



Waste to Value - doing well while doing good in ending plastic waste

SCIC Sustainability Conference

8 APRIL 2021

The logo for the Singapore Chemical Industry Council (SCIC) is located in the bottom right corner. It features the acronym 'SCIC' in a large, bold, black sans-serif font. Below it, the full name 'SINGAPORE CHEMICAL INDUSTRY COUNCIL' is written in a smaller, all-caps, black sans-serif font. The background of the slide is a teal-colored image of crumpled plastic with a clear plastic bottle cap in the lower right quadrant.

SCIC
SINGAPORE CHEMICAL
INDUSTRY COUNCIL

Plastics have powered human progress but their disposal is becoming a complex challenge - especially in SEA



The problem with plastic

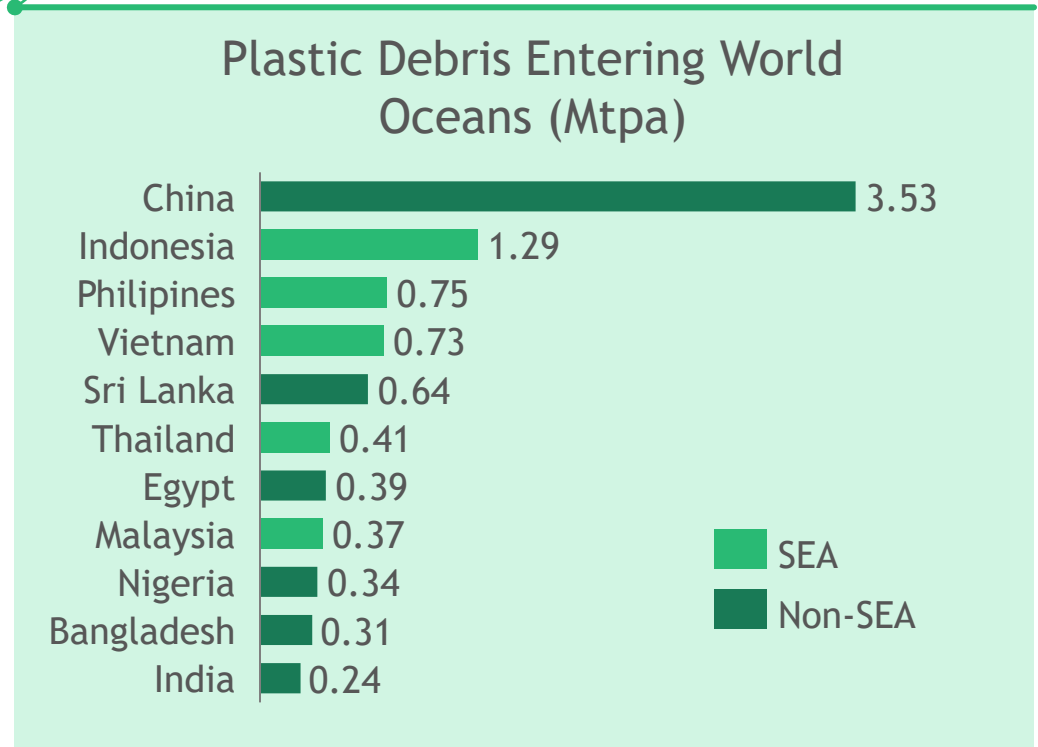
From the stomachs of baby seabirds to the depths of the oceans — plastic pollution is everywhere

A Patch of Plastic Garbage in the Pacific Ocean Amounts to Twice the Size of Texas, a New Study Says

Ocean plastic waste set to triple within a decade, government scientists warn



Top countries contributing to ocean plastic waste



Large corporations across the value chain are already taking actions to address this issue



All of its plastic bottles from 100% recycled plastic by 2025



350 Kt recycled plastics solutions by 2025



100% of packaging to come from renewable, recycled or certified sources by 2025



200 Kta renewable feedstock of chemical basic products by 2025



100% of its packaging to be recyclable, compostable or biodegradable by 2025



Waste generation below 2010 levels by 2025

SEA govts pushing for greater plastics sustainability through policy levers, but still not as aggressive as advanced economies

Country	Plastic-specific strategy	Ban of single-use plastics	Levy/charge on single-use plastics	Deposit-refund scheme	Sorted collection	Import regulation
Indonesia	●	●	●	●	●	●
Malaysia	●	●	●	●	●	●
Philippines	●	●	●	●	●	●
Singapore	●	●	●	●	●	●
Thailand	●	●	●	●	●	●
Vietnam	●	●	●	●	●	●

Plastic-related policy/strategic: ● Exists ● Partial ● Does not exist

Recent press clippings:

ENVIRONMENT
Viet Nam and the WEF Launch Partnership to Tackle Plastic Pollution

Philippines: Banning Single-Use Plastics at the National Level and Strengthening Existing Laws Needed to Curb Plastic Pollution Crisis

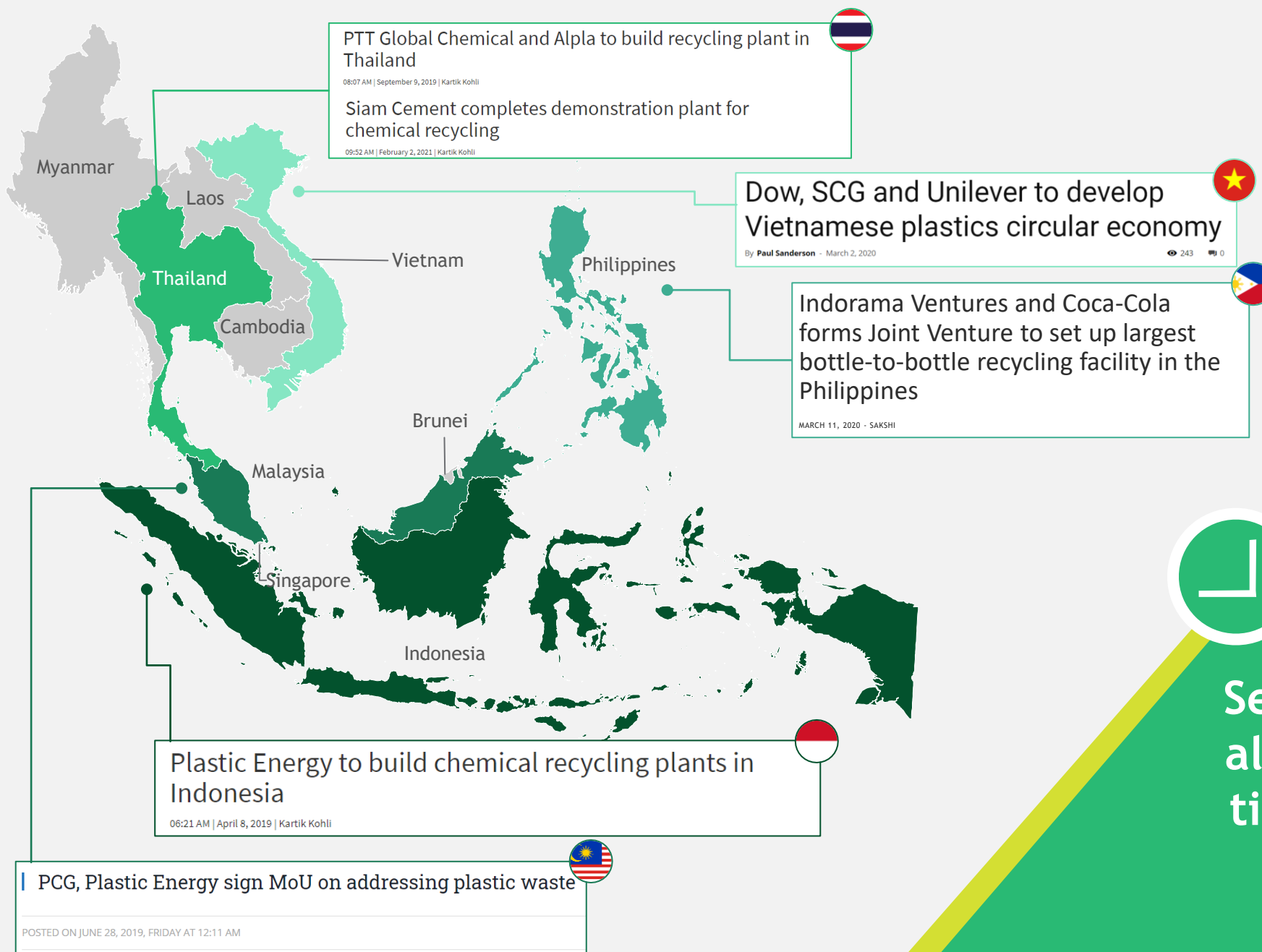
Indonesia to reduce marine plastic waste 70% by 2025
 Tons of waste enters oceans every year, says Indonesian Institute of Sciences
 Nicky Aulia Widadio | 13.12.2019

Ready to report: How Singapore firms are preparing for new packaging mandate
 With Singapore set to introduce mandatory reporting requirements in 2020 in a bid to raise awareness of packaging waste, companies tell Eco-Business how they are preparing for the mandate, and what they are doing to limit their packaging waste.

Malaysia to ban single-use plastic
 The government has charted a zero-waste plan that aims to abolish single-use plastic by 2030. Malaysia is the first country in Southeast Asia to take bold action to tackle plastic pollution.

ENVIRONMENT AUGUST 16, 2018 / 3:53 PM / UPDATED 2 YEARS AGO
Thailand to ban imports of high-tech trash, plastic waste

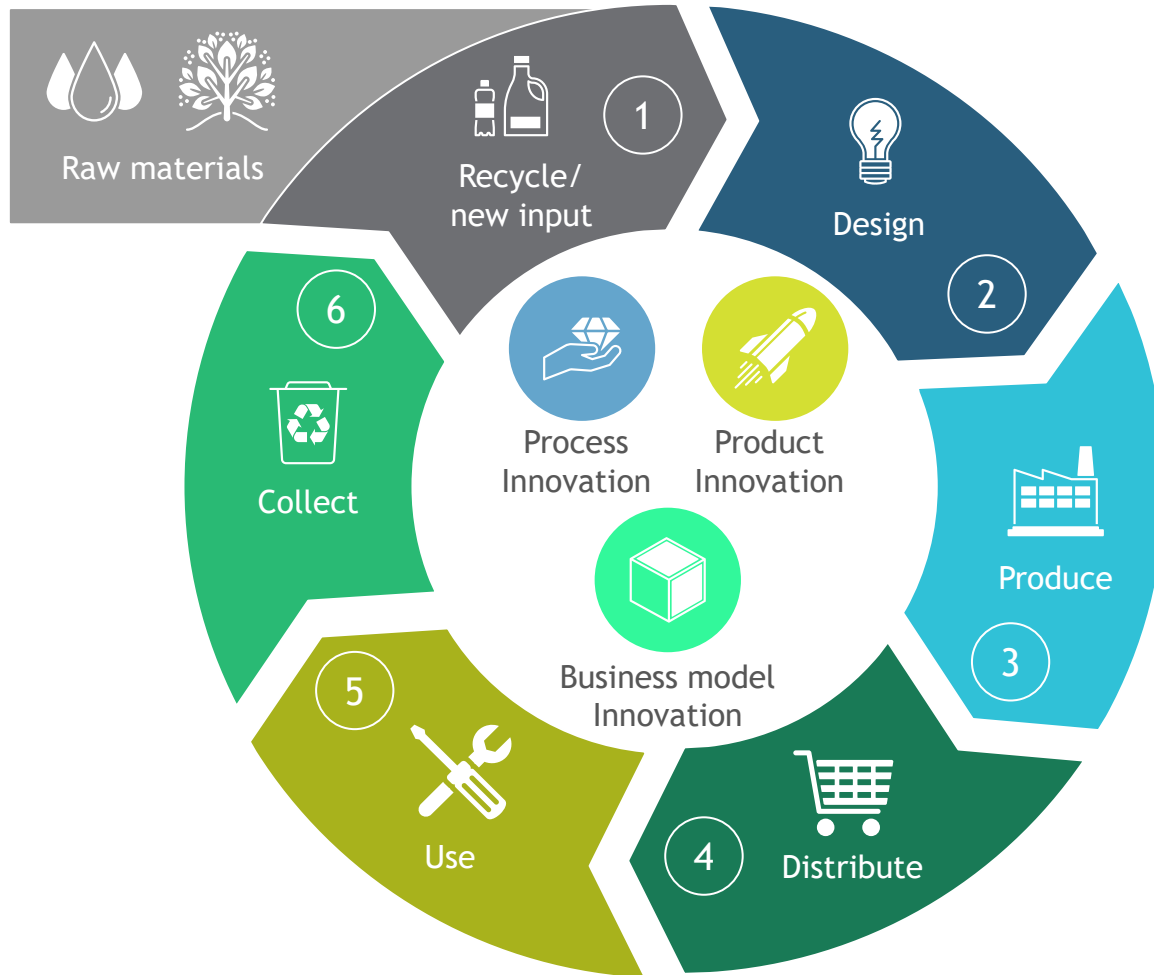
1. Extended producer responsibility
 Source: ASEAN Cooperation on Environment: Circular Economy and Plastics Report 2020; Press search



Several SEA ChemCos already moving fast - time is now for us to come together to address this existential issue

Source: ChemWeek, Plastics Insights, Press search

Circular economy as an ecosystem of sustainable life cycles can help minimize the problem



- 1 **BUY** materials that are regenerative or recycled
- 2 **DESIGN** products that are recyclable and reusable
- 3 **MAKE** product waste-free and resource-efficient as possible
- 4 **SELL** access (rather than ownership) leasing or sharing products
- 5 **USE** products responsibly, not excessively to extend their lifetime and to reduce pollution
- 6 **COLLECT AND RECYCLE** products and materials at the end of their current life to close the loop

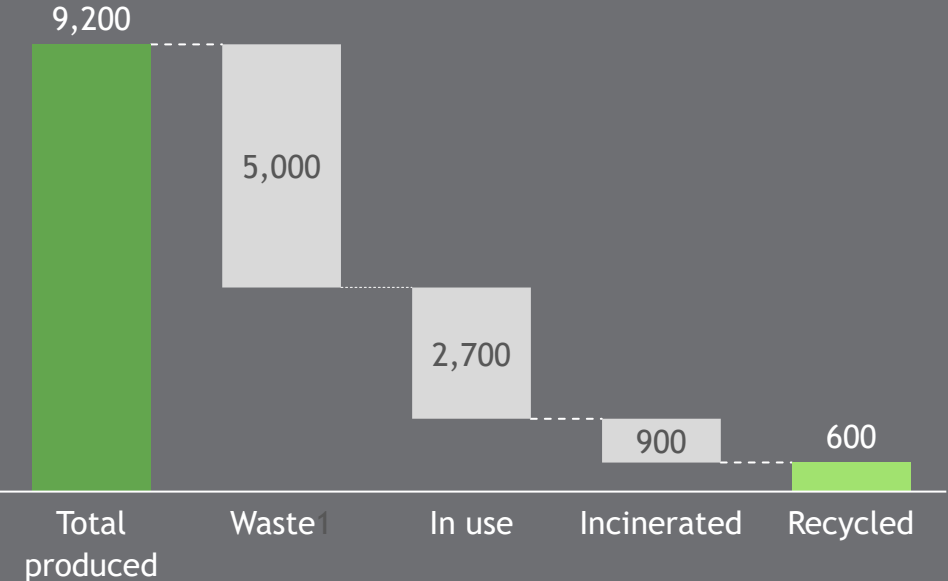
'Recycling' has been the most active value chain step in Sustainability



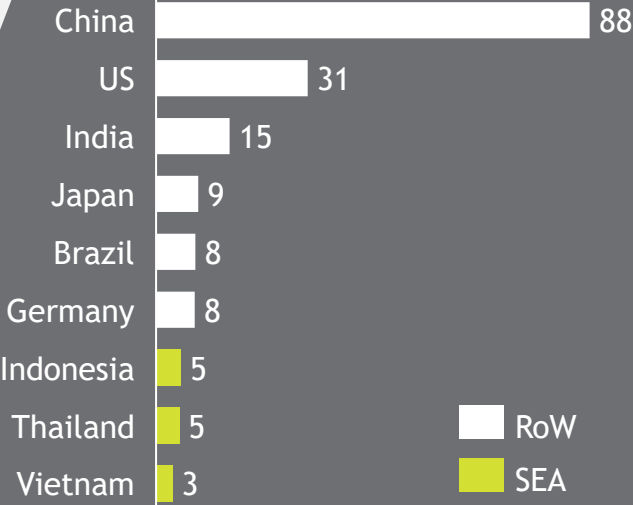
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Recycled plastics command low share of total plastics production in the past and today

Cumulative global production, use and disposal of plastics between 1950 to 2017 (Mt)



Estimated plastic consumption for select countries in (Mt)

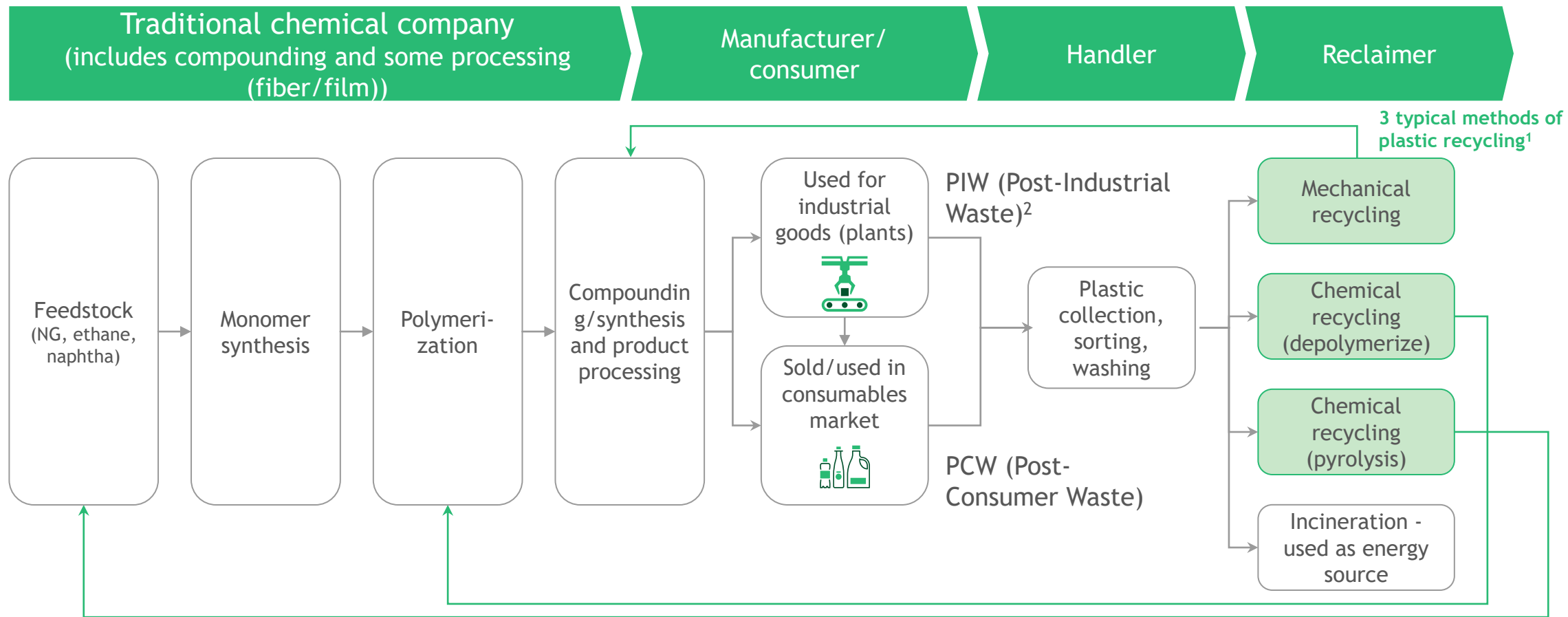


Recycling rate at only 10-15%²; while rate of incineration at 20-25%²

1. Incl. landfill and ocean; 2. Weighted average recycling/ incineration rate across top 20 plastic consumers i.e., CN, US, IN, JP, BZ, DE, TR, RU, KR, MX, IT, ID, TH, FR, IR, UK, VN, SA, ES, CA; Source: Plastic Atlas 2019, BCG publication: A Circular Solution to Plastic Waste



3 plastic recycling methods return reusable inputs to different parts of the traditional plastic production process



1. In some classifications, use as fuel after incineration (sold recovered fuel) is also included in recycling but, in general, only 3 recycling methods, where circular systems are ensured, are considered recycling; 2. Residual products from processing (release film) or scraps where quality defect has occurred after processing

Note: Primary recycling, where defected products from the production process and post-use scraps are collected and re-processed, is not included in this presentation

Source: BCG

Major methods of plastics recycling include mechanical and chemical



Recycling process



Market maturity



Impact on Chem market



Example players

Mechanical recycling
(~95% of market)

Separate through precipitation after removing contaminants

H

Typical recycling with highly mature biz model/ technology. Difficult to gain economy of scale vs. petchem. market

H/M

Limited potential for technology innovation but likely to become a powerful competitor of virgin plastic

morssinkhof-group

INDORAMA

BOREALIS

Keep Discovering

Chemical recycling (~5%)

Depolymerization

Depolymerize to monomers through chemical process and use as feedstock

L

New area that requires development of economically feasible technology

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Significant part of the upstream plastic monomer market is likely to be replaced with scale expansion

INDORAMA

agilyx

سابك
sabik

BASF
The Chemical Company

BOREALIS

Keep Discovering

Feedstock conversion (pyrolysis)

Produce petchem feedstock/fuel by randomly dissolving chemical bonds with heat²

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Old technology - however, business model/ process improvement is required for full-fledged growth

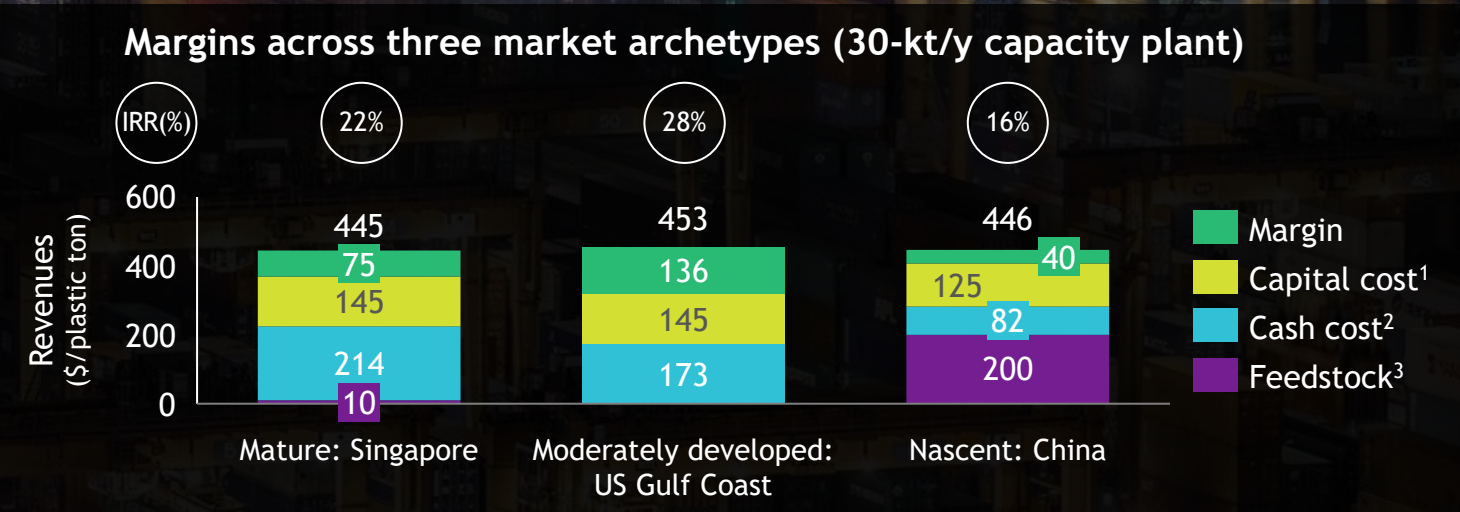
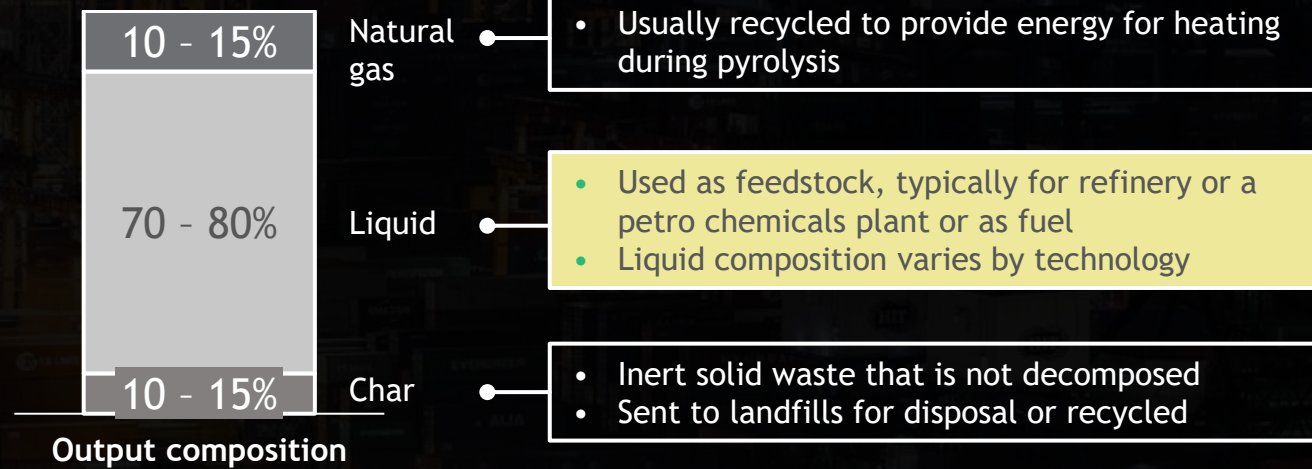
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Limited potential for improvement through tech development. Limited market impact as it will be an additional option to petchem feedstock

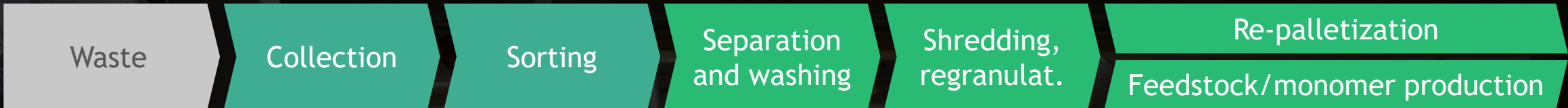
1. Out of entire petchem market; 2. Pyrolysis using heat of over 400 °C and thermal conversion using heat of 250-300 °C. Manufactured product varies by temperature. Source: Press search, BCG

Deep-dive on Pyrolysis: Positive Investment possible under certain conditions

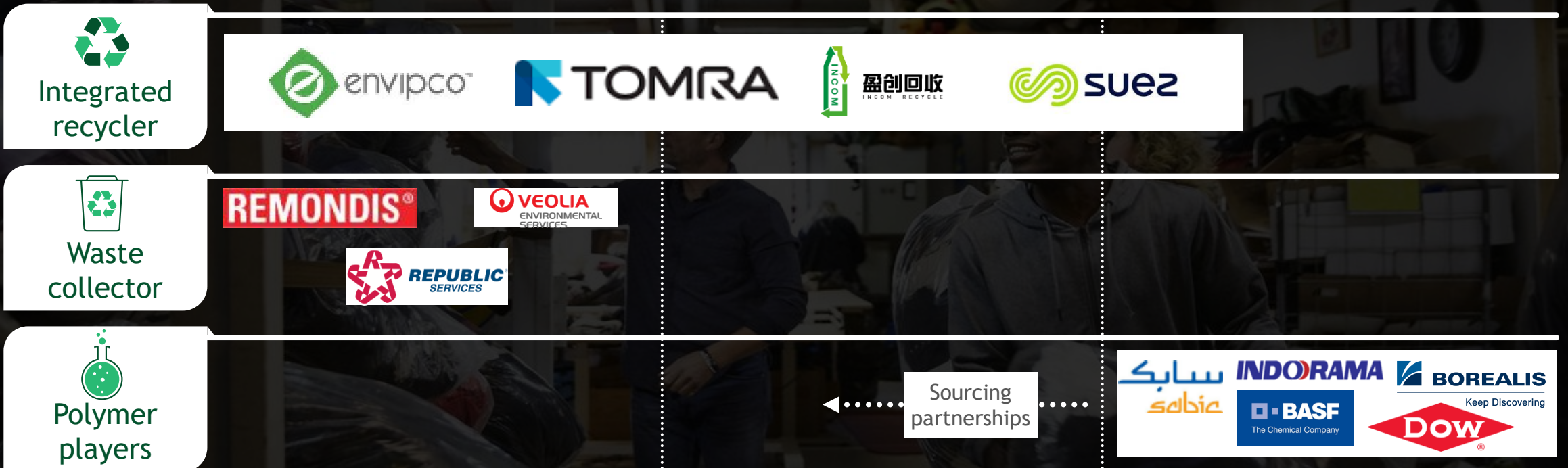
Note: Consumers may be willing to pay a premium on goods from recycled content, which may result in higher revenues from pyrolysis liquids
¹Capital cost of installing pyrolysis plant as well as sorting, cleaning, and pretreatment facilities if required are valued at a 12% hurdle rate; ²Cost to prepare and process pyrolysis feedstock, including labor and utilities, transport of feedstock, and shipment of pyrolysis product; ³Cost of acquiring plastic feedstock;



Three relevant business models in post consumer/industrial waste; ChemCos play the key role of recreating usable inputs from waste

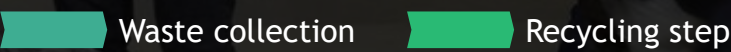


Select plastic recycling players playing across three key business models



and many localized SMEs for re-palletization

1. Examples are usages of heat or steam
Source: Recycling player web pages; BCG analysis



SEA ChemCos can consider multiple pathways to enter and expand into plastics recycling space such as partnerships

Mechanical recycling



Collect plastic waste (e.g., PET bales) and produce recycled resins to be sold to end-product manufacturers

Chemical recycling



Develop chemical recycling plants (e.g., pyrolysis plants) to create recycled feedstocks/ polymers

ChemCo activities

Entry pathways

Key success factors incl. build scale and access quality waste

- **Increasing scale:** Potential to acquire and consolidate fragmented SEA recycling facilities (>800 companies in the region¹) or develop own facilities
- **Access to quality plastic waste:** Partnerships with domestic waste management companies or plastic waste importers crucial to secure quality plastic wastes at competitive prices

Key success factors incl. obtain recycling tech and feedstock supply

- **Access to recycling technology** (e.g., pyrolysis): Potential to coinvest or license technology from the existing players globally
- **Secure steady supply of feedstock:** crucial to secure supply agreements or supply partnerships to ensure steady flow of feedstock (e.g., mixed plastic waste) to maintain utilization rates

1. Number of companies engaged in recycling and processing plastic waste in Indonesia (300), Vietnam (>200) Malaysia (190), Thailand (150),
Source: BCC Research, BCG analysis

Potential innovation may even come from outside of established players - will need to seek collaboration with broad ecosystem

60+ technology providers globally at different levels of maturity



Companies are also participating in multiple parts of the chain

Founded in 2004, Agilyx began as a thermal conversion technology provider converting mixed plastics into liquid oil products.

Volatile and low oil prices inspired Agilyx to adapt technology to develop a Polystyrene-to-Styrene Monomer (PSM) System (chemical feedstocks)

They now have a dual revenue model of producing both chemicals and fuels.

Call for action for chemical companies and industry bodies in Southeast Asia and Asia

Develop a circular economy strategy before you are forced by regulations

Don't have to do it alone - leverage partnerships across the value chain

Approach with an open mind - innovative solutions, new business models possible





BCG Credentials & Contact

BCG
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pace-setters on
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green agenda

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Challenge**, Chief
Advisor to **CEO Alliance
of Climate Leaders**



Member of the
**Climate Working
Group** of the
**Business
Roundtable**

Partnership with
COP26 Presidency in
preparation of COP26
meeting in 2021



Partnership with
OGGI on investment
strategy, CCS,
leakage reduction

Partnership with
World Business Council for
sustainable development on
climate investments

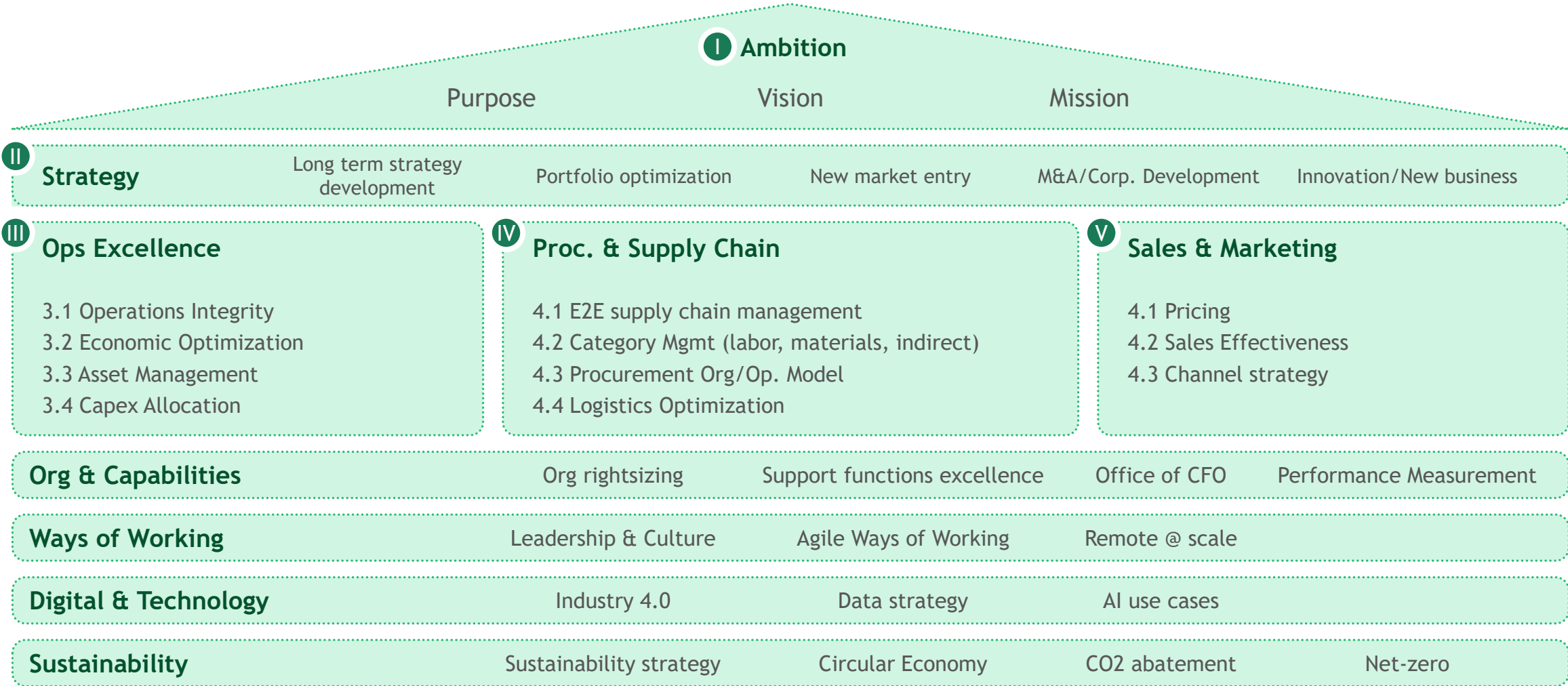


Partnership with **SBTI**



Partnership with
BDI on association's
strategy to reach
climate targets

BCG's capabilities span the full range of issues in the chemicals business



We have successfully delivered **>2,000 projects** globally with all major chemical & petrochemical companies in the last 5 years

Selection of players only



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