NEDO Biomass Projects

12 March 2019

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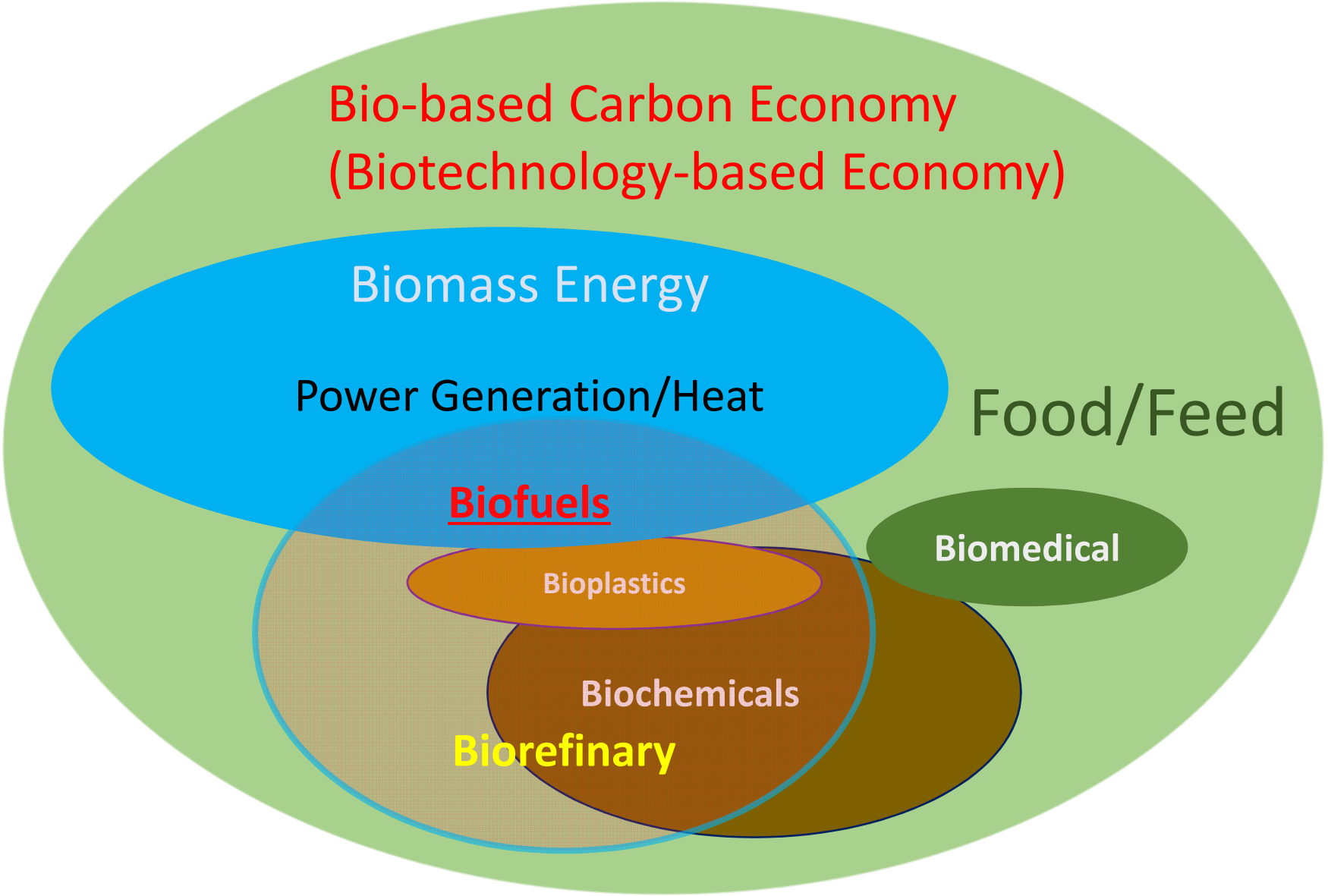
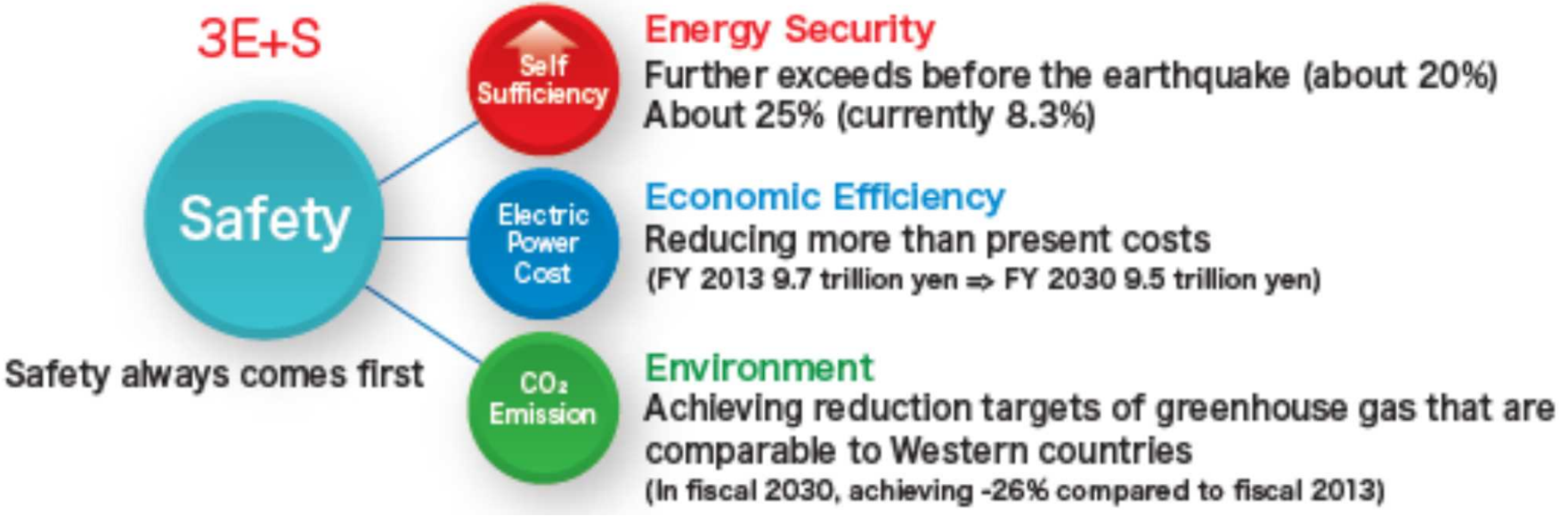
Positioning of Biomass Energy and fuels



Source : NEDO TSC

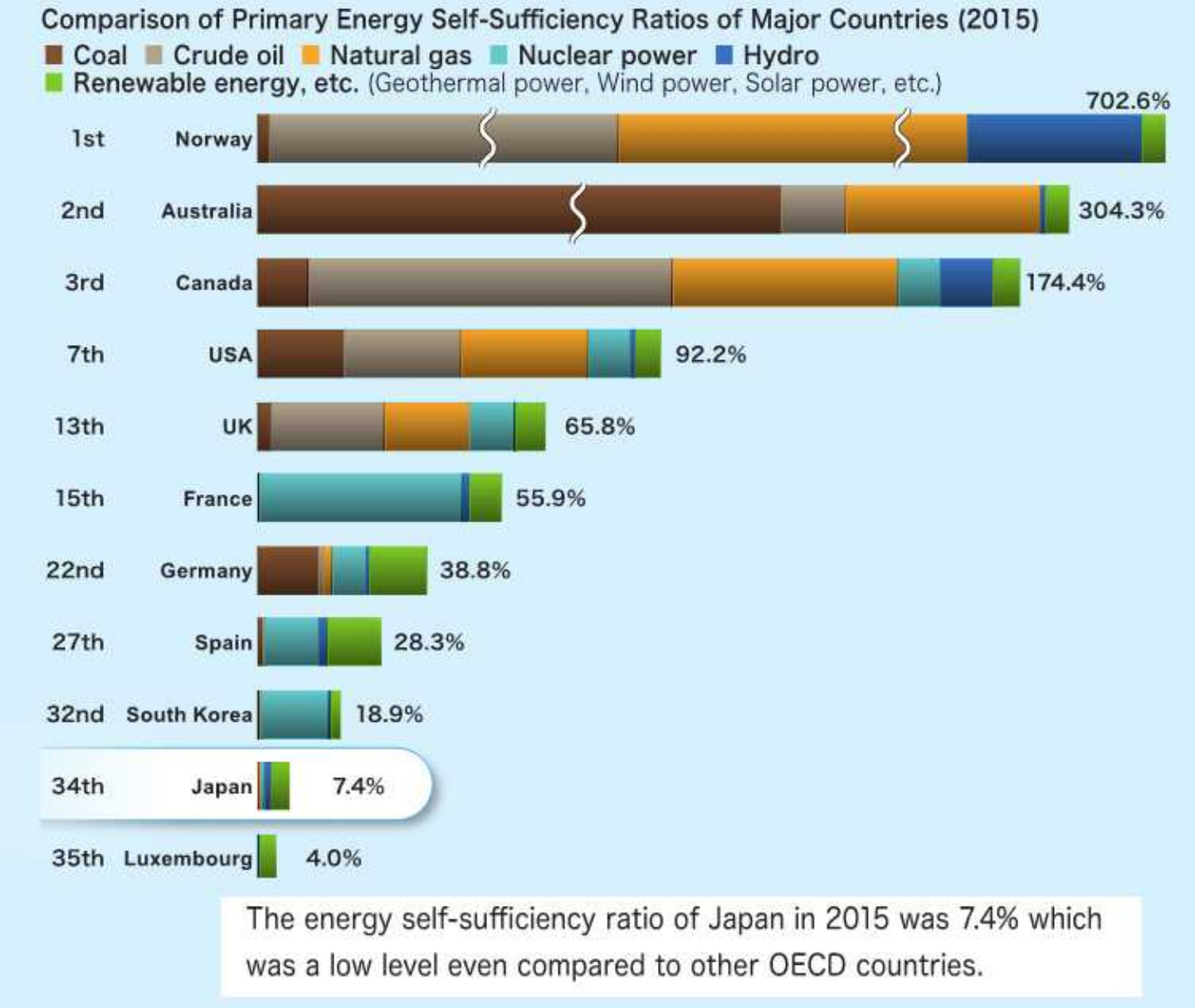
New Energy Policy in Japan (July 2018)

Keeping in mind that Safety always comes first, in order to simultaneously achieve improvement of Energy Security, Economic Efficiency, and Environment Suitability (3E+S), continuous efforts are being implemented. It is indispensable to implement the multi-layered energy supply structure where each power source exhibits maximum performance and offsets weakness.



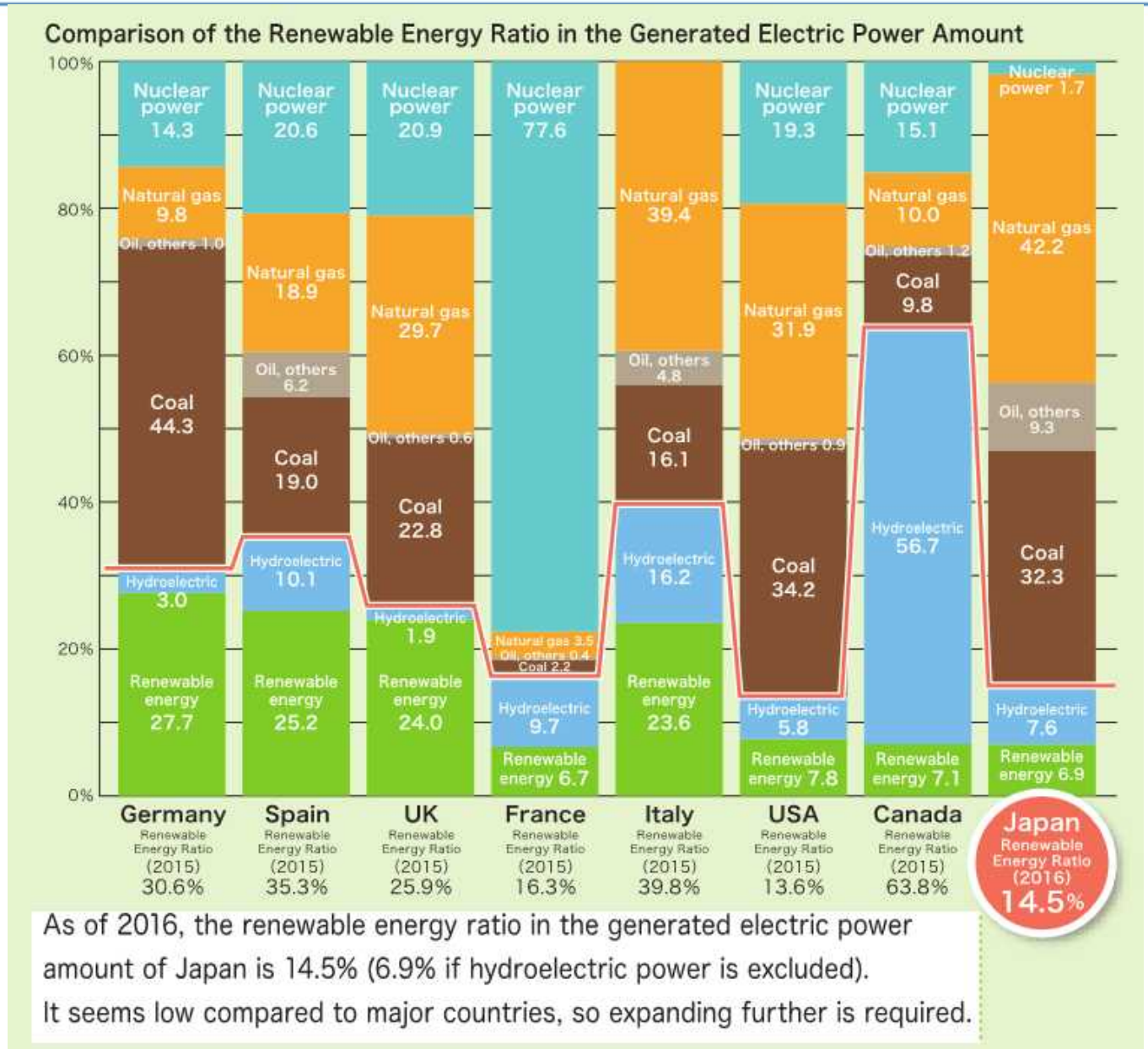
Source : Agency for Natural Resources and Energy, METI

Comparison of primary energy self-sufficiency of major countries



Source : Agency for Natural Resources and Energy, METI

Comparison of renewable energy ratio to power output



As of 2016, the renewable energy ratio in the generated electric power amount of Japan is 14.5% (6.9% if hydroelectric power is excluded).
It seems low compared to major countries, so expanding further is required.

Source : Agency for Natural Resources and Energy, METI

Paris Agreement

Country	compared to 1990	compared to 2005	compared to 2013
Japan	▲18.0%	▲25.4%	**▲26.0%**
USA	▲14～16%	**▲26～28%** (until2025)	**▲18～21%**
EU	**▲40%** (until2030)	▲35%	**▲24%**
China	・Reduce carbon dioxide emissions per GDP by 60 to 65% compared to 2005 by 2030 ・Achieve the peak of carbon dioxide emissions by around 2030		

reduction target

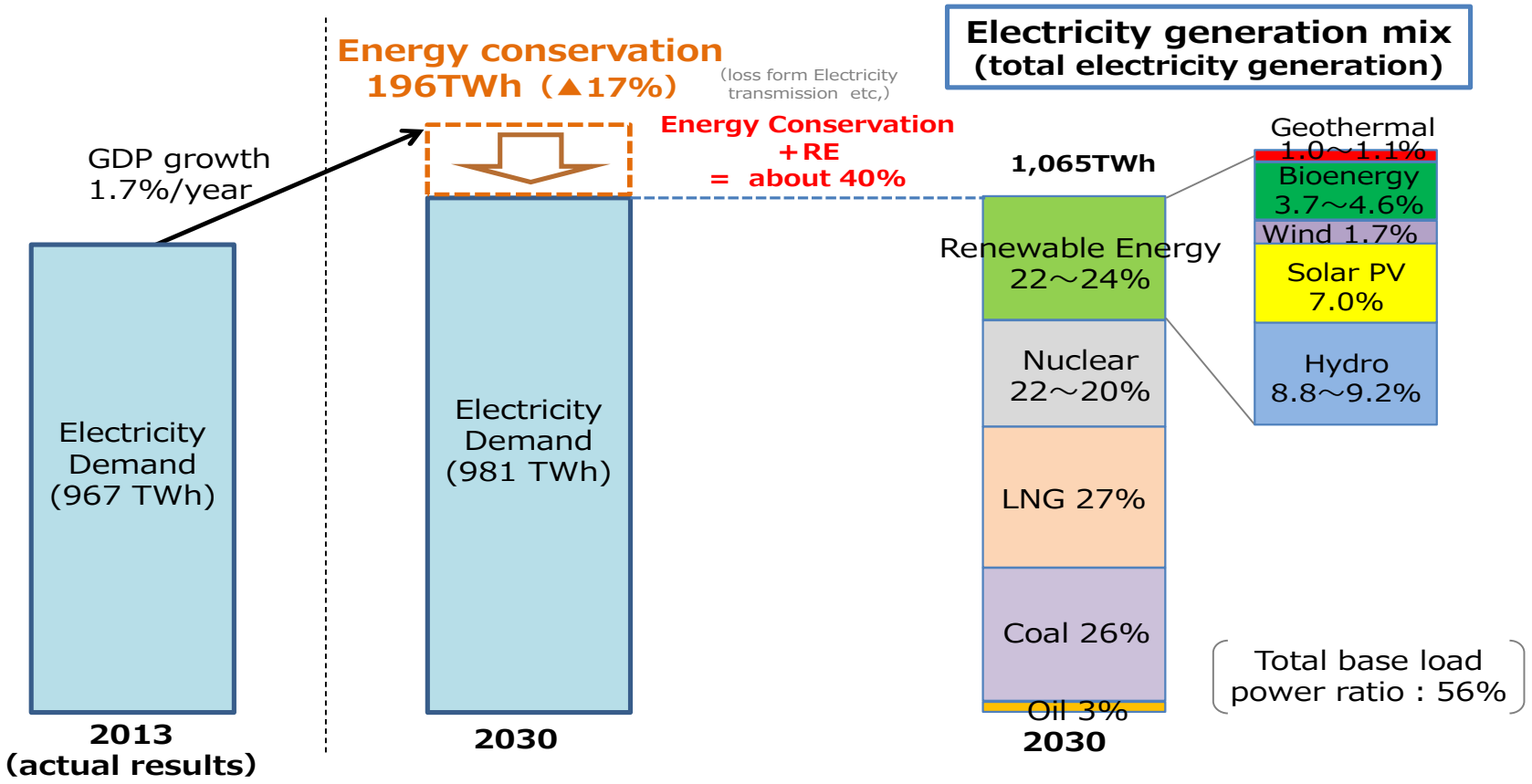
reduction target

reduction target

Source : METI

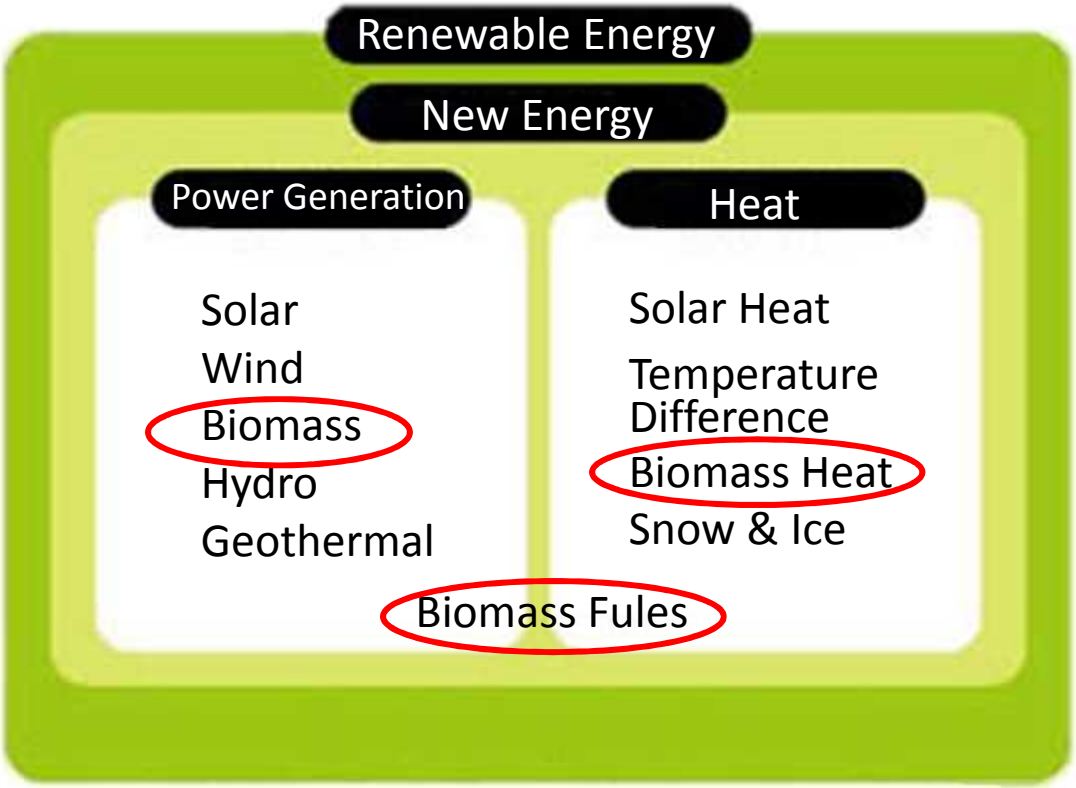
New Political Target on Renewable Energy in Japan

- The target of 2030 energy mix is 22-24% of renewables in which 8.8-9.2% of hydro power, 7.0% of PV, **3.7-4.6% of biomass**, 1.7% of Wind, 1.0% of Geothermal.



Source : Ministry of Economy, Trade and Industry (METI)

Renewable Energy in Japan



Environmental measures

・Greenhouse gases (GHG) reduction・
Verification of greenhouse gas reduction

Energy security

・Japan's energy self-sufficiency is only 6%
・Fossil fuel is a finite resource

New Energy Law
(Act on Special Measures for the Promotion of New Energy Usage, etc.,Apr 1997)

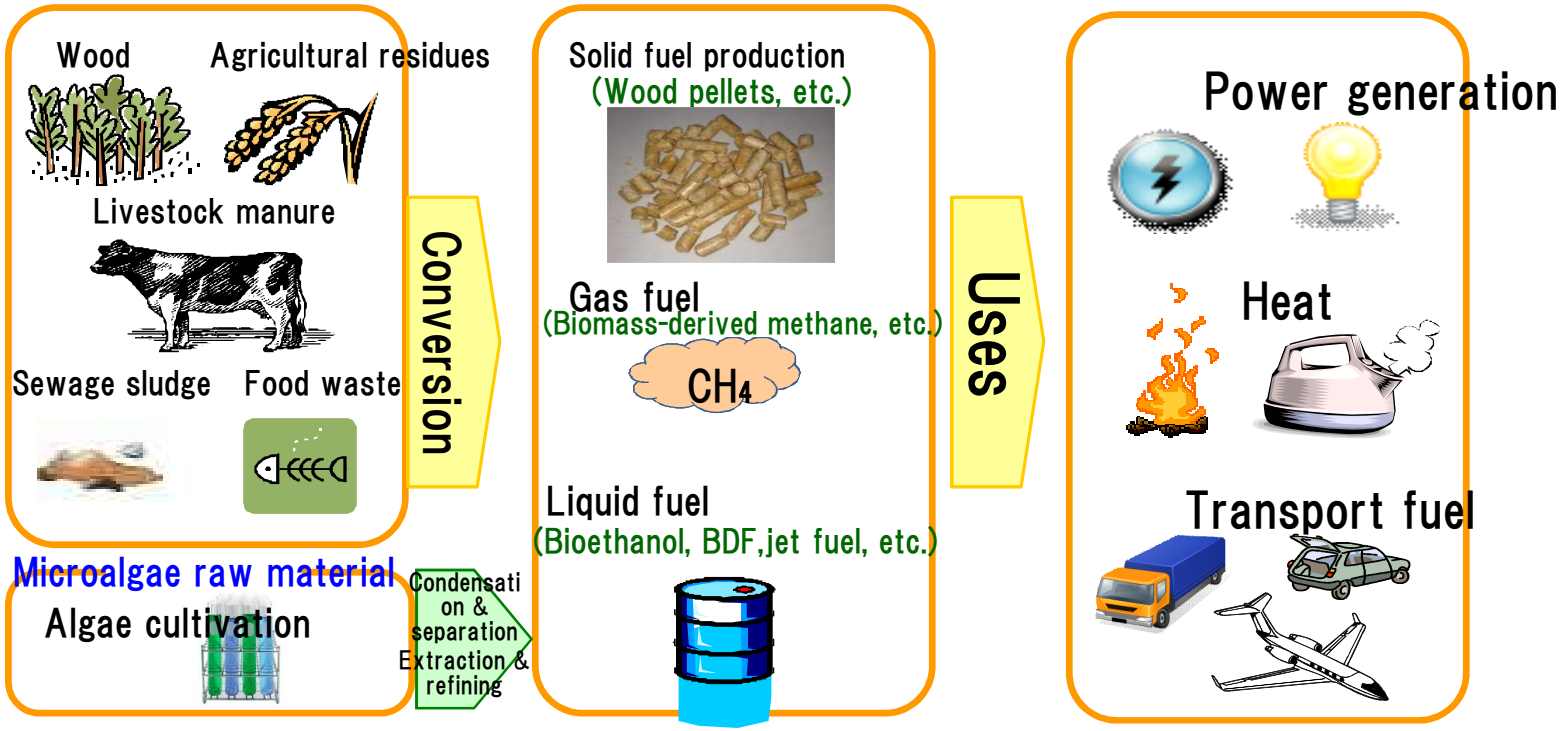
What are biomass uses?

■ Biomass is a renewable, organic resource based on living organisms, excluding fossil resources.

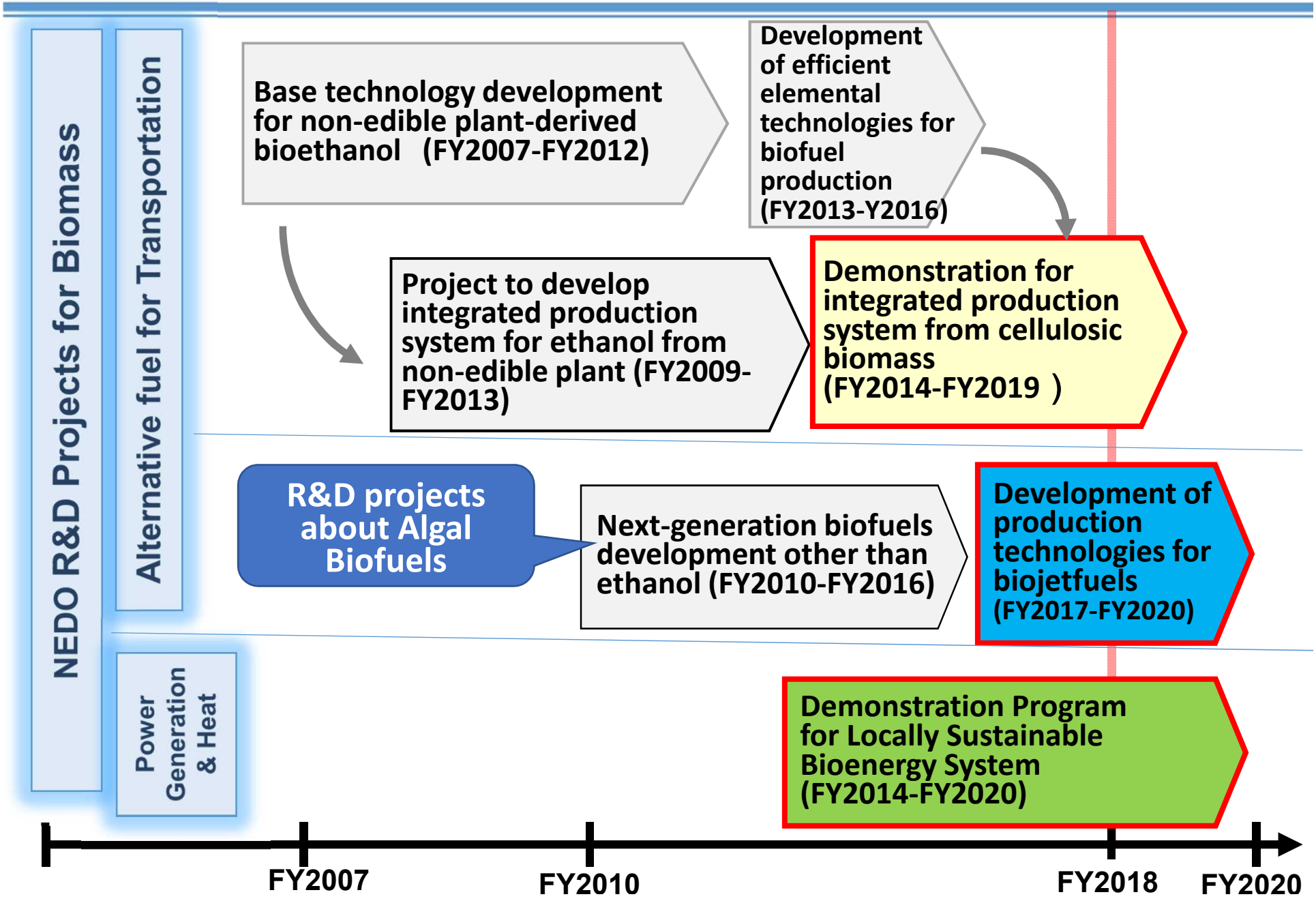
■ It consists of biomass resources used as raw material, types of energy use (electricity, heat, transport fuel, etc.) and energy conversion technology that connects them together. Also, biomass may be used for generating power and for heat without conversion but through direct incineration.

■ Biomass use is largely divided into material use as construction material, etc., and energy use. Effective utilization is possible by cascading, beginning with use as material and finally using as energy source. It can also be used to convert to liquid fuel for transport, etc., depending on the application.

■ Although biomass generates CO2 when incinerated for its energy, various CO2 that it had absorbed from air in its growth process (carbon neutral) and is therefore classified as renewable energy.



NEDO's Biomass Energy & fuels Project



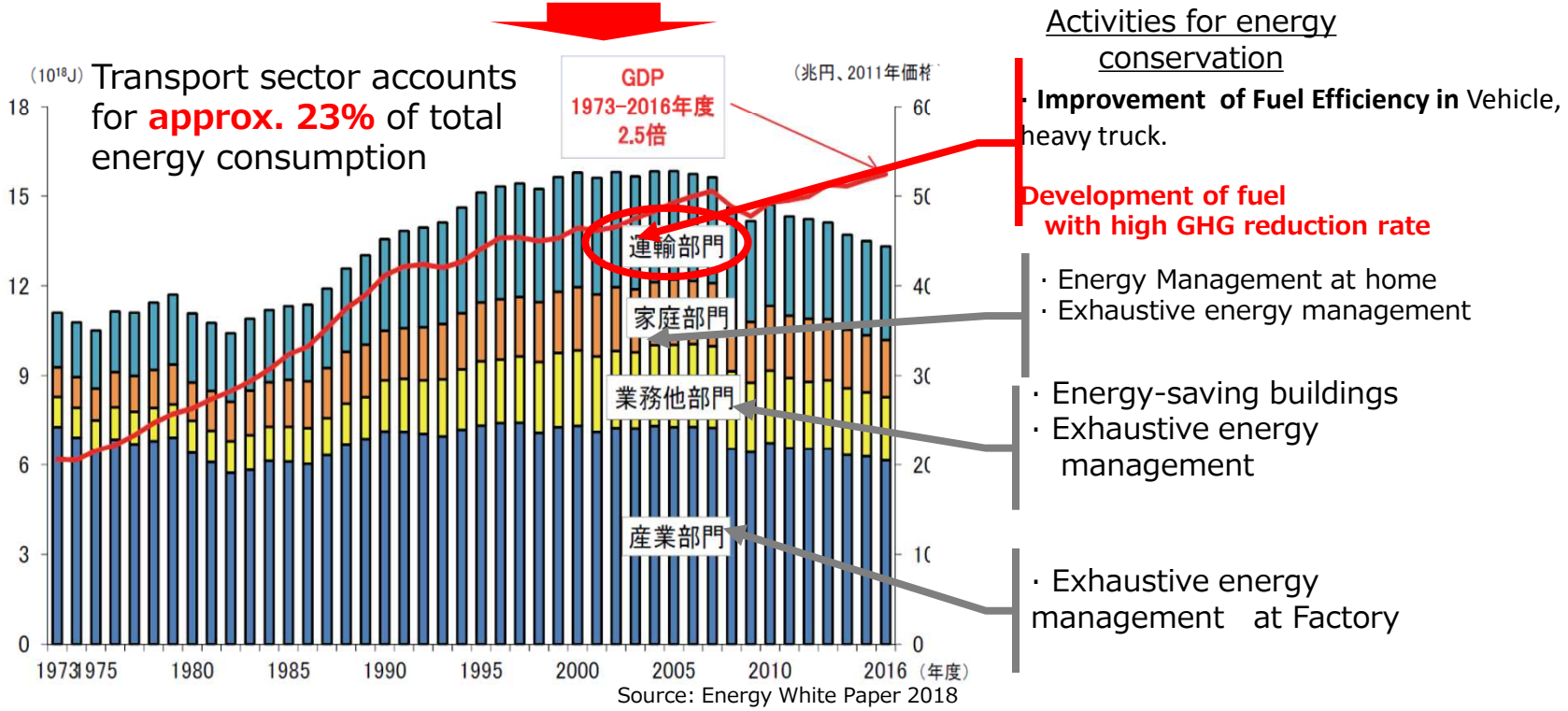
Fuel Ethanol from Cellulosic biomass

Alternative Fuel for Transportation

■ Nearly all of the fuel consumed by the transport section, which accounts for approximately. 23% of primary energy use in Japan, is liquid fuel

■ Despite the shift to EVs and FCVs, the existing internal combustion mechanism (in developing countries and used car market) and transport functions that require high-energy density that cannot be replaced with storage battery (large vehicles, maritime vessels, aircraft, etc.) continues to require liquid fuel

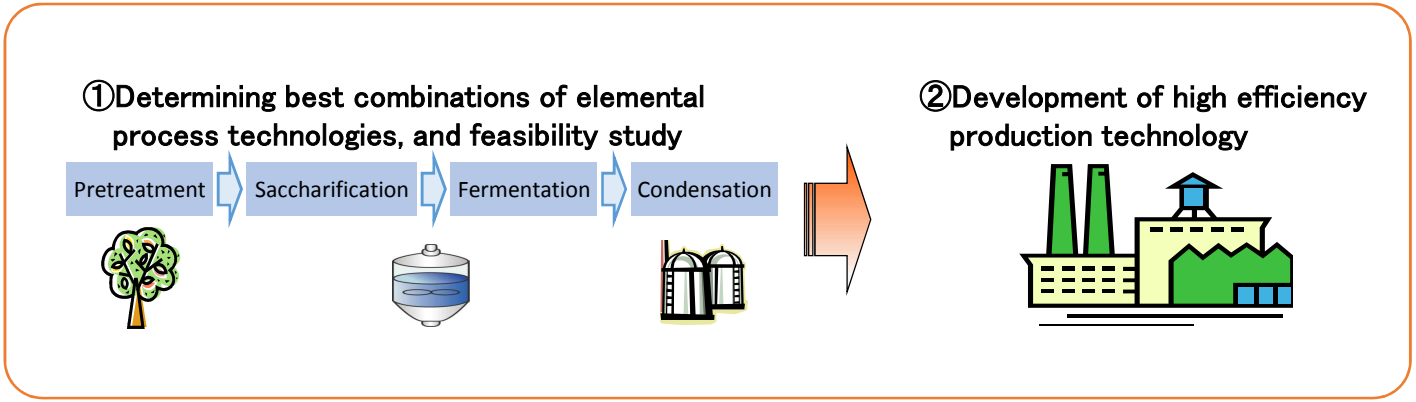
With the development and production of biomass-derived alternative fuel that does not compete with food production (cellulose-based biomass), GHG output by the transport sector must be reduced.



Source: Energy White Paper 2018

Cellulosic ethanol production system comprehensive technology demonstration

- Installing bioethanol in automobile is a promising solution to reduce CO2 emissions of transportation sector which accounts for about one-fourth of energy consumption.
- NEDO is developing technology to produce second-generation bioethanol in an economical manner. Pulp waste, coffee waste, and depleted mushroom substrates are collected and the fiber structures of such materials are ruptured using an explosion process and then are saccharified and fermented to produce bioethanol.
- Its target is reducing 50% of GHG compared with gasoline, more than two times of energy are generated from input and cost competable with ethanol produced overseas.

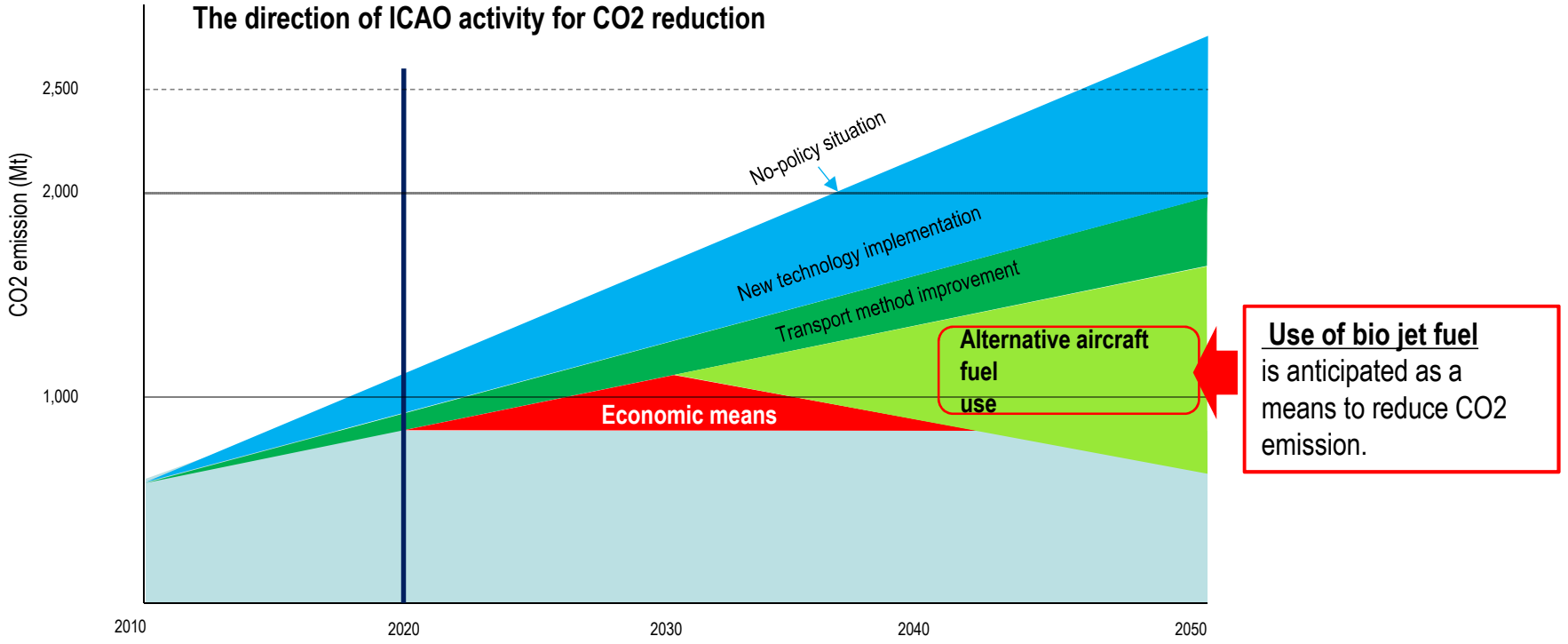


Bio Jet Fuel

Background and Position of Bio Jet Fuel Production Technology Development
CO2 emission reduction target for the air transport sector

○In order to curb CO2 emission in the air transport sector, ICAO (UN organization for the sector) announced the target of **"not increasing CO2 emission in 2020 and later**."

○ **Use of bio jet fuel** is anticipated as a means to reduce CO2 emission.



(Based on ICAO resources) (Partial quote from METI reference materials)

Circumstances surrounding bio jet fuel
— Overseas activities in fuel supply —

The world's first bio jet fuel supply, employing shared fuel storage facility, has started at Norway' Oslo Airport in January 2016.
In March 2016, bio jet fuel supplies started at Los Angeles Airport in the US.

The world's first bio jet fuel supply at Oslo Airport

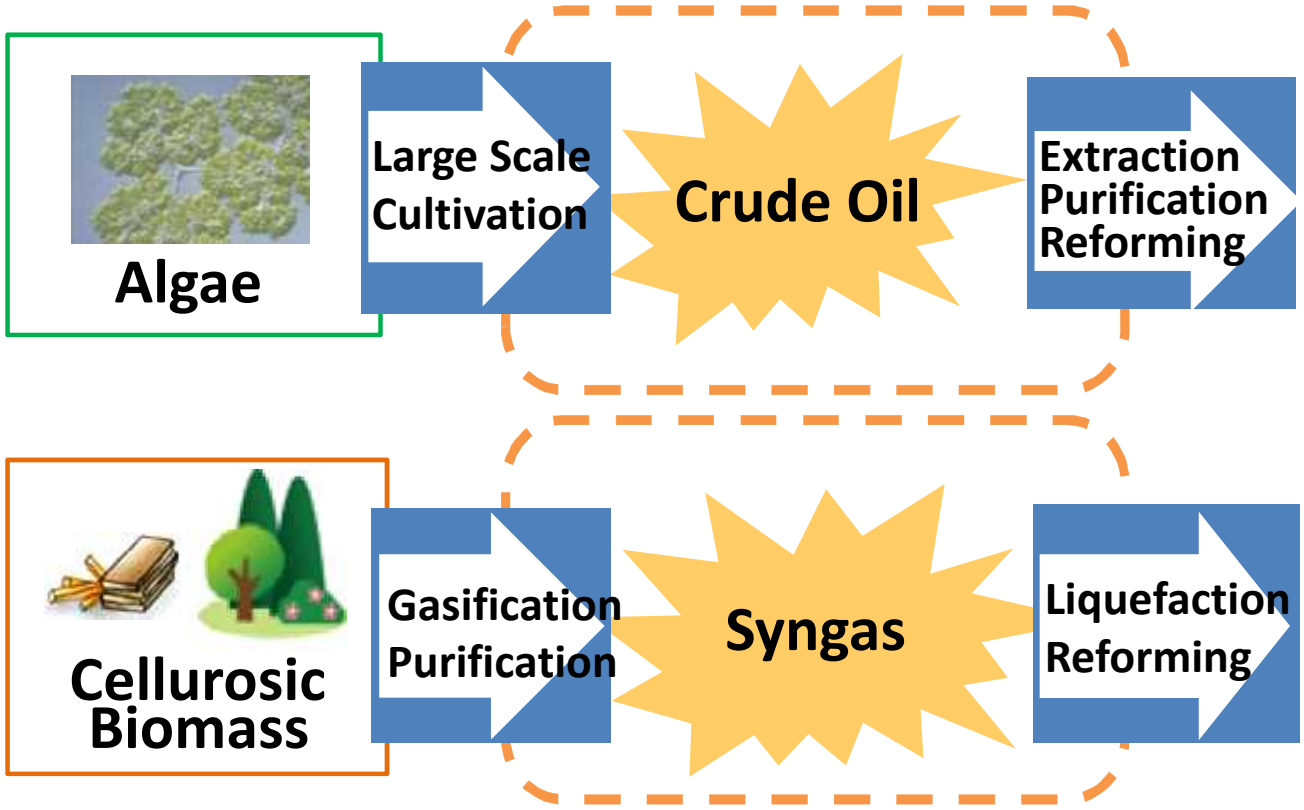
Source: Avinor website

Bio jet fuel supplies at Los Angeles Airport

Source: United Airlines website

(Partial quote from METI reference materials)

Development of Production Technologies for Bio Jet Fuels

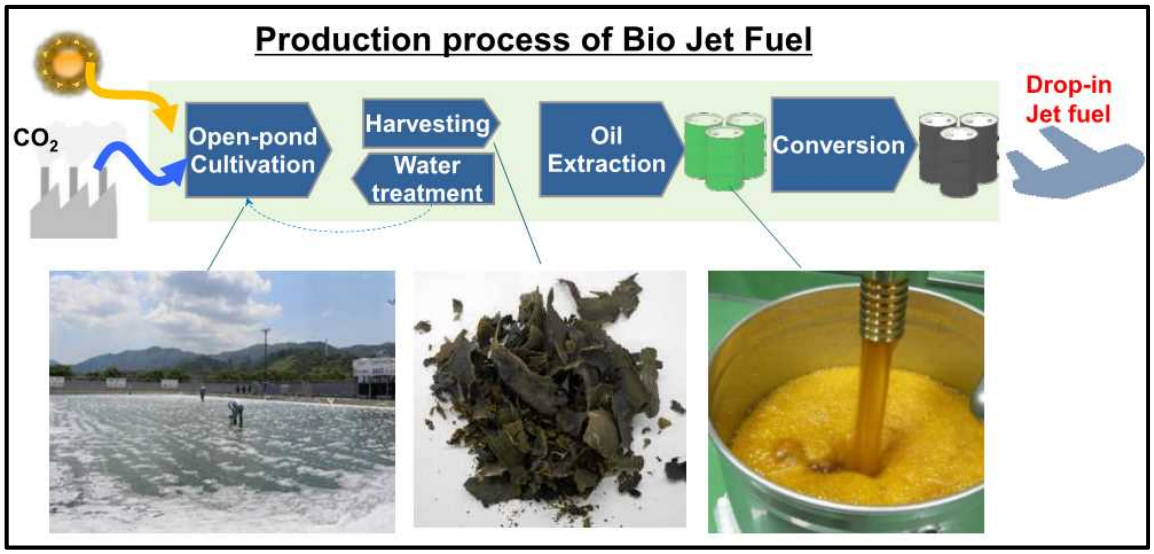


Alternative Aviation Fuels with Bio Jet Fuels

Development of an Integrated Pure Bio Jet Fuel Production Employing Fast-Breeding Botryococcus Braunii

Technology development is conducted on an integrated manufacturing process for bio jet fuel derived from microalgae.
Plant containing a cultivation pond in the scale of 10,000 m² is built in Thailand, for pilot-scale test employing fast-breeding Botryococcus braunii.
Additionally, issues involved in industrialization with greater efficiency and their solutions are examined for verification into the feasibility of stable, long-term and continuous operation, reduction of production cost, etc.

Location: Saraburi Province, Thailand (on property owned by Siam Cement Group)
Demonstration period: FY2017-FY2020



Source: IHI website

Regional & Sustainable Biomass Energy System

Issues in Biomass Energy Use

■ Biomass energy is an energy source that stands out among renewable energy sources in providing stable electric power generation and that contributes to local community revitalization.
■ After the introduction of the feed-in tariff system in 2012, use based on the system expanded. On the other hand, the following issues make purchasing independent of the system difficult under current conditions.
■ In order to promote biomass energy use independent of the FIT system, these issues must be resolved.

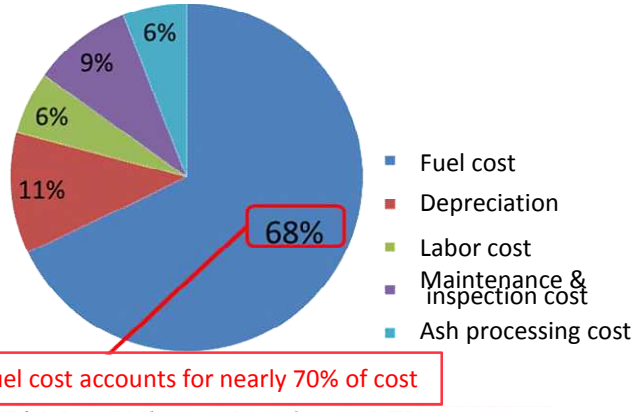
① Economic viability cannot be secured without FIT (fuel cost accounts for 70% of cost for wood biomass power generation)
→Fuel cost reduction & diversification of income sources
② Securing stable raw material procurement: Supply of unused materials and waste over a long-term period is difficult

Energy input in facilities (already in operation)

Biomass type and purchase price	Feed-in tariff purchase Prior to system start Cumulative input until end of June 30, 2012	Feed-in tariff system After system start July 2012 ～ September 30, 2017	Total
Unused materials	20,000 kW	400,000 kW	420,000 kW
Wood in general, etc.	160,000 kW	480,000 kW	640,000 kW
Recycled materials	440,000 kW	40,000 kW	480,000 kW
Wastes & materials other than wood	1680,000 kW	210,000 kW	1890,000 kW
Methane gas	20,000 kW	30,000 kW	50,000 kW
Total	Approx. 2300,000 kW	1160,000 kW	Approx. 3460,000 kW

The cost structure for wood biomass power generation

Example of cost structure for wood biomass power plant



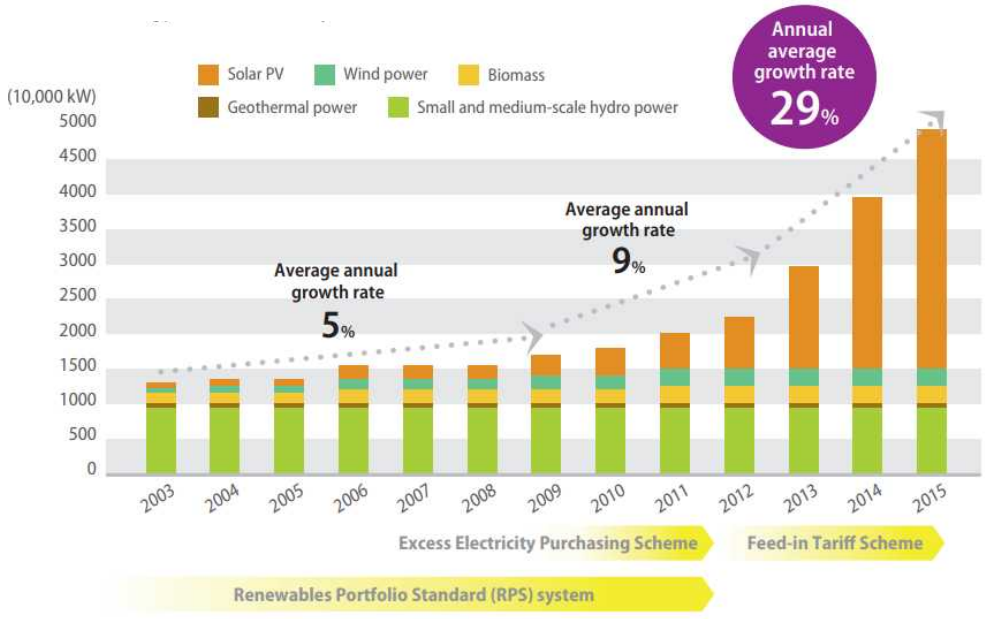
※Wood biomass power plant (5700 kW) current operating under FIT certification

Source: Study into the Promotion of Power Generation, Heat Supply & Heat/Power Joint Supply, FY2013 Project for Development of Wood Biomass Utilization Support System

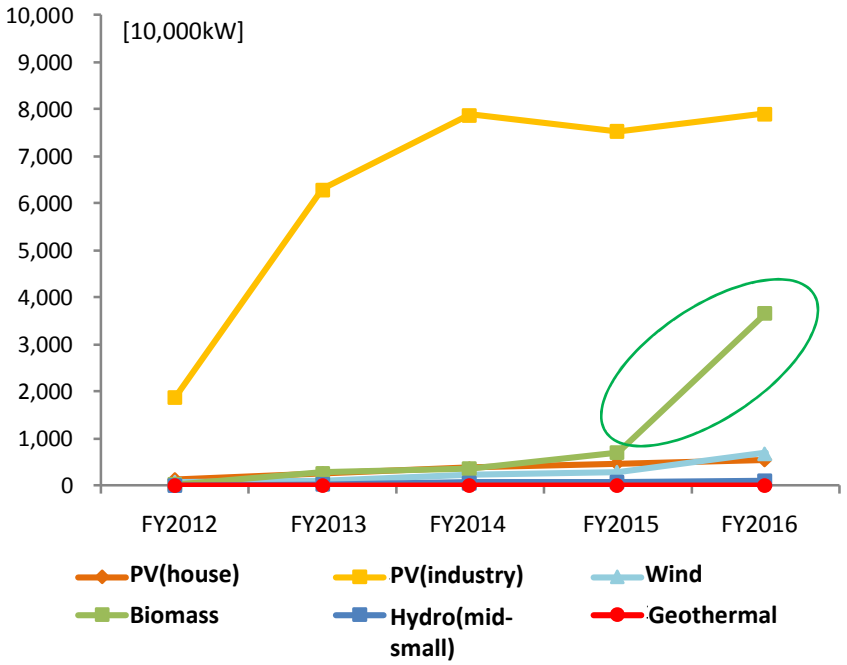
Feed in Tariff

- The nuclear power plant accident in 2011 became a turning point for the Japanese government to accelerate the growth of renewable energy
- Feed-in-tariff (FIT). Woody biomass has especially attracted attention for use.

Renewable Energy Facilities in Operation

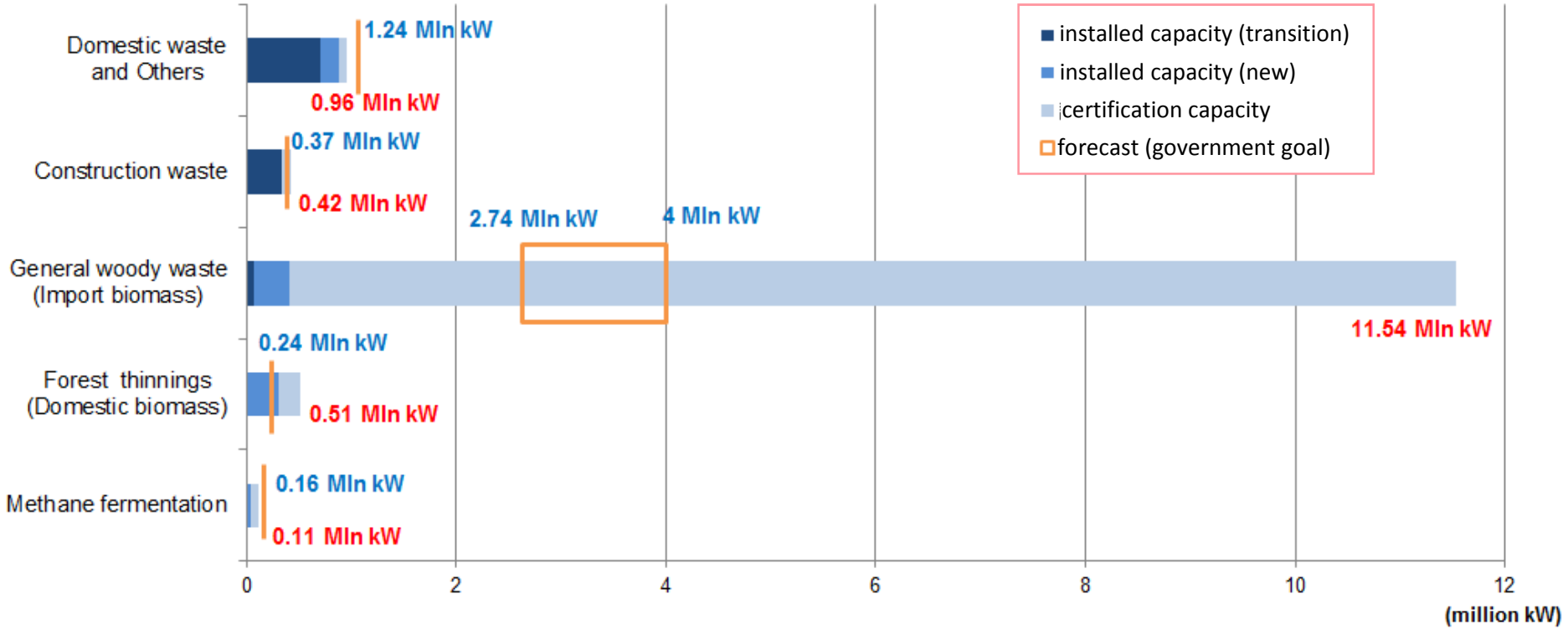


Certified facilities in FIT



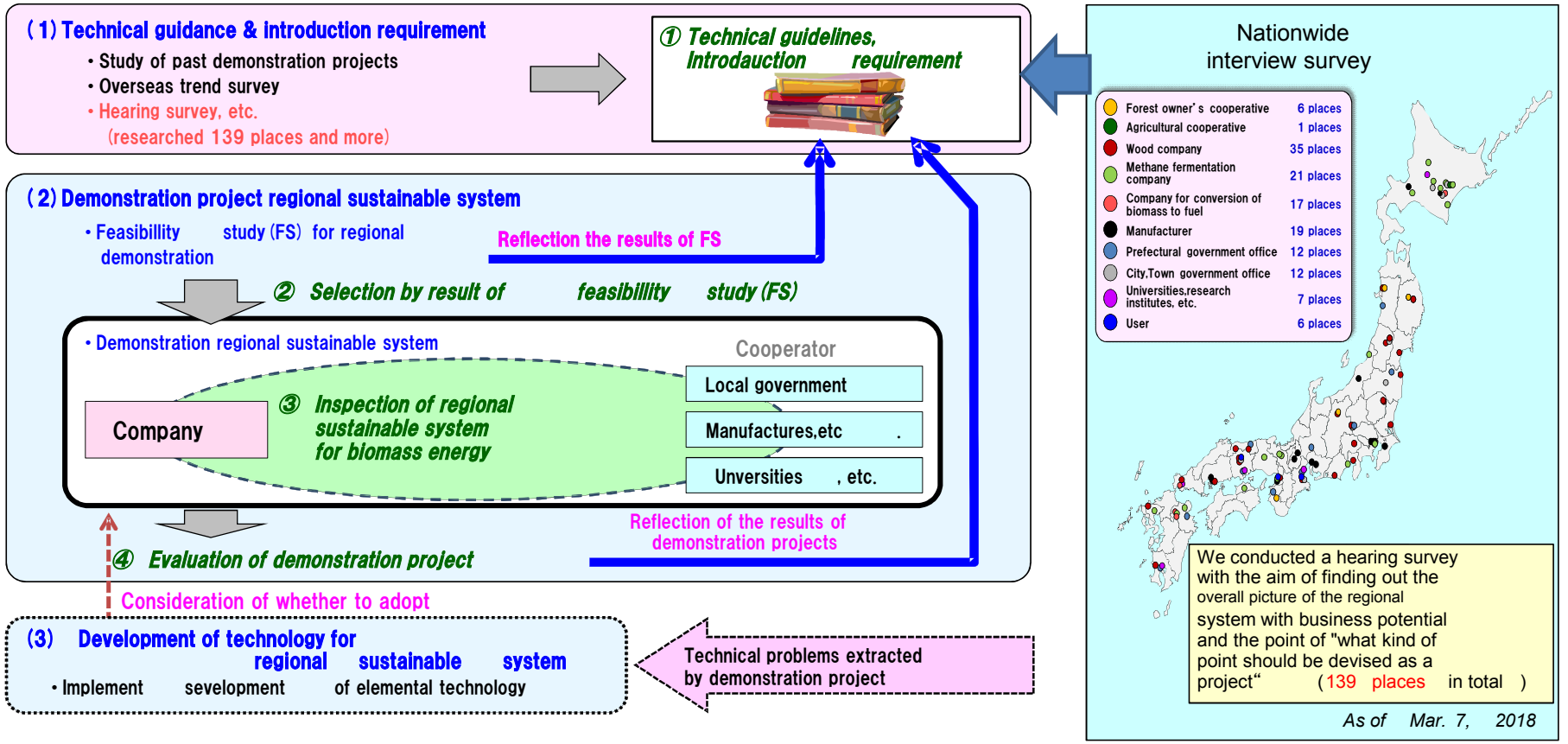
FIT generation plans of biomass

※March 2017



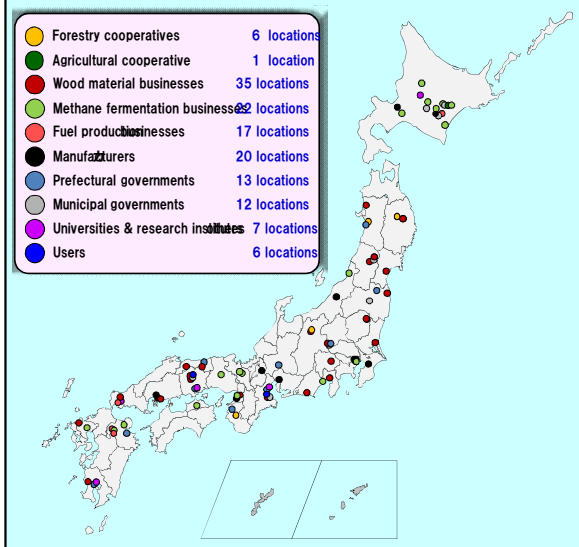
Biomass energy regional independent demonstration

- To save the transportation cost of raw materials biomass power plant and heat utilization is suitable for deploying at local levels together with cooperation of local authority.
- NEDO is supporting F/S and demonstration project of collecting biomass, transforming to electricity and heat and supplying neighborhood. NEDO is supporting models without relying on FIT.
- Biomass power plant is expected to be carbon free adjustable resources for balancing demand and supply of electricity.



Key points in the regional autonomous system

Nationwide interview survey



Total image of an economically feasible regional system and what to do to make it viable as a business operation?
Interview survey was conducted with focus on these points
(Total of 139 locations)

As of March 7, 2018

What are the "strengths" of businesses and communities?

+

4 ideas

Balance between raw materials and energy demand

① Raw material procurement

② Energy use

③ Energy conversion

④ Total system
(Coordination with the community)

Feedback

+

Agreement with local communities (*Win-Win Relationship*)

Establishment of technical indicators & implementation criteria for businesses

Demonstration project

	Operation type	Description of operation	Subsidy recipient
1	Methane Fermentation type	The project aims at the use of various types of mixed biomass that is generated in the region for production of biomass energy with dry methane fermentation technology. For this purpose, system is developed to promote wider utilization through coordination with neighboring regions.	Fuji Clean Co., Ltd.
2	Methane Fermentation type	The project aims at energy conservation for dairy farms and the community with production of quality compost and liquid fertilizer, quality livestock feed and milk production. It also aims at reduction of foul odor, groundwater contamination and financial burden on cooperative members with a reduction in animal waste treatment fees.	Japan Agricultural Cooperatives Akan
3	Wood	The project aims at collection of usable biomass resources in the region for use as energy for diatomaceous earth drying at existing factories, as well as use of surplus heat.	Showa Chemical Industry Co., Ltd.
4	Wood	The project aims at use of construction wastes and low-grade wood biomass containing foreign matter, that does not compete against wood biomass produced in a wide range of area centering on Kurashiki City, Okayama Prefecture, for fueling boilers and supplying steam to industrial complexes.	JFE Environmental Services Corporation
5	Wood	Bamboo, material that has become an issue in the region, is utilized effectively for high-efficiency supply of both power and heat via ORC unit to bamboo processing plant and primary material processing plant.	Bamboo Energy Co.
6	Wood	Chipping rotary is utilized for production of wood chips from timber residue materials and transport of the chips for efficient wood biomass fuel production. Forest residue material collection system is developed, and stable supply of wood chips is promoted.	Tajima Forest K.K.

Thank you very much for your kind attention