



**Asia-Pacific
Economic Cooperation**

Advancing Free Trade
for Asia-Pacific **Prosperity**

Good Practices for Traceability Mechanism of Marine Debris Recycled Products in the APEC Region

APEC Oceans and Fisheries Working Group

August 2023



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Executive Summary

Marine debris has been a hazard to our marine ecosystem and livelihood for a long time. Many Asia-Pacific Economic Cooperation (APEC) member economies have been aggressively investigating and researching this challenge in recent years. One of the key disposal approaches is to collect marine debris and convert plastic wastes into recycled products to promote recycling and reuse with matched traceability certification marks to verify the sources of marine debris.

In order to promote the cooperation between local enterprises, NGOs, government officials, and agencies of APEC, on 24 March 2023, a one-day hybrid workshop was commenced in Chinese Taipei with the participation of experts and participants from 13 APEC economies, including Canada; Chile; Indonesia; Japan; Republic of Korea; Malaysia; New Zealand; Peru; the Philippines; Chinese Taipei; Thailand; United States of America; and Viet Nam, onsite or through online meeting. 38.77% out of the total 147 participants were female to meet the gender equality requirement. Participants from 6 member economies that are eligible for travel participated in this event and actively interacted with other APEC members, exchanging professional experiences with APEC members to address the complete circular supply chain and the vision of sustainable development of marine resources.

In the meantime, this project conducted an online survey through APEC Oceans and Fisheries Working Group (OFWG) with the assistance from APEC Secretariat on 21 February 2023 to collect policies and practices in APEC member economies regarding marine debris management. This survey was completed on 31 March 2023, and received 12 valid questionnaires, with a response ratio of 57.14%. Malaysia and the United States of America have made relevant regulations and action plans on marine debris management. Peru and Chinese Taipei are actively engaged in recycling derelict fishing nets through project plans. Every year Japan held training on waste management for economies in Asia and Pacific areas through the affiliation of Ministry of the Environment, Government of Japan (MOEJ) to facilitate technology cooperation and capacity building.

After the discussions on the three session topics and analysis of

questionnaire data by experts from industry, government, academia, and research units of APEC member economies, the results revealed that both public and private sectors have acted aggressively to address issues on marine ecology. It is clear that the stakeholders' cooperation is critical as the involvement from upstream and downstream industries and experts and scholars of different domains were required for the establishment of a marine debris recycling system, the monitoring and analysis of marine debris, the reusing of recycled marine waste, and the promotions for traceability mechanisms or certification. This project made the following recommendations on the policies from three aspects:

1. Capacity building

- A. The establishment of traceability mechanism for marine debris requires the collaboration of multiple stakeholders, and should start from the trainings at the user end on how to classify and clean marine debris correctly in order meet the basic standards of back-end industries for marine waste materials.
- B. Educations and training, or forum sharing, as well as demonstration site observations for the industry, government, academia, and research units are important for the enterprises in order to have continuous knowledge updates, thus providing them with more options for the source of marine waste materials to develop more recycled products, and to promote a traceability mechanism for marine debris or certification marks, and enhance the capacity building of all parties.
- C. Annual cross-economy Ocean Day or environment-relevant campaign day is held to collectively foster borderless economic benefits from marine debris recycling and the reuse of marine waste, and boost the multichannel promotion of marine waste recycling products.
- D. A cross-economy joint project should be established to set up examples for the cooperation in marine debris recycling and solutions in order to promote marine waste products that are co-branded by multiple economies, the traceability mechanisms of marine debris or the development of certification marks.

2. Research and innovation.

A marine debris recycling consultation committee should be established for APEC economies based on the existing marine debris recycling systems constructed by these economies. These exchanges could facilitate the optimization and innovation of their recycling models and standards. These efforts are expected to promote technological advancements among the member economies of APEC in terms of their marine debris recycling, reuse, tracing, and monitoring activities.

3. Private sector engagement

The APEC OFWG should communicate the idea of marine debris reuse by showcasing their achievements in this field and making their contact information available on various media platforms. This could create cross-economy business opportunities and facilitate visits at prestigious businesses or institutions, which in turn would offer opportunities for exchanges between projects, ultimately boosting economic growth in member economies.

Acknowledgement

We are grateful to all of those with whom we have had the pleasure to work during this project. The members of the OFWG forum have nominated the speakers and active participants and invited by the project to guidance and share their knowledge in the Workshop.

Chapter 1 Research Report

1. Background

The November 2011 report of the Scientific and Technical Advisory Panel (STAP), United Nations (UN) highlighted the presence of marine debris, including artificial waste, in coastal areas, river mouths, as well as the surface and bottom of the sea. Marine debris is largely composed of plastics, which could be detrimental to the health of both wildlife and humans and damage the aesthetic appeal of the sea.

In 2011, APEC merged the Marine Resource Conservation and Fisheries Working Groups into the APEC OFWG to address issues of sustainable economic growth, development, and prosperity of the Asia-Pacific region. The APEC OFWG is committed to promoting trade and investment opportunities in fishing and aquaculture industries and developing sustainable marine ecosystems. Moreover, the group places emphasis on collaboration between public and private sectors and the prevention of illegal, unreported, and unregulated fishing.

At the 2014 APEC Ocean-related Ministerial Meeting in Xiamen, China, the Xiamen Declaration was adopted, which emphasizes the need for more comprehensive, sustainable, inclusive, and reciprocal partnerships and encourages collaborations in order to achieve the goal of reduction of land-based and marine pollution. In line with the declaration, the OFWG collaborated with the Virtual Working Group on Marine Debris and established a plan for controlling marine debris. In 2018, Republic of Korea proposed the Workshop's Recommendation for a Draft on APEC Marine Debris Management Guideline, which provides a framework for the APEC Roadmap on Marine Debris published in 2019 and serves as the basis for the APEC's promotion of marine debris management. APEC's efforts along with other related forums and platforms have fostered multilateral collaborations among industrial, governmental, academic, and research bodies and encouraged private businesses to focus on recycling and reusing marine debris, which can help create circular economies, thereby reducing the threat of marine debris to marine life and ecosystems. Many APEC member economies have initiated or announced action plans for

marine debris management, Chinese Taipei being one of these economies. Chinese Taipei collaborated with environmental groups to establish a marine debris management platform in July 2017. The first and second versions of its action plan were published in February 2018 and August 2019, respectively. The action plan was implemented from 2018 to 2022.

In recent years, APEC member economies have made major contributions, based on scientific evidence and experience from their regional efforts, to understand the impact of marine debris on the ocean and the cost of managing it. The management and preventive measures established by the APEC member economies to address marine debris help promote sustainable economic growth in the Asia-Pacific region. The APEC Group on Services' policy briefing in 2022 defined the four types of waste cleaning services that APEC member economies can undertake to address the issue of marine debris, namely cleaning of beaches, cleaning of rivers, cleaning of coastal waters, and cleaning of open waters. The removal of plastic marine debris is challenging because it involves the highest cost, with the expenses paid by governments and nonprofit organizations, and is still in the experimental stage. This policy briefing provided some suggestions for engaging the private sector in addressing marine debris, including ensuring the availability of local waste management systems and infrastructure for marine debris cleaning, reducing trade and investment barriers, and promoting expert exchange among different economies.

The purpose of this study was to collect data on the marine debris management policies and measures of APEC economies as well as their feedback on the best practices for managing and recycling marine debris within their jurisdictions.

2. Methods

This study involved a qualitative investigation through a questionnaire survey, which assesses three aspects of marine debris management. The first aspect is related to the APEC economies' marine debris management policies, regulations, plans, and initiatives. The second aspect encompasses their action plans for reducing marine pollution. The third aspect addresses joint efforts aimed at reducing the amount of land waste

entering the ocean, including marine debris recycling, product traceability projects, circular economy establishment, capacity building, research, innovation, and private sector engagement.

3. Results

3.1 Ongoing or implementation action area on the management of marine debris to reduce marine pollution

3.1.1 Developing recycling marine debris scheme

This part of the survey was completed by eight APEC economies, namely Canada; Chile; China; Thailand; Peru; Chinese Taipei; Malaysia; and the United States. All of these economies had developed their marine debris recycling strategies through various models such as designating temporary marine debris storage areas and managing product lifecycles.

A. Canada

The Fishing Gear Coalition of Atlantic Canada (FGCAC), funded by Ghost Gear Fund, developed the End-of-Life Fishing Gear Management Project in 2022 to coordinate the fishing gear collection and recycling systems of the fishing sector in Nova Scotia.

B. China

The Department of Ecology and Environment of Zhejiang Province proposed the “blue cycle” model, which aims to collect marine plastics; reduce the volume of waste; store and transport waste; achieve high-value-added utilization of products throughout their lifecycles; and ensure the traceability, certification, and closed-loop supervision of products through the collection of marine debris, land recycling, and value addition to carbon trading activities.

C. Thailand

A circular economy approach was proposed through the collaboration of the Save Andaman Network and the International Union for Conservation of Nature (IUCN),

which was based on Thailand's existing plastic management model, to manage marine debris in Libong, an island in southern Thailand.

D. Chinese Taipei

This economy implemented the extended producer responsibility system in 1988 and the 4-in-1 recycling program in 1997. These initiatives aimed to promote recycling among the public by integrating the public community, recycling enterprises, local authorities, and recycling funds. Since 2020, Chinese Taipei has been promoting its policy of paying tribute to the ocean, which aims to effectively remove marine debris by using the expertise in recycling and reusing waste. In addition, the Fisheries Agency offers coaching services and has established temporary storage areas for marine debris collected by environmental fleets and divers. The marine cleaned by the environmental fleets and divers is then passed to the Marine Debris Recycling Coalition for recycling and reuse. Thus, private sector engagement is crucial for Chinese Taipei to achieve resource sustainability.

E. United States

The United States has established and implemented recycling standards and guidelines at the local and municipal levels. In 2023, new recycling strategies are expected to be implemented to create a more robust, flexible, and cost-efficient solid waste recycling system for US cities.

F. Malaysia

Malaysia plans to establish a recycling promotion system and related infrastructure in 2023 to engage stakeholders in the recycling value chain (e.g., deposit refund schemes, curbside collection, and reverse vending machines), thereby increasing the recycling efficiency.

3.1.2 Recycling marine debris technologies development

This part of the survey, which addresses the implementation or launch of technology development projects for marine debris recycling and reuse, was completed by seven APEC economies, namely Canada; China; Peru; Chinese Taipei; Thailand; Malaysia; and the United States.

Different types of marine debris exhibit different material compositions after being preprocessed, which may affect their recycling and reuse potential. Canada; Thailand; China; and Chinese Taipei are actively involved in the technological development of marine debris recycling and reuse, especially for fishing nets and plastics, with the aim to turn marine debris into valuable products.

A. Canada

Canada established its recycling facility in 2020, which was based on the Ghost Gear Fund's effective model of recycling fishing gear that are scrapped, abandoned, lost, or otherwise discarded. The facility recycles plastics into plastic particles, which are then used as materials for the production of secondary products.

B. China

Shenzhen Ocean Guard Environmental Protection Technology Co., Ltd. is a manufacturer and developer of automatic collectors for large plastic marine debris and owns several patents related to this field.

C. Chinese Taipei

With an effort to establish a circular economy for marine debris, for years, the Plastics Industry Development Center has helped businesses establish their marine debris recycling systems, modify recycled marine debris, and produce merchandise from marine debris. Their goal is to engage related industries in managing marine debris and create an industry chain for marine debris, including

fishing nets, buoy balls, and oyster shells. The recycled debris is then be used to manufacture products such as particulate plastic materials, sunglass frames, and fabrics.

D. Peru has developed unconventional technologies for recycling and reusing marine debris, for example, the use of Calcium carbonate (CaCO_3) from Scallop's shells and Shrimp's shells chitin in wastewater treatment.

E. Malaysia

Based on its marine debris policies and action plans, Malaysia plans to establish a dedicated facility for recycling and treating plastics and resins. In addition, in 2024, a grant will be provided to fund research on noncombustion treatment/disposal technologies for polluted or non recyclable plastics.

F. United States

To expand the market for recycling technologies and products made from recycled materials, the United States plans to introduce the Recycling Strategy in 2023 for supporting technological and product development.

3.1.3 Stakeholder awareness building and education training related to marine debris management and recycling of marine debris

This part of the survey was completed by 11 APEC economies, namely Canada; Chile; Japan; China; Hong Kong, China; Mexico; Peru; Chinese Taipei; Thailand; Malaysia; and the United States. These economies primarily focus on enhancing their marine debris management capacity. Specifically, to promote recycling and reuse of marine debris, they are developing systems recycling and reusing marine debris and raising awareness related to relevant topics among stakeholders through relevant training.

This study established four dimensions of marine debris management capacity, namely the capacity to (1) organize regular marine or environmental protection events, (2)

implement pilot projects and collaborate with communities or regional partners, (3) conduct consultation committee meetings or workshops, and (4) incorporate marine and environmental topics into the formal or informal education systems.

(1) Holding regular marine or environmental protection events

All the economies hold regular marine or environmental protection events on specific dates every year, such as the World Environment Day on June 5, the World Ocean Day on June 8, and the International Coastal Clean Up Day on the third Saturday of September. During these events, the economies engage nonprofit organizations, educational institutions, volunteer groups, and both the public or private sectors to raise the awareness about environmental issues and promote environmental education. These events are also conducive to forming partnerships between the public and private sectors.

A. Chile

Chile has been actively involved in the cross-economy Beach Cleaning Day events. It has completed nine beach cleanups and one seabed cleanup; a total of 29 tons of waste has been collected in these events. Moreover, Chile has installed signs along its coast that promote environmental protection and has conducted three lectures to raise environmental awareness.

B. China

To enhance the education on marine debris control, the government organizes events every year on the World Environment Day and World Ocean Day. In addition, it provides support to environmental organizations to organize various educational events.

C. Chinese Taipei

On 8 June 2020, Chinese Taipei held the first Ocean Day celebration in Kaohsiung City and published its Ocean

Policy White Paper. This white paper reveals the Chinese Taipei government's plan to actively work toward six policy goals, including developing regional strategies and protecting its sovereignty and rights over the waters, within the following five years. Many of the policy actions have been fruitful. The 21 strategies developed by the government with the 14 Ministry of the Interior departments ensure alignment with cross-economy developments as well as joint efforts toward common goals among various bodies. Such collaborations between the public and government are expected to help Chinese Taipei become a marine economy with sustainable ecology, safe waters, and prosperous industries.

D. Thailand

Thailand has organized coastal cleanup events to raise awareness regarding marine issues among schools, local communities, and private sectors.

(2) Implementing pilot projects and collaborating with communities or regional partners

Some APEC economies are implementing pilot projects and collaborating with communities or regional partners to enhance local citizens' awareness of environmental protection and improve marine debris management. These economies include Japan; China; Hong Kong, China; Mexico; Peru; Chinese Taipei; Thailand; Malaysia; the United States; and Japan. According to the marine debris management guidelines it established in 2020, the Japanese government launched a pilot project in 2020 aimed at recycling used fishing gear. Moreover, in collaboration with local governments/communities, Japan has also encouraged fishers to collect marine debris.

A. Mexico

Through regional participation, Mexico actively promotes communication on, encourages a citizen culture of, and launches environmental and educational campaigns on the appropriate management of solid waste, particularly emphasizing the prevention of waste from entering the ocean, source sorting, and recycling. Mexico aims to facilitate training, knowledge sharing, and exchanges on the prevention, reduction, and control of marine debris and best management practices.

B. China

With the joint support of the government and Qingbang Island (Zhejiang), China has implemented a zero waste project on the island and has started a campaign called “fishing waste does not fall into the sea,” which urges fishers to bring all their waste back to the mainland. This pilot project has been supported by 12 ships.

C. Hong Kong, China

Hong Kong, China has introduced the Good Aquaculture Practice to enhance fish farmers’ mariculture management measures. This initiative aims to reduce the risk of disease and death as well as reduce aquaculture-induced environmental pollution.

D. Peru

Peru has launched the Perú Limpio movement to encourage and guide people to reduce their use of plastics and clean up beaches. Another initiative is Redcicla, which involves collecting and recycling monofilament fishing nets from communities in northern Peru, including Los Organos, Mancora, and San Jose. Basura Cero is another initiative launched by World Wildlife Fund for Nature Peru with the support of the United States Agency for International Development’s Clean Cities, Blue Ocean program. This initiative aims

to enhance the management of inorganic waste generated from artisanal fishing in northern Peru.

E. Chinese Taipei

Chinese Taipei implemented the “Salute to the Ocean Program” program in 2020, which included a recycling and reuse pilot project for polystyrene on offshore islands and waste fishing nets (oyster farming ropes). This project has been commissioned to be implemented by local governments. The number of counties/cities participating in this pilot project increased from 6 in 2020 to 12 in 2022. Chinese Taipei assists these 12 counties and cities by providing training and support related to technical (e.g., offering technical consultation services related to the handling of waste fishing nets and gear and providing related training or demonstration sessions) and marketing (e.g., facilitating the trading of waste fishing nets between upstream and downstream businesses) aspects. Moreover, these 12 participating counties and cities voluntarily receive feedback from their respective governments, which helps them in acquiring fundamental knowledge of the reuse and circulation of marine debris.

F. Thailand

The Thai government has partnered with hotels and the tourism industry to launch an initiative in which marine debris from coastal communities in the Talamu subdistrict, Phang Nga are collected. The Department of Marine and Coastal Resources has collaborated with PTT Global Chemical to reduce plastic waste in fishing villages in Nakhon Si Thammarat.

G. United States

The US National Oceanic and Atmospheric Administration (NOAA) provides funding to the civic society, private sector, academia, and other groups to

support their initiatives on marine debris prevention and/or removal within the US territory. This effort aimed to engage local communities and increase their awareness of the importance of reducing waste and marine debris while promoting sustainable behaviors. The administration funds a waste fishing gear recycling partnership project called the North American Net Collection Initiative. The purpose of partnering with industries, the civic society, and the US government is to collect, process, and recycle used fishing nets to be used as materials for the production of consumer products.

(3) Conducting consultation committee meetings or workshops

Some economies, including Canada and Malaysia, have organized consultation committee meetings and workshops to deliberate on measures for developing or improving their ghost fishing gear initiatives, thereby minimizing the ecological impact of ghost fishing gear.

A. Canada

Canada has developed and implemented ghost fishing gear recycling and reuse technologies and ensured that regional ghost fishing gear coordinators participate in stakeholder consultation committee meetings in which the basic concepts of ghost equipment, the Canadian Ghost Gear Program, threats posed by ghost fishing gear to the environment, and related funding are discussed. The goal of these meetings is to increase the public awareness of the problem of abandoned, lost, or otherwise discarded fishing gear (ALDFG) and prompt the Canadian government to take action in addressing this issue.

B. Malaysia

Malaysia participated in The Regional Ghost Gear

Workshop held in Bangkok, Thailand, in March 2023. A coorganizer of this event, the Coordinating Body on the Seas of East Asia, is part of a regional government-to-government program and 18 regional marine conventions and action plans worldwide. This program is governed directly by the United Nations Environment Programme (UNEP) and covers topics such as the search, identification, and tracking of ALDFG and fishing activities, monitoring of lost fishing gear, and innovation in waste management.

(4) Incorporating marine and environmental topics into the formal or informal education system

The collected survey data reveal that Mexico and Malaysia are planning to include marine environment courses in their formal or informal education system to improve young people's understanding of environmental ethics and promote ecofriendly practices.

A. Mexico

Mexico has incorporated environmental and marine topics into courses in its formal and informal education systems (e.g., public schools and private education centers). These courses focus on the management of land waste to prevent it from entering the ocean.

B. Malaysia

On the basis of its marine debris policies and action plans, Malaysia plans to include topics and activities related to marine debris in textbooks and extracurricular activities by 2027. The topics include improper waste management, marine debris and microplastics, beach cleanups, littering, recycling, and circular economies.

3.1.4 Certification mark on marine recycled products for visibility and consumer traceability

This part of the survey was completed by six economies, namely Australia; China; Malaysia; Chinese Taipei; Thailand; and the United States. Chinese Taipei launched the Recycled Marine Debris Product Label in May 2021 and has granted this label to 13 and 5 products in 2021 and 2022, respectively. More information on the measures taken by Chinese Taipei is provided in subsection 3.2.1.

Both businesses and nonprofit organizations actively promote the use of recycling labels on consumer products. In addition, they may also include a quick response code on the products that leads consumers to educational content about the environmental impact of marine debris. These measures can help increase the awareness about recycling and reuse among the public and ultimately lead to a reduction in marine debris. These practices are observed in Thailand and China. Qualy Design Space is a famous Thai company that works in collaboration with nonprofit organizations to collect fishing nets from the fishing sector and turn them into new products, which are labeled with the content and source of recycled plastics. More information on Thailand's practices is provided in subsection 3.2.2. The Blue Alliance in China is an cross-economy trading center for marine plastics formed by marine debris recyclers, environmental organizations of the UN, certification bodies, and businesses. In Taizhou, Zhejiang, recycled plastic marine debris has been reprocessed into high-value-added plastic materials for use in the manufacturing of phone cases, storage baskets, trash cans, and stationery. A platform that integrates the Internet of Things, block chain, and big data technologies is used to manage the collection, reprocessing, and remanufacturing of these products. Cameras are installed for monitoring purposes, and the end products are encoded to ensure their traceability.

Australia currently does not use traceable labels for products manufactured from recycled marine debris; however, it

is working on developing a brand and labeling program called ReMade in Australia for verified Australian made recycled content products. The purpose of this program is to help consumers identify and purchase products made from recycled materials. Although the United States does not have an economy-level recycled product certification, some consumer brands in the economy are using recycled materials in their products. Malaysia plans to launch an open traceability program for packaging and other forms of solid waste in 2024.

3.1.5 Other industry-led traceability solutions to recycling marine debris for visibility

This part of the survey was completed by Chile; China; Chinese Taipei; and Thailand. Identifying the root cause of marine debris is crucial in addressing the problem, and both governmental and nongovernmental bodies play a critical role in the problem-solving process. For example, Sonapesca, a Chilean organization, has signed the Clean Production Agreement and has been actively working toward achieving the zero waste goal for fishing boats and improving the reuse and recycling of plastics, thereby reducing their impact on the ocean and the human food chain. In China, six provinces, namely Liaoning, Tianjin, Hebei, Shandong, Fujian, and Hainan, have established their own marine hygiene standard procedures for marine debris disposal; these include improving related infrastructure and implementing real-time cleaning and monitoring of marine debris. Various governments and authorities in coastal cities and counties, such as Shantou in Guangdong, Zhoushan in Zhejiang, and Shanghai, have been actively working to facilitate the quick removal of beach debris after typhoons.

3.2 Sharing best practices in recycling of marine debris

Based on the survey data and the content shared by speakers in the

Workshop on Good Practices for Traceability Mechanism of Marine Debris Recycled Products in the APEC Region held by Chinese Taipei on 24 March 2023, we selected Chinese Taipei and Thailand as our case studies. The case study data were collected from the aforementioned workshop held by Chinese Taipei and from the official websites of Environmental Protection Administration (EPA) and the studied Thai business.

3.2.1 Case study #1 : Chinese Taipei



Figure 1. Recycled Marine Debris Product Label.

EPA launched an initiative for the Recycled Marine Debris Product Label in May 2021 and suggested that the label be managed using its recycling fund. The label has thus become the first government-funded marine debris labeling initiative. The label was developed to establish certification and labeling regulations for products made from marine debris in response to the threat marine debris poses to the environment and the survival of organisms in coastal areas and oceans. The government has been encouraging businesses to apply for the use of this label on qualified products to raise public awareness of this label and how marine debris affects the environment. This increased awareness can encourage the public to recycle and reuse marine debris, which may ultimately lead to its reduction. The label is depicted in Figure 1.

According to the official site of the Recycled Marine Debris Product Label (<https://recycle.epa.gov.tw/MarineDebris/en>), the Operation Directions for the label define a recycled marine debris product as “a product with at least 20% of its weight originating

from a marine debris.” Moreover, this product must be certified by a domestic or foreign certification institute that conforms to both ISO 17065 and ISO 17021, approved and granted the right to use the Recycled Marine Debris Product Label. The label application process (Figure 2) is divided into two stages: the preparation stage and the application and approval stage. In the preparation stage, applicants are required to provide identifiable and traceable data, which include the following:

- (1) Identifiable marine debris (location, time, and amount of marine debris recovered/collected)
- (2) Appropriate and effective collection and selection processes
- (3) Product quality that meets the requirements for the product’s intended use
- (4) Records of control procedure data
- (5) Replicable and traceable data

According to the current regulations, the label may be used for a term of 3 years. The person granted the right to use the label may apply for an extension 3–5 months before the 3-year term ends. Any application filed later than the specified timeframe shall be reviewed as a new application.

The eligibility and document requirements are the same for label applications for products made from recycled marine debris sourced. Both the categories of products shall be certified by a qualified certification institution, and the applicants shall be a brand, recycler, or product manufacturer (Figure 3). According to the official data, 13 and 5 products were granted the right to use the label in 2021 and 2022, respectively. Hong En Group, a business that was granted the right to use the label, was one of the businesses invited to deliver a speech in the workshop.

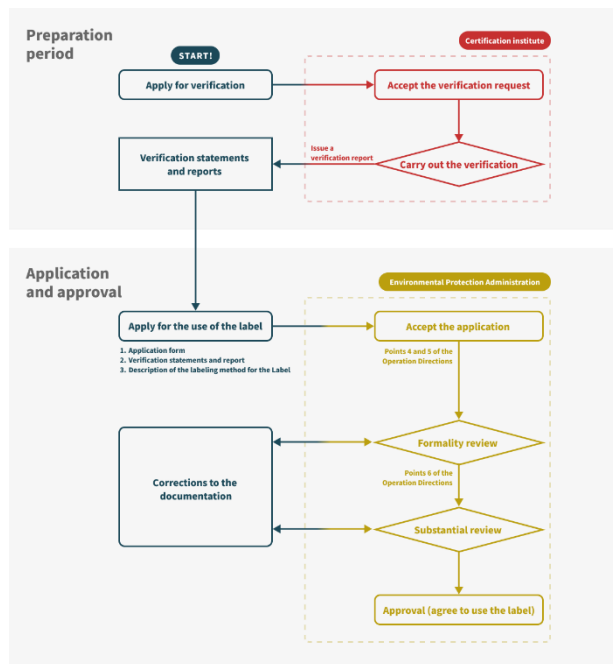


Figure 2. Application process for the Recycled Marine Debris Product Label.

Scenario Process /Location	1 Collecting, recycling, and manufacturing domestically		2 Collecting, recycling and manufacturing into product all done abroad		3 Collecting and recycling done by entity abroad, manufacturing into product domestically		4 Collecting and recycling domestically, product manufacturing by entity abroad		5 Collecting abroad, recycling and manufacturing domestically	
	Domestic	Abroad	Domestic	Abroad	Domestic	Abroad	Domestic	Abroad	Domestic	Abroad
Marine Debris Collecting	○			○		○	○			○
Recycling	○			○		○	○		○	
Product Manufacturing	○			○	○			○	○	
Certification Body	Any certification body recognized by the TAF or IAF									
Target	Brands, recyclers or product manufacturers									

Figure 3. Eligibility for the Recycled Marine Debris Product Label application.

3.2.2 Case study #2: Thailand

Qualy Design is a Thai company (<https://qualydesign.com/international/>) popular for its commitment to the design of sustainable and circular-economy products manufactured using recycled materials. Its designs encourage consumers to reflect on their impact on the

environment while using them. The company constantly strives to improve its product designs to encourage consumers to reuse them instead of discarding them after use. Circular-economy product designs are engaging and educational. For example, a tissue box could have a design that highlights the issue of melting icebergs and a plastic bag holder could be made from recycled plastic bags. Similarly, product packaging may include information related to environmental problems, the circular economy concept, material sources (e.g., “This recycled product is made from waste fishing nets”), content of recycled materials (e.g., “This product is made with 100% recycled plastics”), or the company’s partners in sustainability efforts. The storytelling technique can effectively connect different pieces of information to enhance consumers’ environmental awareness (Figure 4).



Figure 4. Information imparted using a storytelling technique on Qualy Design’s product packaging.

Mr Thosaphol Suppametheekulwat, the chief executive officer of CirPlas Tech, chief marketing officer of New Arriva, and cofounder of Qualy Design, shared his thoughts in the workshop on 24 March 2023. According to him, CirPlas (<https://cirplas.co/>) mainly collects ocean-bound plastics and urban-bound plastics and has established a recycling tracking system. In collaboration with third parties, the company selects, cleans, crushes, and granulates plastic waste and uses it to manufacture postconsumer recycled products. A quick response code will be

printed on the product packaging to enable consumers to access information about the sources of the recycled materials, as shown in Figures 5 and 6. As of 2022, CirPlas has collected 26,497 kg of urban-bound plastics and 33,120 kg of ocean-bound plastics and has been working toward its zero-waste goal.

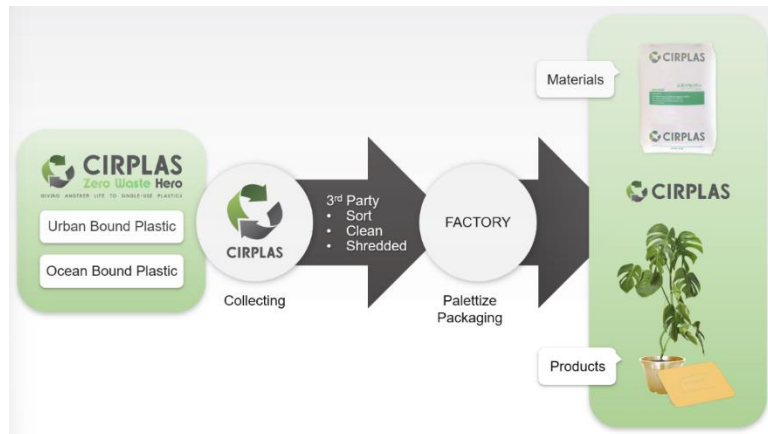


Figure 5. CirPlas' marine debris recycling process

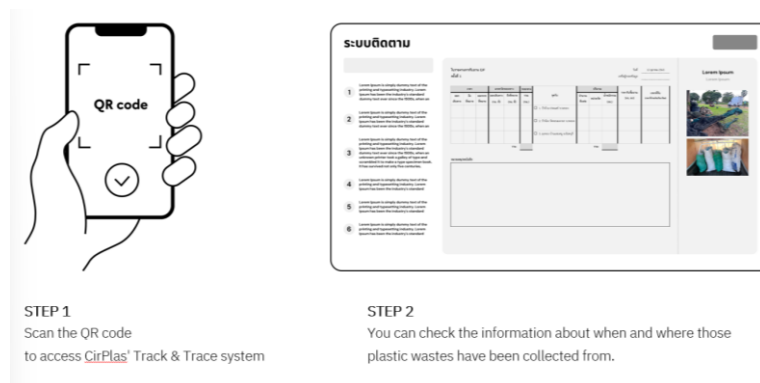


Figure 6. CirPlas' recycling tracking system.

3.3. Aspect of cooperation to promote the traceability scheme for marine debris recycled products and circular economy to reduce the land-based marine debris into the ocean

3.3.1 Capacity building

The capacity building part of the survey was completed by six economies, namely Chile; China; Japan; Malaysia; Mexico; and Peru. Most of these economies recommended offering opportunities for relevant organizations to exchange information,

share experiences, and learn bilaterally or multilaterally with key partners, such as academic institutions or private businesses, topics related to marine debris recycling and reuse, including traceability systems or labels, monitoring capacity, and strategies. These opportunities can help increase the capacity of relevant parties in the recycling process. Japan's Ministry of the Environment stated that Japan provides a waste management training scheme every year for economies in the Asia-Pacific region. This scheme is also discussed in the present study.

3.3.2 Research and innovation

Chile; Malaysia; Mexico; and Peru economies emphasized the exchange of ideas and views on plastic waste separation technologies, monitoring and reporting systems of marine debris (e.g., standardized reporting websites/mobile applications, such as Clean Swell), and collaborations on research and innovation projects (e.g., technological innovation that reduces waste generated from aquaculture).

3.3.3 Private sector engagement

Regarding private sector engagement, Chile suggested that businesses could share their successful experiences in using marine debris to manufacture fishing equipment. Chinese Taipei presented the efforts taken by Marine Debris Recycling Coalition over the years in marine debris recycling and expressed its hope to collaborate with the private sector of other economies.

4. Conclusion

This study distributed 21 copies of the survey online on 21 February 2023, of which 12 valid responses were returned by 31 March 2023, with a valid response rate of 57.14%. Based on the obtained responses, three policy suggestions were proposed.

(1) Capacity building

Many of the economies are actively building their capacity in marine debris recycling and reuse by organizing annual marine or environmental protection events, implementing pilot projects, collaborating with communities or regional partners, participating in consultation committee meetings or workshops, and incorporating marine and environmental topics into formal or informal education system. Based on the responses of the economies, capacity building was identified as an area that they would like to collaborate more on in the future. They sought opportunities for exchanging ideas, sharing experiences, and learning bilaterally or multilaterally with academic institutions or private businesses topics related to marine debris recycling and reuse, including traceability systems or labels, monitoring capacity, and strategies. These opportunities could benefit various parties in the recycling process.

Policy recommendation: Cross-economy events should be organized on the World Ocean Day or environmental events annually and cross-economy pilot projects could be launched. This strategy could facilitate cross-economy exchanges, create borderless economic benefits in marine debris recycling and reuse activities, and diversify the distribution channels of recycled marine debris products.

(2) Research and innovation

Research and innovation is the second most emphasized area of collaboration among these economies. The research and innovation models include economies sharing their experiences of establishing their marine debris recycling systems, which could help them improve or innovate the existing systems. As soon as effective recycling systems are established, the economies can invest in the development of technologies that can be used to transform recycled fishing nets and plastics into products of value. The different material compositions of marine debris after being preprocessed for recycling affect their recycling and reuse potential. The economies emphasized the exchange of ideas and views on plastic waste separation

technologies, monitoring and reporting systems of marine debris, and the collaborations on research and innovation projects, such as technological innovation that reduces waste generated from aquaculture.

Policy recommendation: A marine debris recycling consultation committee should be established for APEC economies based on the existing marine debris recycling systems constructed by these economies. The committee may consist of members from the industrial, governmental, academic, and research sectors to facilitate exchanges among economies. These exchanges could facilitate the optimization and innovation of their recycling models and standards. These efforts are expected to promote technological advancements among the member economies of APEC in terms of their marine debris recycling, reuse, tracing, and monitoring activities.

(3) Private sector engagement

Engagement of the private sector is the third most important area of collaboration among the APEC economies. Businesses in these economies may share their successful experiences in turning marine debris into fishing equipment. To enhance their marine debris recycling and reuse systems, the member of APEC economies, especially developing member economies can benefit from the Chinese Taipei Marine Debris Recycling Coalition's expertise in the field of marine debris recycling. By promoting exchanges and cross-economy collaborations between their private sectors, APEC economies can ensure that industries grow while protecting the ecology and environment through improved traceability.

Policy recommendation: The APEC OFWG should communicate the idea of marine debris reuse by showcasing their achievements in this field and making their contact information available on various media platforms. This could create cross-economy business opportunities and facilitate visits at prestigious businesses or institutions, which in turn

would offer opportunities for exchanges between projects, ultimately boosting economic growth in member economies.

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Chapter 2 Output of Workshop

This project held a hybrid workshop “Good Practices for Traceability Mechanism of Marine Debris Recycled Products in the APEC Region” in Taipei City at The Lecture Hall of GIS Convention Center NTUT on 24 March 2023. Wu, Meihong, Vice Minister of the Ocean Affairs Council (OAC) was invited to make the welcoming remarks (Figure 7). Her speech concluded that initiatives were raised by NPOs based on sciences with systematic actions led by the government to build highly efficient cooperation network, awake environmental awareness in society, reduce plastic consumption and expand the outcomes and impacts locally and globally.



Figure 7. Welcoming remarks delivered by Wu, Meihong, Vice Minister of OAC.

This campaign invited participants from 13 APEC member economies, including Canada; Chile; Indonesia; Japan; Republic of Korea; Malaysia; New Zealand; Peru; the Philippines; Chinese Taipei; Thailand; the United States of America; and Viet Nam, to participate through online or onsite meeting. 38.77% out of the total 147 participants were female to meet the gender equality requirement. Hsiang-Wen Huang, Director-General of the Ocean Conservation Administration (OCA), was invited to deliver a keynote speech, followed by speeches in 3 sessions and group discussions. The group photo of the speaker

and participants is shown in Figure 8.



Figure 8. Group photo.

The topic of Director-General Huang's speech was "Marine Debris Management Strategy and Implementation". She shared that marine debris issues were initiated by NPOs based on scientific research, and systematic management strategies were only proposed in 2018 at the time the OAC and OCA were established. There are three major strategies, including monitoring and investigation, recycling and removal, supplemented by marine education

and cross-economy cooperation. OCA joined the marine debris governance platform in 2018 and focused on four major dimensions of “source reduction”, “prevention and removal”, “research and investigation”, and “cooperation expansion”. As for research and investigation, the implementations covered the studies on coastlines, ports, marine derelicts, seabed garbage, and even micro-plastics. These investigations were conducted by government with the participation of civil scientists to collect data. The implementation of the Salute to the Ocean Program started in 2020, with the involvement of the 15 units to manage every inch of the coastline. The “Ocean Clean-Up Alliance” was composed of environmental protection fleet, submarine warriors and the outposts of ocean cleansing to remove marine litter through the cooperation of local governments and the public. Furthermore, temporary storage areas were set up to solve the waste problems in fishing ports through the cooperation with the Fisheries Agency. As for recycling, the “Marine Debris Recycling Coalition” was established in 2021 with the participation of 42 enterprises. Derelict fishing gear and Styrofoam scape from local fishermen were recycled and transformed into multiple products like neckties and handbags to achieve a circular economy. In addition, cross-economy cooperation and dialogues were promoted proactively in recent years to exchange experience in marine debris management. At last, through education, public environmental awareness would be lifted in order to accomplish the goals for sustainable ocean



development (Figure 9).

Figure 9. Keynote speech “Marine Debris Management Strategy and Implementation” by Dr Hsiang-Wen Huang, Director-General of OCA.

1. Session I - Sharing Best Practices for Traceability Mechanism of Marine Debris Recycled Products

Speaker sharing from the representative of Chinese Taipei, Mr Damon Tsai, Special Assistant and Carbon Asset Manager from Horng En Group, “The best practices and commitment to collect marine debris to recycle into eco-friendly products”. Horng En Group has been established for more than 40 years and is now one of the biggest recyclers in Chinese Taipei covering the recycling of PE, PP, PC...etc. with plants located at various places in Chinese Taipei. The circular economy is the core concept of our company. The garbage is sourced from private and overseas recyclers. Currently, Horng En has less than 10% waste sourced overseas and will further concentrate on local garbage recycling. Horng En is committed to the development of converting rare garbage into reusable materials with a standardized process. The processing steps for plastic wastes are divided into crushing, cleaning, classification, and tests are completed after each step to identify the physical and chemical properties of the debris. Meanwhile, Horng En cooperates with local government on recycled products, e.g. the cooperation with Tainan City Government to recycle and convert Styrofoam scrap into electronic products Horng En is one of the founding members of the marine debris recycling coalition. The recycled raw materials from Horng En can be supplied directly into the manufacturing process. Marine debris classification is difficult. Recycled marine debris requires additional costs in manpower, resources, and energy. Regardless, there is still a lot of solid waste that cannot be recycled. As for the recommendations for marine debris disposal in the future, Horng En suggests there should be more cooperation between the public and private sectors to develop high-value products, enhance public education, and promote the application of recycled products (Figure 10).

The representative of Thailand, Mr Thosaphol Suppametheekulwat, Marketing Director from New Arriva Co., Ltd. shared that “Upcycling the ocean plastic waste into new reusable products”, Mr Thosaphol established a company called Qualy, which is dedicated to designing products made

with sustainable and circular economy concepts using recycled materials, allowing consumers to reflect their impacts on the environment while using the products. Mr Thosaphol continues to think about designing non-disposable products which are not unnecessary to consumers. Products with circular economy concepts must be storytelling oriented and educative, such as the iceberg concept of tissue boxes, plastic bag extractors for recycling plastic bags, and even printing the story of the bags on the product packaging. As for derelict fishing gears, local NGO offered to buy back fishing nets from fishermen. Yet most recycling companies were reluctant to disposing fishing nets. Currently, Qualy uses the traditional approach of clay steel processing for fishing net disposal, manually cleaning and sorting the items. The disposal was very challenging as fishing nets were smelly and misted with garbage. Products made from recycled materials are more expensive than those fabricated from virgin materials due to the investment of additional resources. Except for PP, which is the best to recycle, all other plastic recycled products have high disposal costs, and this is where consumers need to be educated. As for materials, in order to promote the concept that only products embedded with CR (corporate responsibility) concepts are truly environmentally friendly, the speaker set up a new company, CirPlas Tech. Co., Ltd, where he serves as the CEO and focused on marine debris recycling and designing products with PCR concepts. Meanwhile, Mr Thosaphol built a tracking system for garbage recycling by printing QR codes on the packages so that consumers can trace them. By 2022, CirPlas Tech had collected 26,497 kgs of Urban bound plastics and 33,120 kgs of Ocean bound plastics (Figure 10).

The representative of Peru, Mr Ricardo Dioses Avellaneda, the researcher from Instituto del Mar del Peru shared “The approach of Peruvian status in marine debris recycling.” Mr Ricardo mentioned that, every year, 58% of plastic garbage in Peru were disposable, whereas only 9% were recycled. The most common pollutants on beaches are plastics. Local people need further training to properly identify trash on the beach. They worked with different partners and deployed approaches from UN for simple classification so that the general public could be engaged in garbage recycling. Peru is also committed to conducting cross-domain studies on

micro-plastics, holding workshops to understand micro-plastic levels in different species and to understand the respective impacts, which is still a very new subject. Peru has regulations for the management of marine waste plastics to address marine debris issues to people, encourage engagement from private sectors, and reduce plastic usage. In February 2022, Peru issued an updated draft with 68 plans for waste recycling management. In addition, there was research on waste with additional investments in waste recycling. The Clean up Project in 2016 empowered local governments to manage and dispose of local waste. As for recycling, fishermen from both the south and the north were invited to join the fishing net recycling. Recycling stations near the sea were also proposed in the initiative. The Peruvian government also analyzed plastics, fishery wastes and other trash and made brochures to promote waste classification. Resources like fish skin and chitin from shellfishes are reusable, but cost and further validation are required (Figure 10).

The representative of Malaysia, Professor Ir Ts Dr. Pau-Loke Show from the University of Nottingham Malaysia, shared “Recycled products made from marine waste material access the solution to marine plastic pollution in Malaysia”. Prof Dr Show mentioned that there are many direct or indirect wastes in the ocean. Any artificial waste would become debris in the ocean. The advantages of marine waste products include the positive impacts on the environment, reducing landfill and pollution to underground water and lands, creating job opportunities (the incineration of 10,000 tons of waste would create one job while landfill work creates 6 job opportunities and recycling creates 36 opportunities), and economic and social transformation. Malaysia was ranked as the number 8 biggest economy in the world in marine debris contribution. By 2030, Malaysia would remove all disposable plastics and launch the Sustainable Route for Malaysia Plastic (2021-2030) and the Blueprint for Sustainable Circular Economy (2021-2030). Currently, local enterprises are actively reusing recycled marine debris through cooperation with recyclers and furniture manufacturers, or recycling PET bottles into green walls. At the current stage, some relevant Malaysian enterprises acquired the certification for Ocean Bound Plastic. However, Prof Dr Show mentioned that in addition to the recycling of marine

waste plastics, algae could be one of the best tools to solve marine plastics as microalgae can attach to plastic surfaces for biodegradation, producing monomers, O₂, H₂O, and new cell biomass (Figure 10).

Summary

In session I, the representative of Chinese Taipei, Mr Damon Tsai, Special Assistant, and Carbon Asset Manager from Horng En Group, was the session moderator. This session mainly focused on sharing the best practices of existing traceability mechanisms to explore opinions from enterprises or other stakeholders on the dilemma of traceability mechanisms, and even on how to continue the spirit of the existing recycled plastic products from the sea waste in the future, and to share the solutions of producing raw materials from other marine debris or developing more recycled products through marine debris management system in order to realize more cases of product traceability mechanism. The representatives of Chinese Taipei; Thailand; Peru and Malaysia were invited for panel discussions (Figure 11). The certification marks for marine debris recycled products issued by Chinese Taipei were authorized by the government and received GRS certification. Horng En Group had applied and received certifications as one of the best practices. Although it was important to verify the source of recycled marine waste products, the recycling and processing ends of marine debris already bear high cost, and applying for certification is another cost burden, which is also one of the dilemma of enterprises. Mr Thosaphol added that a clear waste classification was recommended from the beginning to reduce cost and improve product quality. Waste classification and cleaning were the most difficult as some materials could be easily cleaned up with infrared technology, while most of the time manual works were necessary, especially for mixed materials, which cost several times more, while the market is also very small. This was why enterprises should consider material updates and re-engineer them. For example, Qualy also cooperated with NGOs for marine debris recycling. It would be very hard to prove the products were made from marine waste without the full engagement from factories. At this time, this company was running on Verra's plastic credit and adopted blockchain technology to trace recycled

marine waste materials. This was one of the best practices to refer to. As for recycling, Peru invited fishermen from the south and the north to join fishing net recycling and proposed to set up recycling stations near the sea in the initiatives. Currently some relevant Malaysian enterprises received certification on Ocean Bound Plastic, which informed people of the level of recycled marine plastic in the products. As for the issues of micro-plastics, scholars had conducted research and the results showed significant impacts on fish. Therefore they were inclined to pursue algae plans.

	
<p>Speaker 1: Mr Damon Tsai</p>	<p>Speaker 2: Mr Thosaphol Suppametheekulwat</p>
	
<p>Speaker 3: Mr Ricardo Dioses Avellaneda</p>	<p>Speaker 4: Prof Ir Ts Dr Pau-Loke Show</p>

Figure 10. Session I Speakers.



Figure 11. Session I Panelists – Panel Discussion.

2. Session II - The Implementation of the Policy of Marine Waste Recycling and Reuse Experience Toward Promoting Marine Conservation

The representative of Chinese Taipei, Mr Yiwei Lian, the Head of EPA, shared his thoughts on “The implementation of recycled marine debris product labels.” Mr Lian mentioned that marine debris would be transferred to coastlines by monsoons and ocean currents due to geographic location. Therefore he hoped to promote the marine waste circular economy and educate the public to take actions for marine conservation with sufficient skills and capabilities to recycle marine debris. Furthermore, many local enterprises in Chinese Taipei had recycled and converted marine wastes into products through mutual cooperation. Governments cooperated with private sectors to connect relevant industry supply chains and make T-shirt containing 96% recycled marine waste from recycled PET bottles. Meanwhile, a dedicated certification mark to trace marine debris was developed in order to assure the recycled products were made from recycled marine waste. The initiatives for certification marks clearly define that marine debris should be collected outside coastlines in order to promote circulation through industry chains. At the current stage certified products covered household items and wood-plastic composites. In the

future, it is expected to develop mutual recognition system to achieve cross-economy cooperation (Figure 12).

The representative of the Philippines, Professor Dr Alvin B. Culaba shared his opinion on the subject of “the experience of adopting a plan of action and a stronger public-private partnership to reduce marine debris in the Philippines.” Prof Dr Alvin mentioned that, in the Philippines, every year there were more than two million tons of plastic waste, and only 16% of those plastic waste was recycled, 2% was converted into fuel rods, 33% was thrown away directly, and 35% was left in the nature. PET, HDPE-rigid, and PP are three recyclable plastics. Only PET bottles could be recycled after sorting. Disposable plastic bags and multi-layer plastic bags were not included. The research indicated that the plastic left in the environment will be doubled by 2040 as all kinds of waste increase continuously. Furthermore, in the Philippines, marine debris recycling was challenging due to the challenges in managing many islands, limited resources and technology in public sectors, incapability of the local governments, local regulations blocking the implementation of central regulations, and lacking integration in plastic value chains. Therefore the state and local governments should be fully coordinated to formulate and implement comprehensive policies. Currently, the use of disposable plastics was still under discussion in the congress. The short-term goal was to capture, limit and remove disposal plastic or to develop markets for recycling and reproduction. It is challenging to meet the zero-plastic target by 2030. Yet we expected to establish a management center for plastic waste with industry support to collect data and enforce IEC education and communication, and to manage plastic recycling works through digitalization and documentation to achieve this target aggressively (Figure 12).

The representative of the Republic of Korea, Professor Dr Young-Kwon Park, shared his thoughts on the subject of “the thermo-catalytic conversion of marine plastics to valuable materials”. Prof Dr Park mentioned that every year the volume of marine plastics increased significantly worldwide, and the most common wastes along Korean coasts were plastics. Korean government made very rigid policies in order to remove and convert marine

debris into valuable materials through technologies. He also pointed out that there were many types of marine debris, therefore, technologies should be engaged to decompose plastics of various sizes into particles, convert blended plastics into useable materials, and extract useful resources from marine wastes with added values, e.g. chemical fuel. At the same time, Prof Dr Park shared his analysis from a professional perspective, and burying marine debris would create smells. Incineration would generate toxins and carbon dioxide emissions. The pyrolysis process in different decomposition approaches is likely to produce hydrogen, which is valued by the government at the current stage. Furthermore, the data showed that scrapped buoys were ideal materials for pyrolysis disposal. The circulation of FNW thermo-catalytic conversion mediated with carbon dioxide would generate more hydrogen with carbon dioxide and Nitrogen as fusion catalysts. The research also revealed that the smell was under control. It was an ideal approach for marine debris disposal (Figure 12).

The representative of the United States of America, Ms Raquel Corniuk, Project Manager, shared her experience in “Floating Derelict Fishing Gear in the Central North Pacific: Quantities, Polymers, Sources, and Reuse”, the research done by her team showed that every year, in the Hawaiian Islands, hundreds of tons of derelict fishing gears were collected. Those fishing gears would cause damage to the habitats of these species. Therefore, through researches, her team studied the variety of derelict fishing gears and collected samples to trace the sources in order to dispose of these fishing gears of more than 1,000 categories and weighted more than 3,000 pounds with aggressive approaches. The fishing gears were preserved at the original conditions as much as possible and sorted by colors for data collection at different stages. A total of 1 million pieces of data records were used for source analysis, and by taking local samples back to the base for analysis, manufacturers can be identified, and even the time of fishing gear in the environment can be found. The most common fishing gears were netted or knitted, but most of them were trawls in green, gray, or blue polyethylene (PE) nets. There were two approaches for marine waste disposal in Hawaii. The first method is landfill, and the second approach is incineration to generate energy. Currently, we are still exploring

better approaches, e.g. converting plastics into asphalt for road pavement to understand if there would be any environmental impacts through experiments, on-site tests, sensitivity analysis on moisture content, rain tests, and microscope investigation after filtering. At present, the project was still under development and is likely to be the main development direction for marine debris disposal in the future (Figure 12).

Summary

In Session II, the representative of Chinese Taipei, Mr Zih Siang Lin, the Head of the Plastics Industry Development Center, was the session moderator. This session focused on the policies and action plans for marine debris recycling and the relevant research to promote technical developments and industry trends. The representatives of Chinese Taipei; the Philippines; Republic of Korea and the United States of America were invited for panel discussions (Figure 13). The speaker of Chinese Taipei, Mr Yiwei Lian, Head of EPA, expressed that the greatest challenge to establish certification marks for marine debris was that it was hard to control the quality and quantity due to northeast monsoons and ocean currents. Currently, marine debris was only collected from beach cleanup, and less than half of the collections were put into the recycling process. Certification establishment would be only possible with matching technologies. Meanwhile, from the enterprise perspective, it is very difficult to invest in the reuse of marine waste, which is full of uncertainty and needs to be achieved through the industrial chain. However, the government is concerned that people may consider that enterprises are green-washing themselves when promoting the policies. Therefore, the proactive introduction of third-party certification could inform people of the value of marine debris, but not to misperceive it as that littering can be tolerated. In the future, the government will continue promoting certification marks to enterprises and to the public, as well as actively promoting collaboration with domestic and foreign brands.

On-site participants asked questions about the action plans in terms of marine debris management in the Philippines. Professor Dr Alvin B. Culaba stated that there were many action plans taken to accomplish the zero-

plastic goal in 2030. Marine debris management was always the most challenging among all actions taken in the Philippines. Furthermore, at present, marine waste management was decentralized. Many initiatives were raised at local levels without integrated plans. Therefore, it is necessary to reinforce the management of local government. Marine debris collection and management were restricted at local levels due to typhoons in the Philippines. In the future, he hopes that the private sector could be empowered and integrated with local authorities to manage marine debris with jointed efforts.

Online participants asked if there was a particular plastic marine debris that is more ideal for conversion. Professor Dr Young-Kwon Park from Republic of Korea said that all plastics have to be decomposed into particles first for conversion. The salts in marine debris would affect pyrolysis. Therefore we used hydrogen as the mediator to deliver better results. Meanwhile, offshore plastic waste could also be recycled and converted into fuel through recycling technologies. On-site participants asked Ms Raquel Corniuk, Project Manager and the speaker of the United States of America, for suggestions to local fishermen on marine debris removal and for manufacturers and recyclers. She believed that no machine is used for marine debris removal in Hawaii. Before waste classification and disposal, the content of marine waste should be fully understood. The approaches were still not standardized but we would move toward the goal of aligning the approaches of the various units through research. Meanwhile, she also mentioned that labeling fishing gear was the most helpful because it would allow researchers to track it more effectively, especially since the current study showed that 97% of the waste could not be traced to its source. The fishing gear labeling system could contribute to the tracing and analysis afterward and facilitate better classification for recycling.

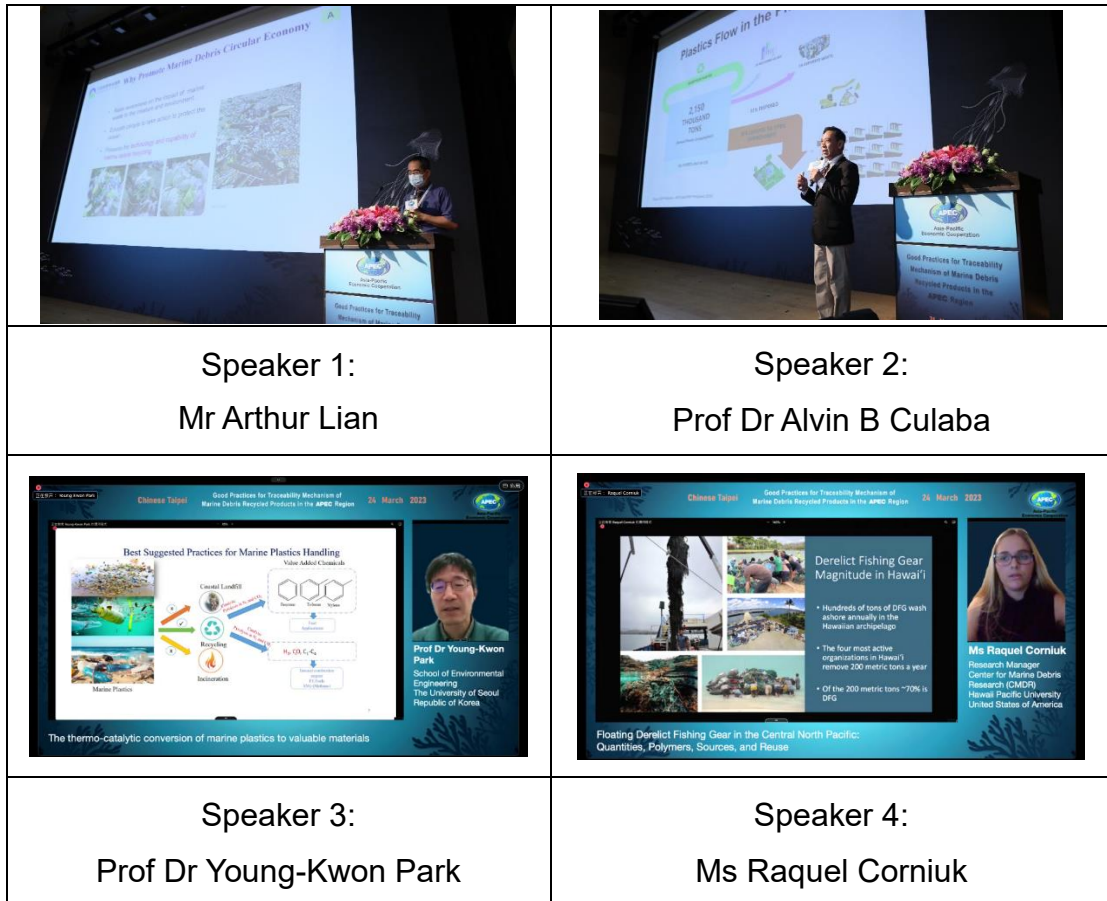


Figure 12. Session II Speakers.



Figure 13. Session II Panelists – Panel Discussion.

3. Session III - The Industry-Government-Academic Cooperation for the Marine Debris Management Program and the Acceleration of the Related Policies

The representative of Chile, Mr Beltrán Orrego, Manager from Atando Cabos, shared his thoughts on “Circular Economy for Marine Plastic Wastes, from Theory to Action”. Mr Beltrán believed that linear economy was the trend in the 1990s, and the recycling economy was only promoted in 2000. However, recycling was only a short-term approach, while the long-term solution should be the circular economy, which is to circulate products and materials as much as possible with the engagement from all manufacturers. Currently, there are challenges in logistics, technology, and value chain collaboration, and those challenges need all stakeholders to discuss together, and the key elements in solving the plastics problem, including the right role, a viable approach, and benefits to the organization. The sabotaged environment should be restored through an ideal business model. Furthermore, all stakeholders would recognize the values through customer sharing. How to prove the effectiveness of the approach? Mr Beltrán mentioned that it was always about storytelling. For example, Atando Cabos touched on 9 sustainability targets to record comprehensive carbon footprints of products from materials to finished products, to co-create different products with different industries, and to reuse the same products repetitively at different places. Tracing will complete the movement of recycled wastes, build trust within value chains, and make the stories of the products visible to everyone in the value chain (Figure 14).

The representative of Thailand, Dr Nattapong Nithi-Uthai, and the founder of Tlejourn and Trash Hero Pattani elaborated on the subject of “Walk to Clean Ocean”. Dr Nattapong is a polymer expert and was authorized to dispose of marine debris in 2011. He believed making products out of products was a better approach for waste disposal. For example, he built Tlejourn to make flip-flops out of massive scrapped flip-flops and successfully cleared up lots of flip-flops waste. After quantifying the environmental benefits of corporate operations, he started a project for beach cleanup, Trash Hero, to scale up the impact. This NGO was

expanded into 300 branches, and another project, Plug in, aims to train young people to become leaders and initiators in the future. In addition, his institution also studied and cleaned up rivers and canals, or cooperated with universities to study water quality. After investigation, he found that 50% of waste accumulated at river openings were glass bottles, and 90% of waste in the ocean was plastics. Recently, his institution has been actively hosting zero-waste camping events to drive people to change their behaviors and to promote eco-tourism and sightseeing. He also worked together with restaurants to promote the concept of zero-waste dining and develop food waste disposal programs so that a zero-waste lifestyle can be implemented (Figure 14).

The representative of Viet Nam, Professor Dr Dang Diem Hong from the Vietnam Academy of Science and Technology (VAST) and Algal Biotechnology Department, Institute of Biotechnology (IBT) shared their experience on “Seagrass/seaweed bed restoration with 3D printed mold (composition made from biodegradable/recycled plastic with growth stimulants).” She first stated that Viet Nam is one of the top 10 economies in marine debris recycling. Plastic waste is scattered all over the beaches in Viet Nam, so plastic marine debris reduction is critical. Seagrass bed has been an important material to provide nutrition, absorb CO₂, and restore the coastline systems. Furthermore, seagrass and seaweed could be used as bioplastics because you could make polymer out of seagrass or algae, which contain higher biomass and could grow with minimal soils. Prof Dr Dang further illustrated that currently, many bioplastic packages are made from algae, which are not only non-toxic and have a short life cycle, but can also replace fossil raw materials and produce bioplastics through the algal polysaccharide reaction, allowing for the production of polymers for 3D printed structures. However, the cost to make bioplastic from pure algae is very high. Prof Dr Dang hoped there would be more industries using natural and recycled polymers in production to reduce environmental impacts. The improvement in cultivating with floating nets design could also contribute to the better growth of algae (Figure 14).

The representative of Japan, Dr Noriko Tamiya-Hase, from the Ministry of the Environment Office of Policies against Marine Plastics Pollution

Water Environment Division made the speech on “The best sharing of monitoring activities of plastics in the environment and possible utilization of remote sensing technologies in Japan.” Dr Tamiya-Hase mentioned that, as plastic marine debris pollution in Japan was very serious, a series of policies against marine plastic pollution were made, such as “The Act of Promoting Marine Debris Disposal” issued in 2009, the 2019 Japan Development Action Plan Initiative, which aims to reach the goal of zero plasticity by 2050, and “The Act of Promoting Resource Circulation” in 2022 to promote the circulation of plastic resource and to reduce plastic pollution in order to solve plastic waste problems with scientific monitoring and evaluation (Figure 14). She also mentioned that, since 2010, the Minister of Environment in Japan had been actively studying the matter of marine debris, including collecting and summarizing information on the quantity, variety, and contents of beach wastes. From 2014 to 2019, nets were also used to collect the micro-plastic particles floating on the ocean surface to study if they were attached with toxic chemicals. In 2019, the Minister of Environment published sampling collection guidelines for micro-plastic particles floating at the ocean surface in the hope of developing a database of marine micro-plastic particles. In addition, Japan published the coordination guidelines for marine monitoring in order to establish marine debris database and solve the relevant issues with remote sensing technologies and Figure recognition capabilities, especially as marine debris comes from all over the world, and cross-economy cooperation is crucial (Figure 14).

The representative of Chinese Taipei, Ms Ning Yen, CEO of IndigoWaters Institute, shared her experience on “Using Continuous Monitoring Data of Coastal Litter to Drive Policy Change,” Ms Yen noted that beach cleanup was getting popular, but are they really making a difference and why is there still so much marine debris? She believes that more concrete data is needed for reference, and that marine debris is affected by climate, with monsoons and currents bringing much of the marine waste. The estimation of marine debris on an island requires heavy manpower. For this reason, IndigoWaters developed a monitoring approach to locate and identify marine debris types precisely with

systematic sampling. Every monitor node covered the investigation within a 100-meter radius. Every quarter, a survey of 2 weeks was conducted, and female volunteers were trained to assist with the survey. The research findings indicated a significant marine debris reduction in recent years, and such data could be served to support the government to effectively control the waste along the coasts and understand the decline in the amount of marine waste, in recent years through quarterly comparisons, as well as the top places where waste is gathered, and the disposal process in order to build an alert system. People could notify the relevant units when spotted waste on the shore. All these measures could be helpful for the government to promote the clean-up act and source control policy (Figure 14).

Summary

The representative of Chinese Taipei, Ms. Ning Yen, CEO of IndigoWaters Institute, was the session moderator. This session mainly focused on sharing experience for subjects on the cooperation between industry, government, academia, innovative marine conservation practices and technology applications in marine debris management programs in various economies, and the acceleration of relevant governance policies. The representatives of Chile; Thailand; Viet Nam; Japan and Chinese Taipei were invited for panel discussions (Figure 15). On-site participants asked how to trace marine debris. The speaker from Chile shared that one of the challenges for his business was to share the value of recycled products with the consumers, especially in understanding the sources and tracing the final products, such as the B2B products currently primarily offered, customers would enjoy additional discounts if they send back products for repair. All the service records would be useful to trace products. On-site participants requested further details on the sharing from Professor Dr Dang Diem Hong, she answered that as not all algae could be used to produce bioplastics, she had to find out the best breeds and the best conditions to grow the product. Meanwhile, the findings from many researches revealed that both algae and microalgae contain bioplastics. She also added that the public does not have to worry about mixing plastics with bioplastics and other plastics as the existing scientific techniques are

capable of distinguishing bioplastics.

Participants asked if the concept of a package-free store in Europe would be effective in reducing plastic waste if such a business model was applied in the Americas or Asia. The speaker from Thailand, Dr Nattapong Nithi-Utha, shared that, at the current stage, the implementation of zero-waste was still at the community level. The solution of a packaging-free shop could be shared within the community. Yet sometimes it required more education to change people's lifestyles. The speaker from Chile, Mr Beltrán Orrego, mentioned that, in Chile, the regulation implementation for disposable plastic was conducted in a progressive approach. The speaker from Japan, Dr. Noriko Tamiya-Hase added that to reduce plastic package, there were new regulations in Japan focusing on the outlines of product design, which will be invested by the Japanese government in green procurement to reduce packaging.

Finally, participants also asked if there are any cooperative models to solve the problem of waste generated by rivers in Southeast Asia, as many rivers span across many economies. For this subject, the speaker from Thailand, Dr Nattapong Nithi-Uthai explained that 80% to 90% of rivers in Thailand originate from the inland. These rivers that flow through different economies have to be solved through cross-economy cooperation, but there is really not much that local governments can do, the only thing that can be done is to bring change from the top down through education. The speaker from Chile, Mr Beltrán Orrego, mentioned that there are many rivers in South America. Generally, there is not much plastic because most of the river is very shallow, and land-based waste does not generally reach the sea through rivers, whereas the inland plastic problem needs to be solved by better management methods. The speaker from Japan, Dr Noriko Tamiya-Hase, believed that river management is one of the reasons to establish guidelines for remote sensing in Japan in order to collect data from land to ocean. The policy will also be promoted continuously.






	
<p>Speaker 1: Mr Beltrán Orrego</p>	<p>Speaker 2: Dr Nattapong Nithi-Uthai</p>
	
<p>Speaker 3: Prof Dr Dang Diem Hong</p>	<p>Speaker 4: Dr Noriko Tamiya-Hase</p>
	
<p>Speaker 5: Ms Ning Yen</p>	

Figure 14. Session III Speakers.

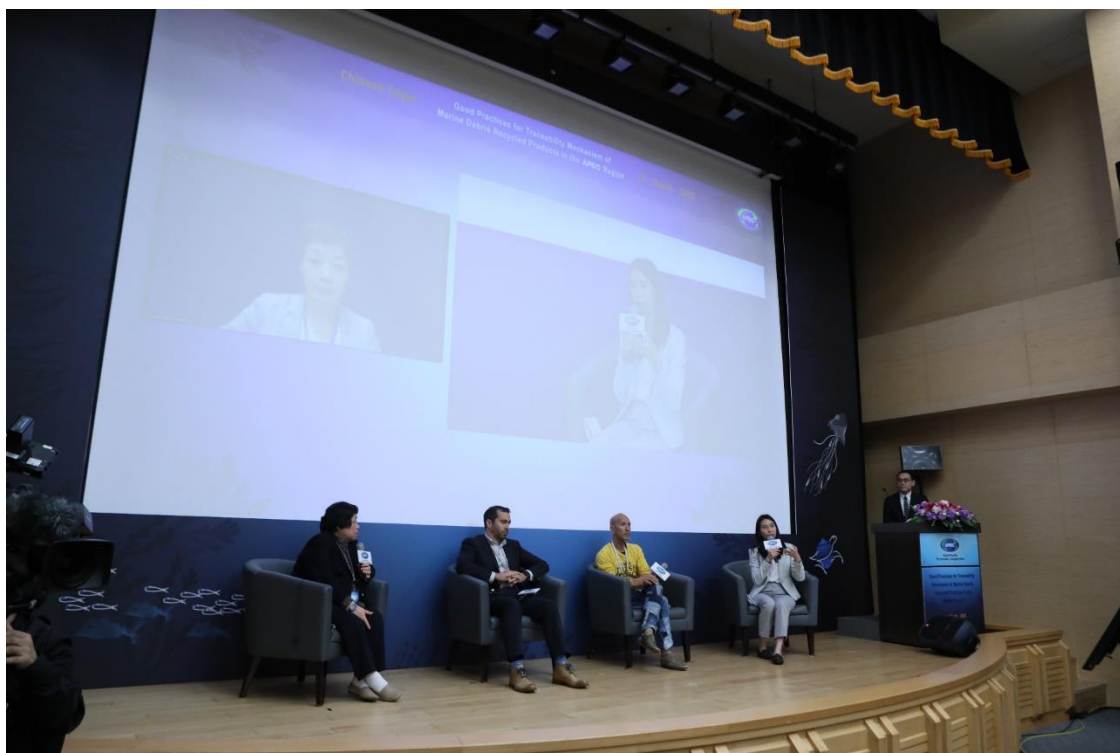


Figure 15. Session III Panelists – Panel Discussion.

Director Hsiao-Hsia Li, the representative of OCA, delivered the closing speech (Figure 16), she shared her gratitude to the 14 experts and scholars from 10 economies (Chile; Japan; Republic of Korea; Malaysia; Peru; Chinese Taipei; Thailand; the Philippines; the United States of America; and Viet Nam) for being the speakers of the workshop and for making the event a success. She also expressed her appreciation to the participants from 3 economies, Chile; Indonesia; and Malaysia, and to everyone for their participation in the event, which made the event even more rewarding.

Marine debris reduction and marine conservation promotion require the cooperation between the public and private sectors. It is the vision of everyone to preserve and guard a clean marine environment and the natural resources inside. Therefore, in the future, the government will continue to plan and invite relevant authorities to jointly promote the management of marine waste, and continue to influence the development of marine waste reuse, hoping to bring the attention and response of the whole society, in order to reduce the generation and impingement of marine waste, and to fulfill people's responsibility to protect the ocean.



Figure 16. Closing speech from Hsiao-Hsia Li, Director of OCA.

Conclusion and Recommendations

Marine debris is a critical marine environmental conservation issue of global concern. Among which, plastic, which decomposes slowly after entering the environment, has the most profound impact. In order to promote the cooperation between local enterprises, NGOs, government officials, and agencies of APEC, this project held a hybrid workshop “Good Practices for Traceability Mechanism of Marine Debris Recycled Products in the APEC Region” in Taipei City at The Lecture Hall of GIS Convention Center NTUT on 24 March 2023. The agenda (Appendix 1) and e-handbook (Appendix 2) are shared in the workshop. This workshop covered three topics and recorded by the project (Appendix 3), and the conclusions are summarized below:

1. Session I: The case shared by Chinese Taipei; Thailand; and Peru in building the recycling mechanism of marine waste and making recycled products into relevant recycled products after recycling, leading to more opportunities for marine waste recycling. The speaker from Malaysia shared that, at the current stage, the scholars from the respective economy are inclined to pursue algae projects. Microalgae is one of the best tools to solve marine plastics as it can lower carbon dioxide and can be attached to the surface of plastic objects for biodegradation.
 2. Session II: The policies and regulations of marine debris recycling were discussed thoroughly. Chinese Taipei shared the relevant policies and certification mechanisms, together with the Philippines’ action plan to promote more enterprises and people to actively participate in marine conservation. Meanwhile, the United States of America and Republic of Korea shared the technologies to reuse marine debris.
 3. Session III: Both Japan and Chinese Taipei shared the practices in applying front-end sensing technologies for marine debris management and other multiple technology applications. Viet Nam has been using recycled plastics to restore seaweed bed. Finally, Chile and Thailand shared the best practices to implement circular economy of marine debris
- After the discussions on three session and analysis of questionnaire data by experts from industry, government, academia, and research units of APEC economies, the results revealed that both public and private sectors have acted

aggressively to address issues on marine ecology. It is clear that the stakeholders' cooperation is critical, as the involvement from upstream and downstream industries and experts and scholars from different domains are required for the establishment of a marine debris recycling system, the monitoring and inspections of marine debris, the reusing of recycled marine waste, as well as the promotions on the traceability mechanisms for certification. Regarding the source certification for marine waste recycled products, currently, some enterprises applied for marine waste certifications from third-party agencies to validate the level of marine waste in the products. Some enterprises are considering the current barriers in traceability and are setting up new companies to cooperate with processing and manufacturing factories from the recycling end, with QR codes marked on package, allowing consumers to obtain information on product sources through their systems. One of the existing dilemmas is that marine debris that is mixed with various materials or that is not disposed properly requires additional manpower and investment from the enterprises and will lift up cost. The level of marine waste materials in recycled products depends on the quality of the raw materials. Employee training for waste classification and clean up before recycling is a problem to be solved and addressed in order to promote marine debris recycling and traceability mechanism effectively.

Based on the conclusions above, this project made following recommendations on the policies from three aspects:

1. Capacity building

- A. The establishment of traceability mechanism for marine debris requires the collaboration of multiple stakeholders, and should start from the trainings at the user end on how to classify and clean marine debris correctly in order meet the basic standards of back-end industries for marine waste materials. This will enable enterprises to implement their corporate social responsibility and make profits at the same time to achieve economic benefits and sustainable management, and to jointly maintain and protect a clean marine environment and the natural resources contained therein.
- B. The quantity and unstable quality of plastic marine waste are issues to be solved by enterprises. Through different decomposition practices,

algae or plastic pyrolysis could generate hydrogen, which is valued by the government. The data showed that scrapped buoys were ideal materials for pyrolysis disposal and could be the best tool to solve plastic marine waste. It is recommended to hold education and training sessions or forums, as well as onsite demonstration observations for industry, government, academia, and research units for sharing knowledge, thus providing them with more options for the source of marine waste materials to develop more recycled products, and to promote a traceability mechanism for marine debris or certification marks, and enhance the capacity building of all parties.

- C. Annual cross-economy Ocean Day or environment-relevant campaign day is held to collectively foster borderless economic benefits from marine debris recycling and the reuse of marine waste, and boost the multichannel promotion of marine waste recycling products.
- D. A cross-economy joint project should be established to set up examples for the cooperation in marine debris recycling and solutions in order to promote marine waste products that are co-branded by multiple economies, the traceability mechanisms of marine debris or the development of certification marks.

2. Research and innovation.

A marine debris recycling consultation committee should be established for APEC economies based on the existing marine debris recycling systems constructed by these economies. These exchanges could facilitate the optimization and innovation of their recycling models and standards. These efforts are expected to promote technological advancements among the member economies of APEC in terms of their marine debris recycling, reuse, tracing, and monitoring activities.

3. Private sector engagement

The APEC OFWG should communicate the idea of marine debris reuse by showcasing their achievements in this field and making their contact information available on various media platforms. This could create cross-economy business opportunities and facilitate visits at prestigious

businesses or institutions, which in turn would offer opportunities for exchanges between projects, ultimately boosting economic growth in member economies.

Appendix

1. Agenda

Time (GMT+8) Taipei Time	Schedule
09:00-09:30	Registration and Test Run
09:30-10:00	OPENING CEREMONY
	<p>Welcoming Remarks by Wu, Meihong, Vice Minister of the Ocean Affairs Council (Chinese Taipei)</p> <p>Keynote Speech “Marine Debris Management Strategy and Implementation” by Dr Hsiang-Wen Huang, Director-General of Ocean Conservation Administration, Ocean Affairs Council (Chinese Taipei)</p>
10:00-12:00	SESSION I: SHARING BEST PRACTICES FOR TRACEABILITY MECHANISM OF MARINE DEBRIS RECYCLED PRODUCTS
	<p>The best practices and commitment to collect marine debris to recycle into eco-friendly products</p> <p>Mr Damon TSAI /Special Assistant & Carbon Asset Manager Chairman's office, Horng En Group / Chinese Taipei</p>
	<p>Upcycling the ocean plastic waste into new reusable products</p> <p>Mr Thosaphol Suppametheekulwat /Marketing Director New Arriva Co.,Ltd. CEO CirPlas Tech Co.,Ltd. / Thailand</p>
	<p>The approach of Peruvian status in marine debris recycling</p> <p>Mr Ricardo Dioses Avellaneda / Researcher Instituto del Mar del Perú /Peru</p>
	<p>Recycled products made from marine waste material access the solution to marine plastic pollution in Malaysia</p> <p>Prof Ir Ts Dr Pau-Loke SHOW Department of Chemical and Environmental Engineering / University of Nottingham Malaysia</p>
<p>Session I- Panel Discussion</p>	
12:00-13:30	Lunch Break

Time (GMT+8) Taipei Time	Schedule
13:30-15:30	<p align="center">SESSION II- THE IMPLEMENTATION OF THE POLICY OF MARINE WASTE RECYCLING AND REUSE EXPERIENCE TOWARD PROMOTING MARINE CONSERVATION</p>
	<p>The implementation of recycled marine debris product labels</p> <p>Mr Arthur Lian / Section Chief Environmental Protection Administration / Chinese Taipei</p>
	<p>The experience of adopting a plan of action and a stronger public-private partnership to reduce marine litter in the Philippines</p> <p>Prof Dr Alvin B Culaba De La Salle University Manila / The Philippines</p>
	<p>The thermo-catalytic conversion of marine plastics to valuable materials</p> <p>Prof Dr Young-Kwon Park School of Environmental Engineering / The University of Seoul Republic of Korea</p>
	<p>Floating Derelict Fishing Gear in the Central North Pacific: Quantities, Polymers, Sources, and Reuse</p> <p>Ms Raquel Corniuk Research Manager / Center for Marine Debris Research (CMDR) Hawaii Pacific University / United States of America</p>
15:30-15:50	<p>Session II- Panel Discussion</p> <p>Coffee Break</p>

**Time (GMT+8)
Taipei Time**

Schedule

**SESSION III- THE INDUSTRY-GOVERNMENT-ACADEMIC COOPERATION
FOR THE MARINE DEBRIS MANAGEMENT PROGRAM AND THE
ACCELERATION OF THE RELATED POLICIES**

Circular Economy for Marine Plastic Wastes, from theory to action

Mr Beltrán Orrego / Development Manager
Atando Cabos / Chile

Walk to Clean Ocean

Dr Nattapong Nithi-Uthai / Co-founder
TLEJOURN SE and TRASH HERO PATTANI / Thailand

**Seagrass/seaweed bed restoration with 3D printed mold (composition made from
biodegradable/recycled plastic with growth stimulants)**

Prof Dr Dang Diem Hong
Algal Biotechnology Department / Institute of Biotechnology (IBT)
Vietnam Academy of Science and Technology (VAST) / Viet Nam

**The best sharing of monitoring activities of plastics in the environment and
possible utilization of remote sensing technologies in Japan**

Dr Noriko Tamiya-Hase / Deputy Director
Office of Policies against Marine Plastics Pollution / Water Environment Division
Ministry of the Environment / Japan

Using Continuous Monitoring Data of Coastal Litter to Drive Policy Change

Ms Ning Yen / CEO
IndigoWaters Institute / Chinese Taipei

Session III- Panel Discussion

17:50-18:00

**Closing speech from Hsiao-Hsia Li, Director of Ocean Conservation
Administration, Ocean Affairs Council (Chinese Taipei)**

2. E-Handbook of the Workshop

https://drive.google.com/file/d/1JU-ahwfAyyVNEhvaGXvpiuHfRYCcEMna/view?usp=share_link

3. Event recording video link (only open access for the participants who has attended the event)

<https://www.youtube.com/playlist?list=PLzyeKKevyLxmo7W2hCGctwBO8JI0ngRJI>