

# Redesign of macroalgae for highly efficient CO<sub>2</sub> fixation by functional modifications and their product generation

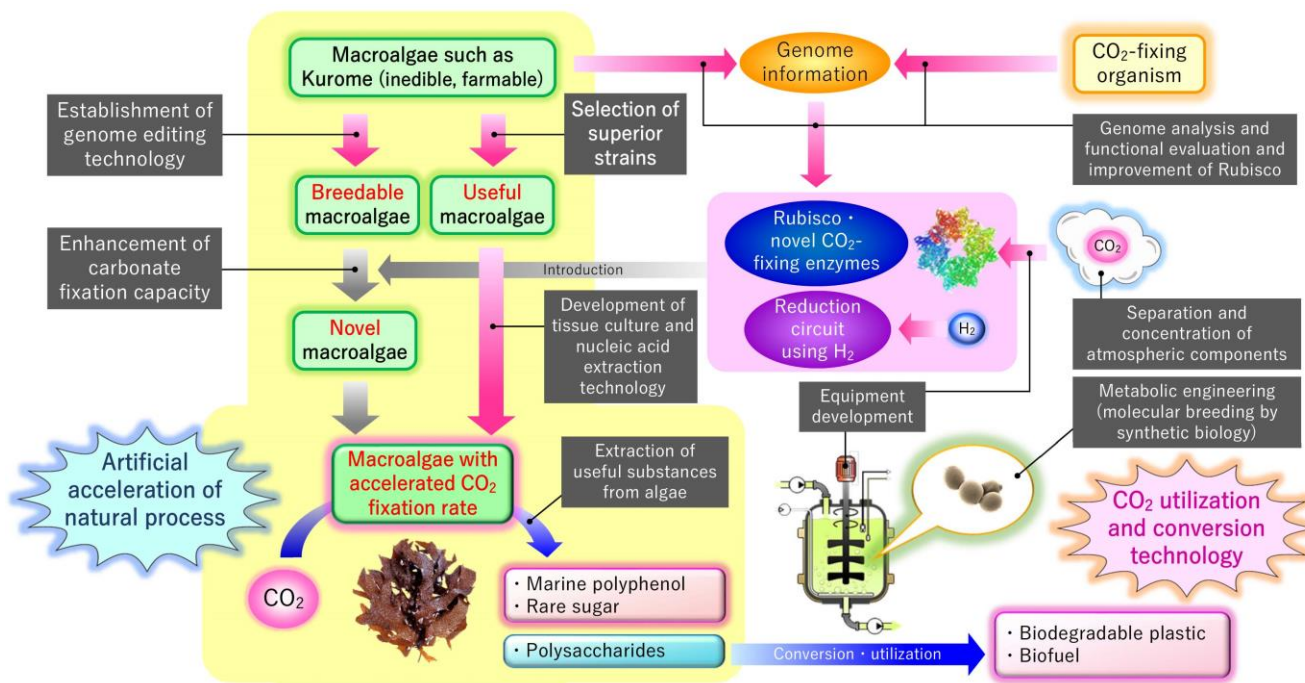


PM : Mitsuyoshi Ueda

Kyoto Univ., Professor

PJ implementation organization : Kyoto Univ., iCeMS,  
Grad. Eng., Grad. Agric., Mie Univ., Kansai Chemical  
Engineering Co., Green Earth Institute Co.

## Implementation structure & period



## Present main results

2011–2017

CREST PJ: Development of biological technologies for complete utilization of macroalgae

2021

NEDO–pioneer research PJ: Development of basic technologies for complete utilization of macroalgae

Establishment of breeding technologies of macroalgae

## 2029 Final targets

Dominance of macroalgae

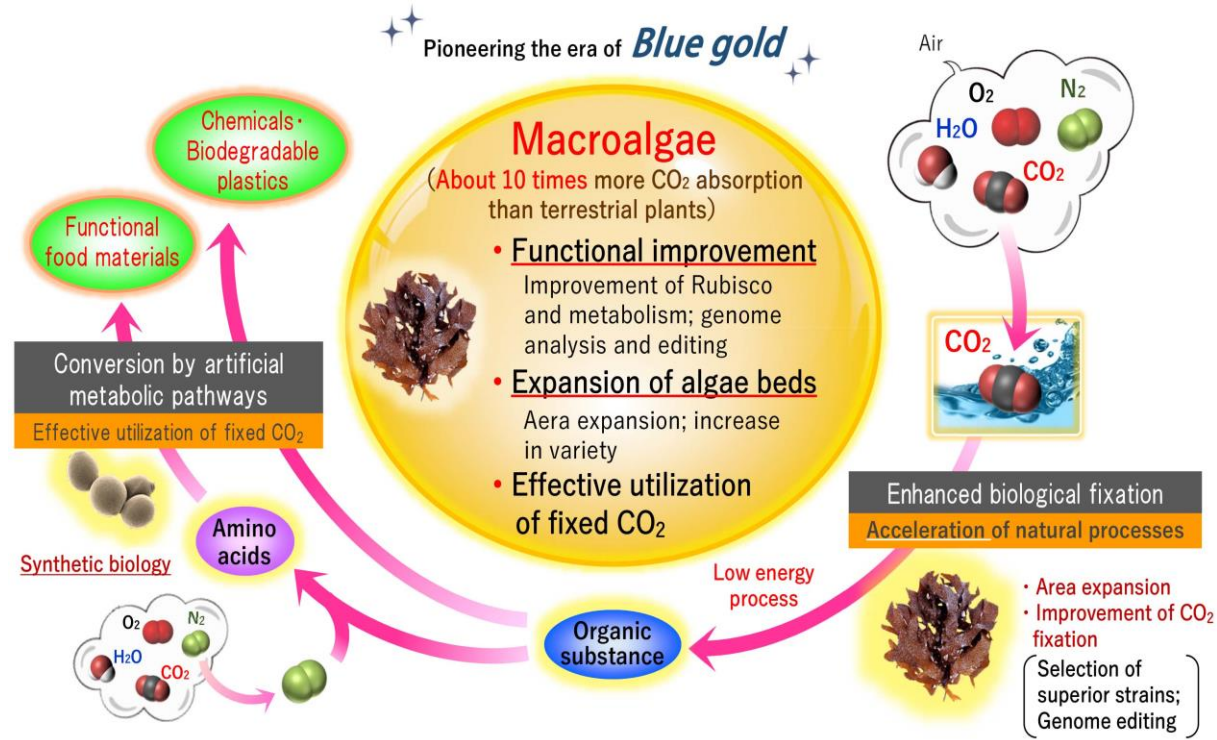
For 2050 scenario

	Starch sugar (1G)	Lignocellulose (2G)	Algae (3G)		Algae (3G)
Raw materials	Agricultural products	Forest	Microalgae	<b>Macroalgae</b>	<b>Macroalgae</b>
Productivity (t/ha/年)	11	9	10~20	<b>30</b>	<b>150↑</b>
CO <sub>2</sub> fixation rate (kg-CO <sub>2</sub> /m <sup>2</sup> /年)	1.6	0.84	1.5~2.9	<b>3.3</b>	<b>16.5</b>
CO <sub>2</sub> fixation ratio	2.3	1	7.6	<b>13</b>	<b>327</b>
Biomass energy production process	Simple	Complicated (Removal of lignin)	Simple	Simple (Utilization of alginates: important)	Simple
Problem	Competing with food	Using land	Using land, Contamination risk, high cost	Expansion of algae beds	Resolvable
Production condition	Sunlight, CO <sub>2</sub> , Freshwater, Land, Fertilizer, Pesticides	Sunlight, CO <sub>2</sub> , Freshwater, Land, Fertilizer, Pesticides	Sunlight, CO <sub>2</sub> , Freshwater/Soda, Land	Sunlight, CO <sub>2</sub> , <b>Seawater</b>	Sunlight, CO <sub>2</sub> , <b>Seawater</b>

【Reference】

• <http://www.ffpri.affrc.go.jp/research/dept/22climate/kyuushuuryou/documents/page1-4-per-year.pdf>

# Researches



# Equipment development- functional improvements & enlargement of algal farms

Utilization of closed thermal power plant site

Closure of aging thermal power plants

Total area of thermal power plants to be closed : 0.93 km<sup>2</sup>

Creation of algae farm around offshore wind power generation facilities



Promotional and promising areas for offshore wind power

Total area : 5,420 km<sup>2</sup>

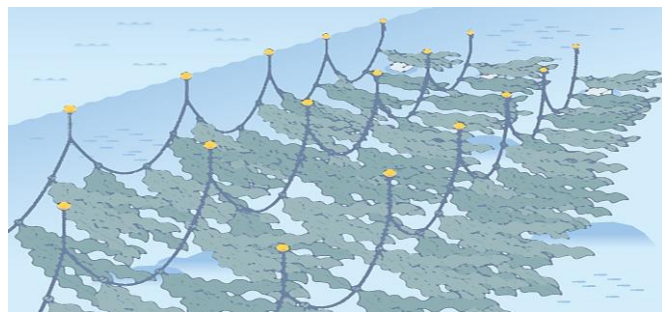
Creation of algae farm around sea airport



Efforts at Chubu Centrair international airport

6 Total perimeter distance of sea airports : 77 km

# Prospective schedule (for 2050 scenario)



Functional improved macroalgae (150 ton/ha/y)

Expansion of algae farms  
6,500 km<sup>2</sup> (約80 km<sup>2</sup>)

• Continental shelf in Japan (250x10<sup>3</sup>km<sup>2</sup>)/38

Kumamoto Amakusa

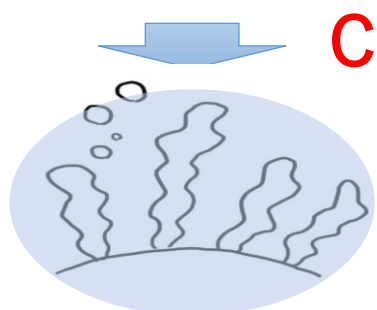


Area of Kurome farms (2013)  
126,700 m<sup>2</sup> (0.1267 km<sup>2</sup>)



CO<sub>2</sub> Fixation

Decrease of CO<sub>2</sub> 1.07 x 10<sup>8</sup> ton-CO<sub>2</sub>/y  
→ 10% Effect on CO<sub>2</sub> decrease



Blue Carbon

2,900 x 10<sup>4</sup> kL/y Ethanol production (1/3 consumed gasoline)