2019 Seoul Fuel Ethanol Conference

2019. 4. 30

BACKGROUND AND FUTURE OUTLOOK OF JAPAN'S ETBE POLICY

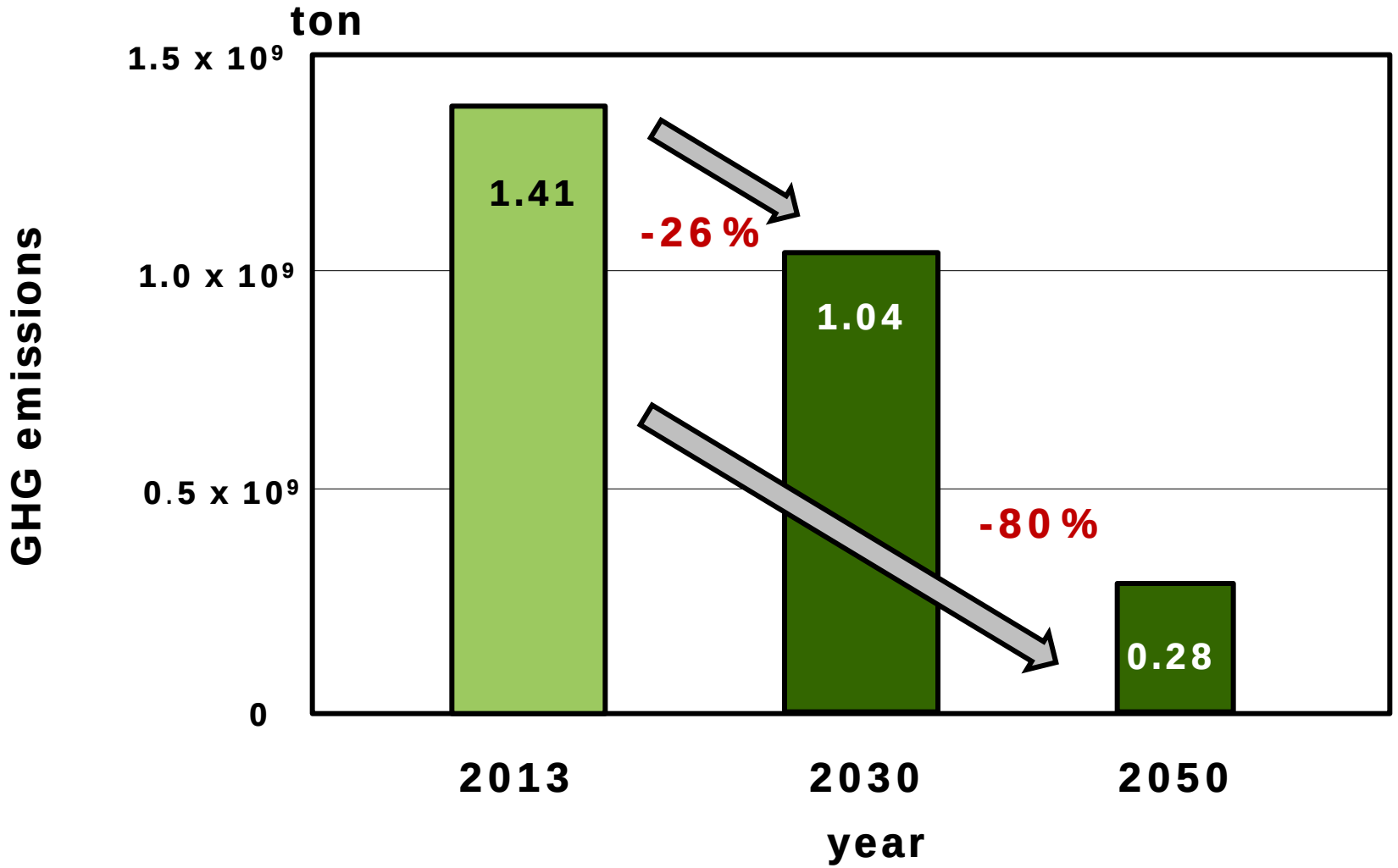
Shinya Yokoyama

Tottori University of Environmental Studies

Japan's Plan to Reduce GHG

The amount of CO_2 emissions in Japan was 1.41 billion tons in 2013, which was 3.5% of the world emissions. Based on the Paris Agreement, Japan's intended nationally determined contribution was submitted to the United Nations in 2015. That established a medium-term goal (to be achieved by 2030) of reducing GHG emissions by 26% compared to the 2013 level, and a long-term goal (by 2050) of reducing them by 80%. It also outlined measures to be taken by all sectors, that is, industrial, transportation, domestic, business and energy conversion, as well as measures to be taken by national and local governments to enable achievement of the Plan's goals.

Japan's Medium and Long Term Goals



The Amount of GHG Emission in 2013

In Japan, the GHG emission in 2013 was 1.41 billion tons as carbon dioxide. Its breakdown is as follows;

Industrial sector	**:**	**34.8 %**
Transportation sector	**:**	**18.3 %**
Domestic sector	**:**	**16.3%**
Business sector	**:**	**22.6%**
Energy sector	**:**	**8.2 %**

The amount of GHG emission from transportation sector was roughly 20%. The ratio of transport fuels were gasoline (56%) , diesel fuel (30%) and heavy fuel (5%).
In order to reduce CO_2 by 26% compared to the 2013 level, about 67 million tons of CO_2 must be reduced in transportation sector by 2030.

Japan's Policy

A law was enacted in 2011 to introduce bioethanol of 830 thousand kL (equivalent to 500 thousand kL of gasoline) to gasoline each year from the viewpoint of energy security, energy efficiency and environmental consideration.

The law lasted until 2018 and was extended until 2023. The goal rate of reduction of GHG was revised upward from 50% to 55%. However, no domestic ethanol was available and, therefore, Japan had to depend on imported ethanol. Ethanol which is produced in Brazil is transferred to the USA in order to convert to ETBE(Ethyl Tertiary Butyl Ether). Then it is transported to Japan and is blended with gasoline.

GHG Reduction Rate

GHG Reduction Rate is defined as follows;

$$\text{GHG Reduction Rate (\%)} = (1 - B/A) \times 100$$

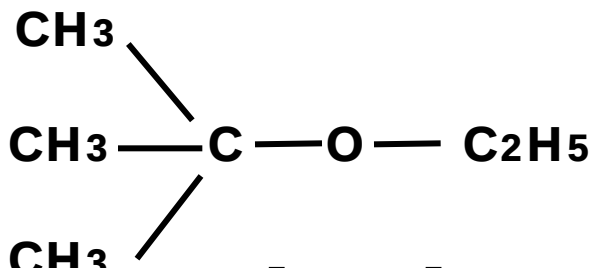
A : GHG emission from gasoline

B : GHG emission from bioethanol production

*** These values are calculated based on LCA.**
GHG emissions from mining, refinery, transport, and combustion are taken into account for gasoline.

Why ETBE instead of Ethanol ?

The vapor pressure of the gasoline to which ethanol is added actually increases, causing greater evaporative emissions on smog formation.



【ETBE】

ETBE provides all the favorable properties of direct addition of ethanol and also lowers the vapor pressure of the blend.

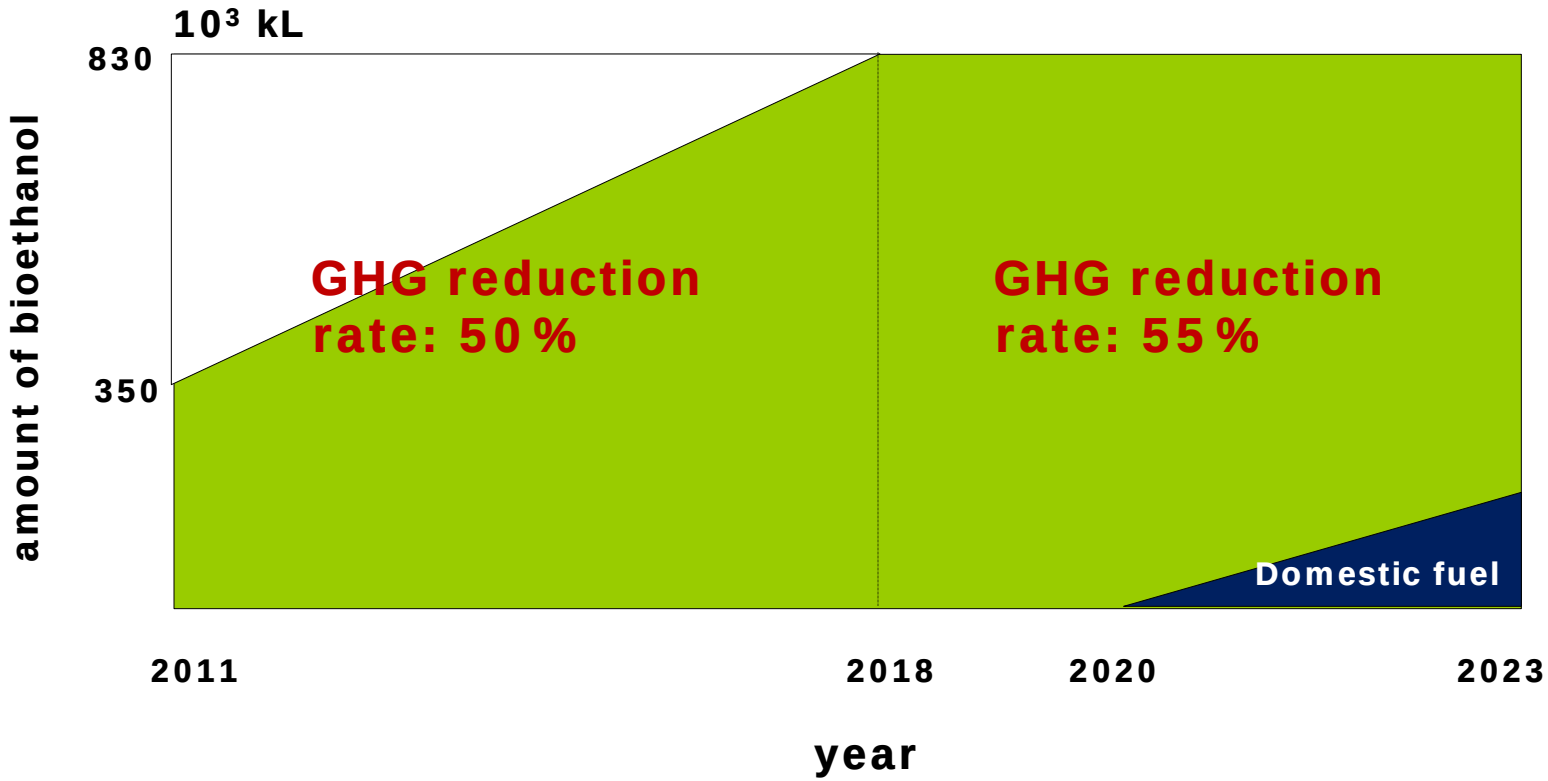
Properties of ETBE	
density (g/cm^3)	0.75
boiling point (℃)	92
octane number	118
calorific value (MJ/kg)	36

E3 in Japan

7% of ETBE (equivalent to 3% of ethanol) is blended with gasoline. In other words, E3 is adopted.

The consumption of gasoline in 2017 was about 50 million kL in Japan. The introduction of bioethanol of 830,000 kL (equivalent to 500,000 kL of gasoline) is regarded as almost E2.

Sequence of Bioethanol Introduction



Why 55% ?

It was required to use ethanol which resulted in a 50% reduction of GHG until 2017. However, the reduction target was revised upward to 55% in 2018 in comparison to GHG reduction of biomass power generation.

The GHG reduction rate of bioethanol introduction must be competitive with that of other biomass conversion technologies.

In the case of power generation of woody biomass, where the plant size is 5700kW and capacity factor is 87%, the reduction rate of GHG is regarded as 56.5%. This is why the GHG reduction rate was revised upward from 50% to 55%.

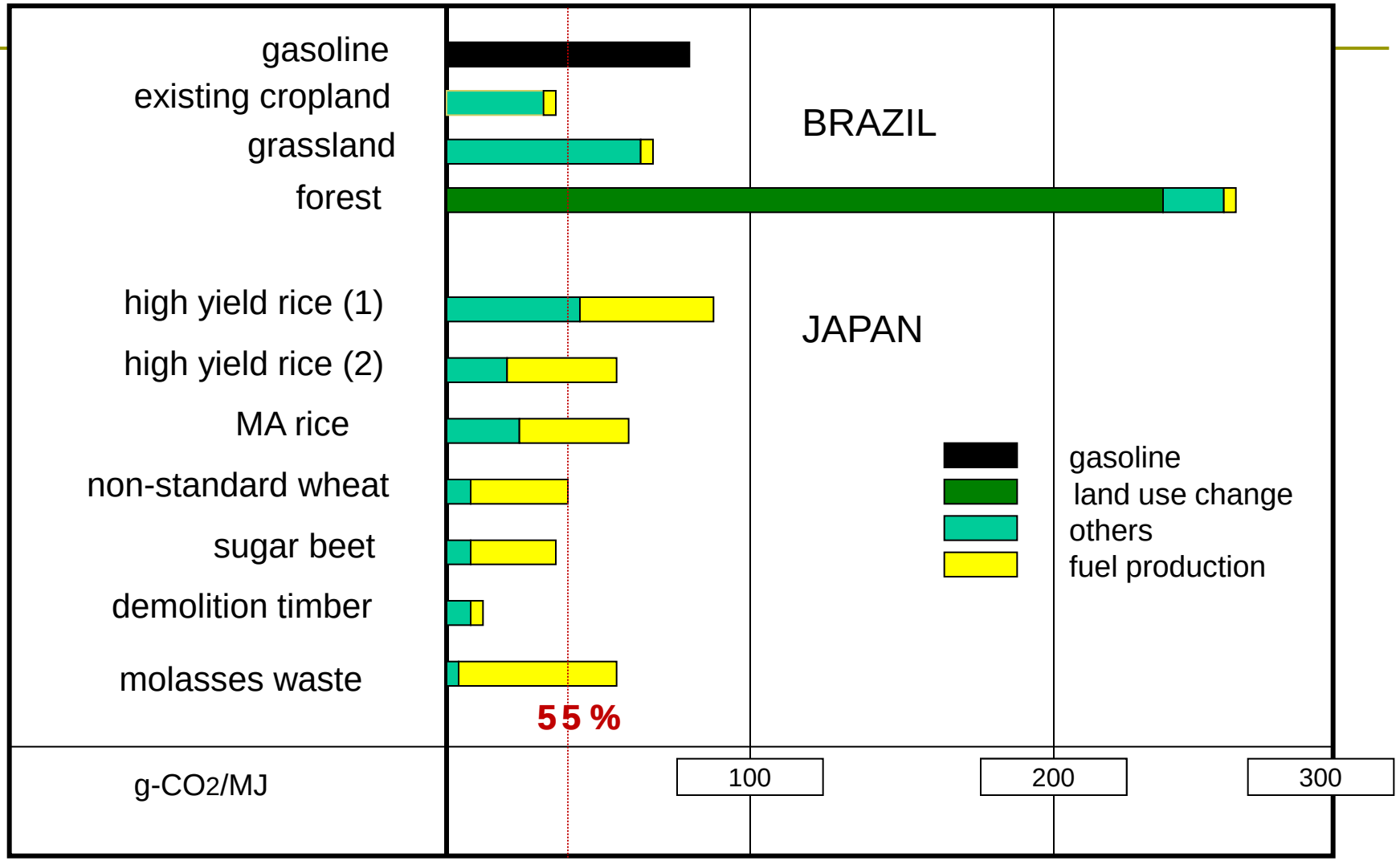
GHG Reduction Rate of Imported Ethanol

To evaluate GHG reduction rate of bioethanol production, the followings have to be taken into account.

- **Cultivation of crops (agricultural machinery, fertilizer, chemicals, etc.)**
- **Transportation of crops**
- **Ethanol production**
- **Transportation of products**
- **Land use change**

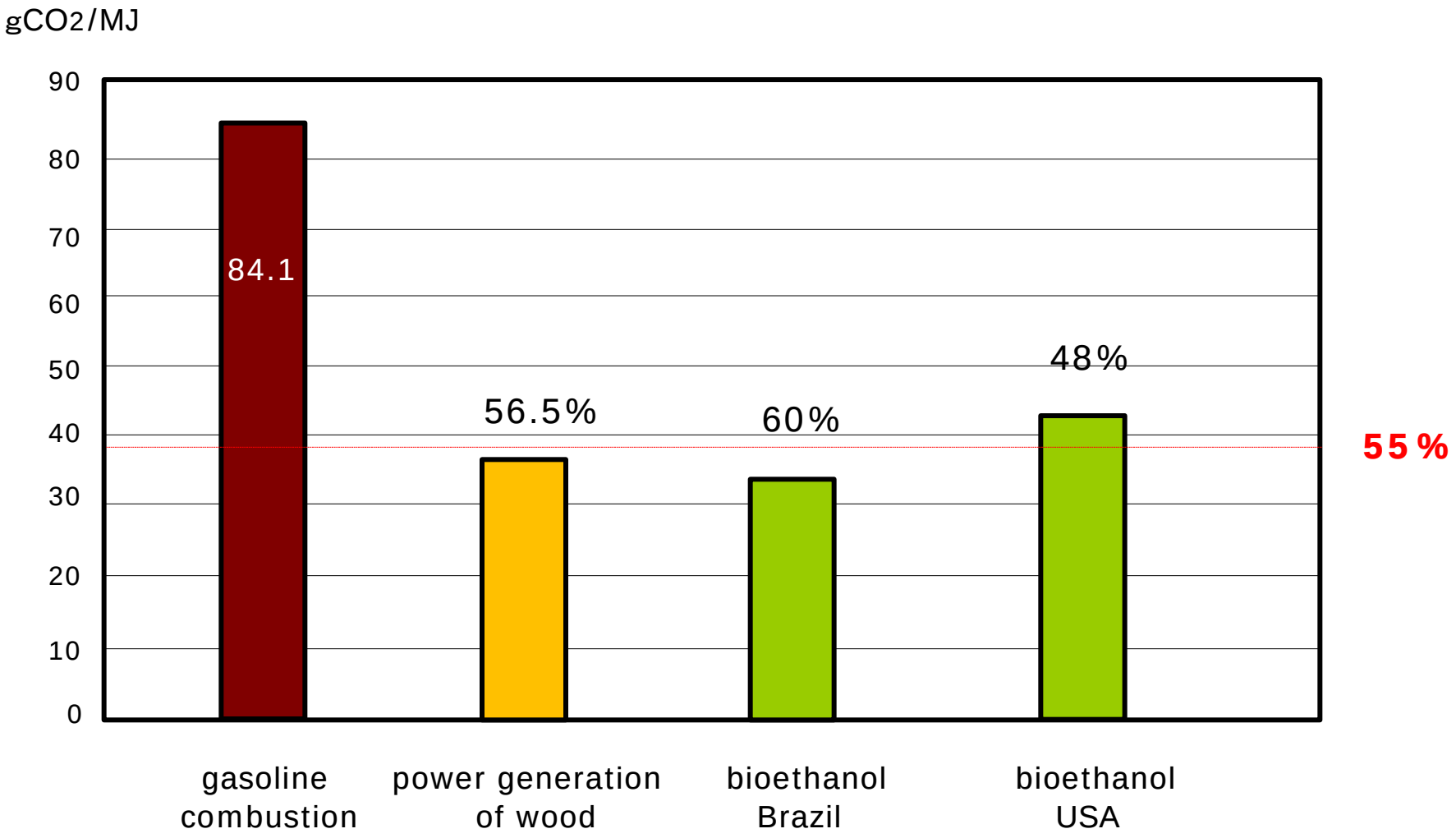
According to the evaluation on LCA basis, the GHG reduction rate of ethanol produced in Brazil was improved from 56% to 60% by regarding sugar cane as perennial not annual. In the case of the ethanol produced in the USA, GHG reduction was much improved from 22% to 48%.

GHG Emission of Bioethanol (LCA)

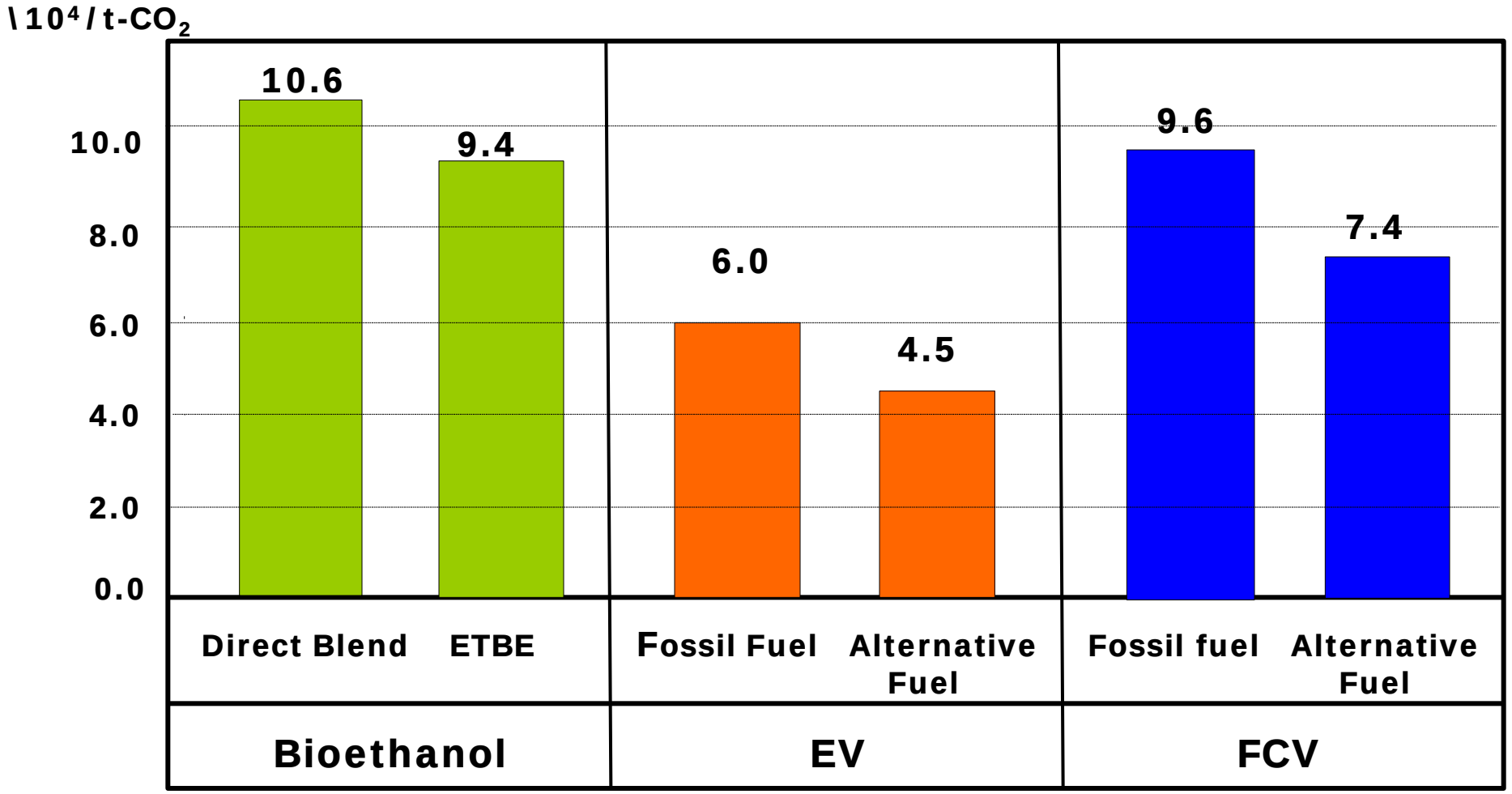


Source: Agency of Natural Resources and Energy, METI

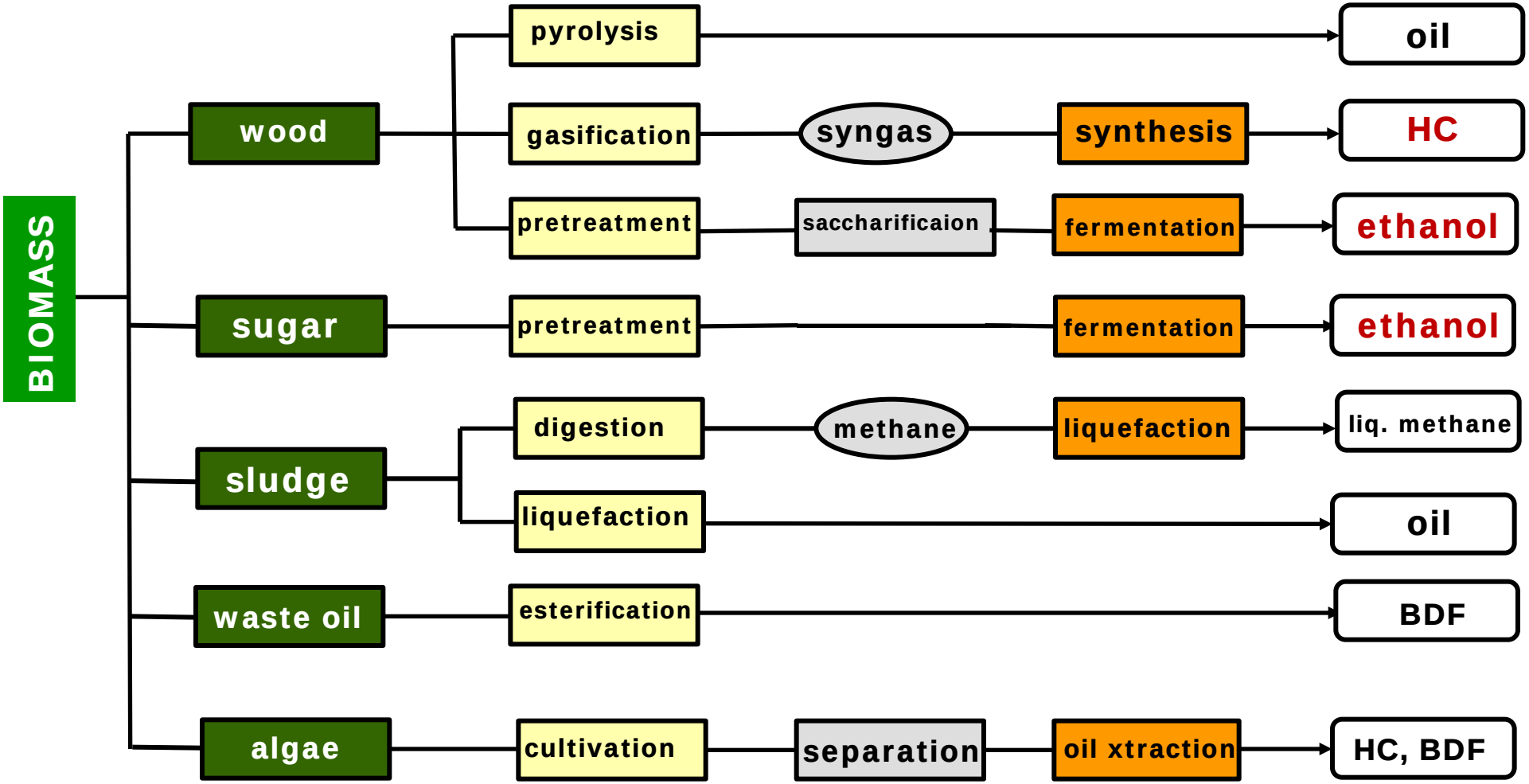
GHG Emission



Reduction Cost of GHG

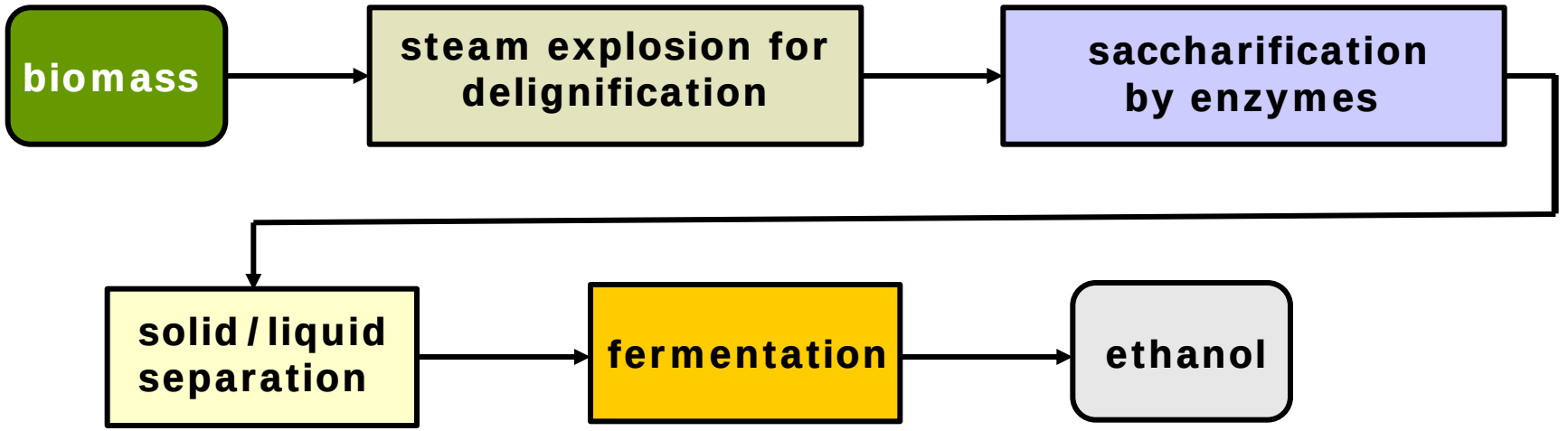


Production Process for Biofuels



2nd Generation Bioethanol

The demonstration plant for 2nd generation bioethanol project supported by NEDO is operating using waste material.

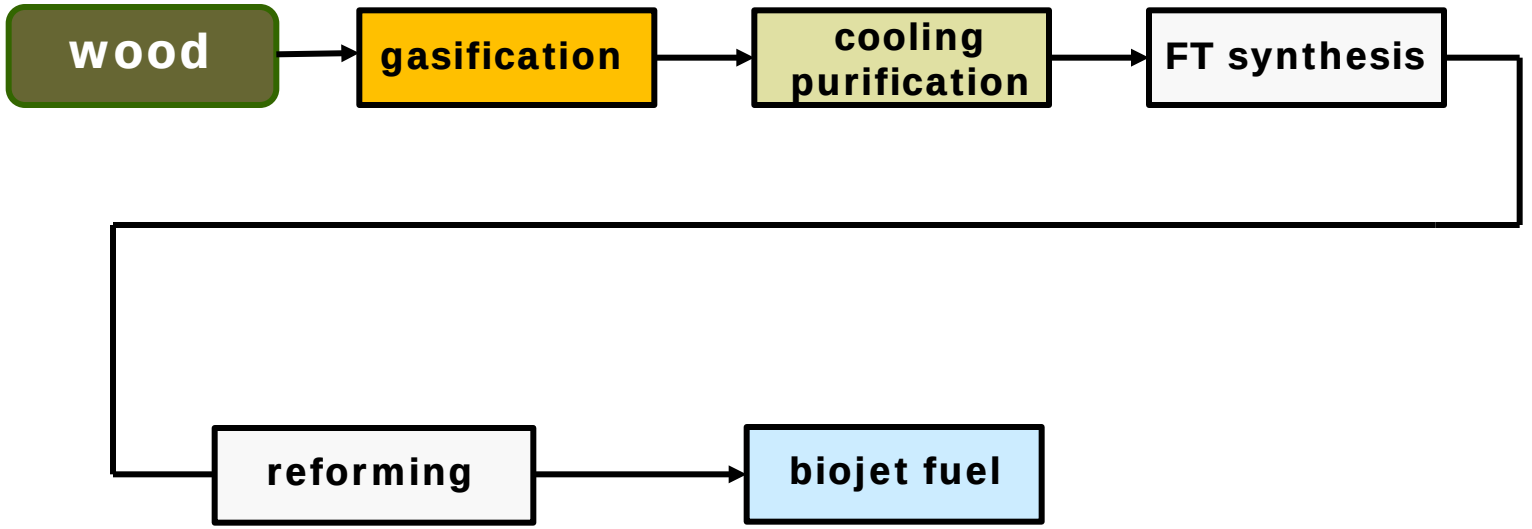


According to the report, EPR is over 2 and the GHG reduction rate is more than 55%.

Source: NEDO report “The R & D for next generation bioethanol”, 2017

BTL (Biomass to Liquid)

Biojet fuels are being produced by advanced entrained type gasifier and micro-channel type synthesis under the NEDO Project. Wood, which is pulverized into small size (4~5mm), is gasified, and then synthesis gas is converted to oil suitable for jet fuel（ASTM D7566).



Summary

In Japan, the introduction of bioethanol (830,000 kL), which is equivalent to 500,000 kL of gasoline, was enforced in 2011 from the viewpoint of energy security, energy efficiency and environmental consideration. Infrastructure was provided until 2017 to support the gradual increase of bioethanol. The blending rate was E3. However, ETBE was adopted instead of direct blending. This law was extended until 2023 after 7 years experience. The ethanol produced in Brazil is transferred to the United States to convert to ETBE and then transported to Japan.

It was decided by the law amendment in 2018 that the GHG reduction rate was revised upward from 50% to 55%. If the reduction rate (55%) can be satisfied by weight average, it would be possible to import ethanol from the USA as well as from Brazil.

R & D for novel technologies to produce transport fuels such as second generation ethanol and biojet fuels has been greatly encouraged and expected.

THANK YOU VERY MUCH!

Shinya YOKOYAMA

yokoyama@kankyo-u.ac.jp