

# MCG and chemical industry's efforts towards Circular Economy

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Eu-Japan Centre for industrial cooperation webinar

***Current Status and Challenges of the Circular Economy - Toward a  
Growth-oriented, Resource-autonomous Economy***

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## Significance of Circular Economy for industry

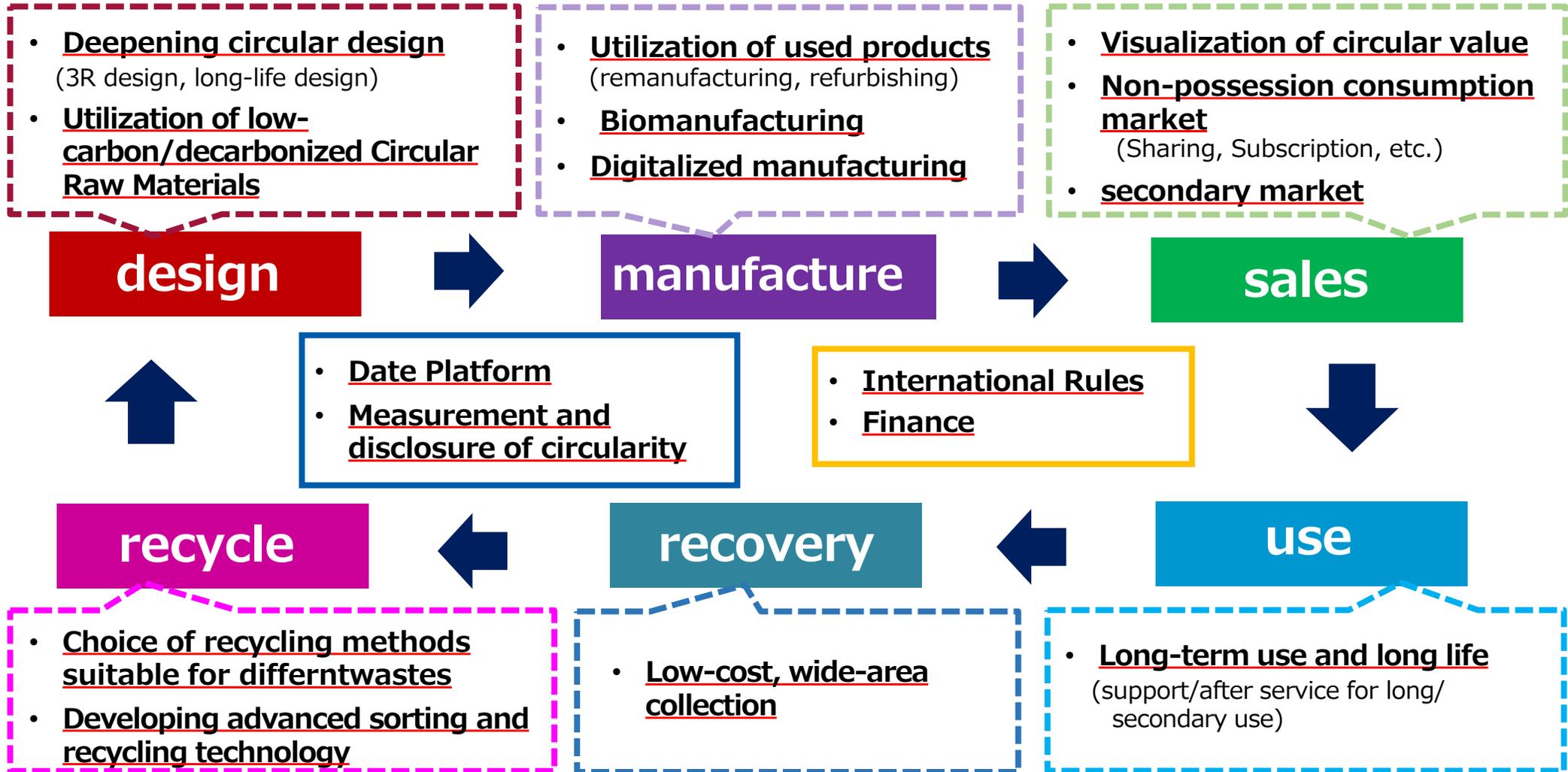
- ❑ Resilient supply chain / securing necessary resources
- ❑ Reduce input for business operation ⇒ higher efficiency and lower costs
- ❑ Closer relation with stakeholders throughout value chain
  - ✓ Downstream industry (customers) ⇒ closed loop and market
  - ✓ Upstream industry and the venous industry⇒ Chemical industry can connect whole value chain with circularity
- ❑ Strong tie with regional economy/eco system
- ❑ Providing new values (described above) ⇒ expansion of market



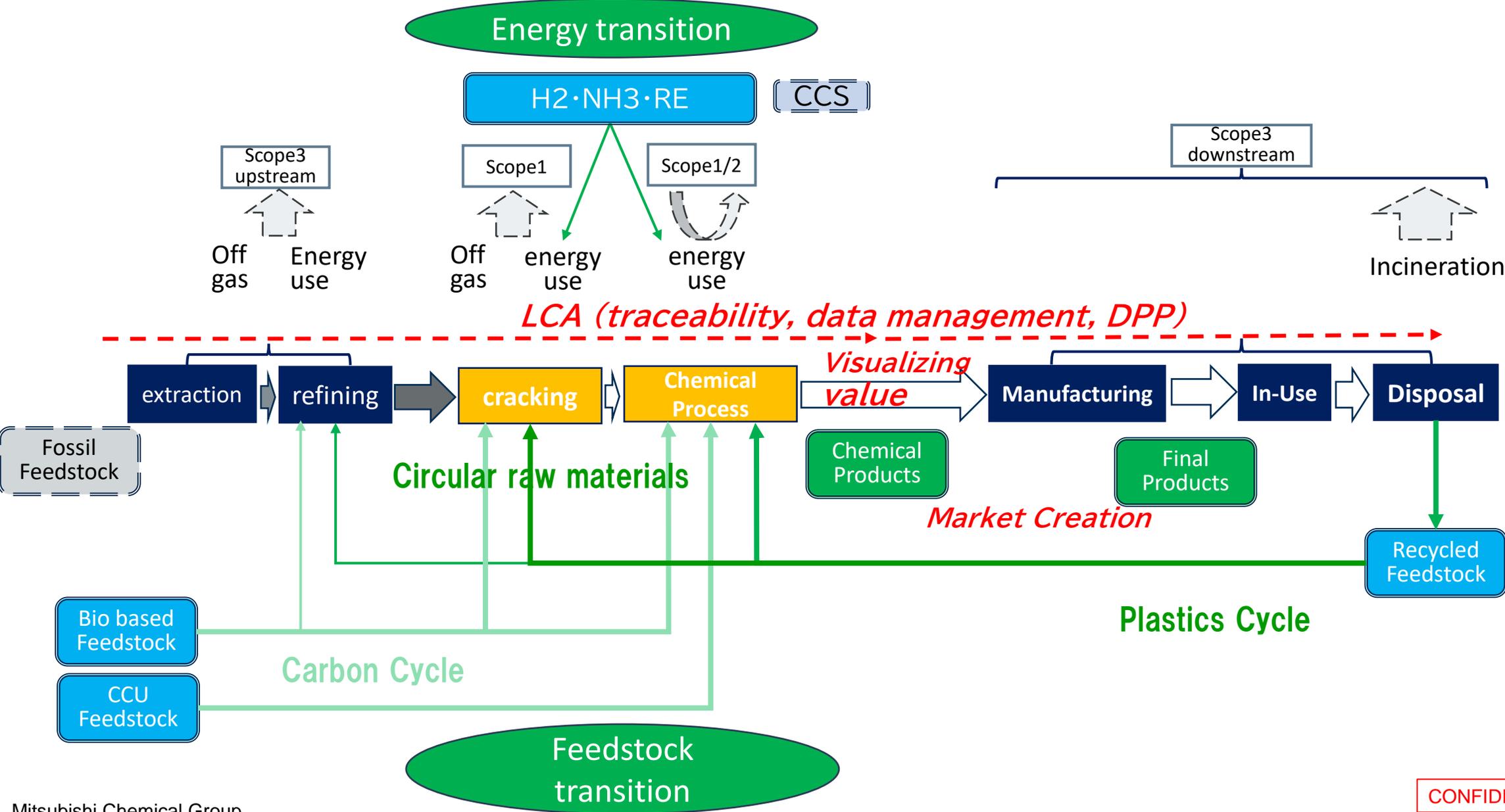
Competitiveness of industry and the region

# CE consideration throughout the lifecycle

- “CE” is not only recycle. “CE” is about contribution to any stage of entire life cycle.
- Take CE consideration/action to all stages. (RD/design, manufacturing process, business/sales model, waste management)



# Circularity and Decarbonization of Chemical Industry



# Examples of our actions in MCG

## Use of bioplastics

**Biomass products**  
(non-biodegradable)



**Biomass + Biodegradable products**



**Biodegradable products**

**G-Polymer™**

## Plastic recycling

**Material Recycling**

PET shrink label  
Carbon fiber composite materials **PYROFIL™NEO**

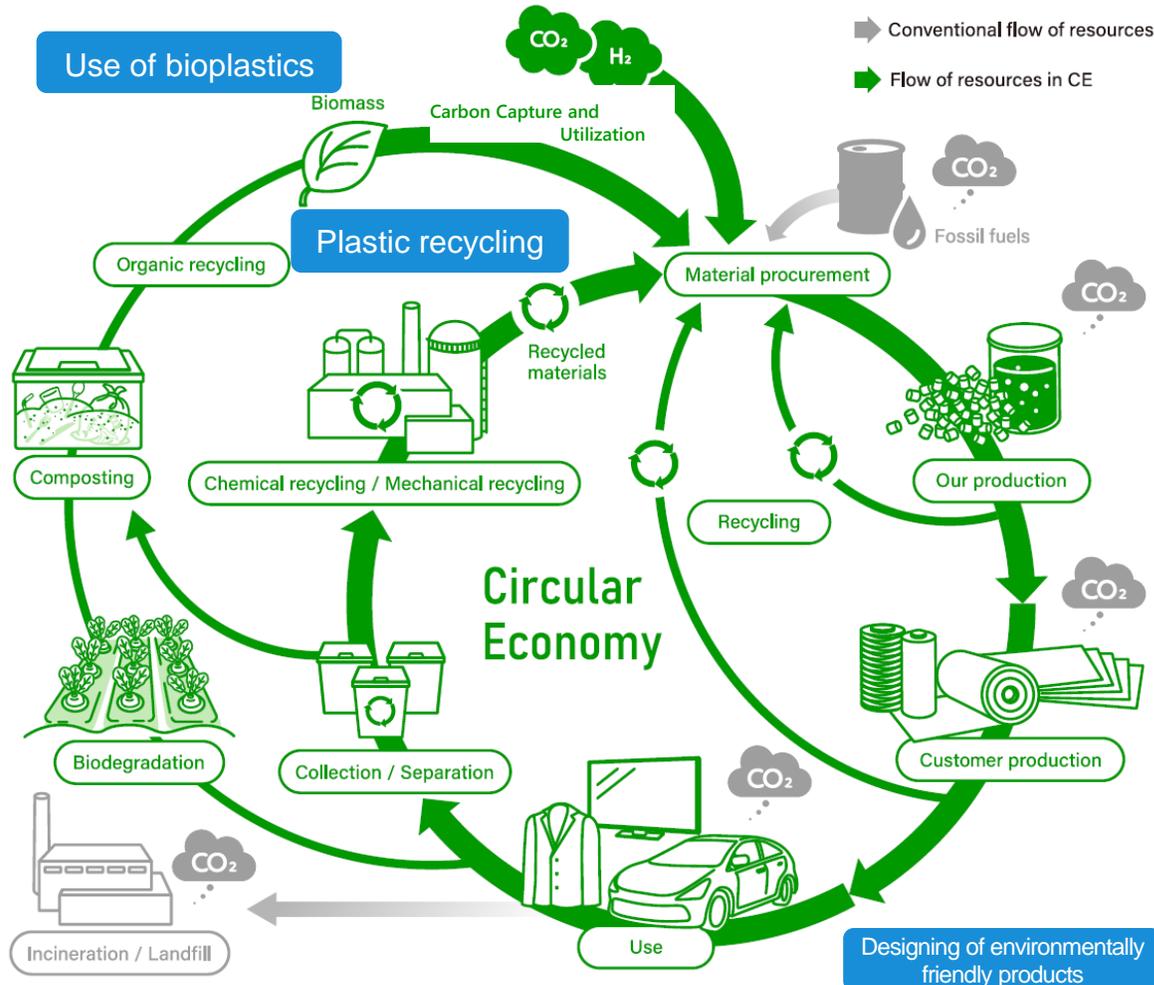
PVC resin  
PBT resin **NOVADURAN™ CEシリーズ**  
Solar panel

**Chemical Recycling**

Pyrolysis of PO-based plastics  
Pyrolysis of waste tires  
Monomerization of acrylic resin  
Monomerization of polycarbonate resin  
Monomerization of epoxy resin

## Carbon Capture and Utilization (CCU)

Commercial production of PP derived from CO<sub>2</sub>/green hydrogen



## Reduce load during manufacturing

**Environmental friendly mobility: Paintless/alternative**

High hardness/transparency **DURABIO™**  
Decorative film **アクリプレン™**

**Ecosystem for advancement of semiconductor**

Semiconductor precision cleaning **新菱 Shinryo**  
Wastewater recycling  
MBR\* water treatment membrane

\*Membrane Bio-Reactor

## Reduce load during use

**Keeping food quality: reducing food loss**

Gas barrier material **Soarnol™**

**Environmental friendly mobility EV :** ソルライト™ スペリオ®UT

Li-ion secondary battery electrolyte  
High heat resistant insulation film

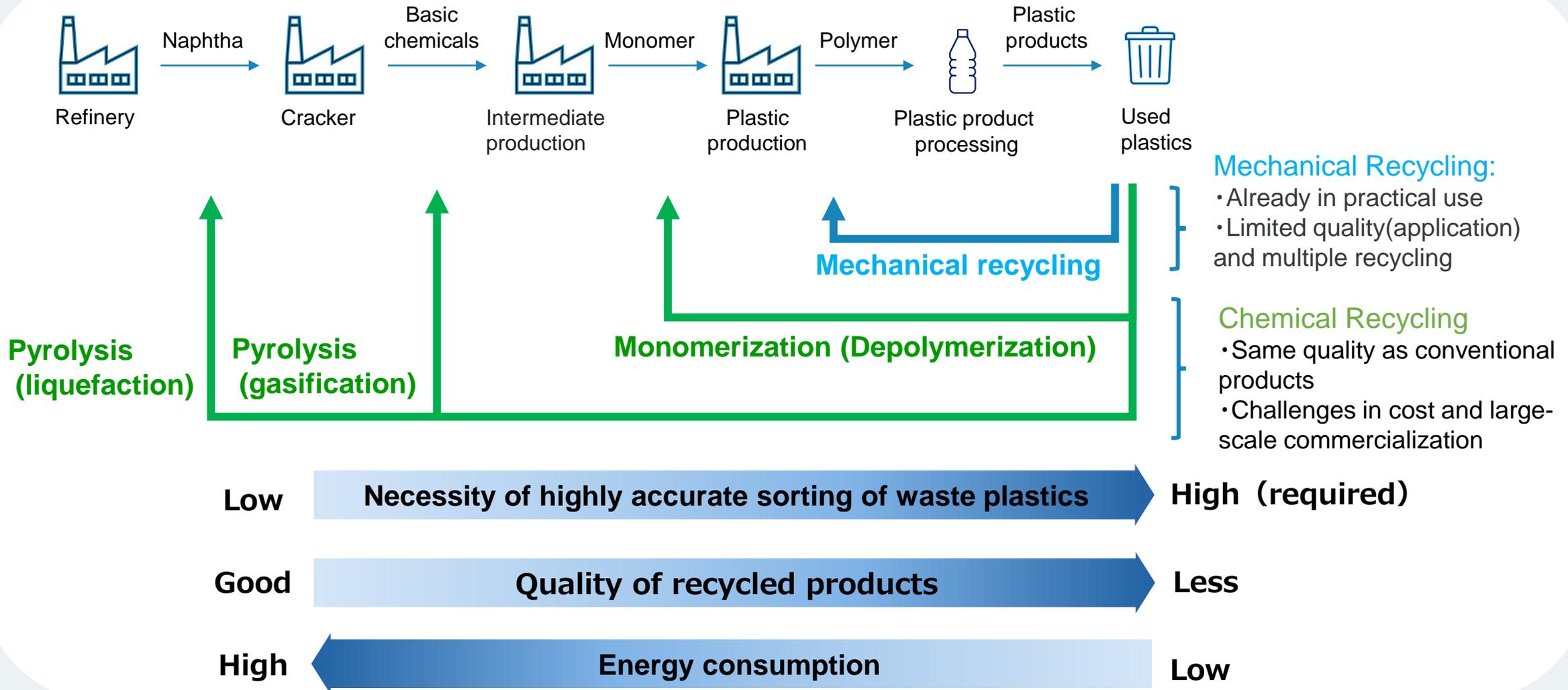
**Lighter weight :**

Carbon fiber/composite materials **DIALEAD**  
Ultra-low warpage PET resin **NOVADURAN™**

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# Types of recycling; Mechanical recycling and Chemical recycling

Each has advantages and disadvantages :  
Material / chemical recycling have a complementary relationship



# Initiatives in MCG

We, MCG are working on commercializing all three routes;  
recycling, bio-based, and utilization of CO<sub>2</sub>



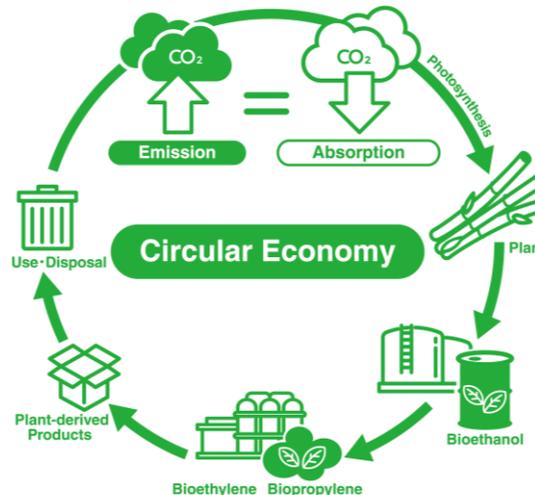
Scheduled for operation in 2025  
@Kashima, Ibaraki in Japan

Chemical recycling of waste plastics  
By pyrolysis using supercritical water



Under consideration for  
commercialization

Production of bio-based chemical products  
made from bioethanol

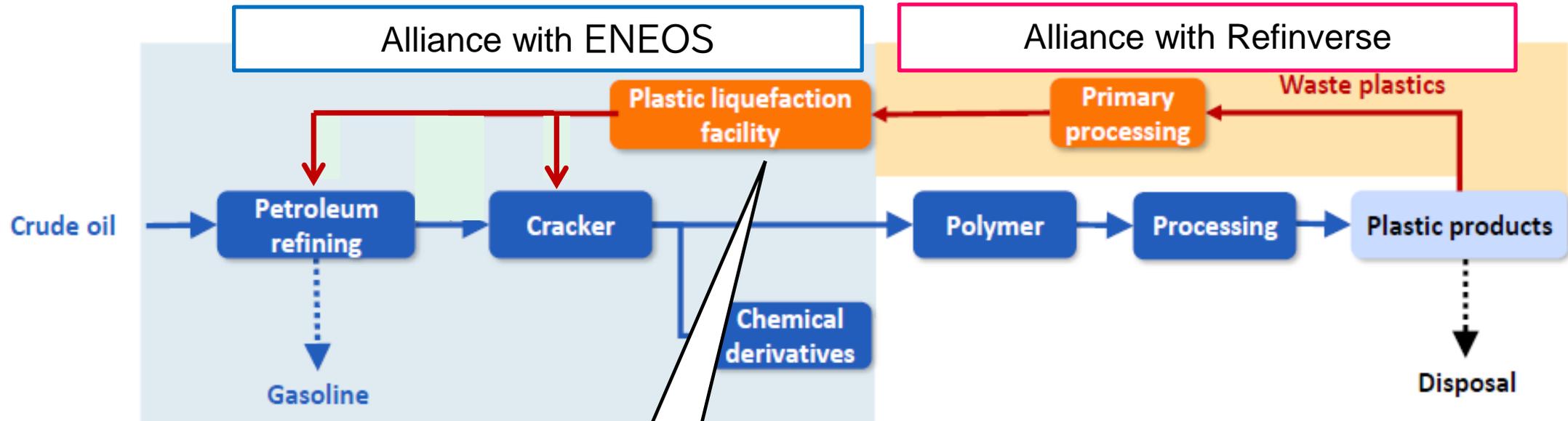


Under consideration for  
commercialization @Abu Dhabi

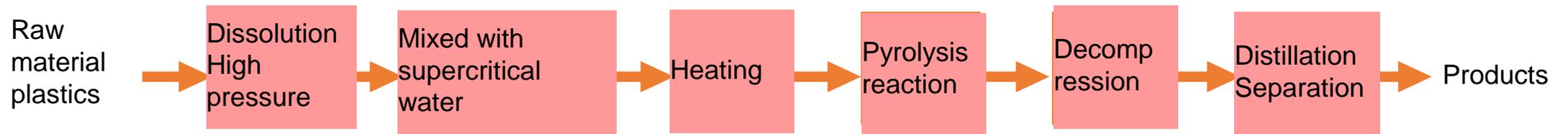
Production of polypropylene made from  
CO<sub>2</sub> and green H<sub>2</sub>



# Overview of plastic pyrolysis



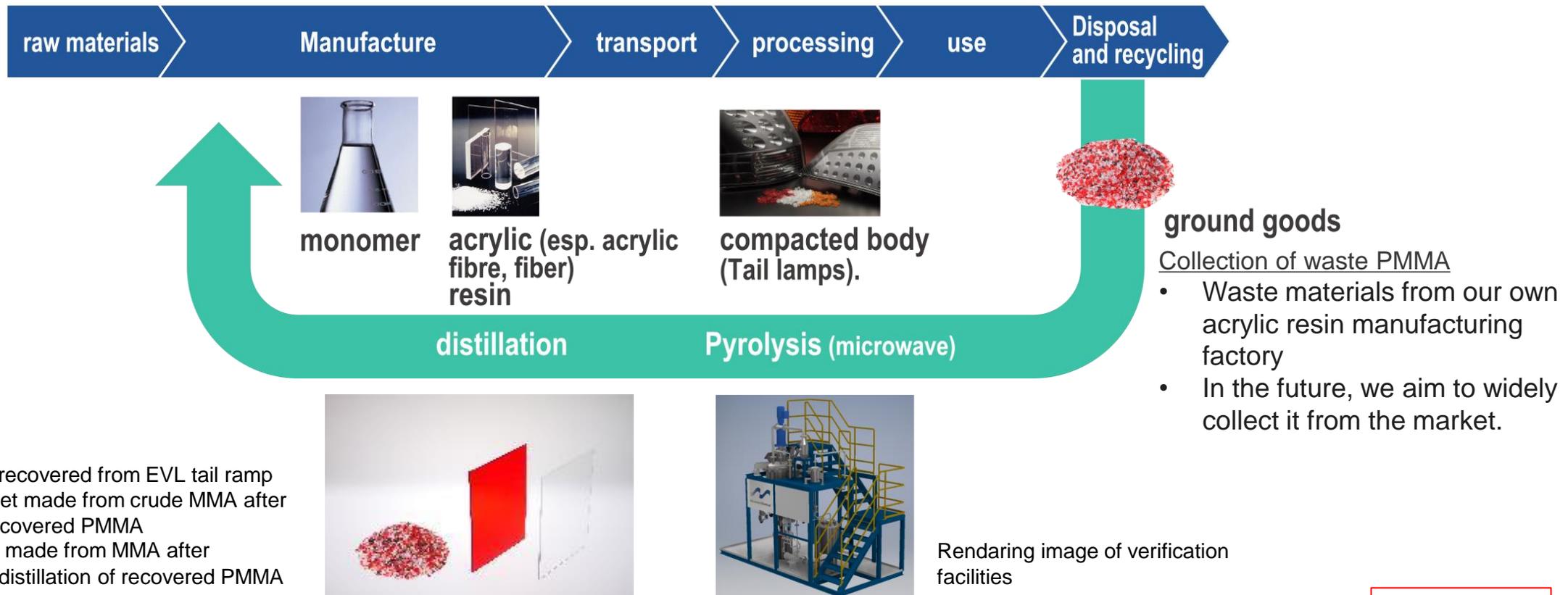
## Outline and properties of pyrolysis technology



- Development of efficient chemical recycling system through collaboration with supply chain companies
- Waste plastic pyrolysis plant scheduled to start commercial operation in 2025 (World's first)

# Chemical recycling and recovery systems of acrylic resin

- Construction of pyrolysis verification facilities using Microwave in Jun. 2021
- MCG is examining a scheme for the collection of acrylic resins, mainly from the taillights of scrapped cars, their molecular recycling and reuse with Honda Motor Company
- Full-scale study has started for the construction of acrylic resin recycling plant



# Recycling of food package

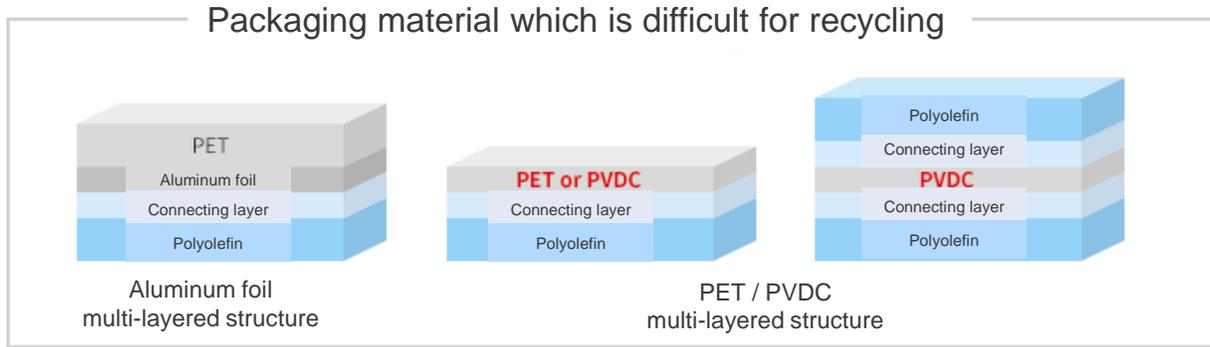
Ensuring food safety

Reducing used plastics

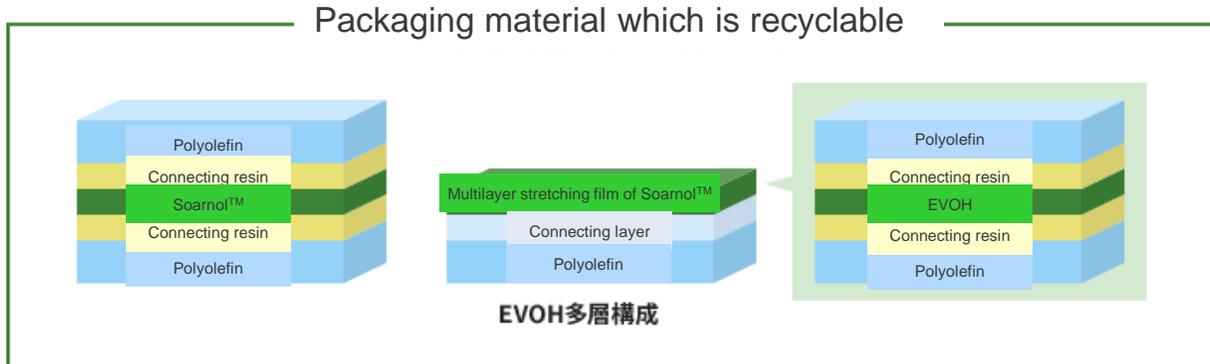
Reducing food loss

Recycling

- Soarnol™ (EVOH) is an environmentally friendly, high-performance resin that has both high gas barrier properties and recyclability.
- Materials such as aluminum foil, PVDC, and PET are said to have poor compatibility with polyolefins.
- Studies are undergoing worldwide to switch designs that utilize Soarnol™ .



Alternative  
▼



Certificate of recycling issued from cyclos-HTP



Certificate of recycling issued from APR

How2Recycle  
Prequalification letter for converters and/or material manufacturers

How2Recycle has evaluated the packaging specifications of the package listed below, and determined that it is eligible for the following How2Recycle label, subject to important conditions below.

Company:	Mitsubishi Chemical America
Date:	04/04/2024
Package or innovation type:	Bag
Product trade name(s):	Soarnol EVOH
Label #:	8012
Label image:	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>USA É.-U.</p> <p>PLASTIC BAG</p> </div> <div style="text-align: center;"> <p>CAN CAN</p> <p>PLASTIC BAG SAC</p> </div> </div>

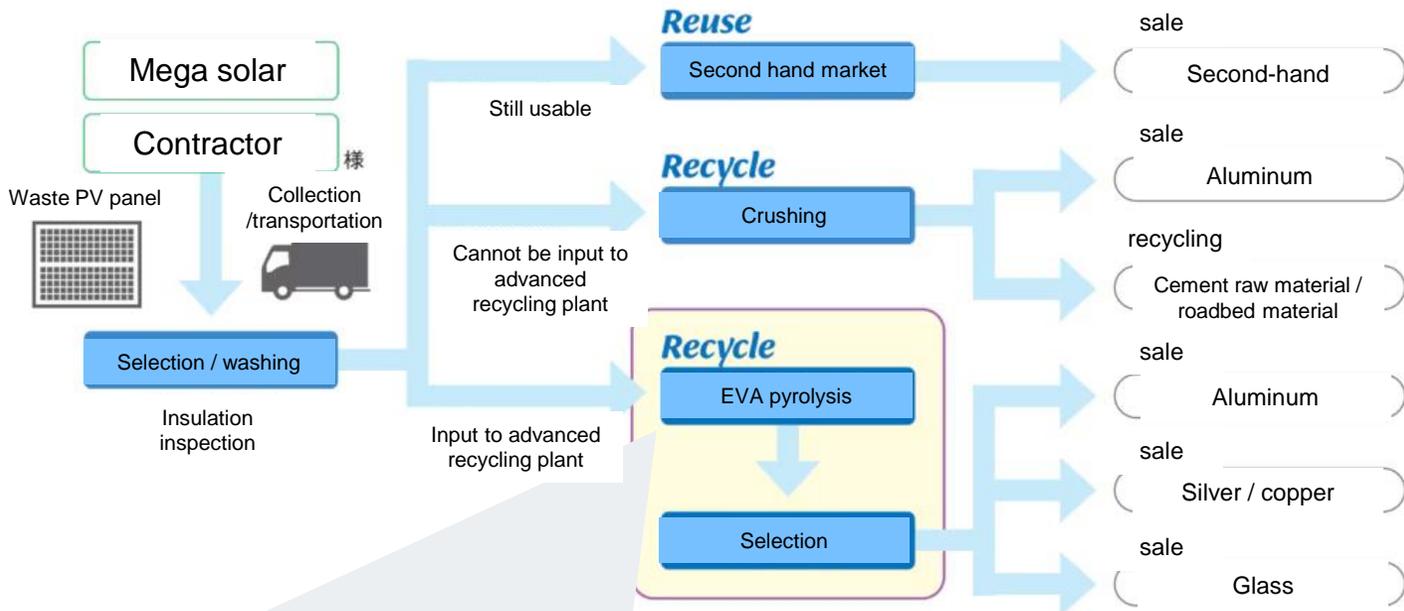
pre-qualification letter obtained from How2Recycle®



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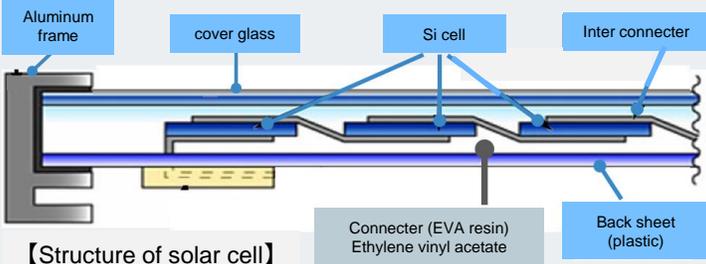
# Recycling of solar panels

- In Japan, it is said that mass disposal of solar panels will reach a peak around 2035.
- We provide reuse and recycling solutions for solar panels that alleviate the pressure on final disposal sites and make effective use of resources.



## Properties

- Types of acceptable panels  
Crystal-Si type, Thin film-Si type, CIS
- Recycle ratio  
for mechanical recycling; around 82%  
approximately 18% of plastic uses pyrolysis  
as a heat source
- Impact of CO2 reduction  
per panel 1-ton : 1,363kg-CO<sub>2</sub>/t\*  
(use of anti-subgrade material )  
at solar power plant scale : about 100t-CO<sub>2</sub>/t  
(1Mw・・・around 5,300 sheets /around 85t)



After pyrolysis, the adhesive (EVA) used in the panel can be advanced sorting into aluminum, glass, silver, copper, etc.

# Challenges for industry(1)

## □ Market creation

- ✓ Visualization and recognition of CE values (cf. GHG)
- ✓ Stronger appetite for CE products (incentives, regulations)
- ✓ CE value vs. expectation (requirement) for quality of products

## □ RD and commercialization (technology, cost and volume) ⇒incentives

## □ Access to waste

- ✓Waste management ecosystem (collection and sorting)
- ✓Market function (ex. standardization of waste specificaiton)

## □ Business model: closed loop (horizontal recycle) vs. open ends

## □ Data management (traceability, DPP)

- ✓ Quality of date (ways to acquire primary date including of suppliers)
- ✓ Attribution and utilization, rights and monetization

## Challenges for industry(2)

### □ Complexity of supply chain and products

- ✓ One final goods contains so many materials  
ex. automobile : metals, lubbers, plastics
- ✓ Collect/sort system needs to reflect such complexity

### □ Cross border movement of circular materials and competitiveness

- ✓ Stronger appetite (by regulation) >> supply capacity of CRM within the region  
(especially in case of export oriented final goods)



- ✓ increasing production of CRM in other regions and import  
(ex. recycled plastics materials produced in big automobile market country)



- ✓ Weakening industrial and geopolitical competitiveness of the region