CLOMA

CLOMA VISION

Alliance Creates New Innovation

Executive summary

Japan Clean Ocean Material Alliance

We are surrounded by plastics being used in various products.
There are numerous types of plastics, each of which
has unique characteristics that serve for our needs.

For instance, plastics with high-barrier capability are used for food packaging to help extend food expiration dates and reduce food loss and waste.

As such, plastics are indispensable materials for our daily lives,
not only because they are convenient, but because they are
key materials that are linked to overcome social issues.

Marine Plastic Litter

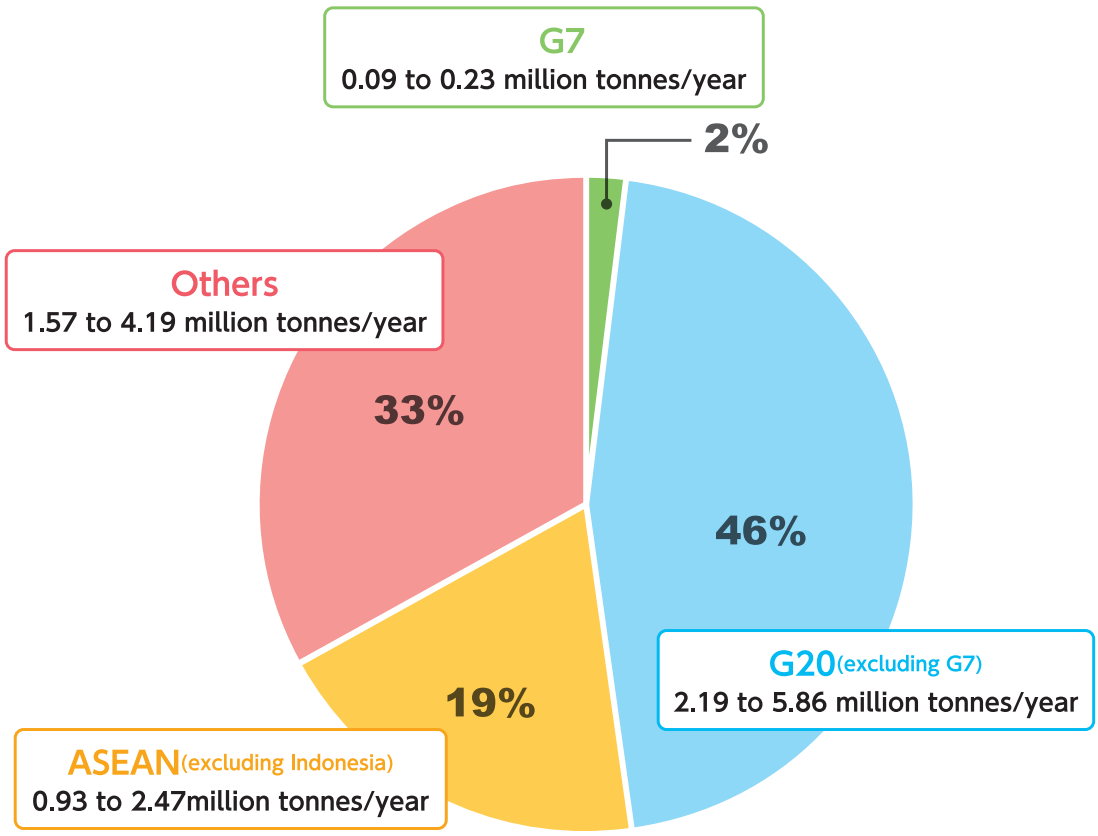
Since plastic became industrialized, production of plastics and plastic products has rapidly increased, spreading widely into our daily lives due to plastic' s convenience and capable to be mass-produced. Plastic production in 1964 was 15 million tonnes, and since then has increased dramatically to 311 million tonnes in 2014. Plastic production is estimated to be doubled during the next twenty years.※1

On the other hand, it has been pointed out that used plastics products are not appropriately collected and/or disposed because they do not meet the existing social system, and are leaked into the environment. In recent years, environmental issues caused by plastic wastes leaked into the ocean has become a concern.

Reports in 2015 have indicated that at least 8 million tonnes of waste plastics have flowed out from land areas to ocean areas each year.※2 Estimates are that by 2050 the volume of plastics in the ocean will surpass that of fish, posing a further threat to sustainability.※3

※1 World Economic Forum Report, The New Plastics Economy, 2016
※2 Jambeck et al., Plastic waste inputs from land into the ocean, Science, 2015
※3 Ellen Macarthur Foundation, New Plastic Economy, 2016

Quantity and ratio of waste plastics flowed into the ocean (breakdown by region)



Note: Percentage rates were calculated using the median of the released amount.
Jambeck et al., Plastic waste inputs from land into the ocean, Science, 2015

CLOMA's Mission

We launched CLOMA (Japan Clean Ocean Material Alliance) to overcome the marine plastic litter issue.

Since the 1990s, Japan has focused on addressing waste problems, while promoting the 3Rs (reduce, reuse and recycle). We believe that technologies and knowhow accumulated in Japan will be useful in tackling the new challenges to the marine plastic litter issue.

However, the challenge is too immense for a single company to tackle. There is a need to combine and build on CLOMA members' knowhow and technologies, while sharing knowledge for technological development. This requires understanding and cooperation among various stakeholders to address this issue as a whole society.

At CLOMA, we strive to disseminate from Japan new solutions aimed for achieving the Clean Ocean, by sharing the CLOMA vision, and by facilitating collaboration among its members.

Details of Major Activities

Dissemination & Promotion WG

Sharing 3Rs technologie and the technological information to select the alternative materials easily

- ◆Technology and Business Matching
- ◆Good Practice Seminar & Exhibition
- ◆Discussion of measures for 3Rs technologies and promotion of sustainable plastics and alternative materials

Technology holders of 3Rs and altarnative materials
(Chemical, Paper Companies, Recyclers etc.)

Sharing information and Matching

Users
(Distribution, Food,Beverage etc.)

Cast & Processing Companies

Collecting Information

Dispatch of Information

International WG

Collecting information in collaboration with international organizations and institutions, and dispatch of information and technical consulting for developing countries

Advanced Countries

UNEP／UNEA※
G7／G20

Developing countries

※United Nations Environment Programme United Nations Environment Assembly

Problem Presentation ↓ ↑ Information exchange

Problem Presentation ↓ ↑ Information exchange

Technology WG

Holding seminars on cutting-edge technologies

Technology holders of 3Rs and developing raw materials

Technology Cooperation

Research and development institutions Representative associations for each industry

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Japan's Current Efforts

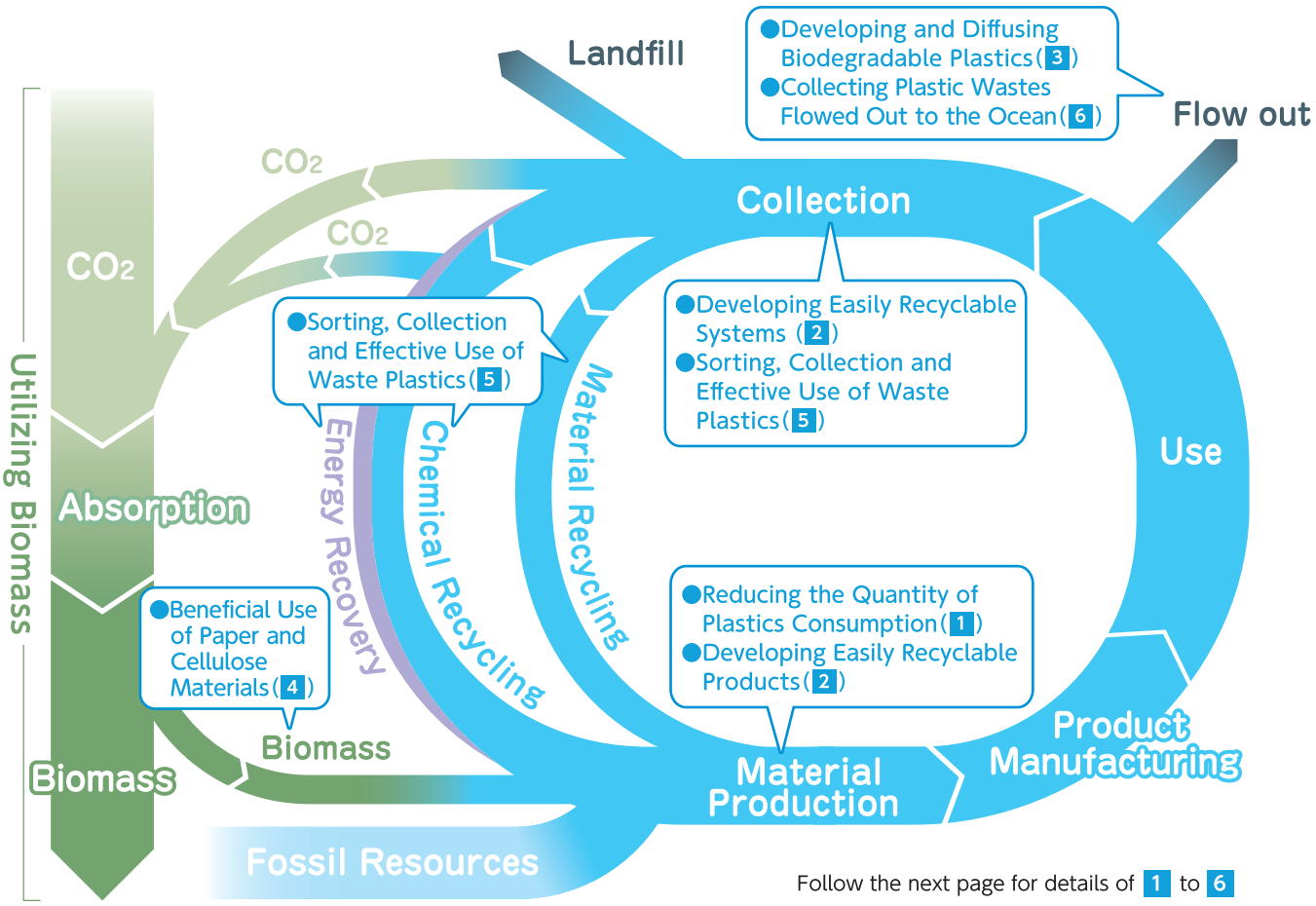
Japan has coped with its scarce natural resources and limited land area over time. For this reason, we established a system which uses its resources efficiently and reduces environmental load.

Japan's PET (polyethylene terephthalate) bottle industry took the initiative in making PET bottles lighter, reducing a bottle's weight by 24% between the fiscal years 2004 and 2017. Moreover, as to plastic bottles for laundry detergent, diffusion of refillable products has contributed to reduction of plastic use volume for packages and containers (such as plastic detergent bottles) per product shipment by 42% between the fiscal years 1995 and 2017. Further, in addition to material recycling for use as recyclable materials, by effectively using broad field of industrial infrastructures, Japan beneficially combines chemical recycling for use as a feedstock and energy recovery as well, and we have achieved 86% of effective use rate with plastic wastes discharged domestically and only 6% of landfill rate.

Despite these efforts, some waste plastics cannot be collected properly, and may end up being abandoned in the environment. Research and development are thus underway on biodegradable plastics that can decompose in the environment. The work of Japanese companies has led to PBS and PHBH to be commercialized as biodegradable plastics.

Note: PBS: Poly Butylene Succinate, PHBH: Poly (3-hydroxybutyrate-co-3-hydroxyhexanoate)

Relationship between Current Efforts and the Lifecycle of Plastic Products



Follow the next page for details of 1 to 6

1 Reducing Use of Plastics

To reduce the quantity of plastics use, Japanese industries have continuously worked on producing thinned and light-weighted products, as well as promoting refillable products. More specifically, improvements in forming and filling technologies have led to lighter PET bottles and greater use of refillable containers such as those for detergents has led to the reduction of plastic use volume per product shipment.

For further resource saving, there is a need to tackle the issue with an innovative perspective, such as by devising creative designs of new products.

PET Bottle weight reduced by

24%

(Fiscal Years 2004 to 2017)

Amount of plastic packages and containers used per product shipment volume reduced by

42%

(Fiscal Years 1995 to 2017)

Refillable Products

2 Developing Easily Recyclable Products, Technologies and Systems

Different types of materials are often mixed or used in a multi-layered fashion to ensure high-functionality. However, mixed and multi-layered materials are sometimes difficult to recycle. As its solution, mono-material methods, which allow a single type of material to perform a required function is promoted as well to increase the recyclability of products.

Aside from designing a product itself, it is also necessary to develop technologies that ensure the recycling quality of items with some degree of remaining dirt and impurities. In Japan, chemical recycling has also been promoted, in which used products are recycled into raw materials for blast furnaces and coke ovens.

If considerable amount of dirt is adhered to plastics, it is not always possible to recycle the plastics. In such cases, the plastic wastes are reused as effectively as possible by collecting energy produced through incineration. It is also effective to expand the use of biomass plastics for items that are difficult to recycle.

3 Developing and Disseminating Biodegradable Plastics

Conventional plastics rarely decompose into the natural environment. Biodegradable plastics are therefore being developed, for plastics may be inadvertently leaked into the environment. Biodegradable products have received attentions just after the marine plastic litter issue became well-known.

At present, there are few types of plastics that have been scientifically recognized as biodegradable. However, Japanese companies have developed products, some of which have already been commercialized and now being developed for use in various applications.

◆Products made from PBS

PBS demonstrates a superior biodegradability in the natural environment, such as soil. Compared to the general biodegradable plastics, PBS has greater heat resistance.

◆Products made from PHBH

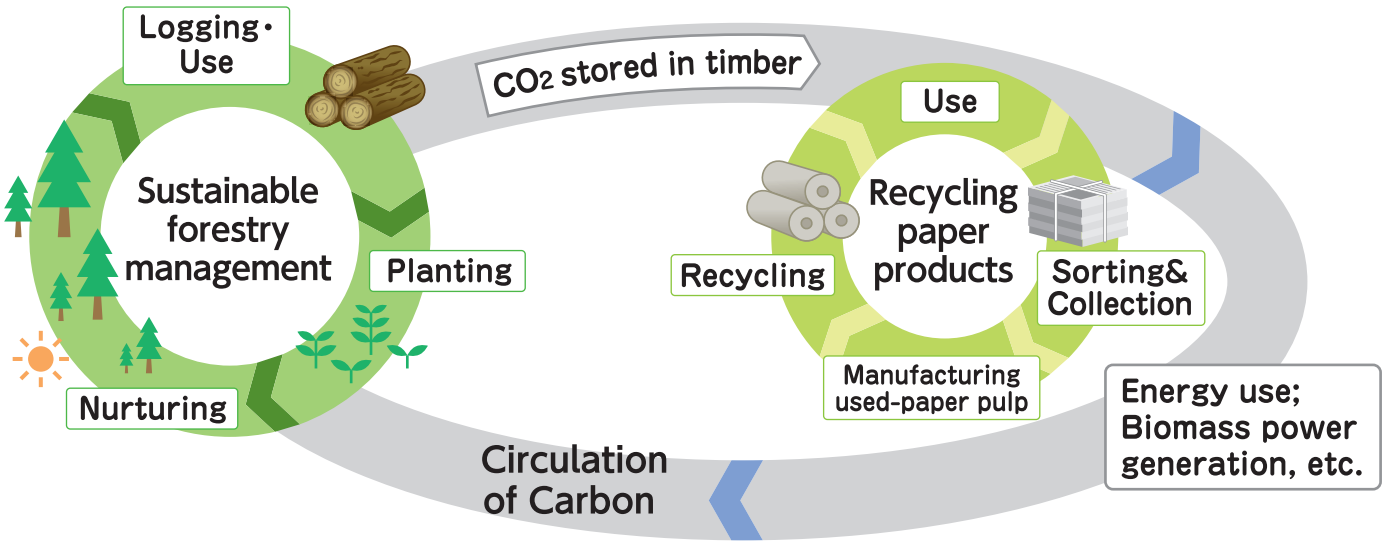
PHBH is a 100% bio-based polymer produced by fermentation of biomass, such as plant oils, with microorganisms. PHBH has an excellent biodegradability. It decomposes into carbon dioxide (CO2) and water in natural environments such as in soil and in seawater.

4 Beneficial Use of Paper and Cellulose Materials

Providing alternatives to plastics is underway, which are derived from biomass and are highly degradable in the natural environment, namely papers and cellophanes.

Plastics are versatile and highly functional. In order for papers and cellulose materials to realize similar qualities and functions of plastics, paper-based materials are laminated with plastic film.

Currently, research and development have been conducted on coating paper-based materials with aqueous paint to improve their barrier properties.



5 Sorting, Collection and Effective Use of Plastic Wastes

In line with the Containers and Packaging Recycling Law, used plastics are collected and treated by local municipalities and recycling business operators. Also, Japan's recycling system is supported by responsible users who sort and dispose waste items in a proper manner.

More specifically, sorted collection of PET bottles and over-the-counter collection of used items such as food trays are implemented. Collected plastics are then separated according to the three types of resins, namely PP, PE, and PS before being turned into recycled resins.

On the other hand, waste plastics with adhered dirt that are not suited for recycling are incinerated. In such cases, energy generated in the process is also used effectively.

In the future, it is vital to create a virtuous circle to further promote recycling, notably by stabilizing the provision and quality of, and creating high added value of recycled resins.

Note: Polypropylene (PP), Polyethylene (PE), Polystyrene (PS)

6 Collecting Plastic Litter Flowed Out to the Ocean

It is also an essential effort to collect and process plastics already flowed out to the ocean. Although the cost of retrieval remains a challenge, the effort is expected to be further promoted if the collected waste plastics can be recycled and can have higher added values.

The Alliance to End Plastic Waste (AEPW), which was founded by world business enterprises tackling the plastic issue, has announced that it plans to finance clean-up of rivers and around areas where waste plastics are flowed out to the ocean. Japanese companies are also participating in this effort.

Ideal Vision

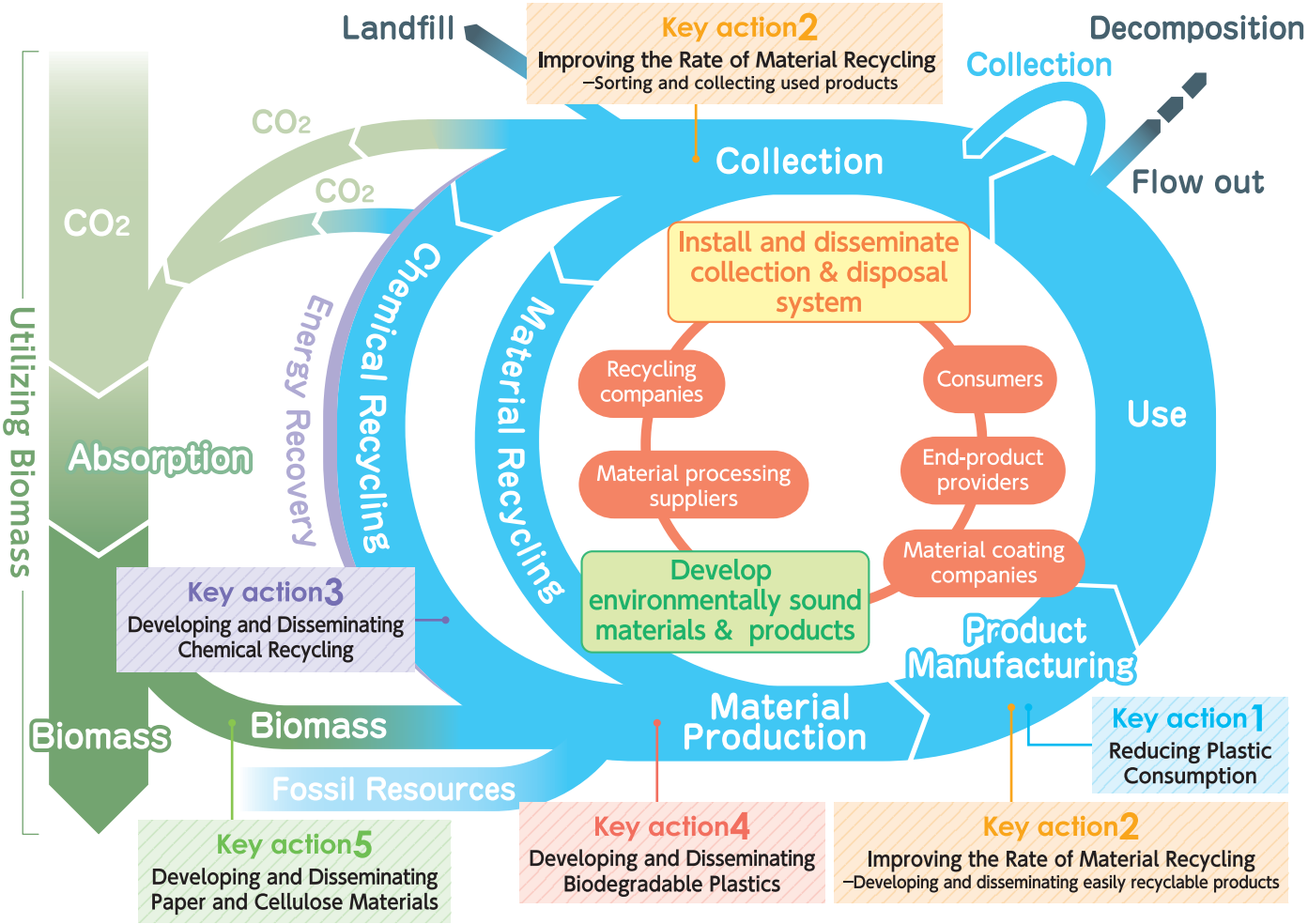
CLOMA builds a sustainable 3Rs system and contributions with its materials technologies to realize the world with the Clean Ocean. We strive to concurrently achieve the Sustainable Development Goals (SDGs) by promoting the five Key Actions while sharing CLOMA Principles.

CLOMA Principles

To solve the marine plastic litter problem, it is essential to ensure the thorough collection and disposal of used plastic products. In addition to this, it is also important to promote developing, manufacturing and using environmentally sound plastic products, and using alternatives that are environmentally sound materials/products.

1. We will contribute to the attainment of SDGs and clean ocean through the development, production and use of materials and products.
2. We will proceed with the following goals as two wheels: thoroughly implement proper collection and disposal of used plastic products, while deepening efforts on the 3Rs and using alternatives that are environmentally sound materials/products.
3. We will share technology, knowhow and experiences among our members at the maximum level, and create larger-scale innovations including new business models.
4. We will optimize the combination of technology development and social systems, and gain understandings from stakeholders to accelerate social implementation.
5. We will disseminate a “Japan model” to the world which enables circular use of materials and reduction of environmental load by accommodating our model to the situation and needs of each country.

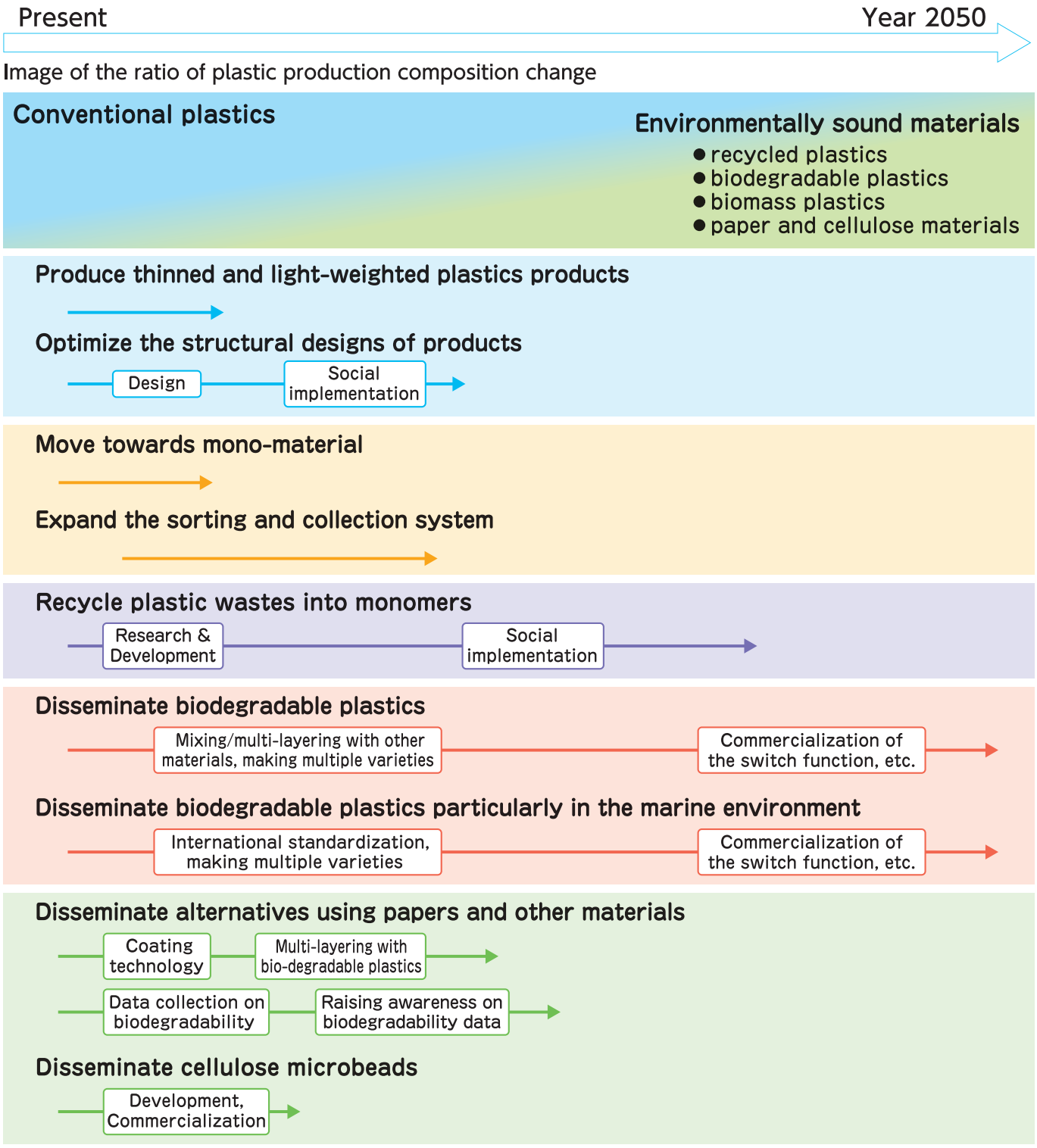
Relationship between the five Key Actions and the Lifecycle of Plastic Products



Overview of Key Actions

It is important to optimize the combination of key actions which suit the given social situation while considering specific advantages and disadvantages of materials and products. For instance, biodegradable plastics, papers, and cellulose materials are effective at solving the issue of plastic litter leaked into the environment, while the expanded use of biomass plastics is beneficial for curbing global warming and reducing fossil resources dependence. Therefore, we expect those measures will be effectively implemented to match the situation.

At CLOMA, we have a comprehensive perspective in considering different characteristics of various materials as well as progress of relevant efforts. By substantiating the key actions, we pursue not only realization of the Clean Ocean but also concurrent achievement of the SDGs.



Key action 1 Reducing Use of Plastics

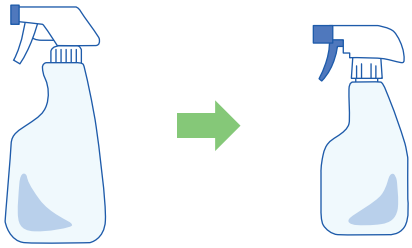
In Japan, efforts have been made to manufacture thinned and light-weighted plastic products, as well as to diffuse refillable products. To achieve further reduction of plastic use in the future, we need to progress the efforts involving an innovative viewpoint, such as devising structural designs of products.

By changing the structural designs of containers, for instance by replacing bottles with packaging films, the quantity of used plastics can be significantly reduced.

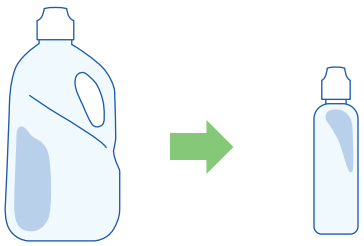
Moreover, we furnish a market environment in which newly designed products can be easily distributed into the market throughout standardization of environmentally sound product designs.

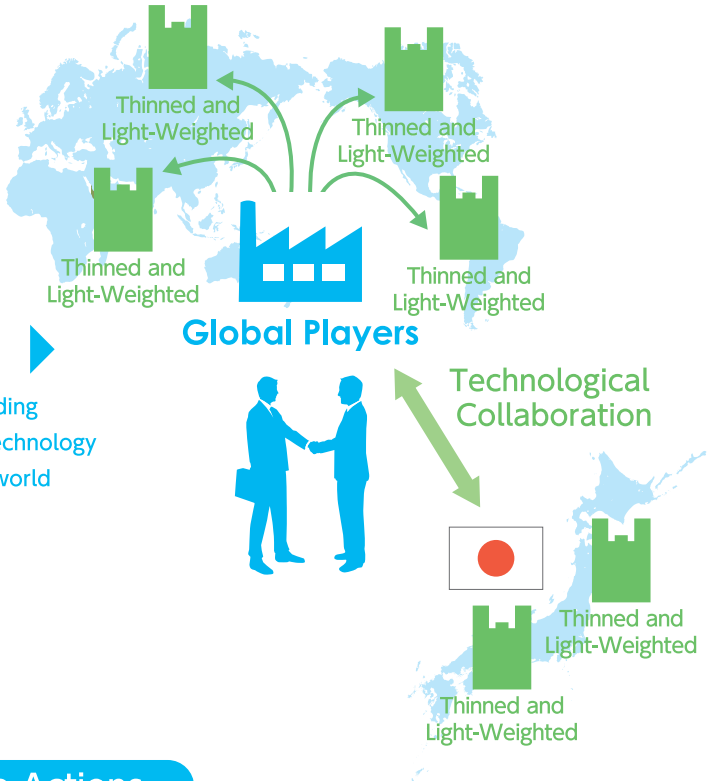
Other ideas would be feasible that Japan's technologies to produce thinned and light-weighted plastics can be expanded into overseas markets. Moreover, packages and containers can become more compact by devising the contents within.

Optimization of products' structural design



Condensing the content





Future Actions

- ◆Make innovative changes in the structural designs of products, such as replacing bottles with packaging films for containers
- ◆Promote diffusion of returnable containers and other items by changing business models
- ◆Develop technologies of vapor deposition and coating layers (i.e. vapor deposition/coating technologies and the like) that enable plastics to exhibit superior barrier properties
- ◆International standardization or de facto standardization
- ◆Expand application of technologies overseas which attain reduction of plastic use

Key action2 Improving the Rate of Material Recycling

We intend to further enhance material recycling, which is identified as advanced in social implementation among methods of effective use of plastic wastes, through its technological development and establishment of supportive social systems.

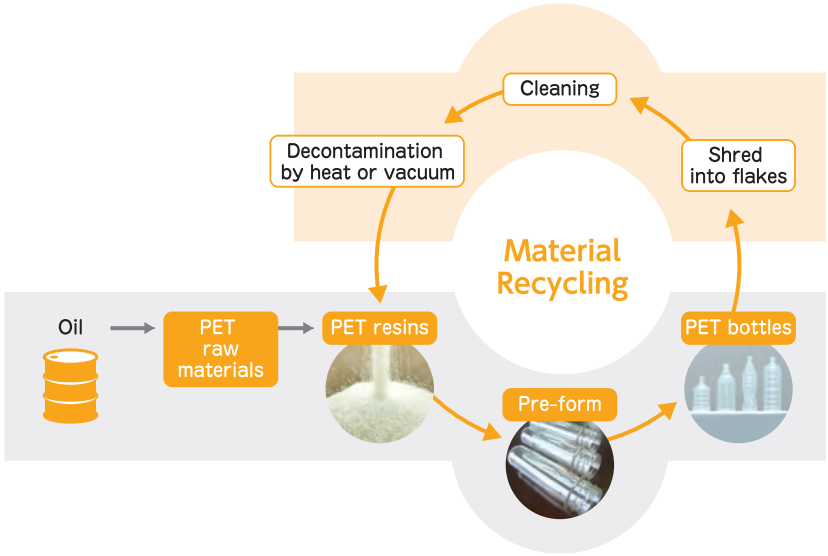
Recycling Technology

mono-materialization, optimization of applications according to the level of deterioration of resins

Sorting and Collection Systems

Collaboration among stakeholders including manufacturers, retailers, recyclers, and users

Efforts on PET bottles to PET bottles



Efforts have been made on PET bottles-to-PET bottles technology, which enables used PET bottles to be recycled into new PET bottles, while promoting its social implementation.
It is important to advance the technology but also to build a social system that supports such technologies.

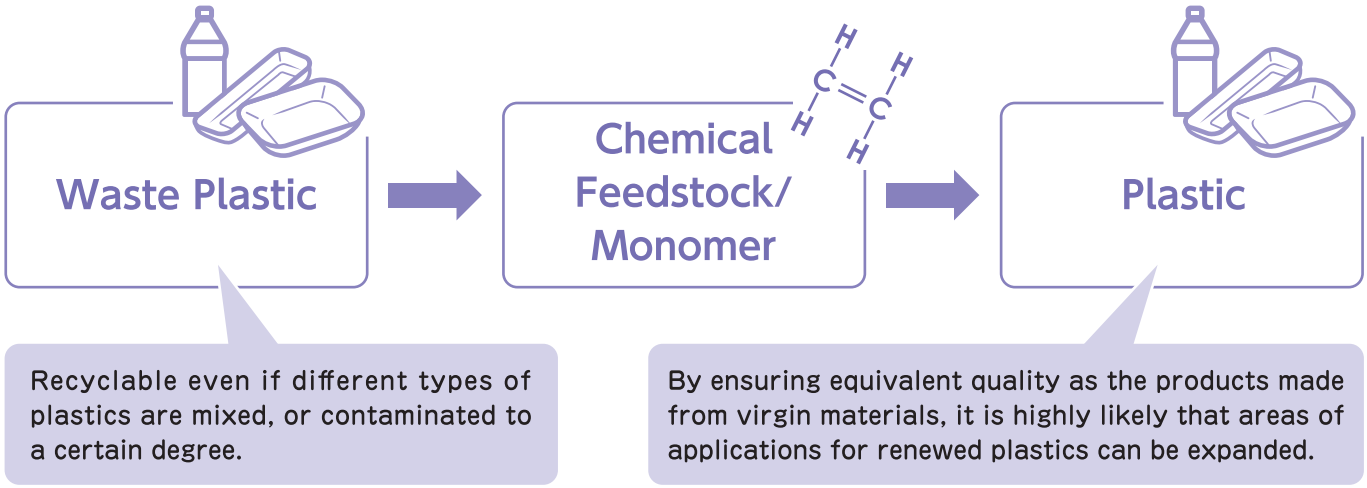
◆PET bottles manufactured with recycled PET resins

Future Actions

- ◆Further advance the technology for recycling mixed/multi-layered materials
- ◆Develop a technology to change multi-layered film into a single material; and search for possible combinations
- ◆Establish a recycling system that facilitates collection of plastic wastes at retail stores and the returning of plastic wastes to their manufacturers
- ◆Devise methods to encourage users to sort wastes according to plastic types
- ◆Develop technologies capable of sorting, collection and high-accuracy sorting according to plastic types
- ◆Expand use and applications of, and add a higher value to, recycled plastics
- ◆Develop technologies to optimize the recycling methods by the applications of recycled plastics based on the level of plastics' deterioration

Key action3 Developing and Disseminating Chemical Recycling

Chemical recycling, creating high added value, will be promoted through which waste plastics are used as raw materials, namely ammonia and ethanol. Also, we aim to gain even higher added value by developing, introducing and disseminating technologies for returning the waste plastics to monomers. Our goal is to reduce the environmental load of recyclables compared to that of virgin material products over their entire life cycle, including load to water environment and energy consumption involved in recycling.



Note: Monomer is a low-molecular constituent forming plastics, which are also classified as polymers (chemical compounds with macromolecules).

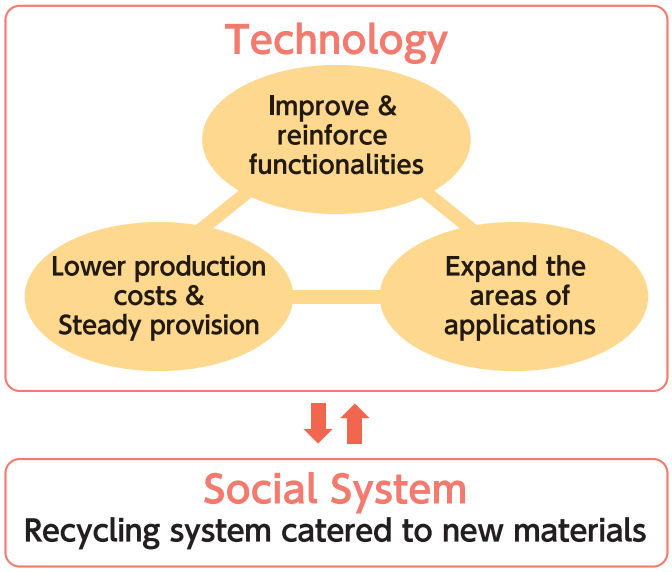
CLOMA aims to optimize recycling technology for those recycled products to have a higher added value.

Future Actions

- ◆Develop technologies to transform waste plastics back into monomers through chemical recycling and promote its social implementation
- ◆Develop technologies that can produce quality renewed plastics regardless of high residual content
- ◆Reduce recycling costs
- ◆Pursue the best mix of material recycling and chemical recycling such as the optimization of sorting waste plastics

Key action4 Developing and Disseminating Biodegradable Plastics

Some biodegradable plastics are easily decompose in soil, while others do so in the ocean. Conditions under which degradations occur vary. Therefore, it is necessary to apply respective biodegradable materials to an adequate purpose depending on their characteristics. To expand their use in various applications, it is also necessary to optimize the existing recycling system.



Soil-biodegradable Plastics

Certain types of plastics can be decomposed by composting or in the natural environment. CLOMA aims to contribute globally by expanding its business overseas, especially in areas where composting facilities exist.

Marine-biodegradable Plastics

This is a key technology to reduce the quantity of marine plastic litter. Using the Japanese government assistance, CLOMA will develop technologies that can control the speed of degradability to expand the material's potential applications.

Image Diagram Showing the Expanded Applications of Marine-Biodegradable Plastics

※Roadmap for Popularizing Development and Introduction of Marine Biodegradable Plastics
(Formulated by Japan's Ministry of Economy, Trade and Industry in May 2019)

Short-term Shopping bags, trash bags, straw, cutlery, plastic bottles such as detergent containers, packaging materials (food packaging such as snack bags that would require cleaning, general packaging including shrink film), multi-film for agriculture, etc.

Mid-term Non-woven fabric (e.g. face masks), foam products (e.g. cushioning/buffer materials), etc.

Long-term Coating material for fertilizers, fishing equipment (e.g. materials for fishing and aquaculture), etc.

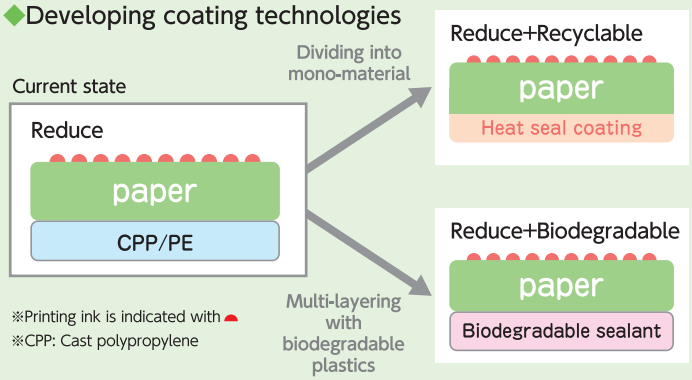
Future Actions

- Develop new biodegradable plastics that can complement and reinforce the physical properties of existing biodegradable plastics
- Develop new materials that will complement and reinforce their physical properties when mixed into biodegradable materials
- Develop processing technologies for products using biodegradable plastics, and apply appropriate purposes depending on their physical properties
- Standardization and de-facto standardization with regard to content of biodegradable plastics and their decomposition abilities
- Develop production processes that ensure steady provision at a reasonable price, and reinforce facility
- Establish recycling methods including the separation of biodegradable plastics, expanding the applications of recycled plastics
- Develop materials that are capable of controlling degradation speed, and other materials that are equipped with a switch function, enabling the material to start decomposing at an intended timing
- Develop plastics that are highly degradable in the marine environment

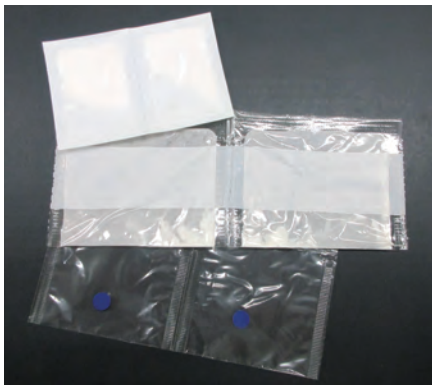
Key action5 Developing and Disseminating Paper and Cellulose Materials

Coating technologies having been developed enable reduction of plastics use with higher recyclability, while maintaining functions that were obtained by laminating papers and films. If papers alone cannot perform a needed function, the papers can be mixed and/or multi-layered with biodegradable plastics to attain decomposition ability.

◆Developing coating technologies



◆Cellophane and related products



At CLOMA, we will develop introduce and disseminate cellulose materials including cellophane and cellulose microbeads.

※Picture on the right shows the packages for medicines
(milky-color cellophane, partially-printed items, and transparent items)

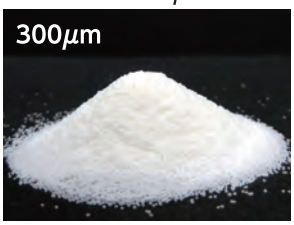
◆Different Sizes and Applications of Cellulose Microbeads

2～4mm

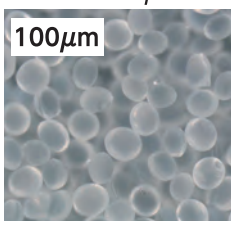
Fields of Applications

Catalytic support for deodorants, air fresheners, anti-microbial agents and insect repellent, artificial culture soil, and base material for kitchen garbage disposal, etc.

300～1000μm



50～300μm



Fields of Applications

Scrubs including cosmetics, toothpaste, body cleansers, lightweight plastic material, catalytic support (agrichemicals, perfume, air freshener), porous ceramic materials, modifying material, etc.

◆Fragrances using cellulose beads

Future Actions

◆Develop technologies for providing papers with advanced function such as water-resistance
◆Develop and diffuse cellulosic materials including cellophanes and the like
◆Develop technologies on mixing and multi-layering with biodegradable plastics among other highly degradable materials
◆Improve the recycling rate of papers and other products that are difficult to recycle under the existing recycling system
◆Accumulate evidence data on the biodegradability of cellulose materials, and raise awareness on this issue

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