Working Group 4

Sustainable Resources Circulation for Global Environment

Chair: Dr. YAMAJI Kenji, Sub-Chair: Dr. INABA Atsushi

The Moonshot [Area],[Vision] for setting MS [Goal] candidate

Area   Recovery for global environment and growth of civilization.

Vision   Sustainable resources circulation.

Significant reduction of resources requirements.
Environmentally natural cities.

The Moonshot goal examples

9)   Reduction of resources losses to 1/100th
10) Reduction of energy consumption per calculated unit to 1/1000th
11) 100% energy self-sufficiency with sustainable energy source
12) Full recycle system for resources and materials
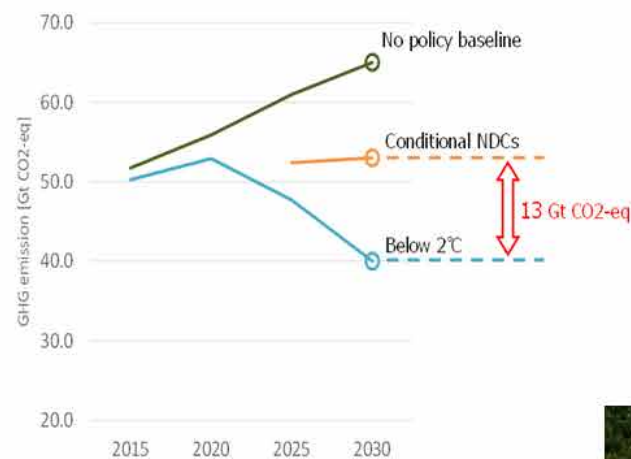14) Elimination of garbage on the earth

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Discussion

Initiative Report: Sustainable Resources Circulation for Global Environment

Dr. Kenji YAMAJI

RITE Research Institute of Innovative Technology for the Earth

Giga-ton Gap for the Below 2°C Target

Marine Plastic Litter
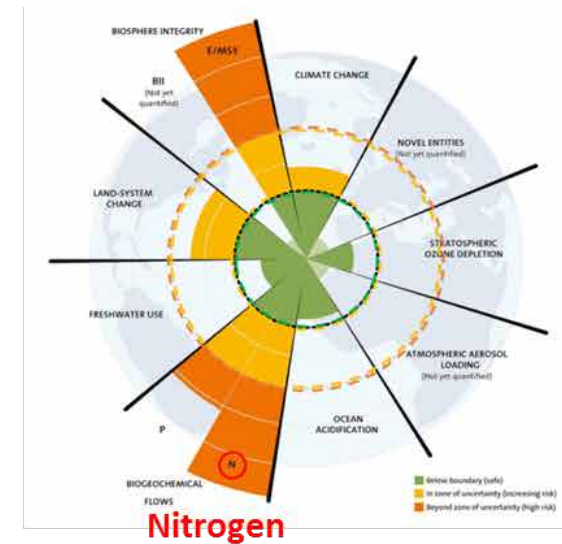
Beyond Planetary Boundaries

Nitrogen

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NREL: Transforming Energy through Innovation

Dr. Martin Keller

Moonshot International Symposium
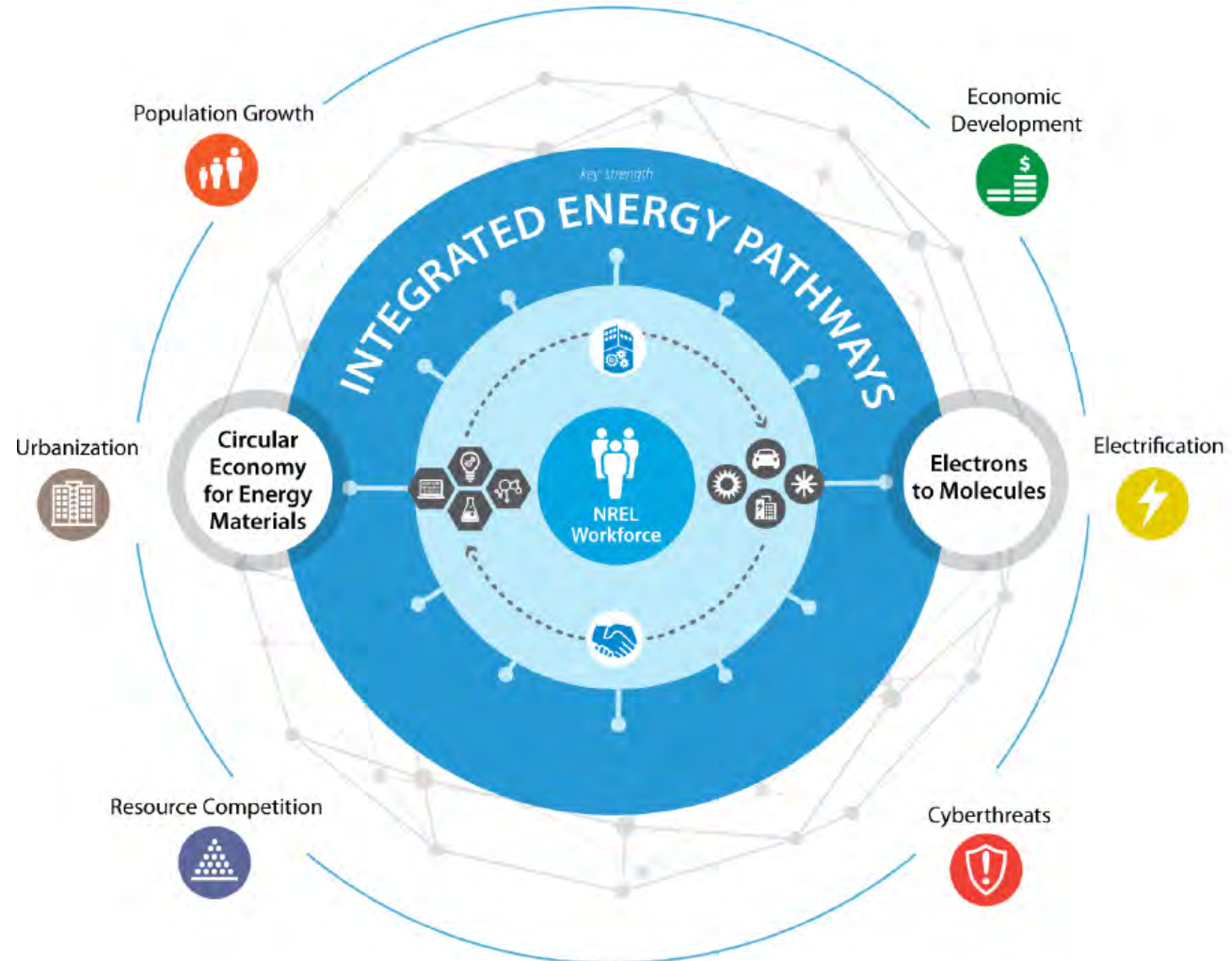
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Science and Research for Climate/Energy Policies and a Circular Economy

Dr. Christian Thiel

- We must reduce our emissions further and faster

- Low carbon solutions are ready for mass market deployment

- Gaps remain that need to be addressed by **bold** R&D initiatives

- We need citizen engagement and empowerment
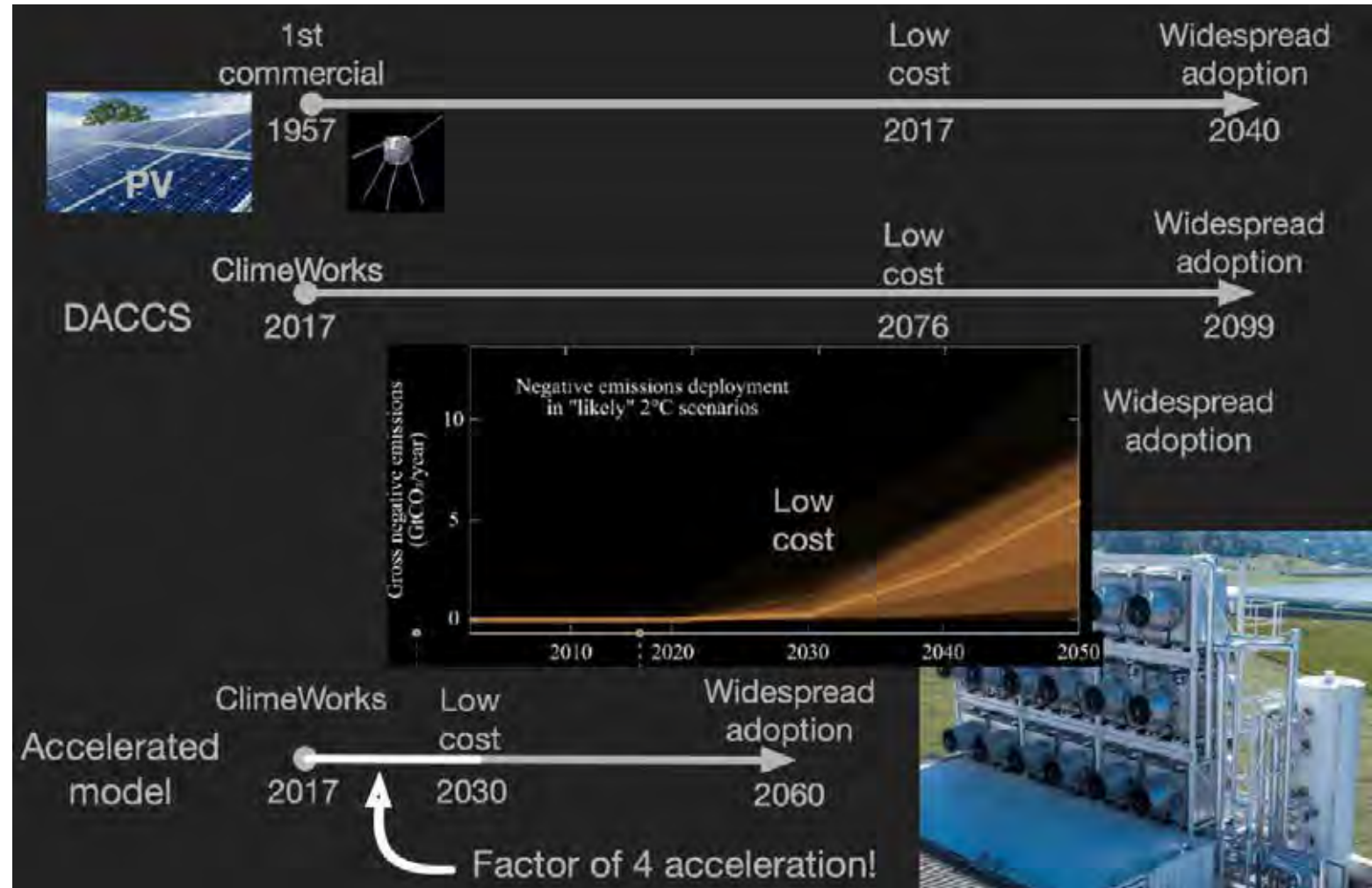
- Let us work together!

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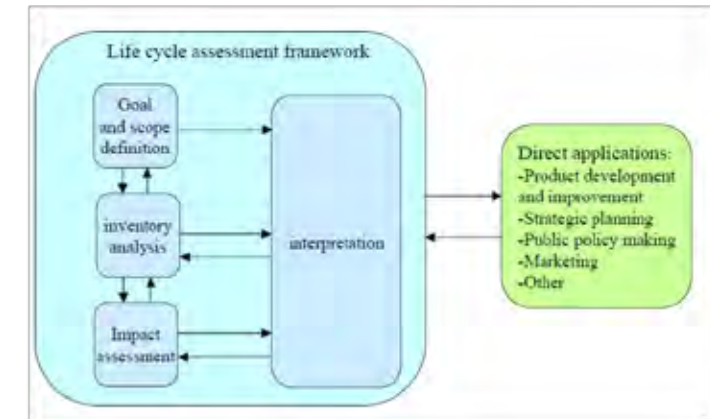# Discussion

Accelerating Innovation in CO$_2$ Removal

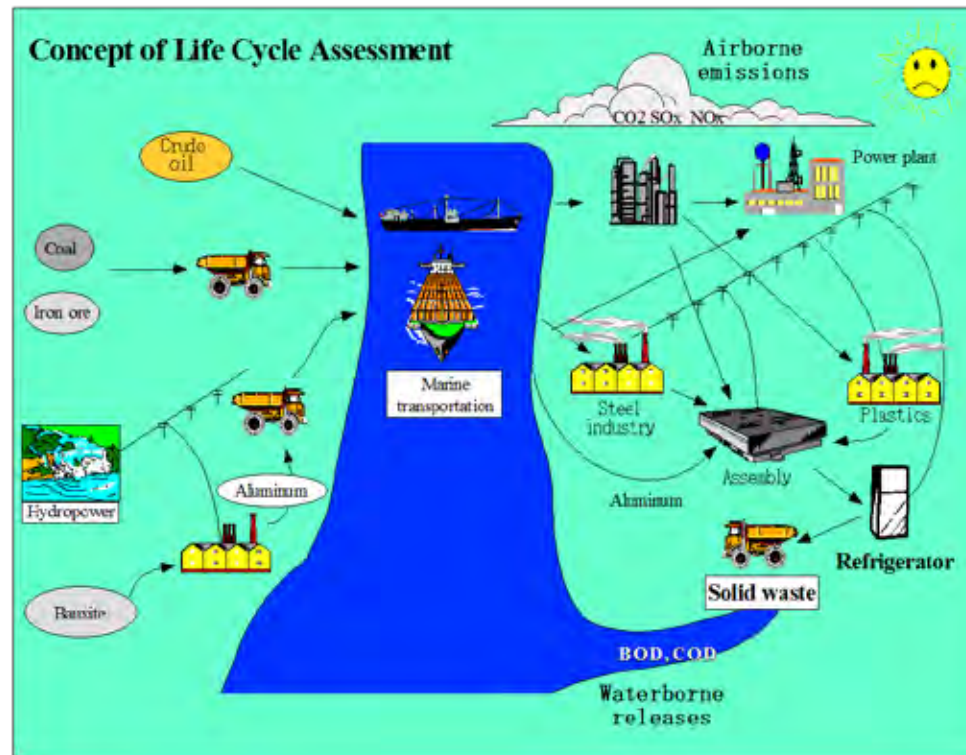Dr. Gregory F. Nemet

Robert M. La Follette School of Public Affairs
UNIVERSITY OF WISCONSIN–MADISON

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Discussion   How to evaluate technologies?

Dr. INABA Atsushi

How to evaluate CO2 reduction?
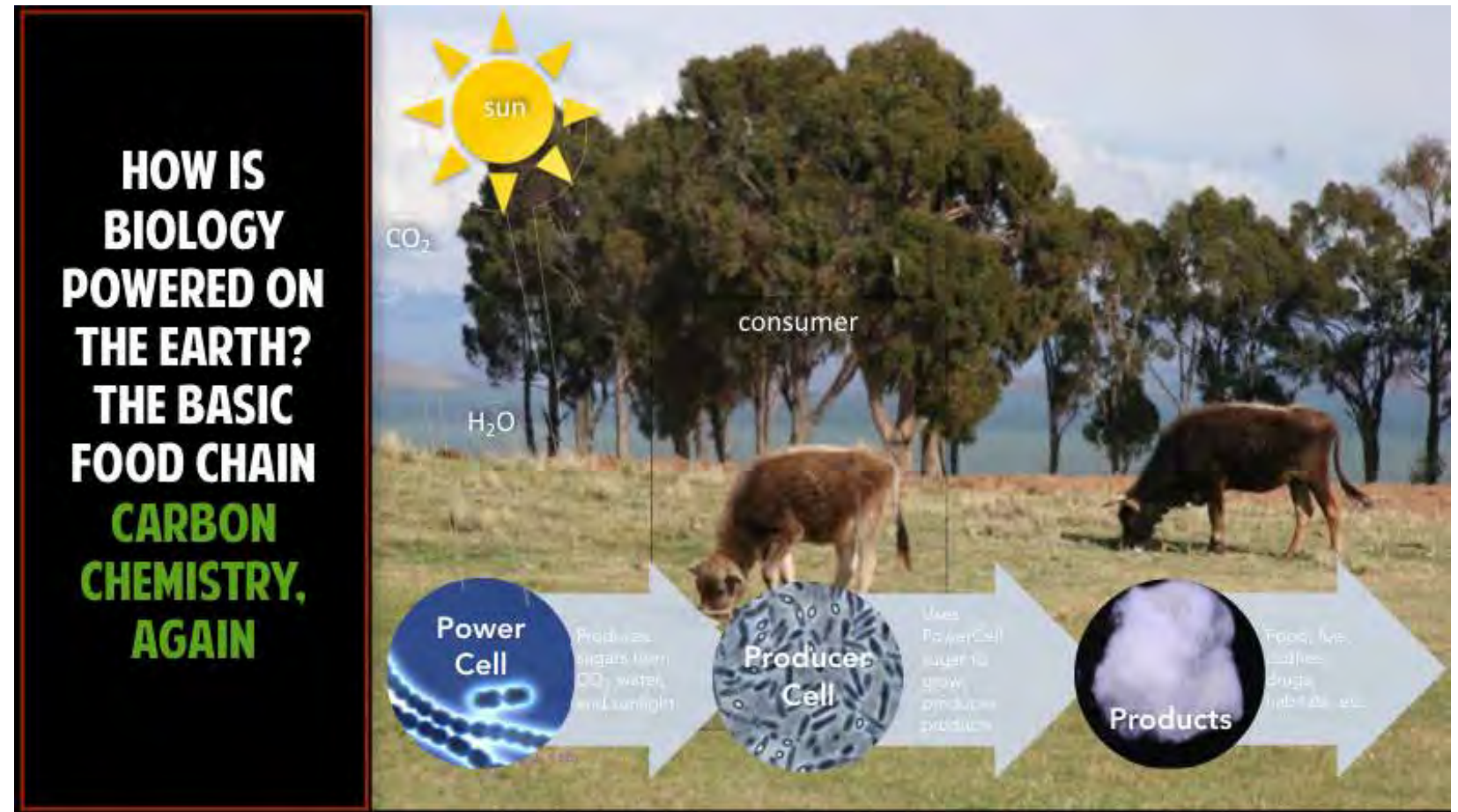
Life Cycle Assessment (LCA)

ISO 140040/44 (2006)

The guideline of LCA to evaluate CO2 removal technologies is needed.

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Synthetic Biology: the 21st C game-changing technology for Earth and beyond

Dr. Lynn J. Rothschild

HOW IS
BIOLOGY
POWERED ON
THE EARTH?
THE BASIC
FOOD CHAIN
CARBON
CHEMISTRY,
AGAIN

sun

CO_2

H_2O

consumer

Power Cell

Producer Cell

Products

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Dr. INAGAKI Fuyuhiko

KOBE GAKUIN UNIVERSITY

Direct Air Capture (DAC):
CO2-Selective Absorbents in Air

Bottleneck Issue = Water Separation?

CO$_2$ 20% energy (12.5 kJ/mol)

heating

80% energy (48.0 kJ/mol)

30% MEA aq.
(MEA =monoethanolamine)
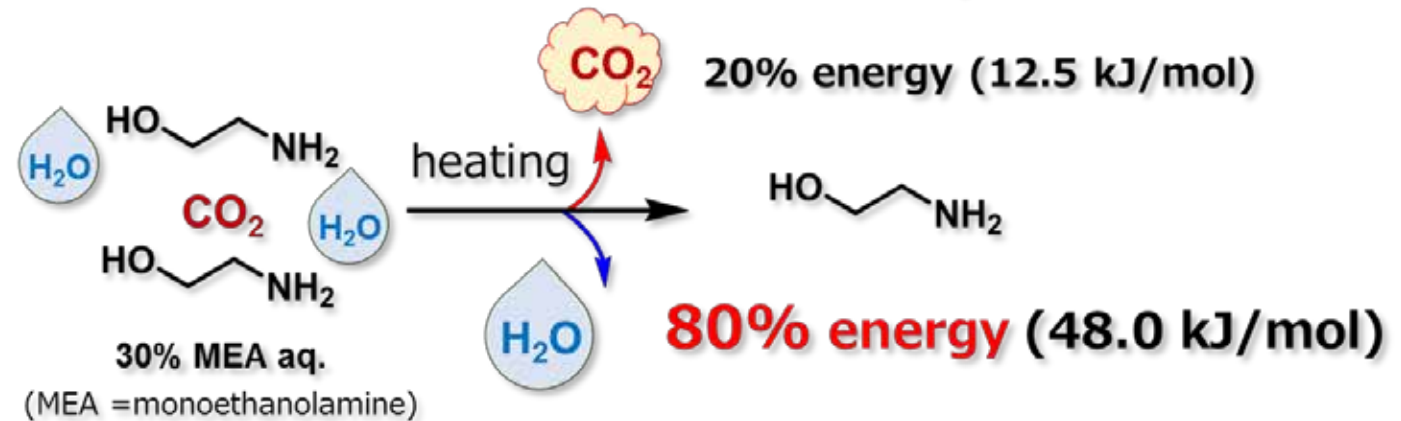
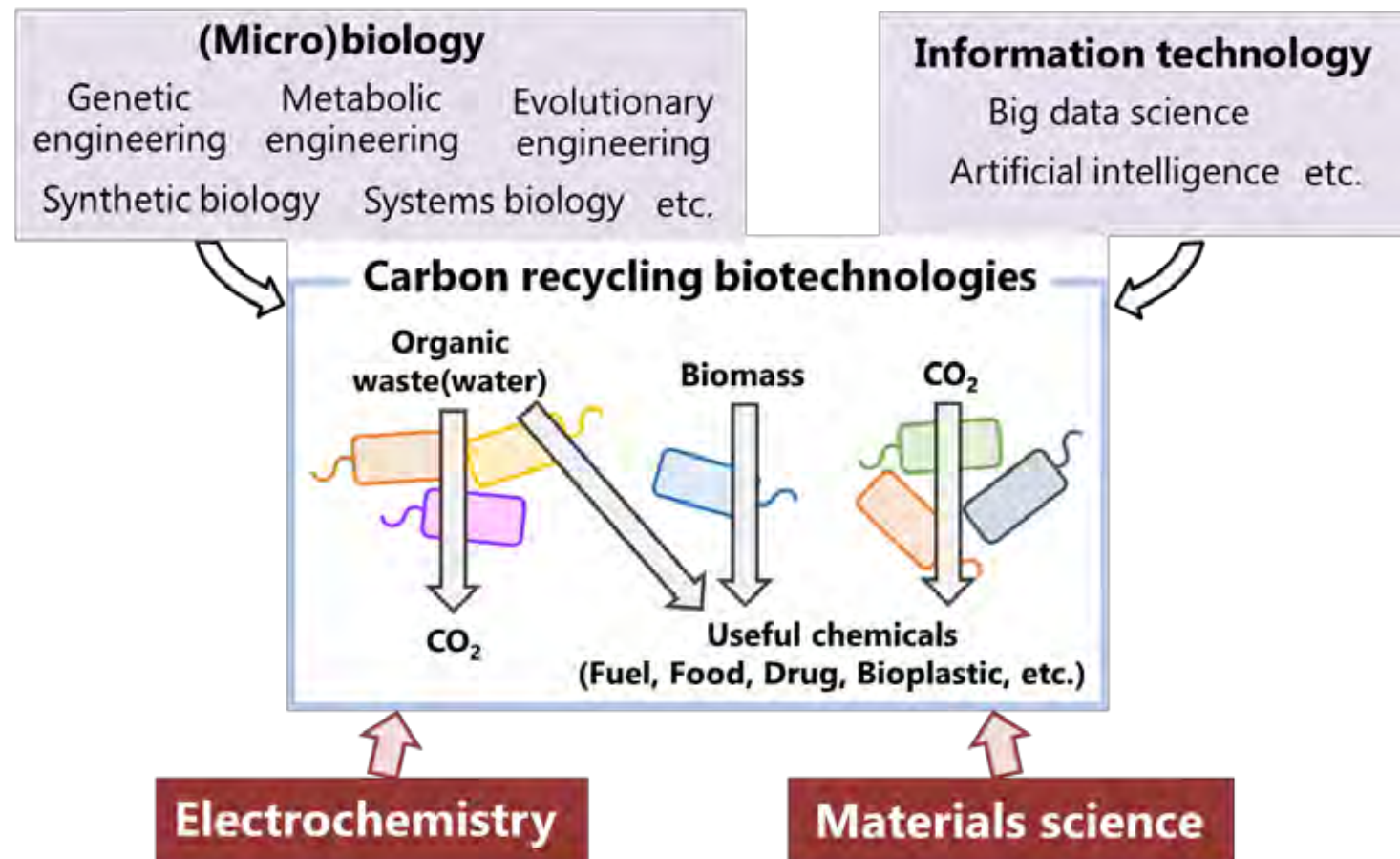Need for extra thermal energy of water!

H$_2$N Ⓡ ← Pairing!
Phenyl (Ph)
hydrophobicity

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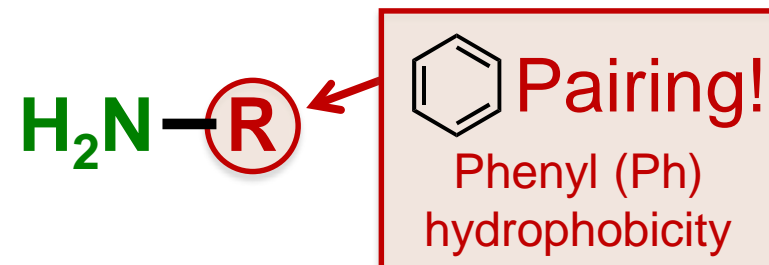
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Carbon recycling technologies based on microbial electrochemistry
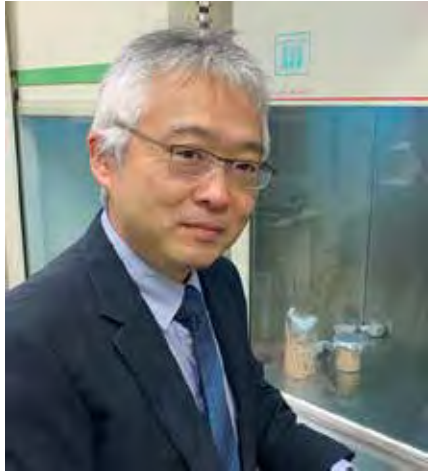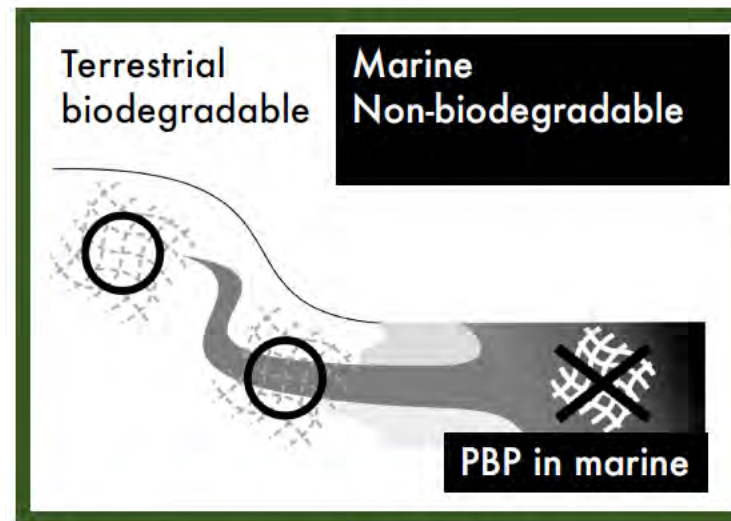
Dr. KATO Souichiro

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Can biodegradable plastics solve the problems caused by plastic debris leaking into sea?
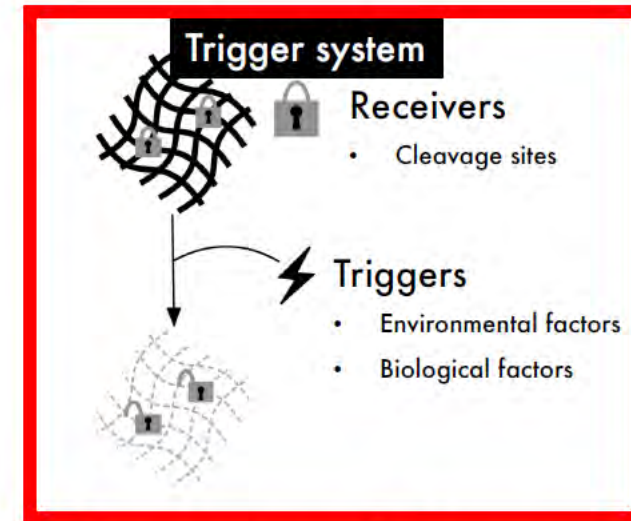
Dr. KASUYA Ken-ichi

NATIONAL UNIVERSITY CORPORATION
Gunma University

Terrestrial biodegradable
Marine Non-biodegradable

PBP in marine

Trigger system
Receivers
· Cleavage sites

Triggers
· Environmental factors
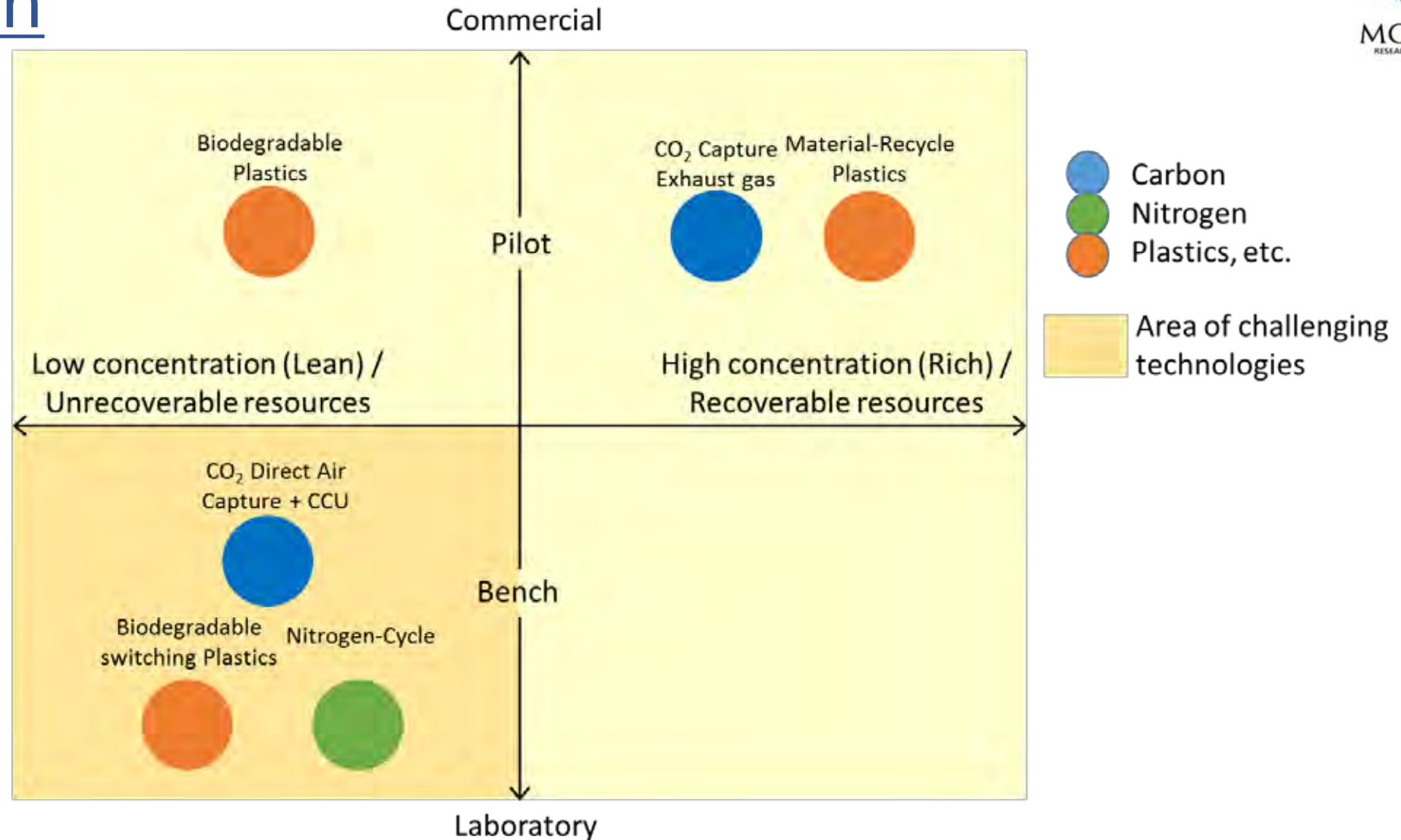· Biological factors

Biodegradability of PBP depends on environments

Biodegradation starts by "Trigger system".

TBP

PBP : Potentially Biodegradable Plastics
TBP : Timing Biodegradable Plastics

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Target(2030)

<Cool Earth>
Development of circulation technology for greenhouse gases, which is effective also in terms of Life Cycle Assessment (LCA) in a pilot scale.
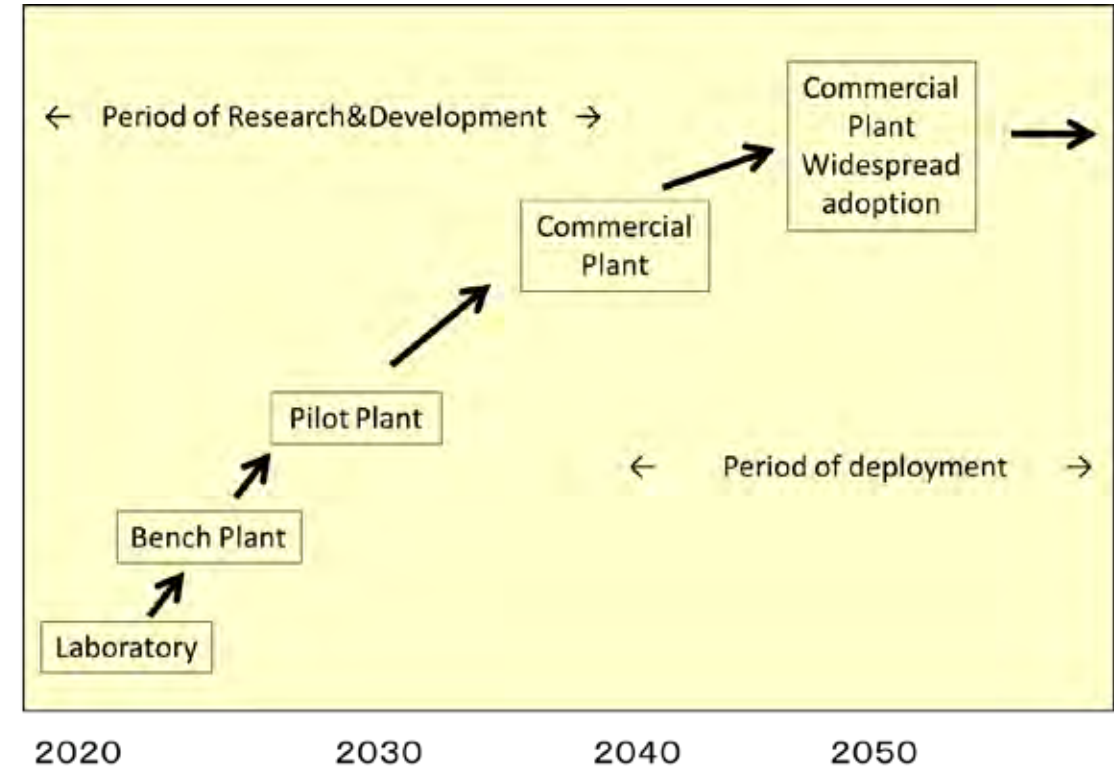
<Clean Earth>
Development of technology in which environmental harmful substances convert into valuable or harmless materials in a pilot scale or as a prototype.

Target(2040)
<Cool and Clean Earth>
Several small markets for the circulation technology will be created.

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MS Goal candidate

Realization of sustainable resources circulation to recover the global environment by 2050.

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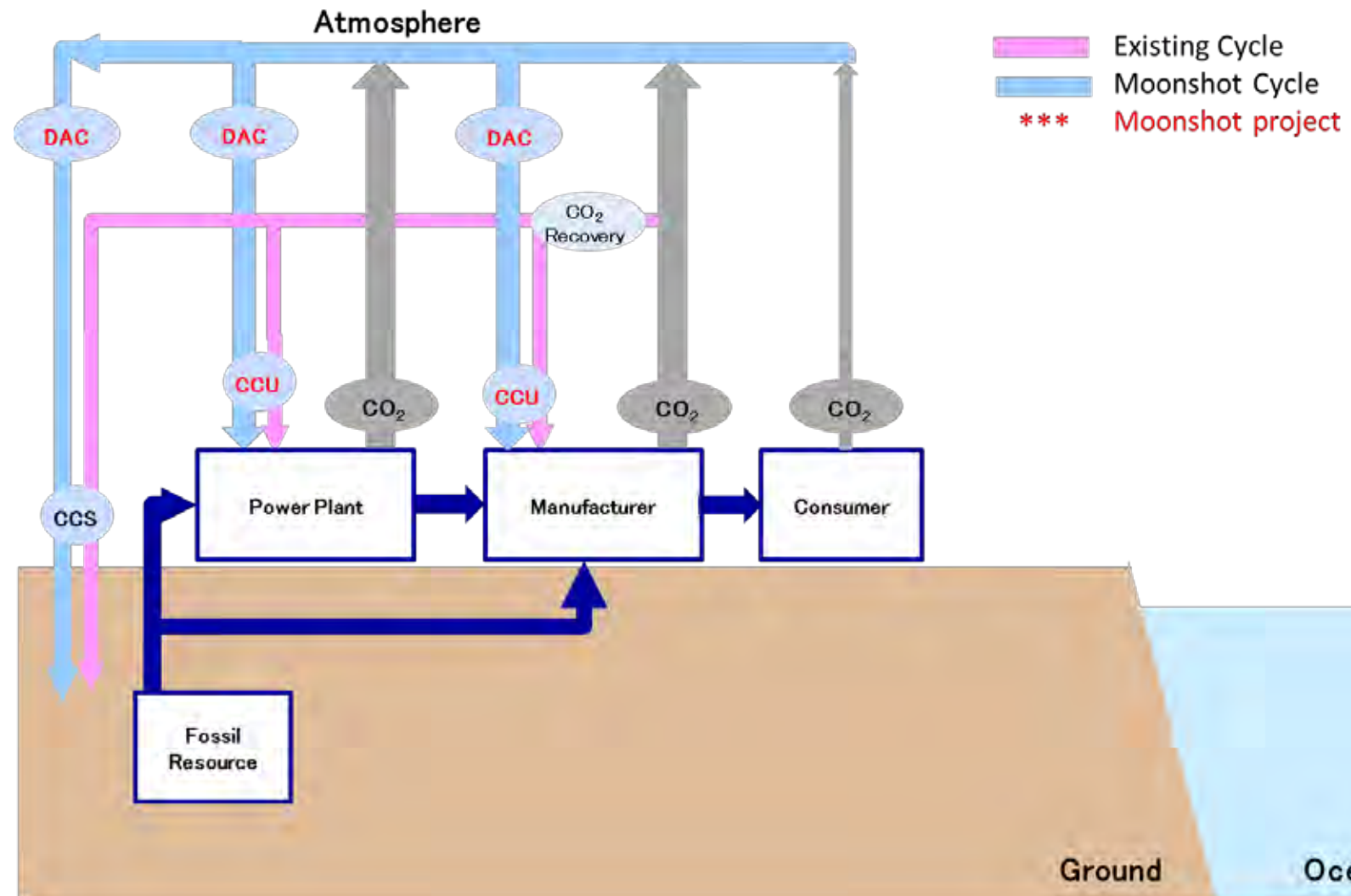
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Moonshot project examples

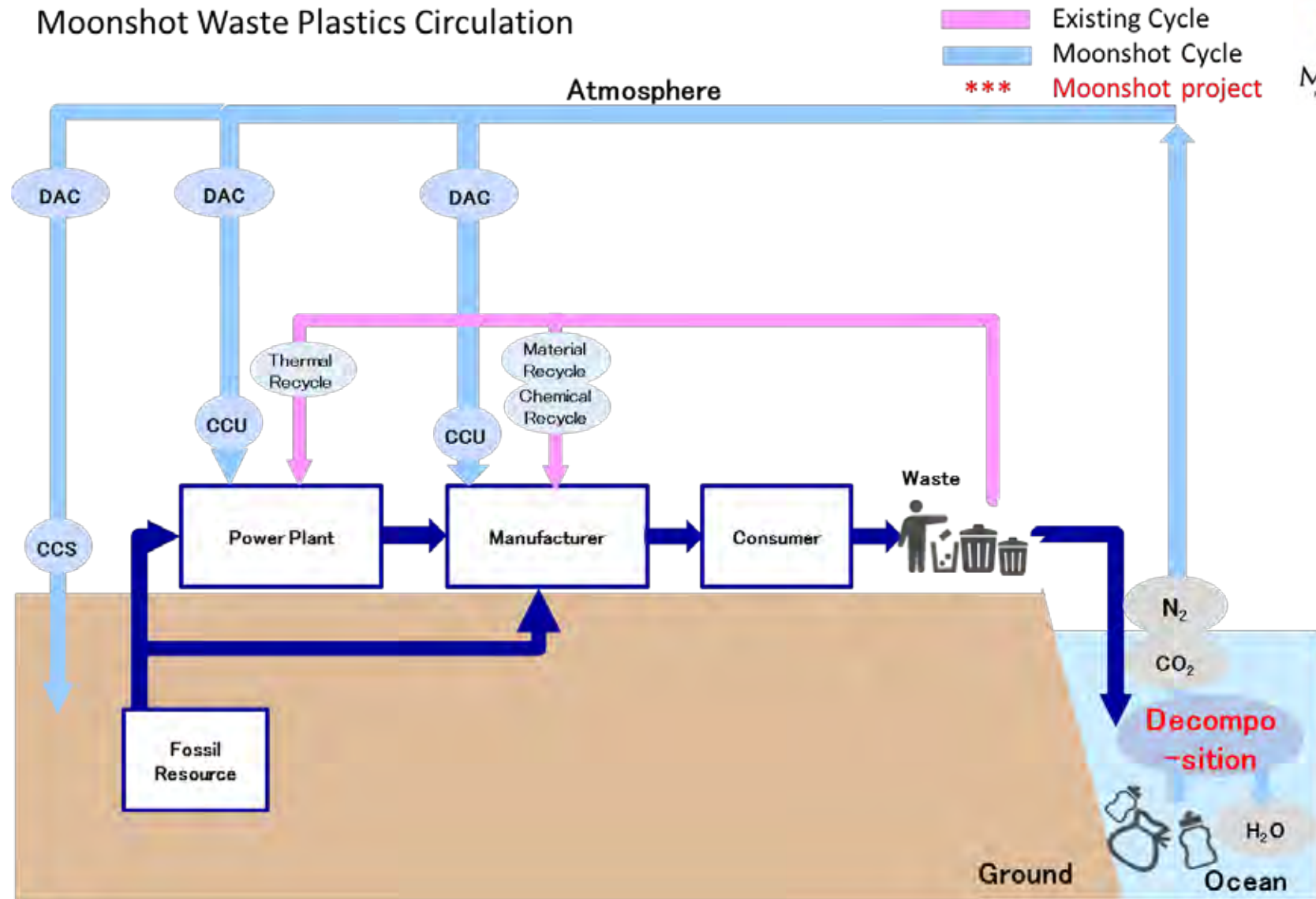|	Target	Background	Moonshot program examples
Cool Earth	CO_2	Paris agreement IPCC 2° C scenario by United Nations	DAC related to CCU
	N_2O		Detoxify N_2O or suppress N_2O generation
Clean Earth	Nitrogen compounds	Planetary boundary	Convert nitrogen compounds in exhaust gas and wastewater to chemicals
	Marine plastic litter	G20 Osaka blue ocean announcement EU plastic regulation	Biodegradation plastic including switch function

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Moonshot Carbon Circulation

Atmosphere

Existing Cycle
Moonshot Cycle
*** Moonshot project

DAC   DAC   DAC

CO₂ Recovery

CCU   CCU   CO₂   CO₂

CCS

Power Plant → Manufacturer → Consumer

Fossil Resource

Ground   Ocean

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Thank you for your attention.