



Development of Aircraft Fuels from Algae



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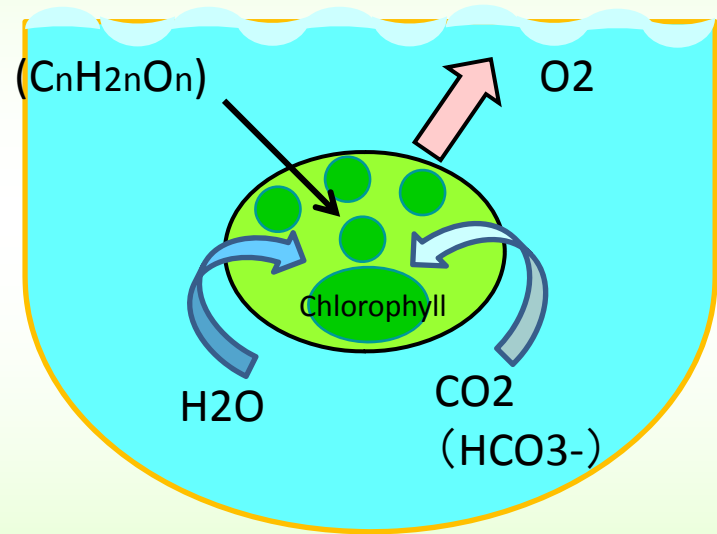
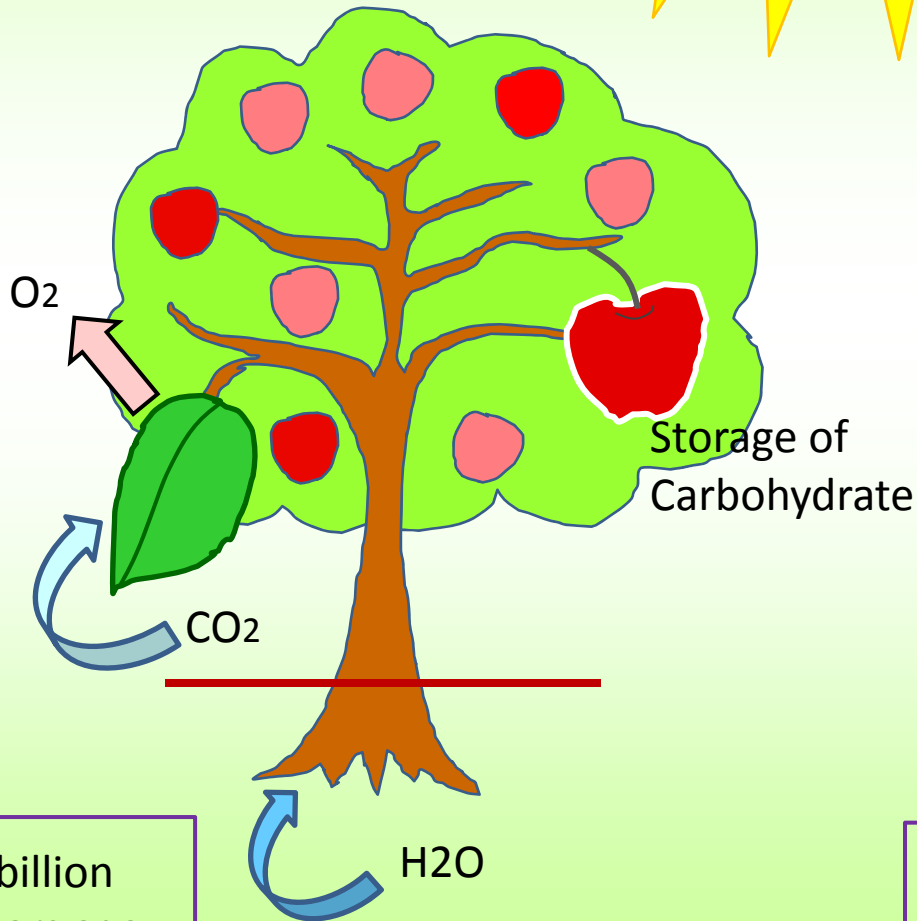
Secretary General of CIGR

Photosynthesis

Solar

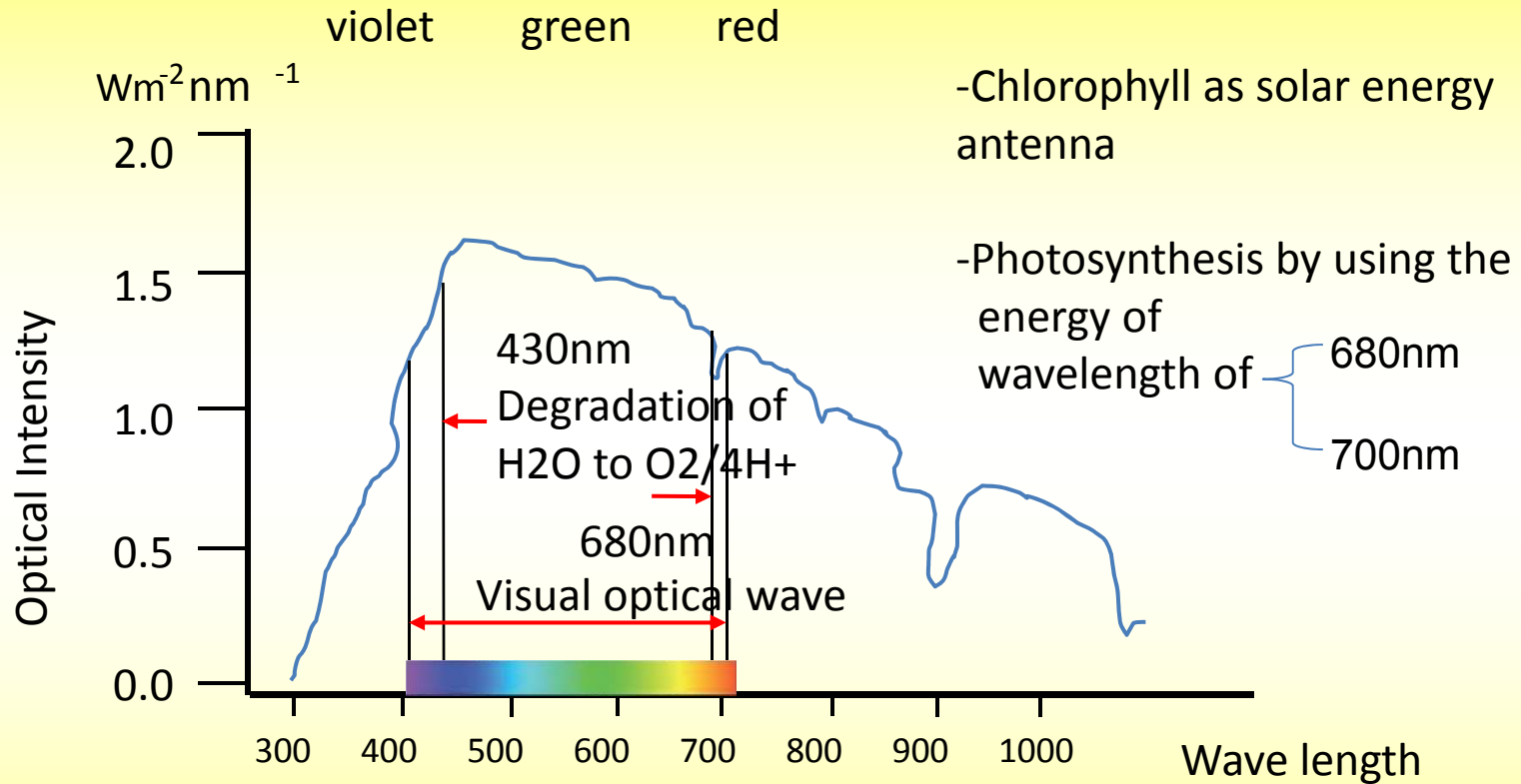
Plants

Micro Algae



Micro Algae : Photosynthesis was acquired by the mutation.

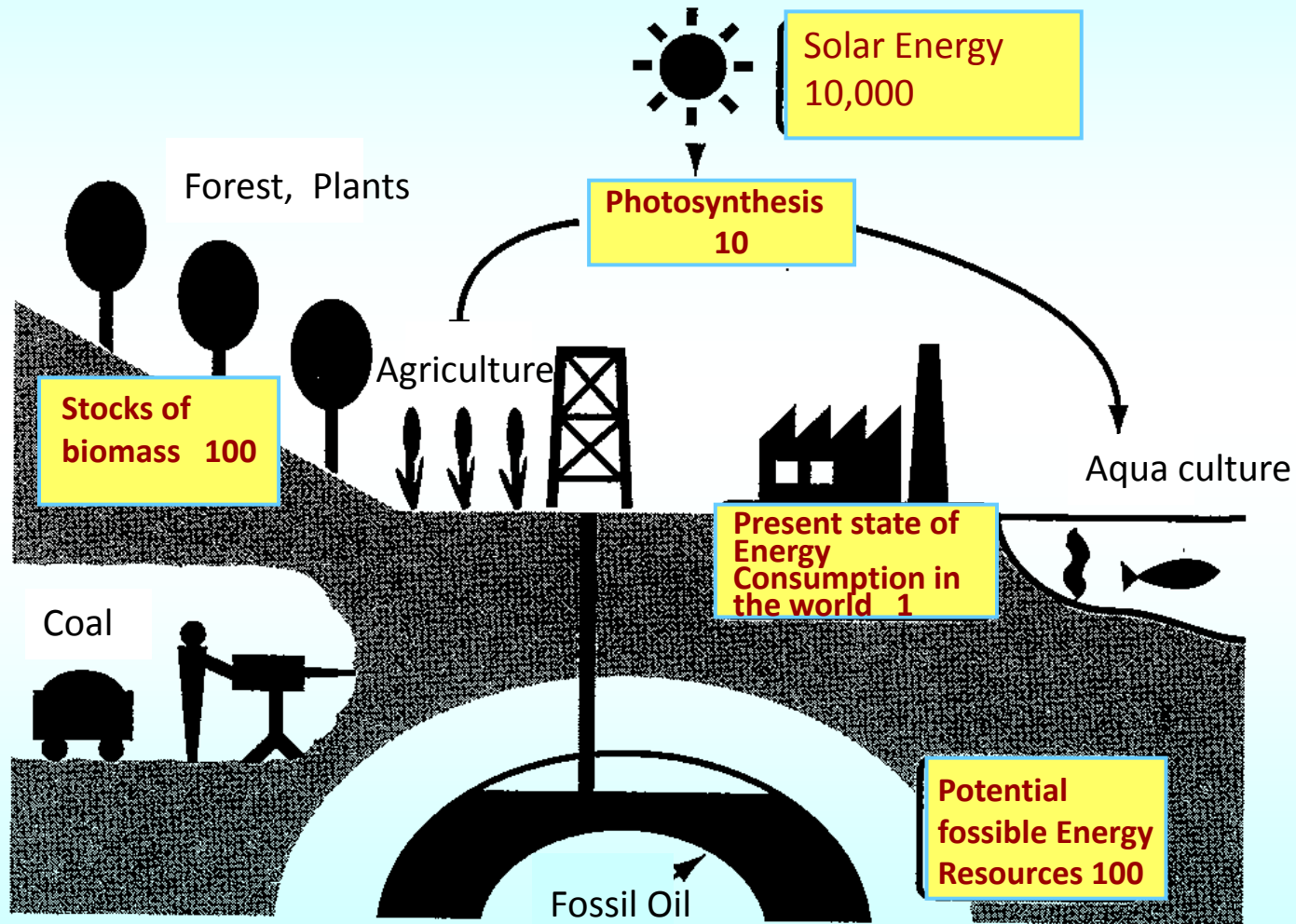
Sunlight & photosynthesis

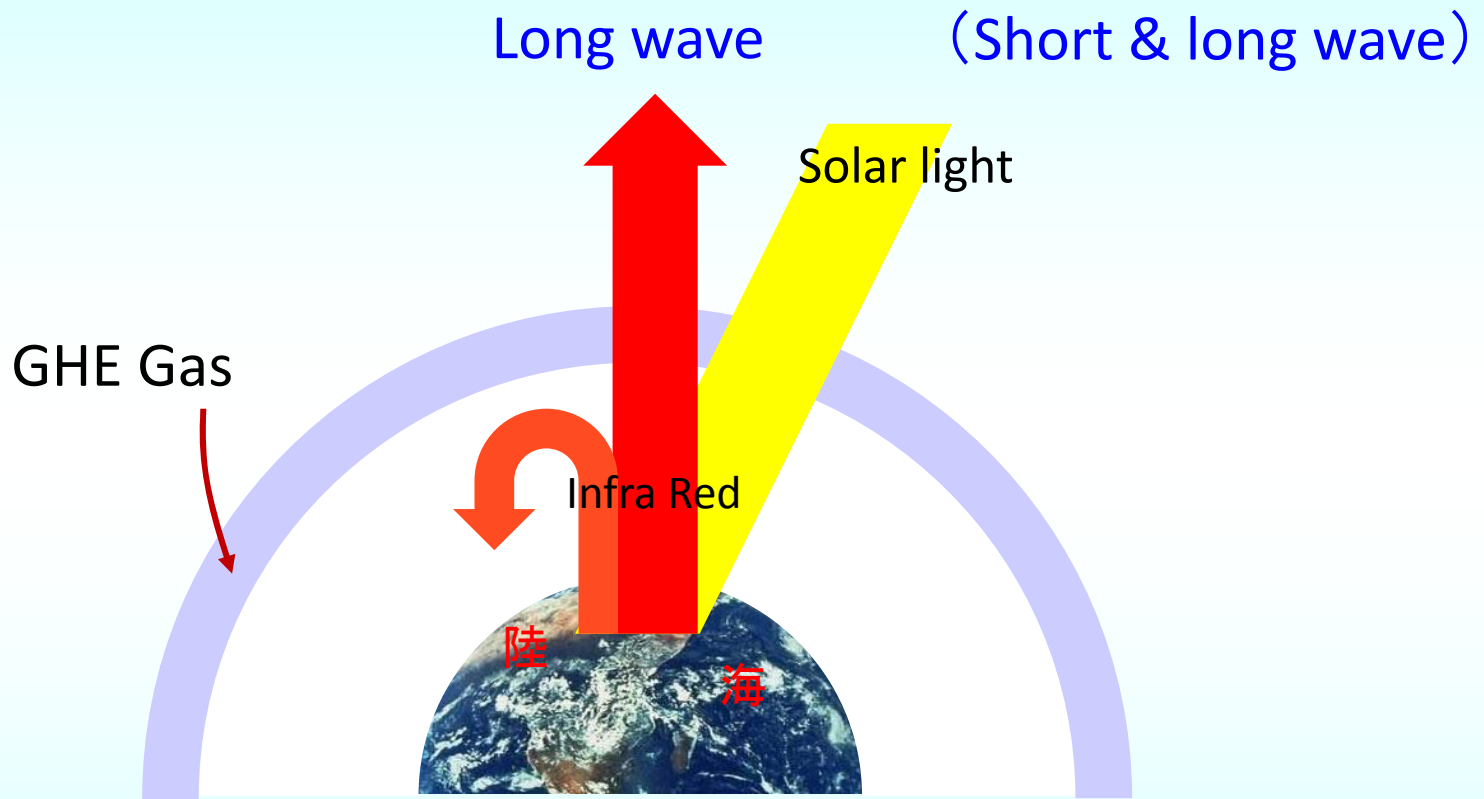


μm : 1mm of 1/1000

nm: $1\mu\text{m}$ of 1/1000

Biomass is One of Renewable Energy Sources





Mechanism of Greenhouse Effect

Exhausted CO2 in Japan and associated with Resources in Industry

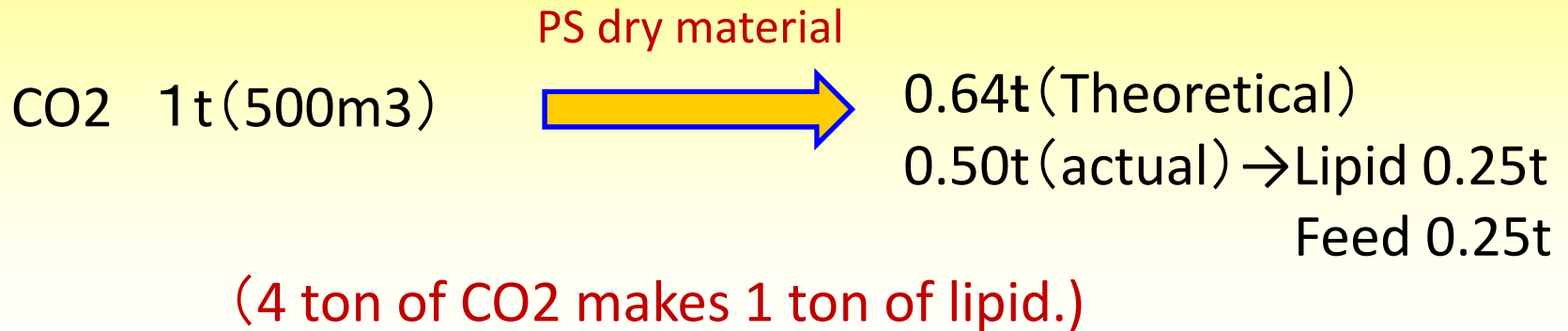
2006

	CO2排出量	備 考
Total	1.3 billion ton	1.6 billion ton ? (2009) (10 ton/ person)
Electric Power Company	0.34 billion ton	
Steel Company	0.17 billion ton	
Chemical industry & Others	67 mega ton	
Cement Company	33 mega ton	
Industrial Total	0.61 billion ton	25% : 0.15 billion ton Reduction : 750 billion yen

Hatoyama regime 25%

Aso regime 15%

Principle Units for Algae Production

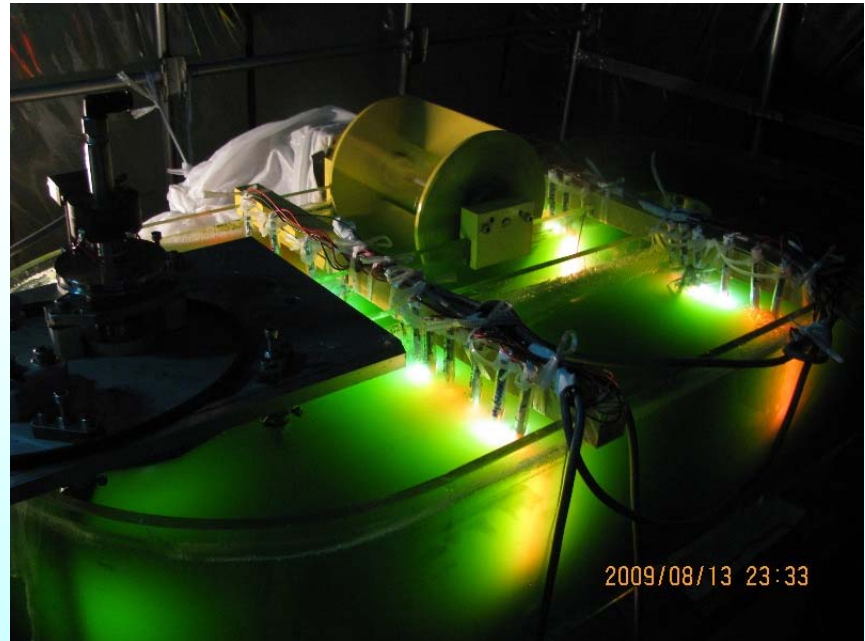


Technological development

1. Light Source (LED, CCL)
2. Optical Electric Power (36w/m³, 200w/m³, 600w/m³)
3. Supply of CO₂ (micro- bubble : 30-40μm)
4. Nutrients (N, K, P, Mg, Mn etc.)



5L PBR



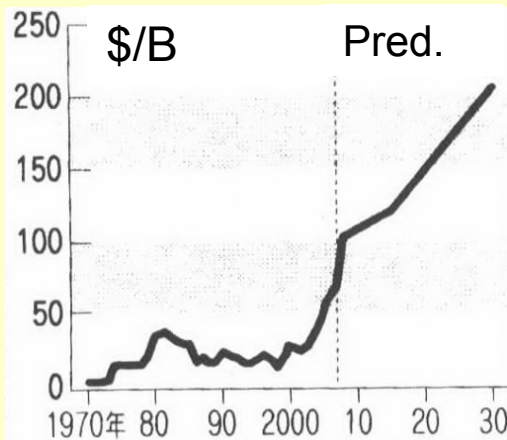
70L Raceway PBR





Why Jet Fuel?

① Price of crude oil



② Cap and Trade

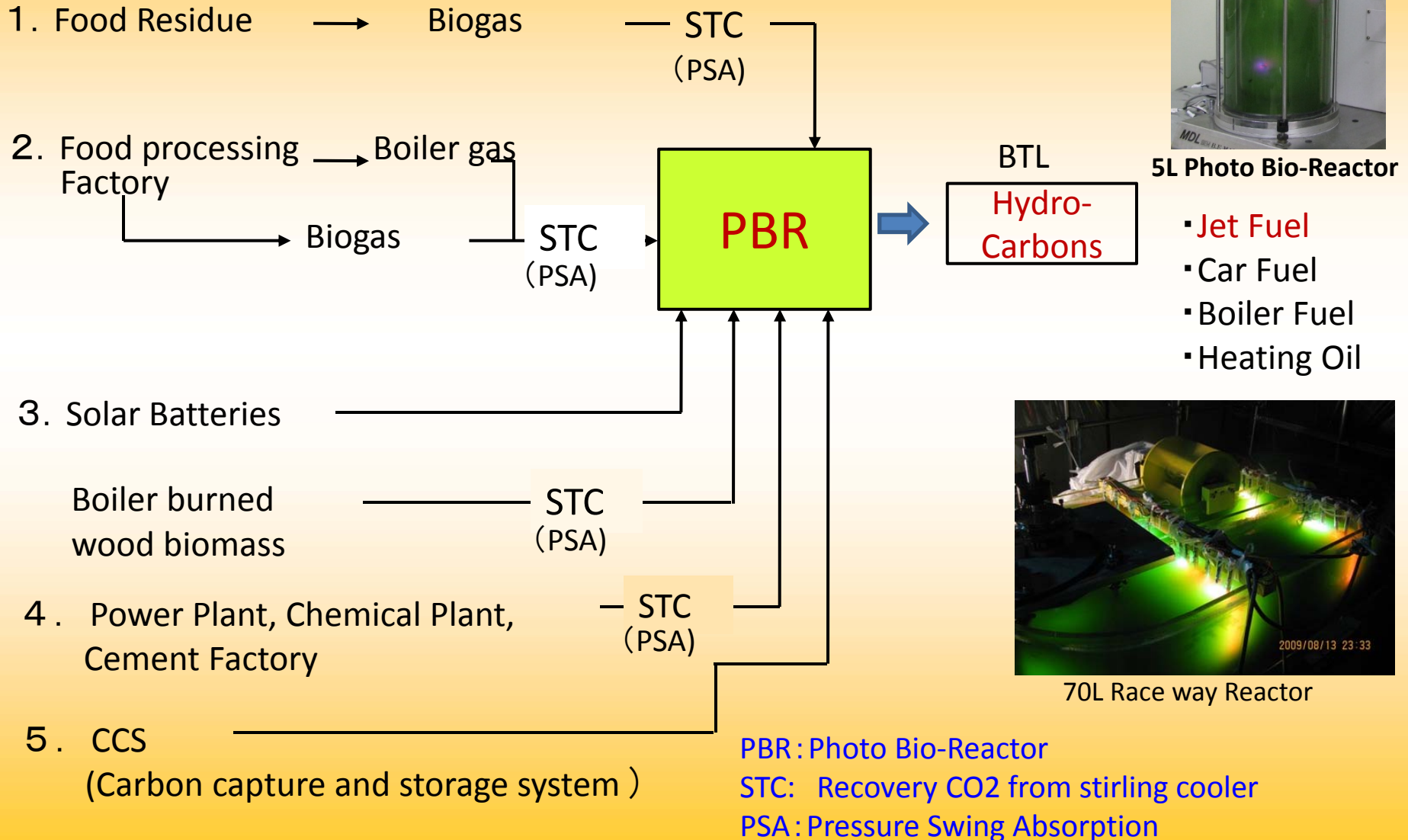
Biomass fuel percentage of Jet oil (Fossil Oil)

EU	until 2011 year	3%	12MKL/y
	2013	5%	Domestic 7MKL/y
	2010年	10%	Abroad 5MKL/y

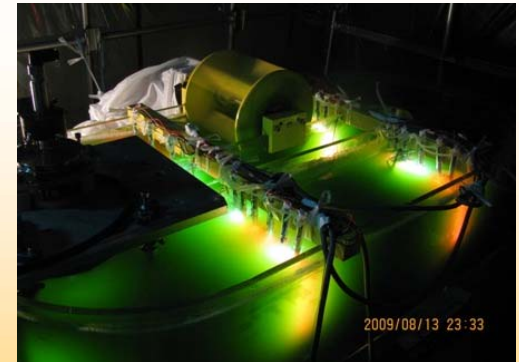
③ Stable price of Jet Oil (independent of currency)

④ Jet Oil from non foodstuffs

Example of Algae Oil production



5L Photo Bio-Reactor



70L Race way Reactor

Cultivating Algae for Liquid Fuel Production

Gallons of Oil per ha per Year

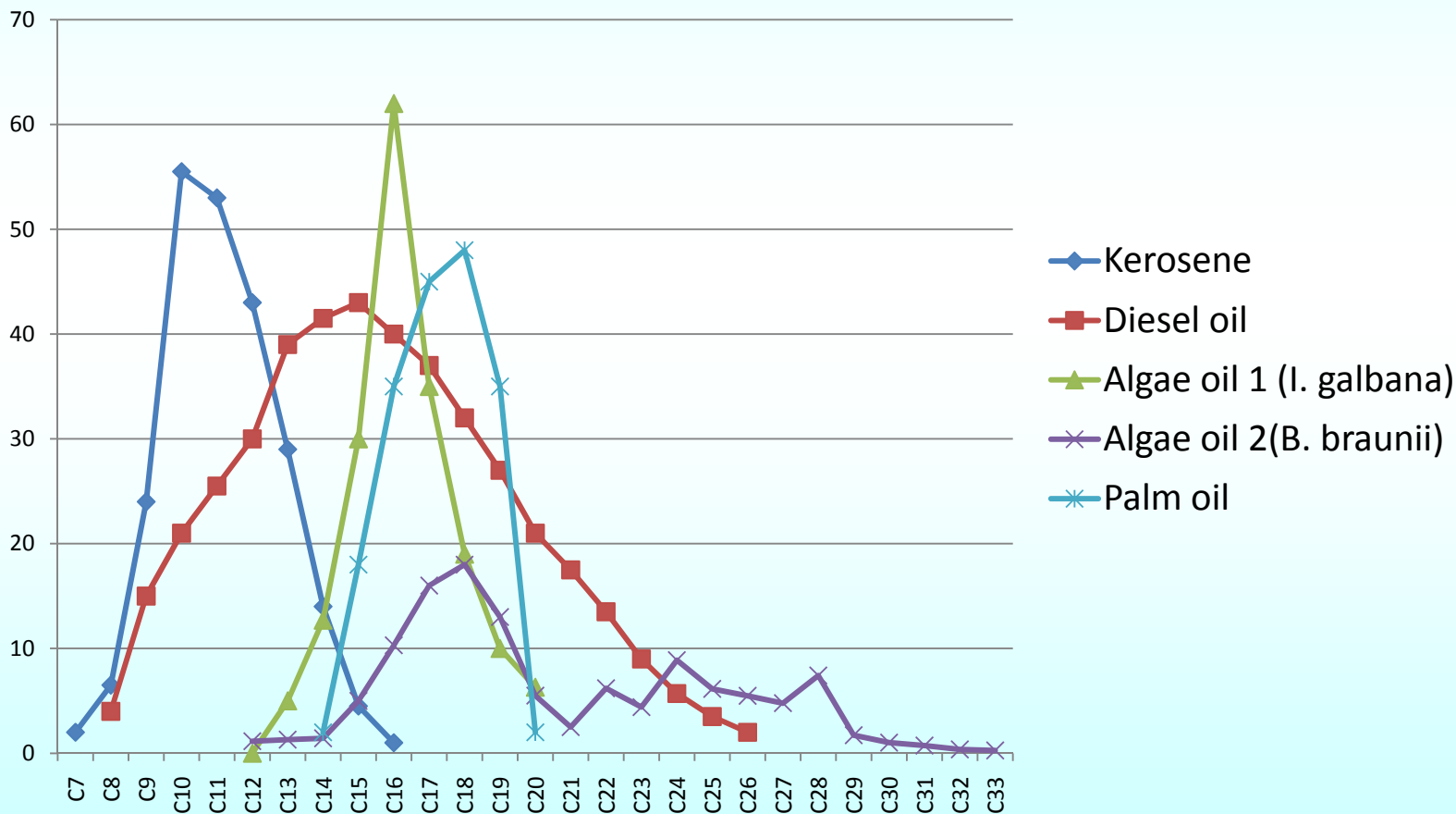
Corn	37
Soybeans	118
Safflower	205
Sunflower	252
Rapeseed	313
Oil Palm	1570
Micro Algae	1850 (based in actual biomass yields)
Micro Algae	5000-15000 (theoretical laboratory yields)

Source: Direction of Diesel Oil from Algae

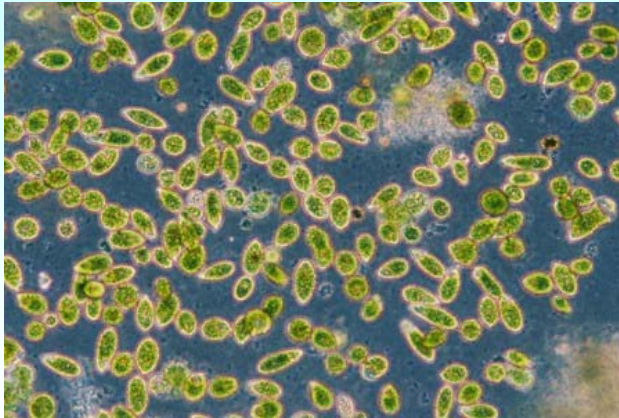
Micro Algae: 16,000-23,000 (Our present data, 2008.12)



Jet Fuel Compositions of the Hydrocarbon



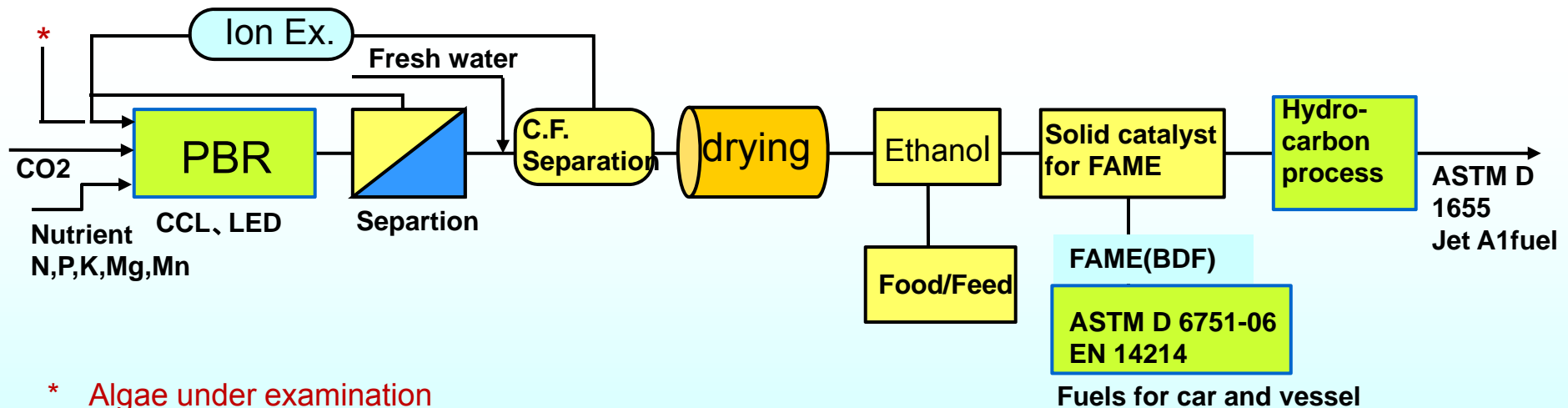
Process for Algae Production to Jet Fuel/BDF



Euglena microscopic photograph



Algae Oil extracted from *Scenedesmus* (EtOH, n-Hex)

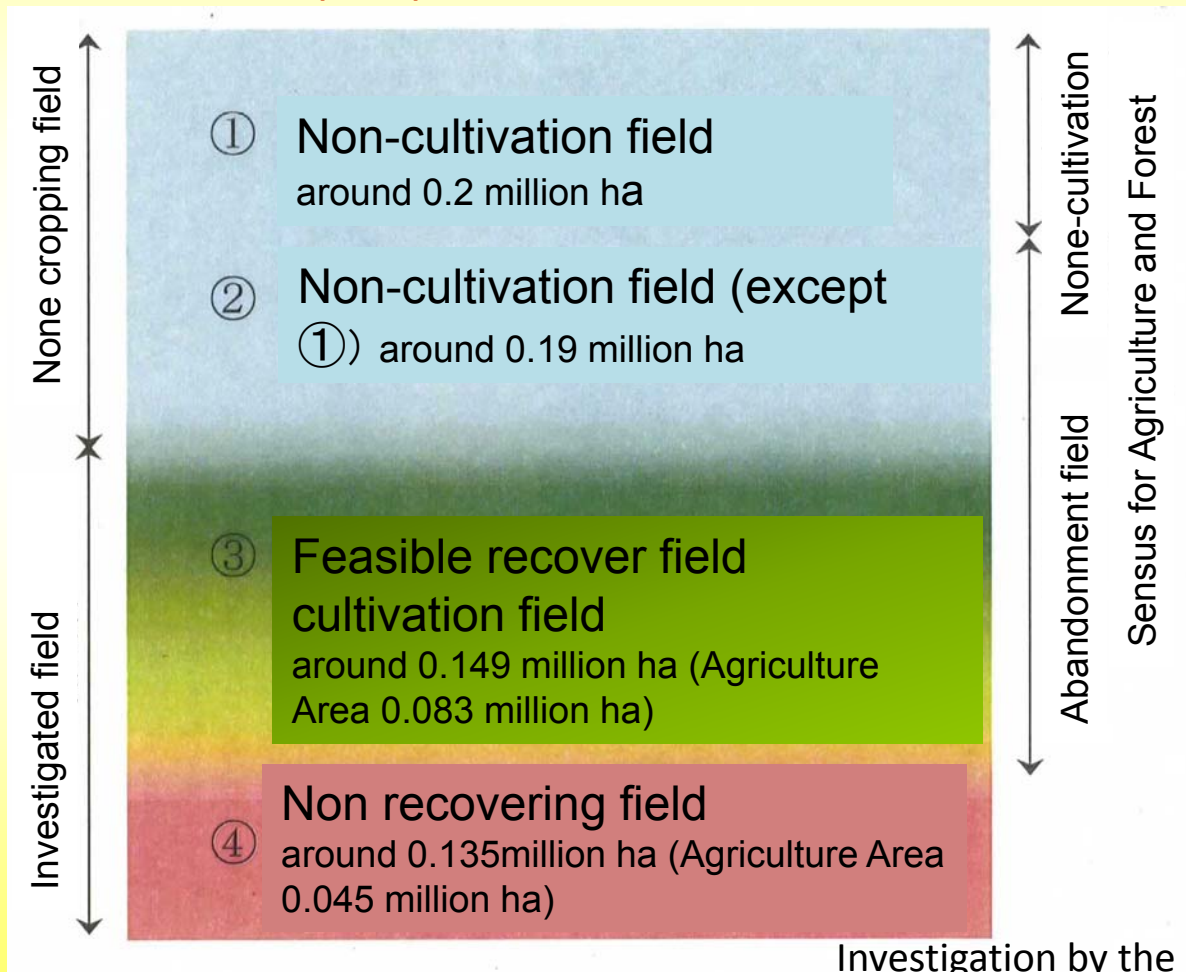


* Algae under examination

- *Scenedesmus quadricauda* (The fresh water and the content of the lipid are low.)
- *Scenedesmus dimorphus* (the fresh water, 40%—50% content of lipid)
- *Euglena gracilis* (Fresh to Brackish water, A lot as FFA (content 20-30% of the lipid))
- *Isochirix galbana* (Seawater: Feed for aquaculture, 40~50% content of lipid)



Future perspective



For reference
 Pool of closing school
 2100 schools in Japan
 1st place Hokkaido
 2nd place Tokyo
 3rd place Niigata prefecture

Capacity of pool
 400~500m³
 (Investigation by the Ministry of Education)

Moreover the fish breeding ground was given up by herpes.

Economy Analysis in the Algae and Algae Oil Production

Product	500m3 Pool unused		1 ha 3000m3 Land out of cultivation	
	Yen	ex-works	Yen	ex-works
Jet Oil	1,500,000	37.5kL	9,000,000	225kL
Food	10,200,000	102t	60,600,000	606t
Cap and Trade	1,500,000	300t	9,000,000	1,800t
Total	13,080,000	————	78,600,000	————

1 kg/m3/d harvest (by Solid /Liquid)

Calculation condition : Algae(*Euglena gracilis*)(Content of lipid 30%)
 : Recovery percentage hydrocarbon oil 75%
 food raw material 96%(dry)
 Price of hydrocarbon oil (ex-works) 40,000Yen/kL
 food raw material (ex-works) 100,000Yen/ton
 CO2 Cap and Trade 5,000Yen/ton

Create New Industries

1. Fuels
2. Feed and Food Stuffs
3. Cap and Trade Business

Everyone can make the fuel oil anytime and anywhere by using Solar and artificial light (LED).



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Thank you for your attention!



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