APEC Workshop on the Latest Plastic Recycling Technologies and Their Policy Applications

APEC Chemical Dialogue

December 2025

Asia-Pacific
Economic Cooperation

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APEC Workshop on the Latest Plastic Recycling Technologies and Their Policy Applications

Seoul, Republic of Korea

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Workshop Summary Report

I. Introduction

On 4 August 2025**,** the APEC International Workshop on the Latest Plastic Recycling Technologies and Their Policy Applications was successfully held, bringing together policymakers, regulators, industry experts, and researchers from across the Asia-Pacific region. The event was organized under the framework of the APEC Chemical Dialogue (CD), with the support of the APEC Structural Reform and Sustainable Green Growth Sub-Fund (SRSGG).

It was hosted by the Korean Agency for Technology and Standards (KATS) and co-sponsored by Indonesia and Japan.

Through expert presentations, case studies, and interactive discussions, participants gained insights into cutting-edge recycling technologies, best practices in policy design, and successful regional and international cooperation models.

The program emphasized not only the management of plastic waste but also strategies for reducing its generation at the source—promoting sustainable growth, climate resilience, and inclusive development in line with the APEC **Putrajaya Vision 2040** and the **Aotearoa Plan of Action.**

The knowledge and connections gained during this one-day event are expected to extend well beyond the workshop itself, supporting long-term cooperation and capacity building across APEC member economies.

II. Background

Plastic waste has emerged as one of the most pressing environmental challenges facing APEC economies. Each year, more than 300 million tons of plastic waste are generated globally, a significant portion of which persists in the environment and causes far-reaching impacts on ecosystems, economies, and communities. Many developing economies in the APEC region face particular difficulties in addressing this issue, primarily due to a lack of expertise, limited recycling infrastructure, and constrained policy capacity.

In Southeast Asia, these difficulties are especially acute in economies such as Indonesia; the Philippines; and Viet Nam.

For example, the Philippines is estimated to leak approximately 356,371 metric tonnes of plastic waste into the ocean each year, representing a substantial share of the regional total.

Indonesia and Viet Nam are also among the top contributors of mismanaged plastic waste—waste that is not properly collected, sorted, or treated—owing largely to inadequate waste management systems and rapid urbanization. (Source: World Economic Forum; Science Advances)

These conditions are aggravated by the fact that coastal populations in these economies are very concentrated, and many communities are located near waterways that serve as channels for mismanaged plastics to enter marine ecosystems.

For instance, Viet Nam struggles with an import volume of plastic scrap that outpaces its ability to recycle, with only about a third of imported plastic waste being properly processed; the rest ends up in landfills or the environment. (Source: Reuters)

To respond to these challenges, plastic recycling has gained prominence as a key solution. Moving beyond conventional waste management, advanced recycling technologies offer opportunities not only to reduce plastic waste but also to stimulate innovation, enhance resource efficiency, and contribute to the transition from a linear to a circular economy.

However, knowledge gaps and uneven capacities across the region remain obstacles to effective policy development and implementation.

Against this backdrop, the APEC Chemical Dialogue has initiated this project to strengthen the ability of policymakers, regulators, and industry stakeholders to understand, adopt, and integrate the latest recycling technologies into their policy frameworks. By sharing international best practices, presenting case studies, and promoting regulatory cooperation, the workshop seeks to build capacity, reduce

environmental disparities, and foster sustainable green growth across member economies.

In doing so, the initiative directly supports the goals of the Putrajaya Vision 2040 and the Aotearoa Plan of Action, as well as APEC's broader commitment to sustainable and inclusive development

III. Workshop Proceedings

1. Current Status and Global Trends

1.1 Global Situation

Plastic consumption continues to rise at an unprecedented pace. According to OECD projections, by 2060 global plastic usage is expected to triple compared to current levels. Yet, recycling remains severely limited: only about 6% of plastics were recycled in 2019, and even by 2060 this share is projected to reach just 12%. At present, over half of plastic waste is still incinerated or landfilled, while only around 20% is effectively recycled.

This imbalance highlights the urgency of adopting stronger regulations and more effective recycling technologies worldwide.

1.2 Policy Developments in Europe

Over the past decade, the European Union has progressively strengthened its regulatory framework to transition toward a circular and plastic-free economy.

1.2.1 2019 Single-Use Plastics Directive (SUP Directive)

The EU took its first major step with the Directive on Single-Use Plastics, which introduced mandatory recycled plastic content targets. By 2025, PET beverage bottles must contain at least 25% recycled plastic, and by 2030, all plastic beverage bottles must include at least 30% post-consumer recycled (PCR) content. To ensure compliance, the EU adopted standardized methodologies for calculating, verifying, and reporting recycled plastic content, officially enacted in July 2025.

1.2.2 2020–2022 France's National Phase-Out Plan

France's **Loi anti-gaspillage pour une économie circulaire** (2020) focuses on the elimination of single-use plastics, implementation of consumer awareness programs with clear labeling systems, waste prevention through collaborative reuse systems, combating planned obsolescence via durability standards and right-to-repair, and the expansion of eco-friendly production across industries.

France's **Single-Use Plastic Phase-Out Plan** (implemented from 1 January 2022) aims for a 20% reduction in single-use plastic packaging by 2025 and a 100% reduction in non-essential packaging, requiring recyclable materials, prohibition of free plastic bottles in public and events, and installation recycling bins in supermarkets.

1.2.3 2024 EU Packaging and Packaging Waste Regulation (PPWR)

The EU **Packaging and Packaging Waste Regulation** (PPWR), adopted in 2024, requires that by 2030 all packaging sold in the EU must be recyclable and contain 10–35% post-consumer recycled (PCR) content, increasing to 25–65% by 2040. By 2030, PET packaging must include 30%, non-PET packaging 10%, and single-use plastic beverage bottles 30–35% recycled content; by 2040, these rise to 50%, 25%, and 65%, respectively.

1.3 Technological Innovation: PET Recycling in Korea

While Europe advances through regulatory measures, Korea provides a strong example of technology-driven recycling innovation.

The company named SuperBin has developed the Nephron system, a smart reverse-vending machine network that incentivizes consumers to return PET bottles and other recyclables. These systems use AI recognition algorithms trained on more than 200 million images of waste, ensuring accurate sorting and improving collection efficiency.

SuperBin's model demonstrates how digitalization and automation can create new markets for circular resources. Recyclables collected through Nephron machines are processed to meet market quality standards and re-introduced into manufacturing. Importantly, physical PET recycling has been shown to significantly reduce greenhouse gas emissions compared to both incineration with energy recovery and chemical recycling. For instance, physical recycling reduces CO_2 emissions by up to 2.4 tons per ton of PET compared to baseline incineration methods

1.4 Emerging Global Trends

Taken together, these cases illustrate two key global trends.

First, policy frameworks are tightening: economies are introducing mandatory recycled content, phasing out single-use plastics, and harmonizing standards to accelerate the circular transition.

Second, technological innovation is expanding: smart collection systems, AI-based sorting, and advanced recycling processes are proving essential for bridging the gap between policy ambition and practical implementation.

The combination of regulatory enforcement in Europe and technological innovation in Korea offers valuable insights for APEC economies. They highlight how both top-down and bottom-up approaches can complement each other in advancing towards a sustainable, circular plastics economy.

2. Technological innovations in plastic recycling

Technological innovation plays a central role in enabling the transition toward a circular plastic economy. The presentation highlighted both the market and policy drivers as well as the key recycling technologies under development and commercialization.

2.1 Global Trends and Regulatory Drivers

Global plastic production reached 460 million tons in 2019 and is projected to rise to 1.2 billion tons by 2060, although recycling rates remain 9 %, the recycling market continues to grow at a CAGR of 7.4% in global and 6.9% in Korea.

Growing consumer awareness, ESG requirements, and government regulations are driving demand for recycled materials. Markets for recycled plastics increasingly show a “green premium,” reflecting their added value under sustainability and compliance frameworks

2.2 Core Recycling Technologies

2.2.1 Sorting Technologies

Advanced sorting is foundational to all recycling processes. Methods such as optical sorting (near-infrared (NIR) sensors, X-ray etc.), crushed product sorting (by specific gravity, electrostatic) and AI/robot-assisted sorting improve material recovery rates and reduce contamination. Emerging traceability systems, such as fluorescent markers and vision-based recognition, further enhance accuracy and lifecycle tracking.

2.2.2 Mechanical (Physical) Recycling

The most widely used approach, mechanical recycling transforms collected plastics into pellets for reuse. It offers low costs, reduced CO_2 emissions, and energy savings. However, it suffers from down cycling—the recycled materials often have lower performance and limited applications. Lotte Chemical’s projects include PCR-PP and PCR-HDPE products.

2.2.3 Solvent-Based Recycling

This process dissolves plastics using selective solvents to recover high-purity polymers. It is particularly effective for multilayer films and composite plastics that are difficult to recycle mechanically. Although there remain issues of additive residues and single stream processing, it produces polymers close to virgin quality and expands potential applications.

2.2.4 Chemical Recycling

- **Pyrolysis**: Converts mixed plastics into pyrolysis oil and remove chlorine contents which can replace naphtha in petrochemical production. R&D aims in Pyrolysis section is to convert batch process to Continuous,

improve yield rate (>85%) and reduce impurities.

- **Gasification:** Plastic waste reacts with a gasifying agent such as steam, oxygen, or air at temperatures above 1,300 °C, producing synthesis gas (syngas) composed mainly of CO and H_2. The resulting syngas can be further converted into hydrogen, ammonia, or methanol through purification and catalytic synthesis processes.
- **Depolymerization**: Breaks polymers down into monomers such as BHET, DMT, or TPA, enabling upcycling into virgin-quality plastics. This method is gaining traction in textiles(clothes) and packaging sectors (PET).

2.3 Standardization and Certification Needs

For these technologies to be successfully scaled and trusted in global markets, standardization and certification frameworks are essential. Recycled materials must consistently meet quality benchmarks—such as purity, safety, and performance standards—to be widely adopted by manufacturers. Certification systems also help build consumer confidence, prevent greenwashing, and ensure compliance with international trade and regulatory requirements. In the context of APEC, harmonized standards and mutual recognition of certification schemes could facilitate cross-border trade of recycled materials, reduce technical barriers, and accelerate the shift toward a regional circular plastics economy.

3. Regional Challenges in Southeast Asia

3.1 Indonesia

Indonesia generates approximately 5.5 million tons of plastic waste annually, of which only 19% is collected for recycling. PET recycling is relatively successful (54%), but multilayer plastics remain almost unrecyclable (0.2%). The informal sector plays a vital role in collection, yet infrastructure gaps lead to up to 48% of losses during sorting and transport resulting in 76 % of recycling rates comes from Java region while rest of the regions (Sumatera, Bali, Nusa Tenggara, Kalimantan etc.). takes 24 % of recycling rates only. The government has committed to reducing marine plastic debris by 70% by 2025, but challenges include reliance on imported virgin and scrap plastics and limited decentralized recycling facilities.

3.2 Viet Nam

Viet Nam generates 3.8–3.9 million tons of plastic waste annually, with only about 33% recycled, while plastic accounts for over 90% of marine pollution, threatening ecosystems and public health. The packaging sector dominates plastic production, but most products are of low added value, made by small and medium enterprises with limited technology and capital.

Despite joining international conventions like the Basel Convention and implementing domestic policies such as Resolution No. 36-NQ/TW (2018) and the

Environmental Protection Law 2020, coordination among ministries remains fragmented.

The introduction of Extended Producer Responsibility (EPR) and Initiative like National Plastic Action Partnership (NPAP) aims to strengthen waste management and promote recycling, source segregation, and community awareness but overlapping regulations, limited collection infrastructure and household-level sorting, high recycling costs hinder its effectiveness.

3.3 The Philippines

The Philippines produces about 61,000 metric tons of solid waste daily, with 12–24% consisting of plastics, including 163 million sachets, 48 million shopping bags, and 45 million thin-film bags used every day.

Mismanaged waste leads to severe marine pollution, flooding, and public health risks from open burning and toxic exposure.

The Ecological Solid Waste Management Act of 2000 (RA 9003) established a framework for segregation, recycling, and prohibiting non-environmentally acceptable packaging.

In 2022, the Extended Producer Responsibility (EPR) Act (RA 11898) was enacted, holding producers accountable for post-consumer waste.

Programs like the National Ecolabeling Program – Green Choice Philippines and Green Procurement Program encourage sustainable products and clean manufacturing.

Research initiatives include plastic-to-asphalt road projects and pyrolysis technologies for industrial waste recovery.

However, challenges remain in EPR implementation, infrastructure investment, and informal sector inclusion.

The government highlights the need for regional cooperation, innovation, and circular economy strategies to effectively address plastic pollution.

3.4 Conclusion: Opportunities for APEC Cooperation

Across Southeast Asia, plastic waste challenges differ in scale and context, but they share common needs for stronger infrastructure, harmonized policies, and inclusive stakeholder engagement.

Indonesia can benefit from APEC support by aligning policy and regulatory frameworks, enhancing technology and infrastructure for collection and recycling, and promoting innovation and investment to reduce marine debris and improve

circular plastic systems. APEC collaboration can also help build testing and certification centers and strengthen partnerships with the informal sector to close infrastructure gaps outside Java.

Viet Nam can benefit from APEC's support in capacity building for Extended Producer Responsibility (EPR), and in developing traceable plastic waste mapping systems that connect informal collectors.

APEC collaboration could also help strengthen landfill management, promote gender equality and social inclusion (GESI) in waste policies, and support innovation for eco-friendly, recyclable products.

The Philippines could work with APEC to enhance waste management infrastructure and support informal sector participation, building a more inclusive circular economy. Through APEC cooperation, the economy can advance EPR harmonization and capacity building to improve policy implementation and compliance. APEC can also assist in creating innovation platforms and regional frameworks that foster investment in recyclable materials and green industries.

4. Stakeholder discussion and policy recommendations

4.1 Impressions from Stakeholders

Stakeholders expressed that the workshop provided a valuable platform for exchanging diverse perspectives from governments, academia, and industry. This exchange enabled participants to identify both effective measures and persistent challenges in addressing plastic waste. The sharing of experiences with Extended Producer Responsibility (EPR) schemes was considered especially useful, as it revealed which policy models had proven effective and which encountered limitations.

Participants also emphasized the importance of harmonized data collection and reporting, as inconsistent approaches across economies hinder effective cooperation. Finally, many noted that education and cultural change are indispensable for achieving long-term progress in recycling and waste reduction, and that the workshop was motivating by providing opportunities for learning and encouragement across economies.

4.2 Key Challenges Identified

Participants identified several critical challenges that continue to impede progress on plastic recycling in the APEC region.

- Collection and Sorting: Inefficiencies in the collection and sorting of plastic waste remain central obstacles to effective recycling.
- Difficult-to-Recycle Materials: Flexible plastics and multi-layer products present significant technical difficulties.

- Data Inconsistencies: The absence of common methodologies for data collection and reporting across economies prevents accurate monitoring and evaluation.
- Single-Use Plastics: The continued prevalence of disposable plastics adds to the strain on waste management systems.
- Limited Public Engagement: Citizens' participation in recycling remains insufficient, often due to low awareness and weak incentive structures.

4.3 Policy Recommendations

Based on these challenges, stakeholders recommended several policy actions for consideration at the APEC level.

First, they stressed the need to establish and maintain a regional data-sharing platform, supported by sustainable funding, to facilitate the exchange of information on waste generation and recycling. They further recommended strengthening EPR implementation across economies, coupled with stricter regulatory frameworks and, where necessary, the introduction of new policy schemes.

The development of common standards for data collection and reporting was seen as essential to improving comparability across economies.

In addition, education and awareness campaigns were emphasized as tools to drive cultural change and reduce plastic consumption. Finally, participants underlined the importance of public–private collaboration to enhance the effectiveness of recycling systems.

4.4 Technical Support and Practical Measures

Stakeholders also proposed practical measures to complement policy actions. They suggested that APEC support data management and harmonization initiatives across member economies. The sharing of successful case studies, such as innovative collection systems implemented in Korea and Chinese Taipei, was identified as a way to encourage replication of proven models. The role of artificial intelligence (AI) was highlighted both in data collection and in enhancing public education.

Participants also called for the introduction of incentive mechanisms, including plastic taxes and reward systems, to encourage participation from both consumers and producers. Finally, the development of certification schemes that could be mutually recognized across APEC economies was proposed as a way to build trust and facilitate regional trade in recycled products.

4.5 Overall Recommendations

The group discussions concluded that harmonized data systems, strengthened EPR policies, and sustained educational initiatives are essential foundations for advancing

plastic recycling in the region. Stakeholders agreed that APEC should play a leading role in establishing regional platforms, fostering policy alignment, and promoting the exchange of best practices to reduce plastic waste and build more sustainable circular economies.

IV Conclusion Towards Stronger Regional Cooperation in Plastic Recycling

In terms of quantitative performance indicators, the workshop exceeded expectations in several areas. The number of participants reached 35, surpassing the initial target of 30, and the number of invited speakers and experts met the planned goal of six. Active engagement was also observed during the Q&A sessions, with more than two participants contributing to each discussion. However, gender balance among both participants and speakers fell short of the target ratio of 50:50, with actual distributions of 70:30 and 5:1 respectively.

To improve inclusiveness in future projects, the Project Overseer will implement measures such as strengthening efforts to identify and invite female experts through dedicated APEC/regional networks and ensuring a minimum of 40% representation in the planning phase of the next workshop.

With regard to qualitative outcomes, four dimensions were assessed: participants' awareness, capacity building, commitment to implementation, and expansion of collaboration.

Survey results indicated that all participants (100 percent) reported an increased awareness of the urgency of plastic recycling and waste management. Self-assessments of knowledge and skills improved from an average of 2.67 prior to the workshop to 3.83 afterwards, demonstrating measurable capacity gains.

Some participants expressed their intention to share the outcomes of the workshop with domestic industry associations and regulatory authorities and to integrate the lessons learned into policy development, such as consumer product refill guidelines. Furthermore, participants emphasized the need for an APEC-level data-sharing and collection platform, the continuation of follow-up workshops and the new forms of technical exchange, underscoring the importance of strengthening collaboration across economies.

In open-ended responses, participants suggested further improvements including the application of artificial intelligence, enhanced data management and standardization, and opportunities for onsite visits to recycling facilities. These recommendations provide practical insights for the design and implementation of future APEC projects.