2025.

4.5.5 Thailand

Thailand, one of the leading industrialized countries in Southeast Asia, has been tackling with various environmental pollution issues emerging along with economic growth. Emissions from industrial facilities and exhaust gas from mobile sources have been causing air pollution in large cities and industrial parks. Chao Phraya River, canals and waterways in urban areas have been deteriorated due to urbanization and economic activities. Social interests on the management of increasing wastes, including municipal wastes, industrial wastes, waste electrical and electronic equipment, infectious wastes, as well as noise and odor issues has risen.

Waste Management Policies and Laws in Thailand

4.3.5.1 The National Strategy 2018 – 2037

The National Strategy 2018 – 2037 outlines the first level plan to drive towards the achievement and requires that the guidelines be conveyed into the second and third level plans. Thailand becomes a developed country with security, prosperity, and sustainability is the country's vision stipulated in the National Strategy, which can be referred to in short as the national motto of "security, prosperity and sustainability". According to sustainability, development lasts and is also achieved by conserving and rehabilitating natural resources, which must not be exploited. Pollution must be regulated for ecological systems to continue functioning naturally. As regards the waste separation behavior of the people, it is a part of the sustainability goal. Manufacturing and consumption must consider environmental impacts and comply with the SDGs. People must be socially responsible, caring, and willing to make sacrifices for the public interest. It is essential to encourage public participation and motivate all sectors in the country to take part in sustainable national development.

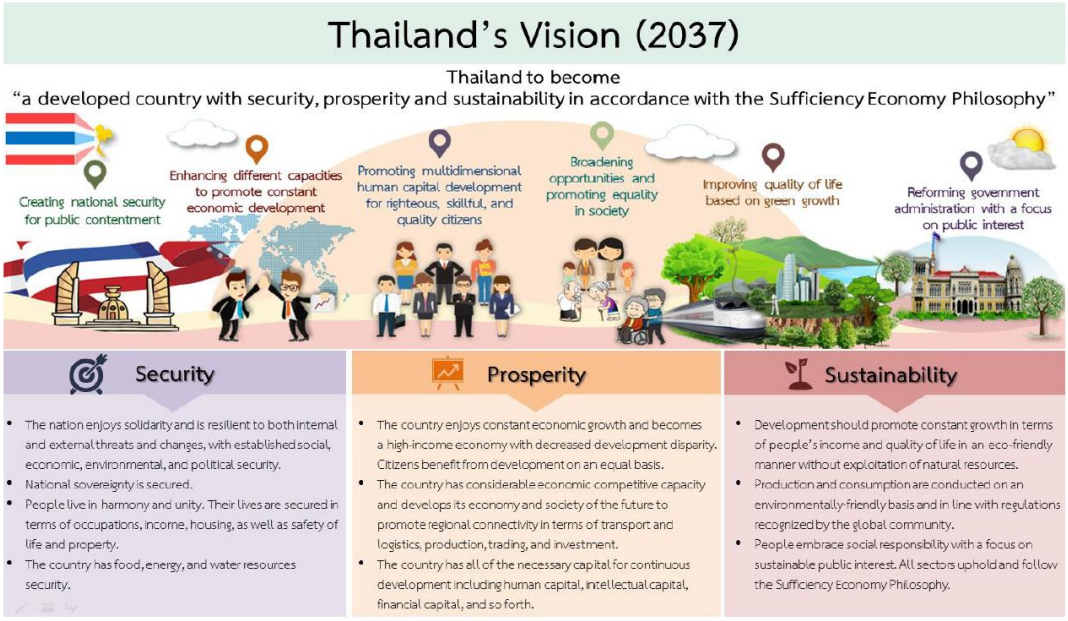


Figure 4-5 Thailand's Vision 2037
Source: The Office of SMEs Promotion (2020)

4.3.5.2. The Twelfth National Economic and Social Development Plan (2017-2021)

The Twelfth National Economic and Social Development Plan is an action-oriented plan set within the 20-year National Strategy (2017-2036). The development strategies are as follows: (1) Strategy for strengthening and realizing the potential of human capital, (2) Strategy for creating a just society and reducing inequality via three major policy directions, (3) Strategy for strengthening the economy and underpinning sustainable competitiveness, (4) Strategy for environmentally friendly growth for sustainable development, (5) Strategy for reinforcing national security for the country's progress towards prosperity and sustainability and (6) Strategy for public administration, corruption prevention, and good governance in Thai Society. According to the strategy for environmentally friendly growth for sustainable development, environmental problems are expected to increase along with economic growth and urbanization. Then, a critical development approach must be carried out to promote sustainable consumption and production related to waste management, recycling, and circular economy (Office of the National Economic and Social Development Council, 2017).

The goals relating to waste management in this plan consist of; (1) MSW shall be properly managed to 75% of the total generation and (2) to promote environmentally friendly products, life cycle waste management and sustainable production and consumption.

4.3.5.3. BCG Model

Thailand has designated the Bio-Circular-Green Economic Model (BCG) to make sustainable use of natural resources even as minimizing environmental effects. BCG leverages a whole-of-society strategy, including the government, private sector, academics, and society which have collectively successfully integrated this philosophy into practice. A new BCG model has been developed to support Thailand 4.0 policy as a strategy for driving economic and social development. BCG is a combination of the bioeconomy, the circular economy, and the green economy. Bioeconomy is defined as the manufacturing of renewable biological resources and the transformation of these resources into value-added products. Circular economy aims to reuse and recycle resources. Green-economy focuses on balancing the economy, society, and the environment, resulting in sustainable development.

The BCG model is expected to enable Sustainable Development Goals (SDGs) by promoting sustainable agriculture, clean energy, and responsible consumption and production, ensuring biodiversity conservation and sustainable utilization, and preserving the environment and ecosystem. (National Science and Technology Development Agency (NSTDA), 2020).

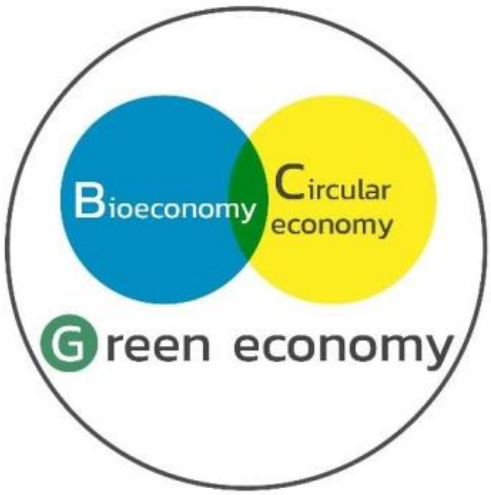


Figure 4-6 The BCG model
Source: National Science and Technology Development Agency (NSTDA) (2020)

The establishment of two BCG committees has begun to promote BCG at the policy level. These are the BCG Policy Board of Directors, which reports to the Prime Minister, and the BCG Model Implementation Committee, which reports to the Minister of Higher Education, Science, Research, and Innovation and is charged with developing action plans to implement the BCG model. BCG is subsequently integrated into Thailand's national agenda.

4.3.5.4. Roadmap on plastic waste management 2018-2030

Roadmap on plastic waste management 2018-2030 is a holistic policy for managing plastic waste in Thailand for conveyed to organizations for use as a framework for preventing and solving plastic waste problems. The vision of this Roadmap is for moving towards sustainable plastic management through the circular economy.

There are two targets:

- Reduce and replace some single-use plastic using more environmentally friendly products; Oxo-degradable plastic, cap seal, plastic microbead in 2019 and foam food containers, plastic straws, plastic bags thicker than 36 microns, and plastic cups less than 100 microns in 2020.
- 100% target plastic waste to the circular economy in 2027

Three measurements under the roadmap are as follows:

- Reduce plastic at production
- Reduce the single-use plastic consumption
- Manage plastic waste in the proper system after consumption.

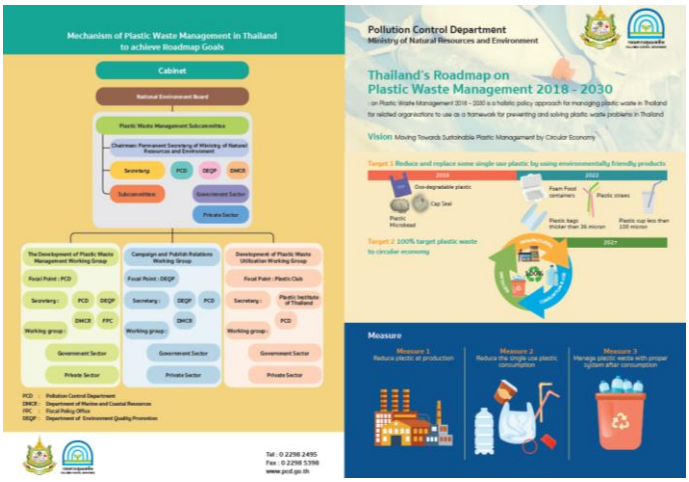


Figure 4-7 Thailand's roadmap on plastic waste management
Source: Pollution Control Department (2021)

4.4 Summary of Circular Economy in Plastics Packaging Trend

circular economy of plastics packaging in many countries is summarized in this chapter. Figure 4-8 showed the target of plastic packaging policies. The European create a strategy for plastic in circular economy in 2017 and set the target in 2025 that plastic packaging will be recycled at 50% by 2025. In 2020, China starts to launch ban plastic bag policy in major cities and set target that in 2020. Plastic bag is banned in shopping malls, supermarkets, pharmacies, bookstores, and food takeout services. In 2022, Canada announced that they will ban single use plastic [eg. Checkout bags, Cutlery, Foodservice ware, Stir sticks and straws] and Pepsi's European set target to create 100% recyclable in 2022. In 2023, England will ban single use plastic by October 2023. In 2025 many countries have plastics waste circular economy target such as China has target to reduced plastics waste straw by 30%. In USA, 100% 0f 100% of plastic packaging will be reusable, recyclable, compostable by 2025. Coca Cola and nestle will change all packaging to recyclable

material. In 2026, China will ban degradable plastic bags. In 2027, Thailand will be 100% recycled plastics waste. In 2030 Malaysia and South Korea will be zero plastics waste country, Vietnam will ban single use plastics bags, Japan will be 60% of recycling rate, EU will have Plastic Packaging recycling at 55% and all P&G packaging will be100% recyclable Material. In 2035, Japan will be 100% effective use of plastics.

The circular economy trend of plastics packaging are widely used in many countries in the world. Countries that do not have policies or laws to save the environment or prevent plastic pollution from plastics packaging will face obstacle of trade to other country. ASEAN countries should study and create more sustainable policies for managing plastic packaging and plastics waste. Circular Economy is one of the solutions that can make countries in ASEAN create laws and policies about plastics (Table 4-1).

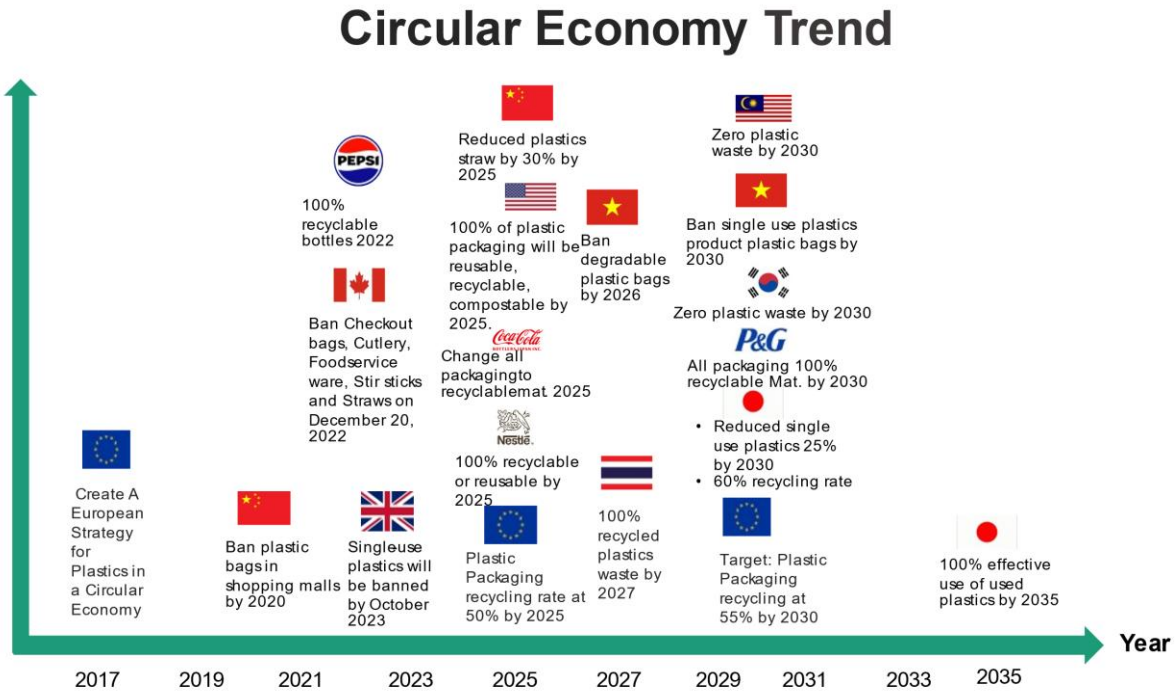


Figure 4-8 Target of plastics circular economy in the global trend

Table 4-1: Summary status quo of CE and plastic choice

	CE	Plastic choice	System
EU	2025: 50% plastic packaging recycling 2030: increase recycling rate to 55%		
The Netherlands	No data		
French	2025: recycle 100% of plastics 2040: phase out single-use plastics		
Italy	2023: plastic packaging tax		
Australia	2025: phase out single-use plastics 2025: all packaging 100% reusable, recyclable, or compostable, 70% of plastic packaging is recycled or composted, 50% of average recycled content is included in the packaging.		
Canada	2030: zero plastic waste		
Japan	2025: reusable and recyclable design for all containers and packaging/products 2030: -25% reduction of single-use plastics and -60% recycling rate of plastic containers and packaging		

	CE	Plastic choice	System
	-maximum introduction (2 million tons) of biomass plastics 2035: 100% effective use of used plastics including circular economy measures		
China	No data	Biodegradable plastic	
South Korea	2030: zero plastic waste		EPR system for packaging waste
Cambodia	No data		
Laos	No data		
Myanmar	No data		
Vietnam	No data	Biodegradable plastic	
Thailand	2027: 100% CE of plastic waste	Recyclable plastic	No
India	2022: ban single-use plastics	Biodegradable plastic	

References

ADB. (2018). Cambodia's Road Map for Sustainable Development: The National Environment Strategy and Action Plan. Retrieved from https://www.adb.org/publications/cambodia-national-environment-strategy-action-plan

APCO. (2023). AUSTRALIA'S 2025 NATIONAL PACKAGING TARGETS. Retrieved from https://apco.org.au/national-packaging-targets

Azadi Ka Amrit Mahotsav. (2022). Ban on identified Single Use Plastic Items from 1st July 2022. Retrieved from https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1837518

CHEN Yang. (2020). China Released the "Guideline for Classification and Label Standard of Biodegradable Plastic Products". Online: Enviliance ASIA. Retrieved from https://enviliance.com/regions/east-asia/cn/report_1207

Coca-Cola Bottlers Japan Inc. (n.d.). What we are doing, Roadmap to 2030. Retrieved from https://en.ccbji.co.jp/csv/environment/

European commission. (2021). Ensuring that polluters pay deposit refund schemes https://environment.ec.europa.eu/system/files/2021-10/Deposit%20Refund%20Schemes.pdf

European Commission. (2018a). Single-use plastics Retrieved from https://environment.ec.europa.eu/topics/plastics/single-use-plastics_en

European Commission. (2018b). Circular Economy Retrieved from https://environment.ec.europa.eu/topics/circular-economy_en

European Commission. (2018c). A European strategy for plastics Retrieved from https://ec.europa.e payu/commission/presscorner/detail/sv/MEMO_18_6

EuCertPlast. (2018). European Certification of Plastics Recycling. Retrieved from https://www.eucertplast.eu/

Government of Canada. (2023). Plastic waste and pollution reduction. Retrieved from https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-plastic-waste.html

Government of Canada. (2023). Single-use Plastics Prohibition Regulations – Overview. Retrieved from https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-plastic-waste/single-use-plastic-overview.html

Government information for entrepreneurs. (2023). Packaging Retrieved from https://business.gov.nl/regulation/packaging/

Japan International Cooperation Agency. (n.d.). Data Collection Survey on Waste Management Sector in The Lao People's Democratic Republic. Retrieved from https://openjicareport.jica.go.jp/pdf/12345914.pdf

Janne Suokas. (2022). Packaging regulation is changing around the globe. Online: UPM Specialty Papers. Retrieved from https://www.upmspecialtypapers.com/articles/specialty-papers/22/packaging-regulation-is-changing-around-the-globe

Jessica Krahl. (2022). Plastic tax in Italy 2023. Online: Ecosistant. Retrieved from https://www.ecosistant.eu/en/plastic-tax-in-italy-2023/

National Science and Technology Development Agency (NSTDA). (2020).

Nestlé News. (2023). What is Nestlé doing to tackle plastic packaging waste?. Retrieved from https://www.nestle.com/ask-nestle/environment/answers/tackling-packaging-waste-plastic-bottles

NSTDA. (2020). New BCG model [in Thai]. Retrieved from https://www.nstda.or.th/home/knowledge_post/bcg-by-nstda/

OECD. (n.d.). Marine plastics pollution MYANMAR. Retrieved from https://www.oecd.org/ocean/topics/ocean-pollution/marine-plastics-pollution-Myanmar.pdf

Office of the National Economic and Social Development Council. (2017).

Phys.org. (2023). Science news. Retrieved from https://phys.org/

Pollution Control Department. (2021). Thailand's roadmap on plastic waste management Retrieved from https://www.pcd.go.th/wp-content/uploads/2021/10/pcdnew-2021-10-19_08-59-54_995414.pdf

The Office of SMEs Promotion. (2020). National Strategies 2018 – 2037 Retrieved from https://www.sme.go.th/upload/mod_download/download-20201012111719.pdf

Towards Osaka Blue Ocean Vision. (2021). Myanmar Action and Progress on Marine Plastic Litter. Retrieved from https://g20mpl.org/partners/myanmar

UMEYAMA Kenichi. (2021). Laos publishes list of prohibited goods for import-export control. Online: Enviliance ASIA. Retrieved from https://enviliance.com/regions/southeast-asia/la/report_4489

World Economic Forum. (2021). New law in France will save 1 billion pieces of single-use plastic annually. Retrieved from https://www.weforum.org/agenda/2021/10/how-france-plans-to-significantly-reduce-its-plastic-waste-from-2022/

CHAPTER 5

CASE STUDIES ECO DESIGN THEORY AND PRACTICE

Chapter 5

5. Case studies Eco design theory and practice

Plastic manufacturers are competitive in price. Today's culture of plastic products is built to compete on price. Causing often finds plastic products to be very similar or similar in shape and have the same price as a result, competition cuts prices and negatively affects the plastic industry among themselves. So, if the industry can differentiate its product, this will create opportunities and create new awareness to consumers.

Product groups in the food industry Plastic packaging will be the largest use. And there is always a change in the form of packaging. Due to high market competition and there are many similar products. Therefore, there has been competition since packaging that attracts the attention of consumers. Until it is the behavior of consumers to choose to buy products.

Look at the packaging design in the first place. Creative design principles have been introduced to add value to household products and attract consumers to forget the image of household products being cheaper. This has encouraged the market to be active in creating creative products for commercial use. By combining art design principles with engineering principles, it can be initiated in a variety of ways without a frame. Of course, if you think that plastic products will start to bring creative ideas into the future, what should be the start? For example:

Color of plastic products

When plastic packaging is colorful, most people seem to think that the product looks cheap and does not have such high quality. The way to bring creativity to the color of plastic. Entrepreneurs in the industry can take initiative with minimal cost. But can adjust the image of the product to look better (see Figure 5-1).

Figure 5-1 Color of plastic cups

Source: IKEA (2023)

Shape of plastic products

The shape of most plastic products is very similar, which makes consumers consider buying mainly from the price side (see Figure 5-2). When the shape and design of the plastic products are similar, the decision making for consumers to purchase the product would be based on prices.

However, there are limitations to changing the shape of new plastic products due to the costs of developing new molds. But if thinking outside the box by applying creative principles will make a difference in the decision-making for consumers. and create added value in product sales.

Figure 5-2 Lavatory Brush in different shapes
Source: Homestoreandmore (2023) and Pinkoi (2023)

Function of plastic products

Increasing the functionality of existing products to be more diverse. To meet the needs of today's consumers who want convenience and value for money,these products can often be found mostly from imports. Because the obstacle is the investment budget in both molds and other electronic equipment that is higher and requires more expertise in manufacturing than plastic products. But it can be seen from examples of foreign products that increase sales value and are accepted by consumers.

Figure 5-3 Normal plastic bin and smart trash bin

Source: Indexlivingmall (2023) and Nocnoc (2023)

5.1 Trend of Eco Design

Many countries around the world have put efforts in reducing wastes both at the source and at the landfill.By solving the problem of plastic waste destination, there are many.

Therefore, the trend of bringing waste back to create value added is a new product. But recycled plastic is seen as a product of low quality and must be cheap. Therefore, product design principles have been introduced. creative use as a result, many activities have been organized for contests made from recycled plastic. And tell the story about what type and amount of recycled plastic products are made from. This caused a trend that made consumers change their minds and there was a campaign to buy products from recycled materials with more markets to support.

Figure 5-4 Products made from recycled plastic

Source: Qualy (2021)

The introduction of the original product that had been produced to use recycled plastic in assorted colors, resulting in artistic creations which originally consumers did not pay attention but when the situation of reusing waste causes new markets to open.

Figure 5-5 Products made from recycled plastic

Source: Precious Plastic (2022)

5.2 Upcycle and Recycle

Recycling process can be described as follows 1) separate and cleaning plastic packaging based on its components and color 2) chop and grind plastic packaging into pellets 3) melt pellets for using as raw materials for producing plastic.

The upcycling process is to bring the collected waste to be cleaned and reinvented into new products without going through the process of melting into recycled plastic pellets which products from the upcycle process will be designed using creative design principles to create new products and gain acceptance in many markets.

Figure 5-6 Products from upcycle process

Source: Compassionate Closet (2023)

At present, there is a new trend of using waste to create added value has begun to change consumer behavior.

Traditionally, there was a practice of Linear Economy to bring resources to produce products and when they are out of use, they will be discarded and not reused.

The linear economy, therefore, affects the world. The world must change. Therefore, the principle of circular economy has been introduced, which is to use natural resources in the value chain and increase the efficiency of waste, raw materials, expired products, and energy.

Figure 5-7 Linear economy

Source: The Siam Cement Public Company Limited (2023)

Figure 5-8 Circular economy

Source: The Siam Cement Public Company Limited (2023)

In Thailand there are many product designers who use the aforementioned principles to upcycle products and large corporate companies in Thailand have begun to be interested in developing products that are manufactured with their own raw materials. Several recycling and upcycling projects are in place. The Plastics Institute of Thailand offers innovative plastic product design and development services for entrepreneurs in Thailand who want to develop products that are Eco designed and compatible with the principles of the Circular economy too.

Figure 5-9 Providing eco design services to entrepreneurs in the business model development activities and new business and engineering products project in 2019 by DIProm ITC

Source: Plastics Institute of Thailand (2022)

5.3 Extended Producer Responsibility [EPR] of plastics product

EPR is a principle that extends the responsibility of the producer to different stages of the packaging life cycle. It is a guideline for manufacturers to consider the full range of environmental impacts. From design, distribution, take-back, collection, reuse, recycling, and treatment, this principle has already begun to be applied to many large brands as a social and environmental responsibility.

EPR is a policy principle that holds producers responsible for the environmental impacts of target products and packaging they put on the market, throughout their entire life cycle, including the post-consumer stage. Various policy instruments can be employed in an EPR system, for instance mandating the take-back of end-of-life products and packaging waste for safe recycling and disposal (Pollution Control Department, 2022)

The EPR includes implementing take-back and recycling programs for products and packaging, setting up collection points and recycling pickups for products and packaging, and designing new products and packaging that are easier to reuse, upgrade, repair, and recycle. The EPR system in the European Union (EU) may typically be ahead of the curve, especially in Germany, the EU's biggest economy. For the packaging sector, Germany has implemented monetary value to returnable containers at €0.25, or around 9 baht, for each single-use recyclable

container e.g. PET bottles and aluminum cans. Packaging refund machines are installed in almost every local supermarket in Germany.

With the German Deposit Refund System (DRS), the cost of beverages in Germany has dropped significantly as consumers only pay for the liquid in the packaging and the value of the container is returned to them when they return the packaging at any drop point nearby. (Bangkokpost,2023)

References

Bangkokpost. (2023). tackling-our-plastic-waste-woes. Retrieved from https://www.bangkokpost.com/opinion/opinion/2475464/tackling-our-plastic-waste-woes

Compassionate Closet. (2023). WOMEN. Retrieved from https://www.compassionatecloset.com/blogs/wearnoharm/79059142-giving-green

Homestoreandmore. (2023). Lavatory Brush. Retrieved from www.homestoreandmore.ie

IKEA. (2023). Plastic cup. Retrieved from www.ikea.com

Indexlivingmall. (2023). Trash bin. Retrieved from www.indexlivingmall.com

NocNoc. (2023). Trash bin. Retrieved from www.nocnoc.com

Pinkoi. (2023). Lavatory Brush. Retrieved from https://en.pinkoi.com/

Plastics Institute of Thailand. (2022). ECO-DESIGN OF PLASTIC PACKAGING FOR THE FUTURE. Retrieved from https://www.itc.or.th/?p=17380

Pollution Control Department. (2022). EPR system. Retrieved from https://www.pcd.go.th/wp-content/uploads/2022/02/pcdnew-2022-02-18_03-24-24_729536.pdf

Precious Plastic. (2022). Designing for Recycled Plastic. Retrieved from https://onearmy.github.io/academy/create/design

Qualy. (2021). Save Turtle Bottle Stopper-Opener. Retrieved from https://qualydesign.com/thailand/shop/all-products/save-turtle-bottle-stopper-opener/

The Siam Cement Public Company Limited. (2023). SCG circular way. Retrieved from https://www.scg.com/sustainability/circular-economy/en/scg-circular-way/

CHAPTER 6

INTERVIEW SESSION SUMMARY

Chapter 6

6. Interview Session Summary

6.1 Representative from Pollution Control Department of Thailand (PCD)

- In 2021, Thailand used 5.68 million tons of plastic pellets, which is the highest amount used for packaging at 41%. There were also 2.76 million tons of single-use plastic waste generated after consumption, which requires management due to the tendency of single-use plastic waste being discarded. Although single-use plastic waste can be recycled, it is not a popular practice due to high contamination levels, lightweight, and difficulty in transportation, leaking to marine plastic pollution that impacts the overall environment. The government has taken action to manage this issue by developing a roadmap for plastic waste management and implementing plans for phases I and II of plastic waste management. Phase I focuses on reducing and eliminating the use of seven types of plastic by the end of 2022. The 7 types of plastic are 1) cap seals, 2) plastic with oxo-biodegradable additives, 3) microbeads from plastic, 4) plastic bags with a thickness of less than 36 microns, 5) foam food containers, 6)single-use plastic cups, and 7) plastic straws
  According to this policy, out of 7 types of plastic, only cap seals and microbeads could achieve 100 percent ban due to supporting laws/regulation enforcement, while other types of plastic waste are still challenging to control due to limitations in usage control. Therefore, the government has evaluated the results of phase I implementation and revise a plan for the phase II. Phase II waste management approach prioritizes proper management of waste throughout the product life-cycle, including design, production, distribution, consumption, sorting, recycling, and disposal based on academic principles. The plan includes four measures: 1) control of environmentally friendly production (eco-design), 2) reduce plastic consumption, 3) management of post-consumer plastic waste (sorting into the system), and 4) reduce plastic leaking to the sea/ocean . The plan was approved by the Cabinet and has been implemented since 2018. Additionally, discussions have been held with relevant stakeholders e.g. industrial operators for the entire supply chain, and government agencies such as the Board of Investment and the Plastic Institute, to develop a plastic take back system. Besides manufacturers and government agencies, discussions have also been held for the consumer sides includingwaste-generating sources, such as department stores, fresh markets, and restaurants. The aim of the discussion wasto develop a continuous policy response and address problems caused by the lack of clear laws regarding packaging waste management. The current laws that are relevant to plastic waste management are 1) the Public Health Act and 2) the Cleanliness Act. However, these 2 acts are based on a linear

economy management approach that emphasizes only end-of-life waste management.

- From the policy that sets clear targets for utilizing plastic waste and increasing stakeholder engagement throughout the entire waste management chain, including the potential for specific legislation and regulations to achieve the objective of bringing unmanaged plastic into the system.
- Additionally, the CE policy is one of the three main pillars aligned with the government's policy of applying the BCG model framework, foreseen as a necessary to achieve sustainable economic and environmental outcomes. Importantly, plastic waste management might be included as a part of trade barriers in the future. In addition, trade barriers may need to be considered by driving with relevant economic organizations. Currently, a bill to promote the CE in packaging is being drafted, which specifies the responsibilities and duties of each agency. However, the enactment of this bill will need to consider the possibility of at which level the law should be enacted to have the most flexible enforcement.
- The obstacles to implementing the CE policy include the lack of law enforcement. Voluntary program only might not be able to achieve the CE target as stated in the Roadmap. Besides, the unclear and discontinues communication also part of the factors that affect the CE.

- The measurement of the success of CE policies requires a waste database and an MFA study, which are currently underway. If such a database exists, it will enable the establishment of realistic targets, monitoring of results, and clear measurement of policy success.
- From the study of foreign countries such as Korea, Taiwan, and Japan, the government has found that these countries have laws that require citizens to practice waste separation. However, the problem in Thailand is that there is no specific responsibility assigned to citizens for waste separation, and only the authority for waste management is designated to local authorities. Therefore, there is a need to push for the enactment of laws that will establish citizen responsibility for waste separation.
- The Department of Pollution Control believes that enforcing appropriate laws throughout all sectors and clearly defining the roles and responsibilities of all parties involved in the supply chain will accelerate the implementation of the CE concept. A waste plastic database will aid in measuring the effectiveness of policies. Additionally, communication with users, such as using eco-labels, should be encouraged. Furthermore, if manufacturers focus on eco-design principles, such as producing plastic packaging with a single type of raw material for easier post-consumption management, it will be beneficial.

6.2 Representative from Public Private Partnership for Sustainable Plastic and Waste Management (PPP Plastics)

- In 2016, there began to be an agenda to address the issue of garbage in the ocean and it was claimed that Thailand was the 6th largest producer of plastic waste in the world. NGOs raised concerns about global warming, plastic waste, and garbage in the ocean, leading to increased meetings, academic presentations, and conferences on these topics by both the government and private sector in Thailand. At the same time, large corporations in Thailand began to engage in CSR, which became a common practice. As all sectors began to participate in more meetings, there was increased awareness and a movement to bring together all relevant stakeholders, including the government, NGOs, and private sector, to form a PPP Plastics organization. It was believed that solving these problems required collaboration from all sectors.
- Since the establishment of PPP Plastics up to the present, there has been a positive trend toward pushing for management solutions for the aforementioned problems. This is because the government has responded and quickly developed policies. All parties are aware that a linear economy is not the future, but a circular economy is a future for all organizations.
- In the name of the business owner, it can be said that Prepack Co., Ltd. is one of the leading organizations that apply CE. They recognized the trend that CE would be a sustainable solution to problems and began investing in solutions that meet the demands. Prepack was one of the first companies to develop PE with high barrier chemicals for coating films, aiming to replace nylon. Today, many international companies have raw materials that are mono materials with excellent oxygen barrier properties. This demonstrates the good response from other business owners, even if the progress is not immediate.
- Several business owners are preparing themselves to invest in technology and research to adapt themselves as recyclable materials and to support the market in the future. However, they still need to listen to customer demands as brand owners have policies and goals to respond to the issues. For example, they set targets that in 2025, their products must be 100% recyclable, or their products should reduce the use of virgin plastic pellets made from fossil fuels by 25%. But due to the current global economic situation, the announced policies have been delayed from the original commitment of 2025 to 2030. Therefore, even though business owners have prepared themselves to invest in technology or research, there are no purchase orders from customers yet.
- PPP Plastics is responsible for creating models to demonstrate to the government that if we promote infrastructure for waste segregation from the source, minimize contamination of household waste segregation, create waste collection businesses throughout the entire supply chain, and ensure minimal waste disposal in landfills from waste management, starting from waste separation, waste buyers, and leaving minimal waste for landfills.

From past projects such as Rayong Less Waste, it has been proven that this can be achieved and sustained. It is hoped that in the next 5 years, the government will apply successful project models and support Extended Producer Responsibility (EPR), create supportive infrastructure, encourage more use of recycled materials, and establish laws, such as imposing fines on citizens for not separating waste, and assigning everyone the responsibility of managing waste properly. In the industrial sector, efforts should be made to develop materials that can be easily recycled. If both sectors can successfully achieve these goals in the next 5 years, it can be said that they are fully prepared for sustainable waste management throughout the entire supply chain.

- The strategy for businesses or industries to create differentiation or increase economic value is to keep up with global trends, follow the country's roadmap, and be able to generate knowledge, understanding, sell ideas, concepts, and develop products that meet the needs. This will lead to gaining new customers and increasing market share.
- In terms of the environment, there still needs to be a search for technology that maximizes the use of recycled plastic pellets with desired properties. For example, currently, Post-Industrial Recycled (PIR) technology can only yield up to 3% of recycled plastic pellets without decreasing the quality. If the quantity of PIR can be increased, it will help reduce the environmental impact even more by reusing plastic waste generated during industrial processes.
- As a managing director of Prepack Co., Ltd., I have set a goal to achieve zero waste, which is considered a challenging goal due to several limitations as mentioned above. For instance, currently, only less than 1% of the entire market is able to handle soft plastic packaging due to the complexity of raw materials and high management costs. However, rigid plastics can be managed more easily as they mainly use the same type of raw materials.
- As the chairman of PPP Plastics, the goal is to reduce marine debris. Therefore, in order to achieve this goal more easily, it is believed that the management style of PPP Plastics should be changed to a corporation. This will allow for a core workforce to push and work in the long term, as CE is a long-term issue that must work together with various sectors, including the government. PPP Plastics itself must understand and filter the needs of the industry to have an appropriate approach throughout the entire supply chain and comply with government policies. Only then can there be positive outcomes for the economy, society, and environment.
- What I would like to convey to the industrial sector is that I would like them to participate in the management and become a part of PPP Plastics to help support the solutions to the circular economy principles and promote various forms of support, such as laws, infrastructure, etc.
- In sum, the PCD has been implementing the Roadmap for plastic waste consumption and management since 2018. The targets to fully ban certain

types of plastic packaging were clearly stated with the timeline. Similarly to the CE target. However, due to the COVID 19 situation, the first phrase of this target has been postponed and extended to the second phrase. In other words, the COVID 19 causes approximately 5 years delay from the original plan. Besides, the country relies fully on voluntary programs. By lacking of law enforcement imposted for both the production and consumption sides, it is challenging for the country to achieve the Roadmap target.

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
Thailand	Thailand, like many countries around the world, is in the midst of a significant plastic waste crisis. In 2019, the Government of Thailand released the Roadmap for Plastic Waste Management 2018-2030 and is developing the National Action Plan on Marine Plastic Debris to alleviate the current impacts and avert future damage caused by marine plastic debris. While these efforts are critical steps toward reining in the country's plastic pollution problem, further insight is needed into where the plastic waste comes	**Production**: Ban on plastic cap seal. FDA ban on recycled content in food packaging. This ban is however being reconsidered and is expected to be amended by end of 2020. (The plastics cap seal ban is in reality a voluntary agreement with manufacturers not to use the plastic cap seals.) **Consumption**: Bans use of single-use plastic bag. (The 2nd Green	Despite implementation of a "National Roadmap on Plastic Waste Management 2018–2030", Thailand has failed to achieve its annual targets. No instrument with wide geographic reach operational aimed at strengthening EPR (extended producer responsibility) on packaging and durables, improving recycling rates by imposing landfill or incineration taxes, and other friendly approaches	**General Legislative Framework**: Plastic Waste Management Roadmap 2030 outlines plans to eliminate and replace 7 types of single-use plastic with more environmentally-friendly materials by 2022 and recycle 100% of plastic waste by 2027. All plastic waste imports will be banned by 2021.	Land-based structural inequities and societal inequalities together pose ongoing obstacles to Thailand's efforts to reduce plastic pollution as problems in the circular economy itself. Geopolitical and economic power imbalances impede the formulation of cross-sector and multi-scalar forms of circular stewardship that are vitally needed to respond to the accumulating impacts of plastic pollution across	Sector-specific pathways for more equitable policy choices. For the private sector, Thai companies could emulate or replicate in their collaborations with state and societal partners. Manufacturers can make products which can be better recycled as well as reduce the amount of plastic it uses in its products. For the public sector, the political fragmentation,

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
	from and how it moves in the environment.	Public Procurement Plan encourages green consumption within the government.) **Disposal**: There are no targets for diversion from landfill or landfill bans currently in Thailand. **Recycling**: There are no Extended Producer Responsibility (EPR), take-back, or source segregation regulations currently in Thailand.	(deposit refund and pay-as-you-throw). Inequality/inequity in Thailand, as a waste-importing country, processes plastic products from several developed countries, compromising its capacity to develop sustainability measures. The political power by petrochemical industry aggravates domestic inequalities and impedes the ability of government agencies to act cohesively in implementing		land and sea boundaries. Major plastic producers and retailers have benefitted the most from such inequities, such as not having to take responsibility for their products. (Marks et al., 2023)	lack of coordination and incomplete data collation within and between government departments in Thailand signals the need to strengthen state waste management capacities at meaningful scales. EPR mechanisms also need to be introduced and enforced by government institutions. Societal transformations should begin with the transformation of the informal

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
			meaningful environmental reforms. (Marks et al., 2023)			recycling sector into a regulated waste management body. In Thailand where spatial inequalities exclude large sections of society from formal waste management regimes, informal service providers will likely remain essential for many communities. Registering and organising these key stakeholders as waste management providers would better align state

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
						and societal interests, thereby enhancing the efficacy of circular activities. (Marks et al., 2023)
Japan	Most plastic pollution comes from inadequate collection and disposal of larger plastic debris known as macroplastics, but leakage of microplastics (synthetic polymers smaller than 5 mm in diameter) from things like industrial plastic pellets, synthetic textiles, road markings and tyre wear are also a serious concern.	**Production:** Requires payment of a recycling fee by manufacturers to the designated organisation for recycling. **Consumption:** The Japanese government has plans to make plastic shopping bag charges mandatory. **Disposal:** There are no targets for	Japan has already applied an extensive policy framework centered around the concept of a Sound Material-Cycle Society, to form the basis of its transition towards a more circular economy. Policy plans such as METI's Circular Economy Vision 2020 and the MOE's plastic resource circulation strategy	**General Legislative Framework:** The Basic Act for Establishing a Sound Material-Cycle Society clarifies the responsibilities of all key stakeholders, and articulates fundamental matters for making policies for the formation of a Sound Material-Cycle society.	The role of non-governmental stakeholders should not be forgotten, as involving civil society and business communities is key in achieving a circular economy. Though the remanufacturing, repair, reuse, and products as a service are still smaller sectors in Japan, circular business models	In order to accelerate the transition to the circular economy, key future policy focus areas in Japan are 1) Implementing a green circular recovery to build back better (Post Covid-19) in a green and circular manner. The EU has proposed a distinctly green and circular

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		diversion from landfill or landfill bans currently in Japan. **Recycling:** Act on the Promotion of Effective Utilization of Resources fosters the recycling of reusable resources.	and its concept of a Circular and Ecological Economy, help increase awareness of the circular economy. The Circular Economy Vision 2020, though not as detailed as the EU's most recent Circular Economy Action Plan, still puts forward some crucial focus points, such as the importance of digitalization, ESG, and an improvement of the market for secondary materials, through measures such as regulation and better cooperation		are commercially viable and that innovative European circular solutions would also be attractive for a Japanese market and Thai market as well. There are several organisations and media companies now specially focused on promoting the circular economy in Japan. The importance of public-private partnerships cannot be underestimated either for combating plastic waste being successful in uniting cross-	recovery, and Japan is moving in the same direction. 2) Continue to enhance global political cooperation on the circular economy building on the EPA, SPA and the EU-Japan Connectivity Agreement, and the high-level environment dialogue, high-level economic dialogue, and bilateral industrial policy dialogue. Japan must continue to align and strengthen both the EU's and

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
			between the upstream and downstream supply chain. (Bangert et al., 2020)		sectorial stakeholders from the entire supply-chain, and showing a clear way forward. (Bangert et al., 2020). In addition, a law charging consumers for single-use plastic bags entered into force in July 2020 which is a step in the right direction. Although it is as of yet too early to assess the impact of the policy, early data from the three largest convenience store chains in Japan sees that consumers declining to pay	Japan's mutual interest areas through such proposals as the EU's Circular Economy Action Plan's Global Circular Economy Alliance. This also helps towards concretizing projects for third market collaboration. And 3) Increase public awareness and support of the circular economy which can be done by actively promoting circular business models and

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
					for bags as high as 75-77%.	showing their commercial viability. Successful public-private partnerships like CLOMA should be encouraged for other key circular economy issues, to strengthen connections between manufactures and waste managers, and the demand for secondary resources. In the long term, more radical steps such as moving towards taxing resources rather than labor should also be

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
						considered. (Bangert et al., 2020)
Singapore	The recycling rate of Plastic waste increased from 4 per cent in 2020 to 6 per cent in 2021. There was a 60 per cent increase in the amount of Plastic waste recycled with more processed locally and exported. More needs to be done to improve the recycling rate of Plastic waste as it remains low despite the increase.	**Production:** Requires mandatory reporting of packaging use for producers and retailers from 2022 onwards. **Consumption:** No legislation for consumer behaviour yet. **Disposal:** The Zero Waste Masterplan aims to reduce waste sent to landfill by 30% by 2030. **Recycling:** A deposit refund system has been	Singapore has low priority and disparities when compared with the EU on Alignment on production and source reduction standards. It would be very complex to implement in Singapore and it will take time to change the regulatory framework. Singapore is a very competitive economy so it is unlikely that the Government would put a break on the manufacturing sector easily especially for	**General Legislative Framework:** The Resource Sustainability Act outlines three focus waste streams (including packaging) and strategies to increase collection for recycling rates for these streams.	Singapore's success is based a review of the EU framework which provides an expansive set of best practices, highlights potential challenges, and helps identify critical instruments that could help achieve circularity goals. It provides a rich discussion ground for policy forward economies such as Singapore that have made forays into the field of circularity.	A framework to prioritize next steps with respect to Singapore-EU collaboration in prioritizing actions to 4 groups: Quick wins, Long term Engagements, low priority, and Exploration. Quick wins are actions with the ease of adoption which strategies will build trust and create a conducive environment for longer-term engagement. Examples

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		announced to be implemented in 2022 and is currently undergoing industry consultations.	SMEs. Developing Secondary Market strategies is also another gap. While these strategies are much needed, it would be best to strengthen existing frameworks before exploring secondary markets. Singapore would need to identify global sources for recycled feedstock, given the lack of a recycling industry. (Krishnan et al., 2020). Other Challenges in circularities on food packgaing are listed as • Lack of consumer demand		Singapore's policy frameworks are driven by an obvious emphasis on an integrated planning approach as engaging in dynamic urban governance i.e. engaging extensively with the public, industry, and other stakeholders and alignment with its focus on resilience. The Climate Change Action Plan and the more recent Zero Waste Master Plan lay the foundations for increasing circularity in	include Adoption of the Waste Hierarchy, Alignment on Landfill Management Principles, Innovation and Research, Adoption of GPP and strengthening of Eco Labels, and Regulation to phase-out of certain single-use plastic products. Long term engagements are strategies that will lead to high levels of circularity and already have the required framework to

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
			• Scepticism of the recycling system in Singapore • Need for multi-stakeholder collaboration • Closed-loop logistics systems challenging for companies without local production sites • Incongruent policies, regulations and infrastructure internationally • Current focus on short-term profits. (European Chamber of Commerce., 2020)		Singapore. The Zero Waste Master Plan spells out specific targets such as a 30% reduction in waste to landfill by 2035 and a 70% overall recycling rate (81% non-domestic recycling rate and a 30% domestic recycling rate). The key drivers for action in the Zero Waste Master Plan are 1) Pushing boundaries through Research and Infrastructure, 2) Transforming the environmental services industry, and 3) Co-creating solutions	adapt to the Singapore context such as Segregated Waste Disposal and Collection, and Adoption of EPR and DRS System. Low Priorities are strategies that are neither easy to adopt nor likely to have a great impact in terms of circularity for Singapore, given disparities when compared with the EU such as Alignment on production and source reduction standards, Developing Secondary

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
					with the community. The Resource Sustainability Act 2019 provides legislative support to the Zero Waste Master Plan, mandating specific reduction and reporting requirements for e-waste, food waste and packaging waste. The Resource Sustainability Act introduces EPR for e-waste and packaging waste, which is a big step in terms of reorganizing financing and organizing of collection, sorting and recycling of	Market strategies, and Waste to Energy (as it is already well taken care of in Singapore and would be the least preferredoption in terms of developing the Circular Economy). Explorations are strategies that may be harder to adopt/ implement but are likely to have great impact on circularity. They merit careful consideration such as Alignment on a comprehensive circular

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
					waste. (Krishnan et al., 2020)	economy policy with deep focus on plastics, and Local and Regional Recycling Opportunities. (Krishnan et al., 2020)
India	Over a five-year period, the plastic consumption in India has risen at a compounded annual growth rate (CAGR) of 9.7 per cent to 14 MT in the financial year 2016-17 to 20 million tonnes in 2019-20,	**Production:** Plastics producers need to work out modalities for waste collection systems for collecting back the plastic waste within a period	The packaging industry represents the largest sector for plastic use in India, accounting for 59%, present in nearly half of all packaged items. Gaps in 4 issues	**General Legislative Framework:** Plastic Waste Management (PWM Rules), 2016. Collection targets exist and minimum requirements for	India is currently facing a substantial plastic challenge. While its plastic consumption per capita remains low, its production of plastic waste in absolute terms	In India, the implementation of EPR is the primary task that needs to be fulfilled. In addition, flows of plastic from overseas often overburden the

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
	Marico Innovation Foundation said in a report released in the national capital	of six months. No targets set. Maharashtra state requires industrial packaging produced to include at least 20% recycled material. **Consumption:** Waste generators including Institutional generators, are required to segregate plastic waste. **Disposal:** Local bodies are responsible for segregation, collection, storage and disposal. No targets set.	have been identified. 1) Effective and Sustainable Plastic Waste Management Strategies. The lack of a functioning solid waste management system is one of the critical barriers, as only one-quarter of PW is recycled in India. The impact is far more widespread, as improper disposal creates burdens on landfills and poses health-related challenges to waste pickers, who are mostly women. Despite high	EPR schemes do not exist in these rules.	makes it the 15th largest producer of plastic waste in the world. A substantial proportion of this waste is mismanaged with negative consequences on the natural environment and human health. While top-down policies are known to play an essential role in tackling plastic related issues, sustainability transitions literature suggest that bottom-up initiatives conducted by communities and industry can play	whole system, requiring controlled monitoring to identify the flow and quality of waste entering the country. Local councils and states that are located along coastlines require an active role in minimizing the environmental impact and leakage of plastic waste into land and marine ecosystems. The legal aspects of waste should provide a more precise and concise

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		Local bodies are required to encourage use of plastic waste for road construction or energy recovery or waste to oil or co-processing in cement kilns under Plastic Waste Management Rules 2016. **Recycling:** The draft 2019 National Resource Efficiency Policy sets targets for packaging recycling including 100% recycling rate for PET by 2025 and 75% recycling and	collection efficiency, the treatment rate is very low. The capacity building and rendering technology have not been adequately prescribed in rural areas. The development of waste management strategies and maintaining the material market value of recycled materials are critically important. 2) Restructuring Reverse Supply Chain. A feedback mechanism in terms of quality and market requirements for		a central role in driving sustainability transitions, by developing niche initiatives that can enter the mainstream and potentially lead to regime shifts. (Ref) In addition, there is a strong need for Improved Rural Plastic Waste Management as Most parts of rural India have no waste collection mechanism in place and as a result, the waste including plastic waste is either dumped in the outskirts of the villages or burnt	outlook regarding the PW supply chain's role and responsibilities. Particular attention should be given to integrating informal recyclers into formal collection and recycling channels and implementing unique recycling technology for multiplayer plastic polymers. The baseline assessment of mismanaged single-use plastic is crucial, along with regulatory, economic,

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		reuse rate for other plastics by 2030.	recycled plastics from end-user industries could help institutionalize and organize recyclers and plastic processors. For India, the primary resource recovery challenges lie within the area of socio-technical model development, transforming the informal sector to the formal economy, the establishment of material recovery facilities, support structures and institutional framework development for the population		periodically at household level or at the village outskirts. In India where more than 60–70% of its people reside in rural areas, improper rural waste management can pose lot of environmental and health threats. Even in states where there is plastic bag ban in place, plastic bags are still in use. Review of India situation suggest that market mechanisms' are important elements of a circular economy	awareness, and voluntary interventions. Capacity building, infrastructural development (material recovery facilities at the micro-level in the country and the proper collection, segregation, and transportation of discarded plastic material), and financial support (incentives and innovative economic model) for chemical and biological recycling should be the priority of

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
			related to waste picking, and the implementation of a technology-supported knowledge management system for waste management. 3) Source-Specific Waste Recovery. Resource recovery from food packaging, considering PE, PET, PVC, and PP, should be the highest priority. Recycling and waste elimination from multilayer food packaging is one of the main challenges for the Indian PW management system. And 4)		which is noy yet developed in India's policy framework.	governments, especially in rural areas. In addition, upstream material management is critical for resource management and the circular economy, making consumer awareness and the mindset towards acceptability of recycled products equally important.

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
			EPR- and PW-Related Rules. There is a lack of clarity regarding roles, responsibilities, and proper guidelines for producers, importers, and plastic products manufacturers. Furthermore, there is a need for real-time monitoring and clear mapping of the producers and associated state-wise plastic demand and supply, which might provide achievable and accountable EPR targets. (Ref)			

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
European Union	The European plastics industry is tackling challenges on multiple fronts. In packaging, by far its biggest market, it has become a victim of its own success, particularly as the ideal material for single-use applications and people on the move. In building and construction, some infrastructure projects may go on hold as governments divert some funds away from infrastructure projects to defence, although business is being boosted as consumers get help to improve energy efficiency in their houses. In automotive,	**Production:** The "essential requirements of packaging" requires the minimization of packaging volume and weight, design of packaging for reuse or recovery and the encouragement of recycled materials usage in packaging. The EU Commission is also initiating work on new harmonized rules to ensure that by 2030 all plastics packaging placed on the	For EU, to reach a sustainable and circular use of plastics, different stages of the value chain as well as different types of environmental and climate impacts are addressed. A combination of the three pathways: Smart use, Increased circularity, and Renewable material, offers a way forward for the longer term. However, there are gaps in such pathways. 1) Smarter use focuses on production and use to alleviate problems	**General Legislative Framework:** The Packaging and Packaging Waste Directive sets targets for the recovery of packaging waste and covers strategies to be implemented by member states to collect packaging waste.	The European Union's approach to Circular Economy is evident both in the regulatory framework as well as the principles that underlie this regulatory framework. The underlying principles include: (1) Clear prioritization of waste management initiatives as evidenced by the waste hierarchy, which allows for the emphasis on treatments that are higher up on the hierarchy. For e.g. supporting recycling over	Three pathways can lead to a more circular, sustainable plastics system: smarter use, increased circularity and renewable material. Good practice examples for each of these pathways across Europe among business, policymakers and citizens will serve as an inspiration for how to make plastics more sustainable and circular. Most good practice examples found are small scale

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
	component suppliers are suffering because car makers have been cutting production – not as a reaction to reduced demand, but because they cannot obtain the chips they need for their electronics.	EU market can be reused or recycled in a cost-effective manner. **Consumption:** The Single Use Plastics directive bans selected single-use products made of plastic for which alternatives exist by 2021 and implements EPR systems for others. **Disposal:** The EU Landfill Directive aims to phase out landfilling for recyclable material by 2025. **Recycling:**	connected to leakage and toxicity, but it focuses less attention on the impacts on climate change and other negative externalities. 2)Increased circularity aims to integrate the entire value chain to improve the circularity of plastics. However, circular plastic economy initiatives often do not address the expanding levels of consumption or the dependence of plastics on fossil resources. And 3) Renewable material takes up		waste to energy. (2) The setting of measurable targets, which allows each of Member States to develop plans to reach the required target rates such as recycling or recovery and explore the appropriate instruments (Extended Producer Responsibility, 'EPR', packaging fees, etc.) which will allow them to achieve the targets. And (3) Development of focused and customized approaches for each object of	and would need to be scaled up and implemented much more broadly to strengthen the circular plastics economy. At the moment, the pathways are not developing at the same pace. Increased circularity is the most developed, with several relatively large-scale good practice examples. Smarter use is emerging, with a growing number of good practice examples showing

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		The Single-Use Plastics Directive establishes EPR systems, by 2025, which covers the costs of collection, transport, treatment, cleanup of litter and awareness-raising measures for all packaging. The directive mandates: (a)new recycling target for plastic packaging, set at 55% in 2030; (b)Specifically for plastic PET bottles a 25% recycled content target by 2025 and 30%	the fossil lock-in of plastics but does not focus on their use and waste management. Switching to renewable materials would not in itself do much for the leakage problem of plastics. (European Environment Agency, 2020)		circularity, which allows for a more customized effort depending on the material and its circularity potential, for e.g. organic waste, waste, and electrical equipment (Waste Electronic and Electrical Equipment/ e-waste), packaging, single-use plastics. (European Environment Agency, 2020)	potential to be scaled up. Renewable material is the least developed, but many examples show high potential for further development. (European Environment Agency, 2020)

Countries	Trend of plastic industries (consumption/waste)	Progress of CE	Gaps CE compare with global situations	Regulations/Law	Lesson learns for Thai government	Outlook for future
		recycled content target by 2030; (c)Collection target of 77% of single-use plastic drink bottles by 2025 and 90% by 2029 through EPR or through deposit refund schemes				

References

Bangert, H. (2020). Japan's Circularity: A panorama of Japanese Policy, Innovation, Technology and Industry Contributions Towards Achieving the Paris Agreement, EU-Japan Centre for Industrial Cooperation.

European Environment Agency, Plastics, the circular economyand Europe's environment — A priority for action, EEA Report No. 18/2020

EuroCham. (2020). Circular Economy: Closing the loop in electric, food and packaging waste, EuroCham Position paper 2020, Powered by KPMG Singapore.

Hossain R, Islam MT, Shanker R, Khan D, Locock KES, Ghose A, Schandl H, Dhodapkar R, Sahajwalla V. (2022). Plastic Waste Management in India: Challenges, Opportunities, and Roadmap for Circular Economy. Sustainability. 14(8):4425. https://doi.org/10.3390/su14084425

Krishnan, S., and S. V. de Forges. (2020). Circular Ecocomy in Singapore: Policy Brief, GA Circular and Expertise France, Retrieved from https://www.eeas.europa.eu/sites/default/files/_circular_economy_in_singapore_-policy_brief_september_2020_execsum.pdf

Marks, D., Miller, M.A., Vassanadumrongdee, S. (2023). Closing the loop or widening the gap? The unequal politics of Thailand's circular economy in addressing marine plastic pollution, Journal of Cleaner Production 391, 136218.

Talwar, S., S. Thanduparakkal, K. Arora, Z. Niazi, and M. Retamal. (2021). A review of the policy framework for a circular economy for plastics in India. Report Number 2021-5. UTS and Development Alternatives, Australia and India.