

# **Chemical recycling of plastic waste – Japanese experiences and potential –**

## **Agenda**

- 1. Definition and purpose of chemical recycling**
- 2. Implemented example in Japan**
- 3. Socioeconomic conditions required for recycling**

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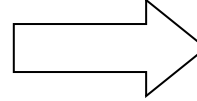
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# Target waste and product of mechanical and chemical recycling, and energy recovery

Fewer plastic components



Mech  
Recycling

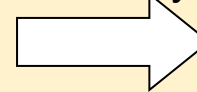


Recycled plastic products

Mixed plastics



Chem  
recycling  
Energy  
recovery



Chemicals,  
fuel oil and gas



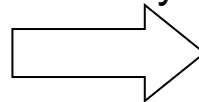
Coal substitute  
in a steel mill

Syn-gas

Mixed  
combustibles



Energy  
recovery

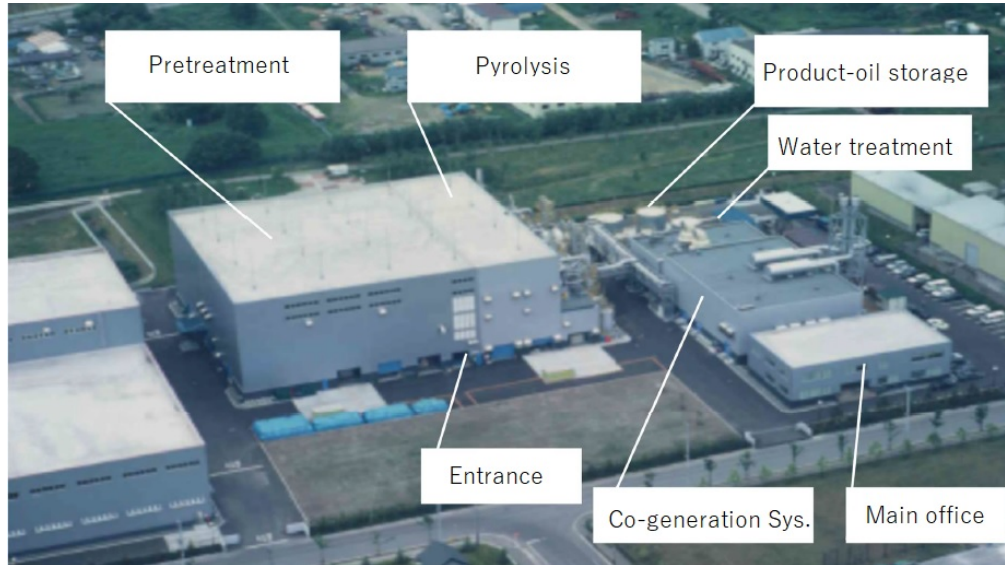


Incineration with  
energy recovery



Solid fuel  
(Coal substitute)

# 40-ton/day pyrolysis plant (120,000 ton/year) for plastic waste from households



## Overview

- Operated in Sapporo, Japan in 2000 - 2010
- 4 lines X 10-ton/day rotary kiln
- Product oil was shipped to oil refinery

Ref. Ibe and Kodera, J. Material Cycles and Waste Management, **23**, 449-460 (2021)

## Waste source and conversion process

Plastic waste separately collected by municipality



Pretreatment --- Pyrolysis --- Distillation  
air separation,  
pelletization,  
dechlorination



Shipping to oil refinery for chemicals and fuel production

# 6-ton/day pyrolysis plant for plastic waste from industry, Fujioka city, Japan

- Target waste: plastic packaging from factory
- Product application: boiler and power generator

Operating since 2006



# Chemical recycling

## Pros

- Accept mixed thermoplastics
- Produce hydrocarbons and syngas, which have potentials to give valuable final products.

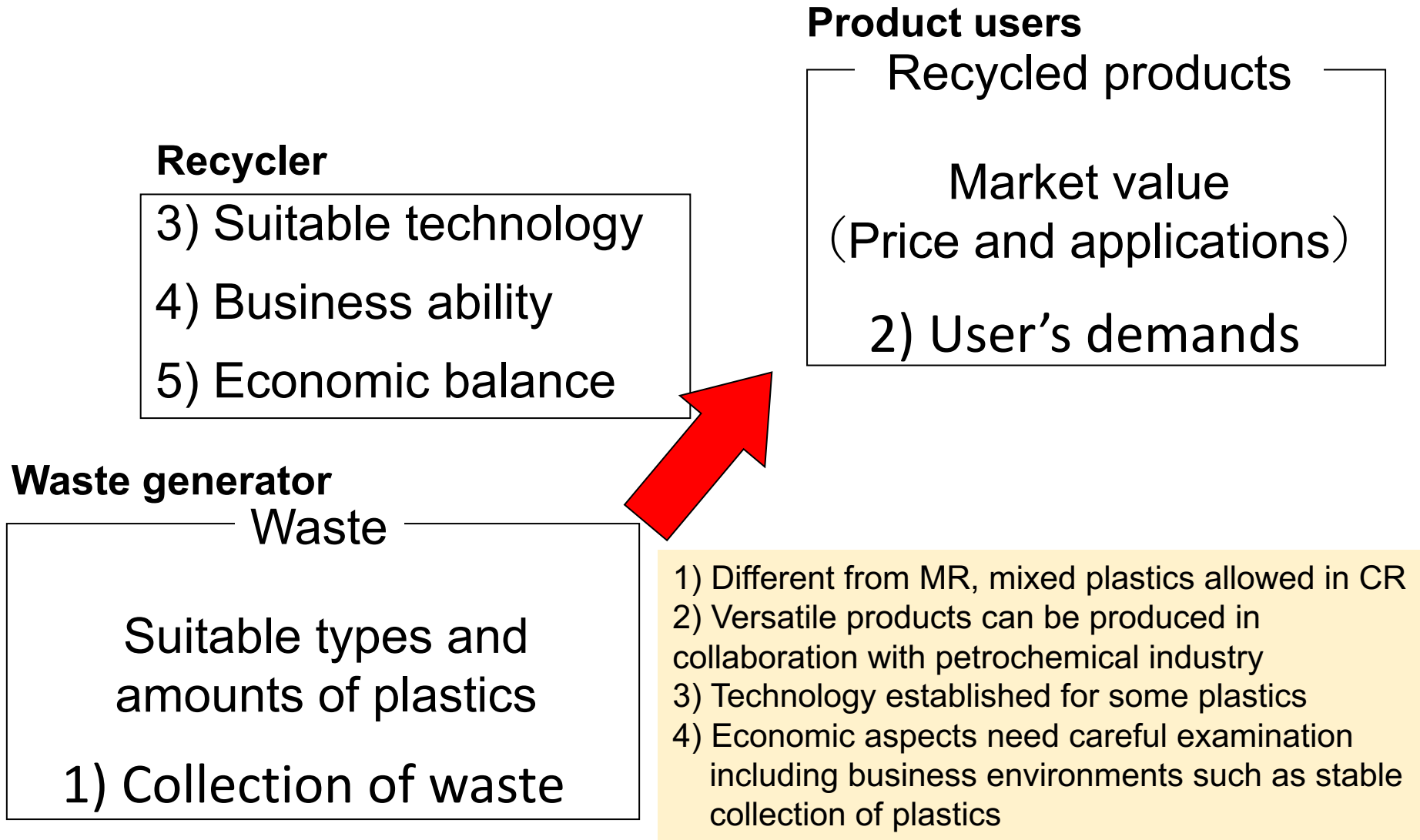
## Cons

- Need other advanced industries to consume products
- Large-scale operation (ex. >10 ton/day) is required for business benefit.
- Stable collection and shipping is required for business success.

Effects of various business conditions on the economic balance: Ref. Ibe and Kodera, *J. Material Cycles and Waste Management*, **23**, 449-460 (2021)

# Summary 1: Chemical recycling

## Required business conditions and



# Summary 2: For Plastic-free rivers

- Plastic industry, package users, municipal governments, and general consumers are all **responsible for plastic-free environments**.
- Chemical recycling is a complementary option to mechanical recycling as **mixed plastic waste** can be converted into valuable products, which will add economic values to waste collection.
- **Increasing value of waste** through recycling is a key to reduce plastics scattering in the environment.
- **Stable collection and carbon-free applications** of plastic waste are of importance considering business success. **Effective collaboration** among municipality, recycler, and petrochemical industry has a critical role for establishing recycling.