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WOODY BIOMASS UTILIZATION IN JAPAN

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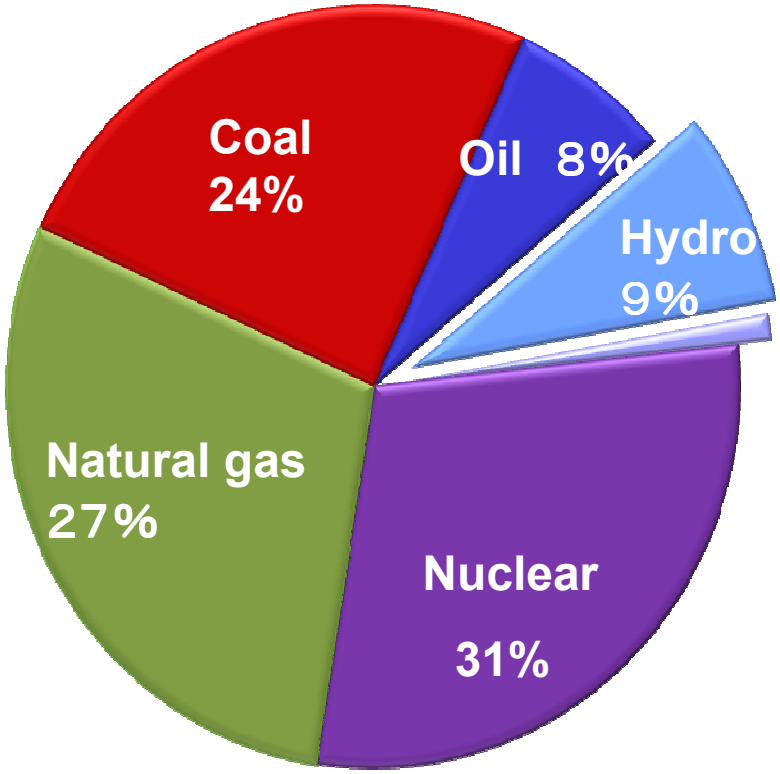
RENEWABLE ENERGY IN POWER GENERATION MIX 2009



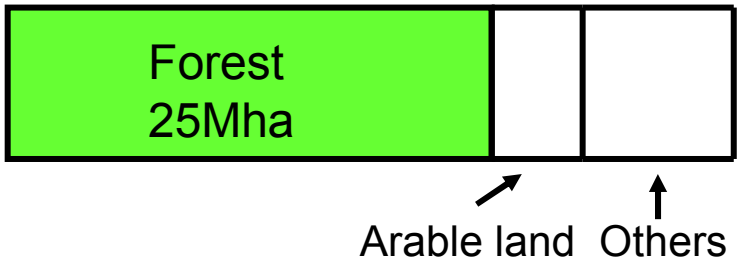
Renewable Energy 1%

Wind	34.8%
Biomass	28.7%
Geothermal	22.6
PV	13.9%

Source: METI

FOREST IN JAPAN

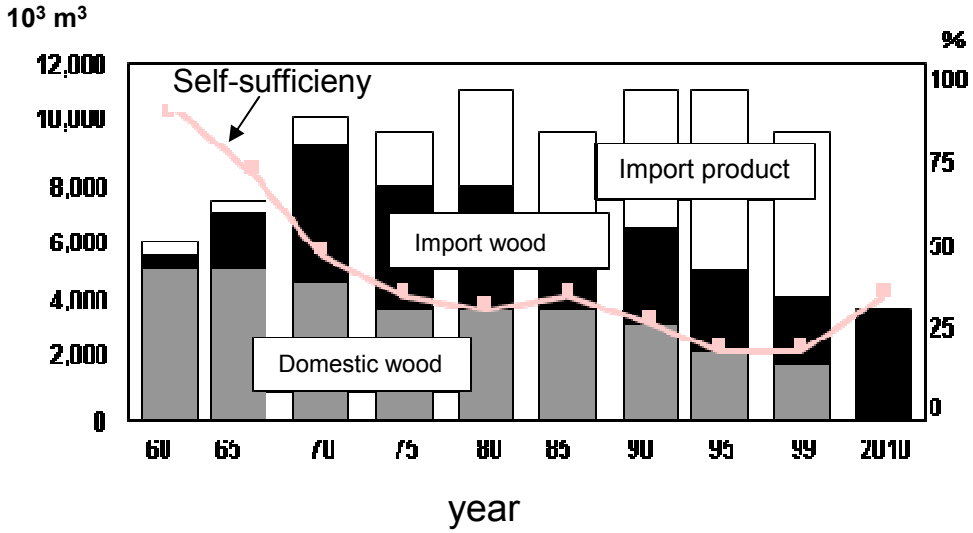
Land Area of Japan : 36.47 Mha



* 2/3 of forest : artificial forest
* 1/3 of forests : natural forests
* Annual productivity of forset:

  70 M to 100M m^3

REVITALIZATION OF FORESTRY AND BIOMASS UTILIZATION



The Forestry Agency of MAFF has proposed " Forest and Forestry Revaitalization Plan" in order to raise the self-sufficiency rate from 24% to 50% within 10 years.

Maintenance of forest road, utilization of forest resources, and system reform and review of budget are important to achieve the target.

Power generation by wood combustion will be economically beneficial in accordance with FIT which will be put into force.

POTENTIAL AND AVAILABILITY OF BIOMASS IN JAPAN

Item	Potential MCton	%	Availability MCton
Animal waste	5.25	25	1.31
Sewage sludge	0. 90	21	0.19
Black liquor	4.66	100	4.66
Paper	10.34	5	0.52
Food waste	0.80	26	0. 21
Sawmill waste	1.70	60	1.02
Construction waste	1.81	47	0.85
Agri waste	4.98	15	0.75
Forest waste	4.00	30	1.20
Enegy crop	0.40	100	0.40
Total	34.84		11.11

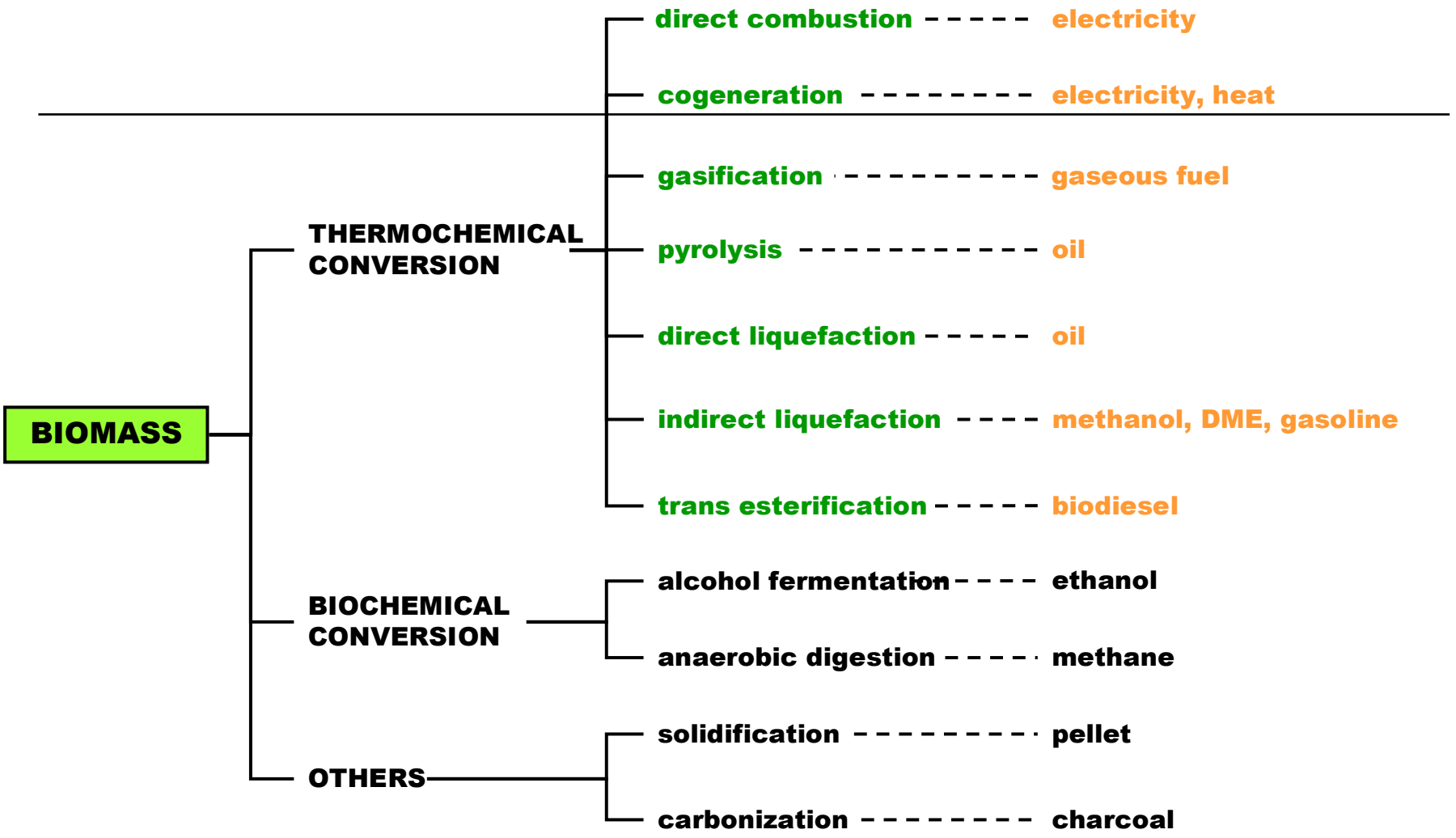
The total energy of maximum available biomass is 460PJ/y.

* If this amount of biomass is converted to electricity, it becomes equivalent to 13 billion kWh/y (2.8 M households)

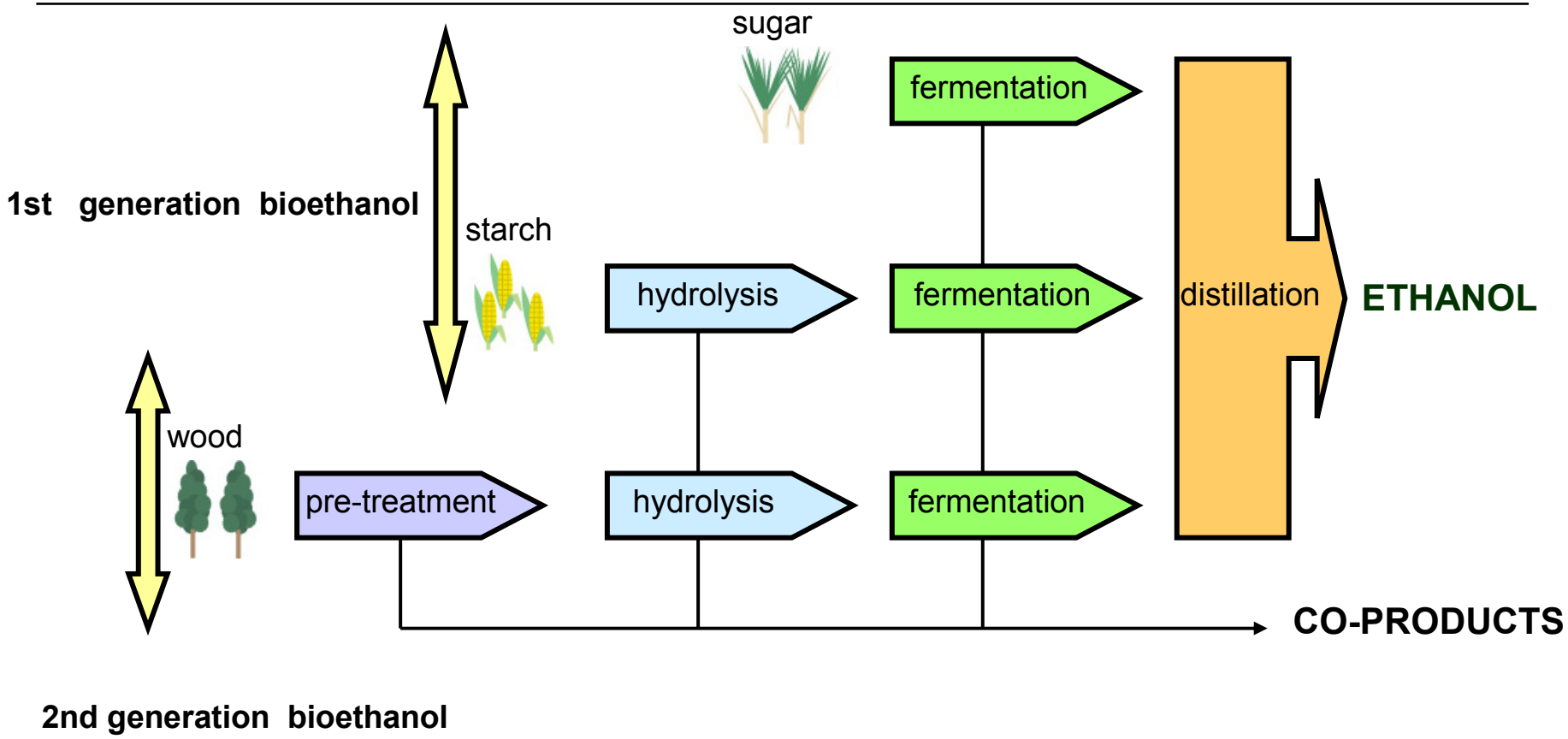
•If this amount of biomass is converted to bioethanol, it can provide 11.8 M kl/y.

* In these cases, GHG reduction will be about 40 Mt-CO_2/year. (3.2% of annual CO_2 emission)

BIOMASS ENERGY CONVERSION TECHNOLOGY



OVERVIEW OF ETHANOL PRODUCTION PROCESSES



BIOETHANOL PILOT PLANT

NEDO Project: Oji Paper Co., Ltd., Nippon Steel & Sumikin Engineering, AIST

Starting material: woody biomass: *eucalyptus*

Pretreatment*:* mechanochemical process

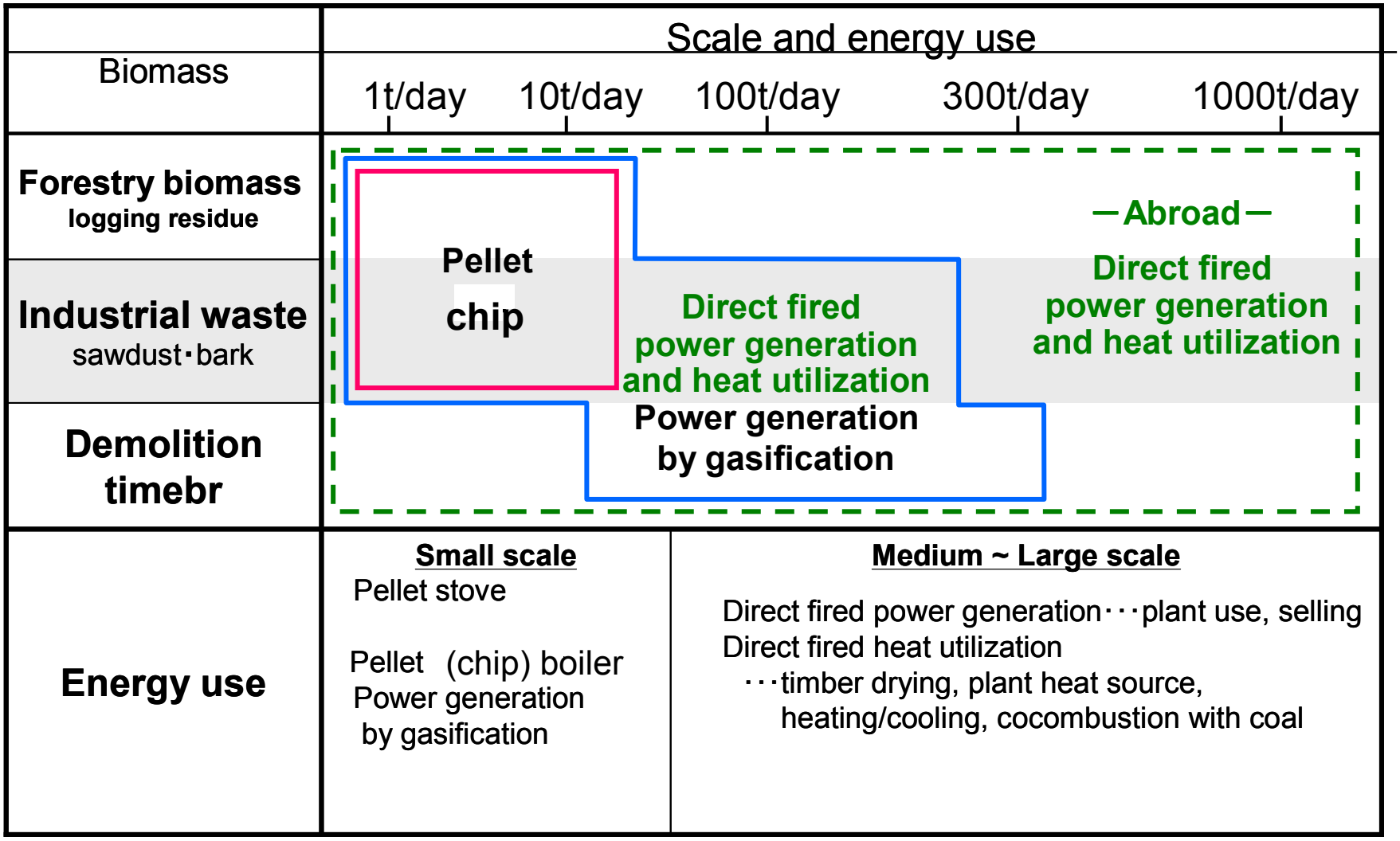
Saccharification: commercial enzyme

Fermentation: C6 & C5

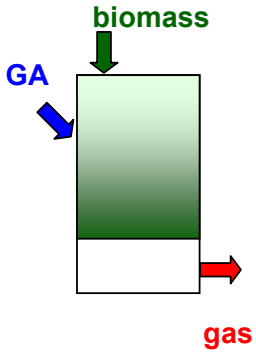
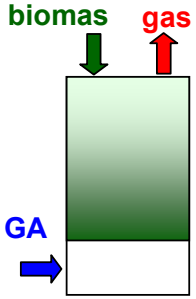
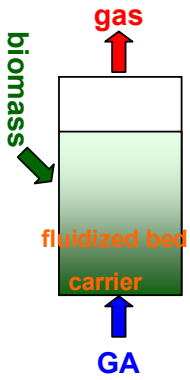
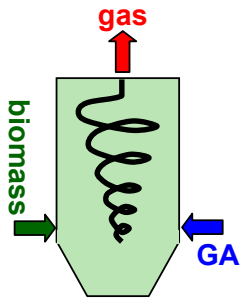
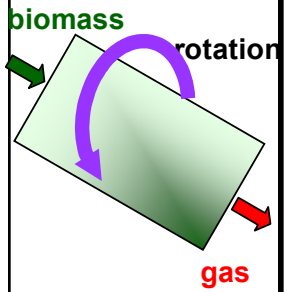
Distillation: new technology

Capacity: 200 L/day

ENERGY UTILIZATION OF WOODY BIOMASS AND PLANT SIZE



TYPE AND CHARACTERITICS OF GASIFIER

Type	Fixed		Fluidized	Entrained	Rotary kiln
	Down draft	Updraft			
Image					
Feedstock	chip, block	chip,block	chip, block	powder	chip, block
Temperature	700～1100℃	700～900℃	650～900℃	800～1000℃	700～1000℃
Remarks	•small scale •small amount of tar • power generation	•small scale • tar •power generation	•big scale •tar •power generation •liquid fuel •bubbling, circulating	•medium, large scale • small amount of tar • easy change of composition •liquid fuel •power generation	•small, medium scale •tar, reduced by after treat-ment •power generation

GA : gasifying agent

EXAMPLES OF ENERGY CONVERSION OF WOOD

DIRECT COMBUSTION FOR THERMAL USE :	162
DIRECT COMBUSTION (INCLUDING COGENERATION) :	111
GASIFICATION :	29
PELLET PRODUCTION :	126
LIQUID PRODUCTION :	3
SOLID FUEL PRODUCTION :	10
BIOETHANOL PRODUCTION :	3
CO-COMBUSTION	11
WOOD + FOOD WASTE COMBUSTION	3

FIT SYSTEM FOR BIOMASS

	Unused wood	Wood	Construction waste	Methane		Solid fuel	
				sludge	animal dung	MSW	sludge
Construction cost	**¥410,000/kW**	**¥410,000/kW**	**¥350,000/kW**	**¥3,920,000/kW**		**¥310,000/kW**	
Running cost *1)	**¥27,000/kW**	**¥27,000/kW**	**¥27,000/kW**	**¥184,000/kW**		**¥22,000/kW**	
IRR	**8%**	**4%**	**4%**	**1%**		**4%**	
FIT/kWh *2)	**¥33.60**	**¥25.20**	**¥13.65**	**¥40.95**		**¥17.65**	
FIT/kWh *3)	**¥32**	**¥24**	**¥13**	**¥39**		**¥17**	
Term	**20 years**						

***1) running cost per annum, *2) including tax, *3) excluding tax**

SUMMARY

∗ In Japan, the potential of woody biomass is about 1.6 million tons (on C basis) depending on the rate of thinning.

∗ The woody biomass is used for thermal use as well as power generation by direct combustion.

∗ A technology of second-generation biofuel seems premature and it will take some time to commercialize.

∗ It is not easy to collect woody biomass in a large quantity, so power generation by gasification is important. It is highly desirable to construct compact and efficient gasfiers at a reasonable cost.

∗ FIT system has been introduced to enhance the introduction of renewable energy. For woody biomass, FIT is different in the origin of the starting materials; green biomass, biomass, and waste wood.

∗ There are many arguments and criticism that FIT is too high due to the lack of transparency in the process of price decision or reasonable cost estimation.

∗ It is expected, however, that utilization of woody biomass will be progressed by reviewing and revising FIT.

Thank you very much

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BOTTOLENECK TO BE SOLVED FOR THE PRODUCTION OF 2nd GENERATION BIOETHANOL

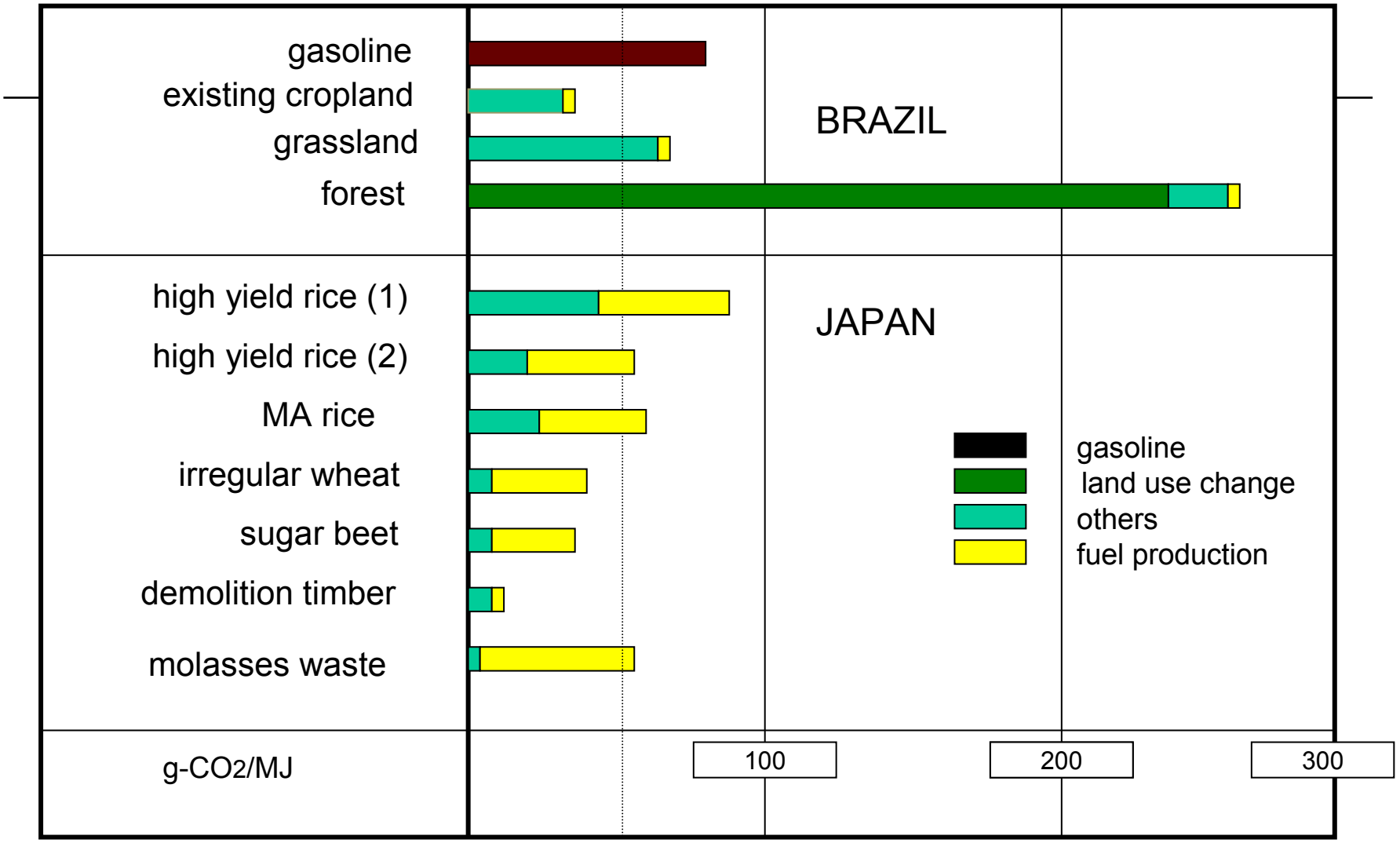
- Separation of holocellulose from lignin
- Saccharification of holocellulose by enzyme

  High efficiency, high selectivity, recycle of enzyme, anti-stress, low-cost production
- Sophisticated utilization of lignin

  aromatic chemicals
- Efficient utilization of by-products

  DDGs, CO_2
- Wastewater treatment technology

GHG EMISSION OF BIOETHANOL （LCA）



Source: Agency of Natural Resources and Energy, METI