Annex : Biofuel Policies in East Asian Countries

Australia

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

With the publishing of the “Clean Energy Future Plan” in July 2011, Australian Prime Minister Gillard made a commitment to reduce carbon dioxide (CO_2) emissions by at least 5 percent (compared with the 2000 level) by 2020 and to raise the CO_2 emissions reduction goal for 2050 from 60 percent to 80 percent.

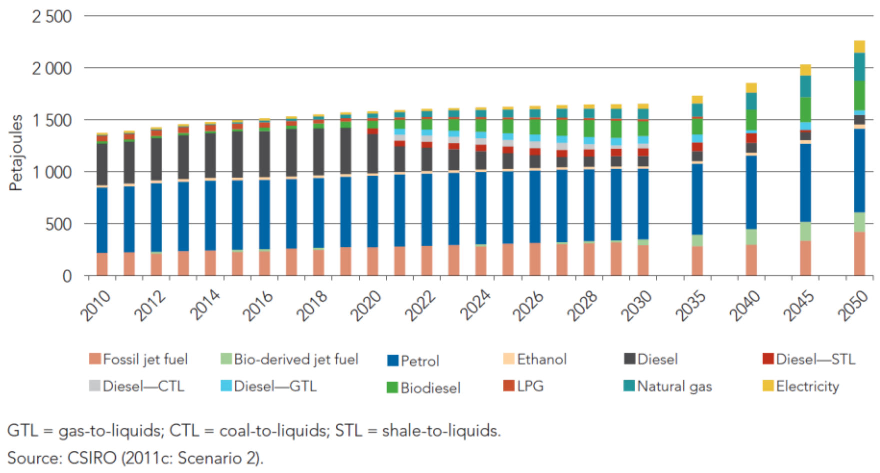
Clean energy supply is also mentioned in the “Australia’s Energy Transformation 2012” (hereinafter, referred to as the “White Paper”) published in Nov. 2012. Biofuels, along with other clean fuels and emerging vehicle technologies, are anticipated to play an important role in transforming the country’s transport sector through 2050.

(2) Target

The Australian government set a target of producing biofuels of 350 megalitres (ML) in 2008. Preferential tax treatment and fuel quality standards are offered to help achieve the target.

The White Paper refers to clean energy supply, but does not indicate specific targets in biofuels. In the “Transport Fuel Model until 2050” mentioned in the White Paper, biofuels are projected to account for around 20 percent (including bio-jet fuel) of total transport fuels in 2050.

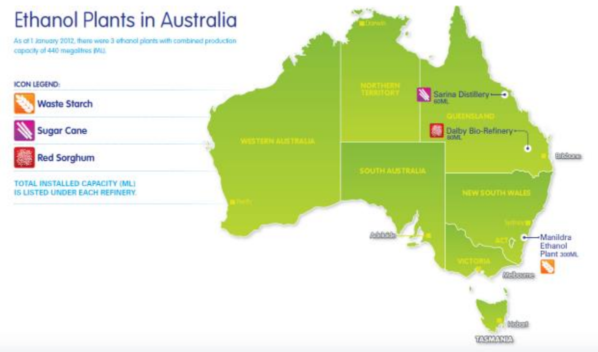
Figure A.1.1 Transport Fuel Mix Projection to 2050, by Fuel Type (PJ)



Source: Australian Government (2012), Energy White Paper 2012.

As of December 2013, there were three ethanol manufacturers with a combined production capacity of 440 ML and an additional capacity of 173 ML expected by 2016. Of the biodiesel plants, only four out of 11 plants with a combined installed capacity of 360 ML are in operation, producing 115 ML of biodiesel from tallow and used cooking oil. New biodiesel plants with a total capacity of 288 ML are planned to be constructed. The following figures and tables show the locations and the lists of biofuel manufacturing plants.

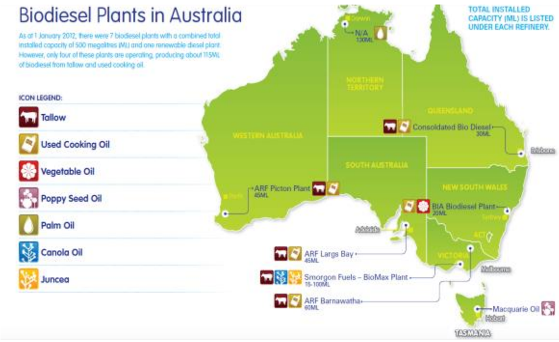
Figure A.1.2 Location and List of Ethanol Plants in Australia



ETHANOL PLANT	LOCATION	OWNER (* BAA MEMBER)	TOTAL INSTALLED CAPACITY (ML) (AT 01.12.13)	FEEDSTOCK	STATUS (AT 01.12.13)
Dalby Bio-Refinery	Dalby, QLD	United Petrolium	80	Red Sorghum	In production
Manildra Ethanol Plant	Nowra, NSW	Manildra Group*	300	Waste Starch	In production, plant expansion continuing
Sarina Distillery	Sarina, QLD	Wilmar BioEthanol (Australia) Pty Ltd*	60	Molasses (by product from sugar processing)	In production
TOTAL CAPACITY (ML)			440		

Source: Biofuel Association of Australia (BAA) (2013a).

Figure A.1.3 Location and List of Biodiesel Plants in Australia



BIODIESEL PLANT	LOCATION	OWNER (* BAA MEMBER)	TOTAL INSTALLED CAPACITY (ML) (AT 01.12.13)	FEEDSTOCK	STATUS (AT 01.12.13)
ARfuels Barnawartha	Barnawartha, VIC	Australian Renewable Fuels*	60	Tallow, Used cooking oil	In production
ARfuels Largs Bay	Largs Bay, SA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	In production
ARfules Picton	Picton, WA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	In production
ASHOIL	Tom Price, WA	Ashburton Aboriginal Corportion*	Unknown	Used cooking oil	In production
Biodiesel Industries	Rutherford, NSW	Biodiesel Industries Australia Pty Ltd*	20	Used cooking oil, Vegetable oil	In production
Ecofuels Australia	Echuca, VIC	Ecofuels Australia Pty Ltd	1.5	Canola oil	In production
EcoTech BioDiesel	Narangba, QLD	Gull Group*	30	Tallow, Used cooking oil	In production
Macquarie Oil	Cressy, TAS	Macquarie Oil Co	15	Poppy Seed Oil & Waste Vegetable Oil	In production
Neutral Fuels	Dandenong, VIC	Neutral Fuels (Melbourne) Pty Ltd	Unknown	Used cooking oil	In production
Smorgon Fuels – BioMax Plant	Laverton, VIC	Smorgon Fuels Pty Ltd	N/A (Prior to closure 15-100)	Tallow, Canola Oil and Juncea Oil	Closed
Territory Biofuels	Darwin, NT	Territory Biofuels Ltd	140	Refined, Bleached & Deodorised (RBD) Palm Oil, Tallow, Used Cooking Oil	Restart in 2014
TOTAL CAPACITY (ML)			360		

Source: Biofuel Association of Australia (BAA) (2013b)

Table A.1.1 shows the historical trend of biofuel production and consumption in Australia. Although bioethanol production and consumption experienced a steady increase until 2011, it has become flat in recent years. Biodiesel also shows a quite moderate growth in its production and consumption.

Table A.1.1 Historical Trend of Biofuel Production in Australia

							(million liters)	
Year End July		2007	2008	2009	2010	2011	2012	2013
Bioethanol	Prodiction	84	149	203	380	440	440	440
	Consumption	84	149	203	380	440	440	440
Biodiesel	Prodiction	54	50	85	130	250	350	400
	Consumption	61	54	96	139	275	371	420

（出所）USDA GAIN Report, Australia Biofuels Annual 7/3/2013

(3) Development Program

(3.1) *The Fuel Quality Standards Act 2000*

On petroleum product standards in Australia, the "Fuel Quality Standards Act 2000" provides the content of biofuels in automobile fuels as follows:

- Gasoline: The ethanol content of gasoline is 10 percent or less.

- Diesel: The biodiesel content of diesel is 5 percent or less.

(3.2) *The Ethanol Production Grants Program* (September 2002–June 2021)

This program was introduced in September 2002 to subsidise ethanol producers by granting an amount equivalent to the excise duty, which is A$0.38143 per litre of ethanol. The program is ongoing and scheduled for review after 30 June 2021.

(3.3) *The Energy Grants (Cleaner Fuels) Scheme* (December 2011–June 2021)

This program subsidises biodiesel producers and importers by granting them an amount equivalent to the excise tax (or customs duty), which is A$0.38143 per litre of biodiesel. The scheme will continue until at least June 30, 2021.

(3.4) *The Ethanol Distribution Program* (Completed)

To increase the number of retailers (service stations) selling 10 percent ethanol blended gasoline (E10), the following subsidies were introduced:

- To compensate the cost of installing E10 sales equipment, up to A$10,000 were provided to each retailer that installed such equipment (October 2006–March 2008).

- Up to A$10,000 were provided to each retailer that achieved the E10 sales goal within 12 months after the installation of E10 sales equipment.

(3.5) *Second-Generation Biofuels Research and Development (Gen 2) Program*

This is a competitive grants program that supports research, development, and demonstration of new biofuel technologies and feedstocks that address sustainable development of the biofuels industry in Australia.

Application for participation in the Gen 2 Program was closed in January 2009 and the scheme expired in June 2012 (For details, see (4) RD&D Information on Biofuels in Australia).

The abovementioned measures (3.2), (3.3) allow biofuels to be retailed at lower prices than regular petroleum products. Also, the abovementioned measure (3.4) has obviously helped increase the sales of bio-gasoline since 2006.

（3.6）*Fund by Australian Renewable Energy Agency (ARENA)*

The ARENA provides a total of A$3.2 billion as part of the Clean Energy Future Package with the aim of enhancing competitiveness of domestic renewable energy technology and facilitating the use of renewable energy. ARENA also subsidises a project through Advanced Biofuels Investment, which intends to promote commercialisation of biofuel technology.

(4) Information on Biofuels Research, Development and Demonstration (RD&D)

(4.1) *Second-Generation Biofuels Research and Development (Gen 2) Program*

A funding of A$12.617 million was allocated to six projects over three years from 2009/10 to 2011/12.

(i) The University of Melbourne (A$1.24 million): This project involves research on biofuel from micro algae, including efficient separation, processing, and utilisation of algal biomass.

(ii) Algal Fuels Consortium (A$2.724 million): The consortium was formed to develop a pilot-scale second-generation biorefinery for sustainable micro algal biofuels and value-added products.

(iii) Curtin University of Technology (A$2.5 million): The project is looking into the sustainable production of high-quality, second-generation transport biofuels from mallee biomass by pyrolysis and utilising the biorefinery concept.

(iv) Bureau of Sugar Experiment Stations (BSES) Limited (A$1.326 million): BSES is developing an optimised and sustainable sugarcane biomass input system for the production of second-generation biofuels, located at Indooroopilly, Queensland.

(v) Microbiogen Pty Ltd (A$2.539 million): The project aims to produce commercial volumes of ethanol from bagasse using patented yeast strains. The project is located at Lane Cove, New South Wales.

(vi) Licella Pty Ltd (A$2.288 million): Licella will examine the commercial demonstration of converting lignocellulosics to a stable bio-crude.

(4.2) *The Australian Biofuels Research Institute (ABRI)*

ABRI was established to promote the commercialisation of next-generation advanced biofuels in Australia. ABRI is administered by the Australian Renewable Energy Agency (ARENA). The government has committed A$20 million to ABRI. Of this funding, A$5 million has been allocated as a foundation grant for an algal biofuels project at James Cook University at Townsville, Queensland. The balance of A$15 million will be used to fund additional grants, awarded on a competitive basis, under the Advanced Biofuels Investment Readiness Program.

（4.3） *Latest development on algae fuel*

(i) In July 2013, Algae.Tec Ltd. signed a deal with Australia's largest power company, Macquarie Generation, owned by the New South Wales Government to locate an algae carbon capture and biofuels production facility alongside the Bayswater coal-fired power station in Hunter Valley, and feed waste carbon dioxide (CO_2) into the enclosed algae growth system. The algae will feed on waste CO_2 emitted by the power plant and the resulting algal oil is converted to biodiesel and hydrogenated to grade A jet fuel.[1]

[1] Algae.Tec Ltd. "Algae.Tec signs carbon capture biofuels deal with Australia's largest coal-fired power company". Press release dated July 2, 2013.

(ii) In July 2013, Dr. Evan Stephens of the University of Queensland and the team at the Institute for Molecular Bioscience, in collaboration with Germany's Bielefeld University and Karlsruhe Institute of Technology, identified fast-growing and hardy microscopic algae that could prove the key to cheaper and more efficient alternative fuel production. Dr. Stephens and the team identified hundreds of native species of microscopic algae from freshwater and saltwater environments around Australia and tested them against thousands of environmental conditions in the laboratory, creating a shortlist of top performers.[2]

(5) Future Challenges

(5.1) Supply disruptions

The devastating Queensland floods in December 2010 and January 2011 disrupted ethanol production at two of the three ethanol plants into the first half of 2011. Given this uncertainty, it remains a concern for many industry participants.

(5.2) No mandates for alternative transport fuels

The Australian government does not support mandates for alternative transport fuels; however, some state governments have legislated or proposed biofuels mandates.

（5.3）Profitability of biofuel plants

To secure the profitability of biofuel plants, it is necessary to facilitate investment and R&D on new biofuels, such as microalgae and pongamia, and to extend the time period of a current subsidy program that is offered to promote the production of biodiesel and bio-jet fuels.

Trend of Biofuels Trade in Australia

Table A.1.2 shows the historical trend of import and export volumes of biofuels in Australia. Bioethanol is currently not imported. In 2012, 10 ML of biodiesel was exported of which China and South Korea accounted for 50

[2] The University of Queensland, Institute for Molecular Bioscience.

percent and 36 percent, respectively. Biodiesel export in 2013 is expected to increase due to the depreciation of the Australian currency.

Table A.1.2 Transition of Import and Export Volumes of Biofuels in Australia

(million liters)

Year End July		2007	2008	2009	2010	2011	2012	2013
Bioethanol	Imports	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0
Biodiesel	Imports	7	4	11	9	25	21	20
	Exports	0	0	0	0	0	10	20

（出所）USDA GAIN Report, Australia Biofuels Annual 7/3/2013

In Australia, 1) customs duty, 2) excise tax, and 3) goods and services tax are imposed on petroleum products.

1) Customs Duty: Tax imposed on the petroleum products imported into Australia—A$0.38143/litre.

2) Excise Tax: Tax imposed on the petroleum products manufactured in Australia—A$0.38143/litre.

3) Goods and Services Tax (GST): 10 percent across the board

Biodiesel is exempted from customs duty under the Energy Grants (Cleaner Fuels) Scheme. However, imported bioethanol is more expensive than domestically produced bioethanol because there is no customs duty exemption system for imported bioethanol.

Brunei Darussalam

Brunei Darussalam is endowed with oil and natural gas, which are rich enough to meet the primary energy demand of the country. For this reason, the country did not have to consider the use of renewable energies and there is no official activity on biofuel utilisation. However, Brunei Darussalam is committed to implement strategies relating to energy security, diversification of supply, and energy efficiency and conservation as an active member of the Association of Southeast Asian Nations (ASEAN).[3] This is reflected in the Energy White Paper presented by the Energy Department in 2011, which set

[3] Asia-Pacific Energy Research Centre (2013).

out a goal of adopting 10 percent electricity from renewable energies in 2035 in order to diversify its energy sources and strengthen energy security.[4]

Although Brunei Darussalam has not implemented an energy policy to promote biofuel utilisation, it does not mean that the country has never shown interest in biofuels development. In 2011, the government indicated an expectation of inviting foreign direct investments through public–private partnership in biofuel facilities that would aim for the European market where the European Union mandated the reduction of carbon dioxide emissions by 80 percent by 2050.[5] Going back to the late 2000s, there were a few biofuel projects discussed with other countries but it is not clear how much progress these projects have made. For example, in April 2007, the Brunei Economic Development Board and a Malaysian company, HDZ Biodiesel Corporation Sdn Bhd, signed a memorandum of understanding to establish a biodiesel project in Brunei Darussalam. Also, the Brunei National Petroleum Company and the Philippine National Oil Company–Alternative Fuels Corporation were in a discussion about a joint biodiesel project in the Philippines using jatropha as feedstock.[6] Therefore, biofuel project development may be seen in Brunei Darussalam in the future.

Cambodia

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The Cambodian government has not established any policies or initiatives for the development of biofuels, so far. Although it has started a series of discussions to promote the development of biofuels, final results have not been announced yet.

[4] "Current State of Renewable Energies in Brunei Darussalam," Asia Biomass Office (November 2013).
[5] "Gov't wants FDI in biofuel projects", *The Brunei Times*, November 26, 2011.
[6] APEC Energy Working Group, Expert Group on New and Renewable Energy Technologies. http://www.egnret.ewg.apec.org/Archive/me_brunei.html

Cambodia is a net oil importer and the demand for oil imports is projected to increase fast in the future. Developing and expanding the biofuel industry could help the country to curtail its rapidly increasing oil imports.

According to some reports released by the Asian Development Bank Institute (ADBI) and the Japan Development Institute (JDI), the bio energy policy in Cambodia is expected to follow the precedent in Thailand.[7] The JDI report suggests that both bioethanol and biodiesel plans for Cambodia can be developed using the same raw materials used in Thailand. As in the case of Thailand, palm oil and sugarcane can be used to produce bioethanol while palm oil and cassava can be used for biodiesel production in Cambodia.

(2) Target

There is no clear target that has been released by the Cambodian government.

(3) Development Program

In Cambodia, technology is available to extract oil from seeds and convert jatropha oil to biodiesel for use in diesel engines. The technology for producing bioethanol is not available, although it is well developed in other Southeast Asian countries, such as Thailand. The energy content of jatropha oil is similar to that of diesel oil and jatropha oil can be substituted directly in most diesel engines.

In 1994, the Mong Reththy Group and its South Korean venture partner, Borim Universal, launched a large-scale project to plant 11,000 hectares (ha) of oil palms near Sihanoukville. The project was the first commercially motivated attempt to develop a vegetable oil plantation in Cambodia.

After that, a South Korean bio energy company, the MH Bio-Energy, opened its cassava ethanol plant in Kandal region. This plant is currently the only ethanol plant in Cambodia.

In addition, Idemitsu Kosan signed a memorandum of understanding with the Cambodian government to promote biofuels production in the country in December 2012. Idemitsu Kosan has also been promoting its biofuel business in Viet Nam, where the company has begun producing biomass on a pilot basis.

[7] The Thailand Cabinet adopted guidelines for promoting the production and utilisation of ethanol as a motor fuel in 2000.

(4) Information on Biofuel RD&D in Cambodia

There is no information available on biofuel RD&D in Cambodia.

(5) Way Forward

The current development of biofuel is based on pilot projects and there is no clear government policy on biofuels.

Food security in Cambodia is a critical issue. Jatropha, which cannot be used as food, is considered suitable for cultivation in Cambodia. However, the economic viability of producing biodiesel from jatropha still needs to be established.

Trend of Biofuels Trade in Cambodia

There is no official statistics that has been released as yet, but there is a presumption of possible production capacity in Cambodia.

Table A.3.1 Biofuel Production Capacity in Cambodia

1. Biofuels in Cambodia	**2. Possible Production Capacity**	**3. Consumption**
Biodiesel	193.2 million litres	No data available
Bioethanol	93.9 million litres	No data available

Source: Schott (2009).

China

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The Chinese government adopted the "National Economy and Social Development—12th Five-Year Plan Outline (2011–2015)" at the 4th Congress of China's 11thPeriod National People's Congress in March 2011. One of the targets set in the 12th Five-Year Plan was to increase the share of clean energy in total primary energy supply to 11.4 percent by 2015.

Chapter 5 of the 12th Five-Year Plan cites the acceleration of up-to-date agricultural development and firm maintenance of distinctive agriculture modernisation policies. Chapter 5 lays out a policy to accelerate the changeover of agricultural development patterns and to enhance overall agricultural production capabilities, risk aversion capabilities, and market competitiveness.

(2) Target

According to the "12th Five-Year Plan on Renewable Energy Development" published by the National Energy Administration of China, the government plans to raise the share of renewable energy in total energy consumption to 9.5 percent by 2015, where the target for biofuels is 3.5 million tonnes of annual bioethanol consumption, and 1.5 million tonnes of annual biodiesel consumption by 2015.

Table A.4.1 Renewable Energy Development Project in China's 12th Five-Year Plan

	Capacity		Annual Production		Ton Coal Equivalent
	Value	Unit	Value	Unit	million ton
A. Power Generation	394	GW	1203	TWh	390
1. Hydro	260		910		295.8
2. Wind	100		190		61.8
3. Solar	21		25		8.1
4. Biomass	13		78		24.3
Agricultural and Forestrial residues	8		48		15
Biogas	2		12		3.7
Municipal Solid Waste	3		18		5.6
B. Biogas			22	billion m^3	17.5
1. Residential	50	million households	21.5		17
2. Industrial organic waste water treatment facility	1000	Unit	0.5		0.5
C. Heating and Cooling					60.5
1. Solar thermal water heater	400	million km^2			45.5
2. Solar thermal cooker	2	million units			
3. Geothermal					15
Space heating and cooling	580	million km^2			
Water heating	1.2	million households			
D. Fuels					10
1. Solid biomass	10	million ton			5
2. Bioethanol	4	million ton			3.5
3. Biodiesel	1	million ton			1.5
Total					478

Source: National Energy Administration of China (2012), 12th Five-Year Plan for Renewable Energy Development.

(3) Development Program

China's bioethanol fuel introductory project began with the "Ethanol-Blended Gasoline Development Program" under the 10th Five-Year Plan starting in 2001. In March 2002, the "Bill for Testing the Use of Ethanol-Blended Gasoline for Cars" and the "Administrative Instructions for Testing the Use of Ethanol-Blended Gasoline for Cars" were announced to implement a one-year test project to develop legislation; set up a competent government department; and establish raw material procurement, production, transport, and sales systems.

In February 2004, the "Act for Testing the Expansion of Ethanol-Blended Gasoline for Cars" and the "Administrative Instructions for Testing the Expansion of Ethanol-Blended Gasoline for Cars" were announced to launch expanded introduction of bioethanol fuels. Within the expansion program, four bioethanol-producing companies were designated and the region where biofuels were to be introduced was expanded to five provinces and 27 cities. By the end of 2005, bioethanol consumption reached 1.02 million tonnes, and about 20 percent of national gasoline consumption was E10.

At the Petroleum Alternative Energy Research Committee formed by the National Development and Reform Commission, China (NDRC) and National Energy Administration in December 2005, it was discussed that future plans to expand the introduction of ethanol fuel should be implemented under the precondition that the nation's food supply and land use were not threatened.

China is the third-largest bioethanol producer in the world following the United States and Brazil. There are five ethanol plants in China: four of these plants use corn and wheat as raw materials, and one uses cassava. In 2011, these four plants (82% of the feedstock supply was corn, and 18% was wheat) produced 2.1 million kilolitres (kL) of ethanol. The plant that uses cassava produced 152,000 kL of ethanol. All other plants, except this one, were said to be running close to their full production capacity. The government, however, has no intention of approving further land use for facility expansion. The blend rate of ethanol was 8–12 percent, with any changes depending on the market price of oil.

China's production volume of fuel ethanol was estimated at 2.43 million kL in 2012—an 8 percent increase from the 2011 level. There is no change to the government's policy that biofuels should be developed on the precondition that the nation's food provisions and land use are not threatened. The government and business operators have been researching on the use of sweet sorghums as an alternative source, which is an annual gramineous plant and cultivated as feed for livestock; however, sweet sorghum has not yet been grown on a large scale.

Some government agencies and state-owned enterprises have been planting jatropha, but there is no government plan announcement of launching large-scale jatropha plantation. As of 2011, two places in Hainan province have implemented biodiesel pilot programs with a blend rate of 2–4 percent. Both the provincial government and an oil company are still in the stage of considering when to introduce a mandate blend of biodiesel in all the cities in Hainan province.

Due to soaring food prices after 2008, the Chinese government has been forced to tighten the management of the grain handling department, including the production of ethanol. As a result, financial support for the production of grain-based ethanol was reduced and the subsidy for ethanol production was dropped to US$0.06 per litre in 2012. By 2015, the Ministry of Finance of China intends to abolish the refund of the value-added tax and impose a 5-percent consumption tax on the production of grain-based ethanol.

Table A.4.2 Government Subsidy for Production of Fuel Ethanol in China (in US$ cents/litre)

2005	2006	2007	2008	2009	2010	2011	2012
21.3	18.9	15.9	20.4	19.2	16.0	16.0	6.0

Note: US$1 = 6.8 yuan
Source: USDA GAIN Report (2010 and 2013). *Peoples Republic of China Biofuels Annual Report*.

The Chinese government has exempted the 5 percent consumption tax imposed on the production of biodiesel, based on the judgment that the use of used cooking oil contributes to the introduction of renewable energy. Biodiesel producers are requesting the government to make this measure permanent.

Since 2008, the Chinese government has implemented mandatory blending of ethanol in the six provinces of Heilongjiang, Jilin, Liaoning, Henan, Anhui, and Guangxi; and in 27 cities in the provinces of Hubei, Hebei, Shandong, and Jiangsu. These districts and cities were chosen because they were close to the grain production areas, and PetroChina and Sinopec were mandated to blend 10 percent ethanol into gasoline. The production of fuel ethanol is premised on use-based mandatory blend or consumption projection by the government. Since this is based on the government's management system, private companies are prohibited to import ethanol when the market price is high.

In the short term, the following issues were considered as requiring immediate solution: (1) investigation and reevaluation of the crop acreage and designing of an energy crop production plan, (2) implementation of a test project for the large-scale production of biofuels from energy crops other than agricultural products that are consumed as basic foods, (3) development of legislations related to biofuels and establishment of a distribution system, and (4) technological development and establishment of an industrial structure.

(4) Information on Biofuel RD&D in China

As part of their energy cooperation program in 2011, the United States and China launched a joint research on sustainable aviation biofuel oil. Jatropha was chosen as an optional feedstock and a test flight was conducted in Beijing in November 2011. The Chinese government had instructed PetroChina to produce jatropha in the southwest region, but the timing of commercial production was not clear.

China has focused on some non-grain sweet sorghums that grow on infertile land and do not compete with food crops. The first commercial ethanol plant, with a capacity of 113,600 kL, is being constructed in Inner Mongolia and will be completed in 2015. However, it is not clear how much the government will subsidise this scheme, and the provincial government has not made clear when to impose the mandatory blend.

(5) Way Forward

Aircraft jet fuel annual consumption in China is currently 20 million tonnes and is projected to reach 40 million tonnes in 2020. In May 2012, the Civil Aviation Administration of China (CAAC) announced a plan to substitute 12 million tonnes (30%) of jet fuel with biofuels by 2020.

Development was initiated on biofuel production using algae. In September 2010, the Boeing Company and the Qingdao Institute of BioEnergy and Bioprocess Technology established a joint institute for promoting research on algae-based aircraft biofuel. The institute would look into its practical use within five years and its commercialisation within 10 years.

Trend of Biofuels Trade in China

Tentatively, China imposes a 5 percent import duty on imports of denatured alcohol. The duty rate has been greatly lowered from 30 percent in 2009, seemingly aiming to promote import of by-products and raw materials. Imported denatured alcohol is used only by the chemical industry and the government allocates the imported products to specific provinces and cities. An import tariff on non-denatured alcohol has been maintained at 40 percent. Both non-denatured alcohol and denatured alcohol are subject to 17 percent value-added tax and 5 percent consumption tax.

Table A.4.3 Import and Export Volume of Ethanol in China (in kilolitres)

	2007	2008	2009	2010	2011	2012
Import	678	402	158	3,612	5,305	15,308
Export	129,974	108,111	107,895	156,020	43,333	44,962

Source: USDA GAIN Report (2013). *Peoples Republic of China Biofuels Annual Report*.

In 2012, the import duty was reduced to zero for imports from the ASEAN countries, Chile, and Pakistan with whom the Free Trade Agreement (FTA) was concluded. In any case, the imported products are much more expensive than the domestic ones and the import volume is limited.

Table A.4.4 Supply and Demand of Bioethanol in China (in 1,000 kilolitres)

		2006	2007	2008	2009	2010	2011	2012
Production		1,647	1,736	2,002	2,179	2,128	2,255	2,509
Export		0	19	8	16	12	8	7
Import		0	0	0	0	3	5	3
Consumption		1,647	1,736	2,002	2,179	2,128	2,255	2,509
Number of Plants		4	4	4	5	5	5	5
Capacity		1,824	1,824	2,065	2,243	2,500	2,500	2,600
Main Feedstock (1000 ton)								
	Corn	3,200	3,420	3,700	4,000	4,000	4,400	5,000
	Wheat	1,050	1,050	1,050	1,050	1,050	1,050	1,050
	Cassava	0	0	364	467	392	336	336

Source: USDA GAIN (2013), *Peoples Republic of China Biofuels Annual Report*.

Table A.4.5 Supply and Demand of Biodiesel in China (in 1,000 kilolitres)

		2006	2007	2008	2009	2010	2011	2012
Production		273	352	534	591	568	852	909
Export		0	0	0	0	0	0	0
Import		0	0	0	0	0	0	19
Consumption		273	352	534	591	568	852	909
Number of Plants		65	96	84	62	45	49	52
Capacity		1,761	3,124	3,351	2,670	2,556	3,181	3,408
Main Feedstock (1000 ton)								
	Used Cooking Oil	267	344	522	578	556	833	889

Source: USDA GAIN Report (2013), *Peoples Republic of China Biofuels Annual Report*.

India

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

It has been more than a decade since a biofuel policy was introduced in India's policy agenda. India implemented a biofuels program primarily to reduce oil import dependence and explore clean fuels. Driven by robust economic growth, India's oil demand has rapidly increased, which has consequently boosted its oil import dependence.[8] As India needs to strengthen energy security, it is important for the country to identify indigenous energy sources to meet domestic energy demand and reduce oil imports.

[8] Based on the IEA's Energy Balances of Non-OECD countries in 2012, the demand for crude oil in India grew at an annual rate of 6.4 percent between 2001 and 2010.

Being the world's third-largest emitter of CO_2, India has implemented policies, such as automotive fuel economy policy and biofuel policy, which are expected to contribute to the reduction of greenhouse gas emissions. In 2003, India introduced the Auto Fuel Policy where under this policy, Bharat Stage IV (Euro IV equivalent) norms for fuels and vehicles were in effect starting April 1, 2010 in 13 cities of India while Bharat Stage III (Euro III equivalent) was applied to the rest of the country.[9]

National Biofuel Mission

In 2003, under the Planning Commission of the Government of India, the National Biofuel Mission was launched to ensure energy security with minimum damage to environment. The Ethanol Blended Petrol Program and Biodiesel Blending Program were the main parts of the Mission and the objectives of these programs were to initiate the blending of biofuels with transport fuels on a commercial scale.[10]

Before the National Biofuel Mission started, an ethanol pilot program, which proposed to blend 5 percent ethanol (E5), was initiated in 2001 and this turned out to be successful. With the start of the Ethanol Blended Petrol Program, an E5 blending target became mandatory for nine states and four Union Territories on January 1, 2003.[11] However, ethanol supplies significantly dropped due to severe droughts in 2003 and 2004, which thereby forced India to import ethanol from Brazil to meet the E5 blending target. To deal with this situation, India amended the E5 mandate so that E5 blending would only be required when ethanol supplies were sufficiently available and when the domestic ethanol price was comparable to the import parity price of petrol. Following the 11th Five-Year Plan (2007–2012), which included a recommendation for increasing the ethanol blending mandate to 10 percent, the Cabinet Committee on Economic Affairs implemented E5 blends nationwide in September 2007.

[9] The 13 cities include Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Lucknow, Camper, Agra, Surat, Ahmedabad, Pune, and Sholapur.

[10] Raju et al. (2012).

[11] ADB (2011). The nine states were Andhra Pradesh, Goa, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Tamil Nadu, and Uttar Pradesh. The four Union Territories included Chandigarh, Damman and Diu, Dadra and Nagar Haveli, and Pondicherry.

For biodiesel, India started a biodiesel program in 2003 with a mandatory target of 20 percent biodiesel blending by 2011–2012, identifying *Jatropha curcas* as the most suitable tree-borne oilseed for biodiesel production. To support the program, the Ministry of Petroleum and Natural Gas enacted a National Biodiesel Purchase Policy and set a price of Rs25 per litre, which took effect on November 1, 2006 and was raised to Rs26.50 per litre in October 2008.[12]

National Policy on Biofuel

In December 2009, India adopted the "National Policy on Biofuels" with a target of 20 percent blending of biofuels by 2017. This policy lays out a strategy and approach to biofuel development and proposes a framework of technological, financial, and institutional interventions and enabling mechanisms. Food security is critical for India due to the increasing demand for food associated with its vast population and stagnant agricultural productivity. Hence, this national policy specifies that the program is to be carried out based on nonfood feedstocks raised on degraded or wastelands that are not suited to agriculture to avoid conflict with food security.[13] In addition, this biofuel policy promotes plantations of trees bearing non-edible oilseeds on government- or community-owned wasteland, degraded or fallow land, and in forest and non-forest areas, which will prevent conflict with food production.

While the Ministry of New and Renewable Energy is responsible for implementing and coordinating the policy on biofuels, several other ministries are also involved in biofuel development and promotion, such as the Ministry of Environment and Forests, Ministry of Petroleum and Natural Gas, and Ministry of Rural Development, among others. Given the different roles of these ministries, the biofuel policy proposes to set up a National Biofuel Coordination Committee to provide overall coordination, policy guidance and review, and monitoring of the programs. It also suggests establishing a Biofuel Steering Committee to provide effective guidance and to oversee the implementation of this policy on a continuing basis.

In February 2011, the Ministry of New and Renewable Energy issued a Strategic Plan for the New and Renewable Energy Sector for the period

[12] Ibid.
[13] Raju, *et al*. (2012).

2011–2017. In the medium term, second-generation biofuels are expected to have potential for production.

In November 2012, the Cabinet Committee on Economic Affairs announced that the ethanol policy would be revised so that the market could decide the procurement price and ethanol imports would be allowed if supply falls short of enabling the 5 percent ethanol blending into gasoline. This would mean that starting December 1, 2012, the oil marketing companies and ethanol suppliers are able to set the ethanol price, and the oil marketing companies and chemical companies are free to import ethanol in case of any shortfall in domestic supply.

(2) Target

As mentioned earlier, the biofuel policy sets an indicative target of 20 percent blending of biofuels, both for ethanol and biodiesel by 2017. At the time of this study, there was no mandatory blending target for biodiesel. The target is planned to be phased in over time—5 percent blending by 2012, 10 percent by 2017, and 20 percent after 2017. The noticeable feature of India's biofuel policy is that the country focuses on nonfood products as biofuel feedstocks.

Ethanol Production

In India, ethanol is produced from sugar molasses for blending with gasoline. Approximately 90 percent of molasses is used as feedstock for alcohol production. Sugar production is the second largest agricultural industry next to cotton in the country and molasses is a by-product of sugar production. About 70–80 percent of sugarcane produced in India is used for sugar production and the remaining is for alternative sweeteners and seeds. About 85–100 kg of sugar (8.5%–10%) and 40 kg (4%) of molasses can be produced from one tonne of sugarcane. Sugarcane is subject to periodic and alternate cycles of surplus and shortages with a typical 6–8 year cycle; 3–4 years of higher production are followed by 2–3 years of lower production.[14] Table 5.1 shows that the level of sugarcane production in 2009–2010 did not reach the same level of production as that in 2000–2001, and the yields were stagnant for the last decade.

[14] Ibid.

Table A.5.1 Area under Production, Production and Yield of Sugarcane in India

Year	Area (million hectares)	Production (million tonnes)	Yield (tonnes/hectare)
2000-01	4.32	296.00	68.6
2001-02	4.41	297.21	67.4
2002-03	4.52	287.38	63.6
2003-04	3.94	233.90	59.4
2004-05	3.66	237.09	64.8
2005-06	4.20	281.17	65.6
2006-07	5.15	355.52	69.0
2007-08	5.06	348.19	68.9
2008-09	4.40	273.93	62.3
2009-10	4.20	277.75	66.1

Sources: (Before 2005–2006) Ray et al. (2011), p. 7. (After 2006–2007) Raju et al. (2012), p. 34.

India faces difficulty in maintaining or increasing the blending level of ethanol with gasoline. First, the cyclical nature of sugarcane production creates uncertainty of ethanol availability for gasoline. Since sugarcane production changes periodically, availability of molasses along with that of sugar production also varies. This indicates that ethanol production may experience substantial ups and downs at interval of several years. Thus, it is difficult to secure a constant and stable amount of ethanol (Table 1.5-1).

Second, instability in ethanol prices caused by the high degree of unstable ethanol production causes uncertainty for both oil marketing companies and ethanol distillers. The fact that sugarcane market is exposed to periodic surplus and deficits in sugarcane production has a strong impact on prices of sugar molasses. During low availability of sugar molasses, its price goes up resulting in higher cost of ethanol production. Hence, ethanol production may be disrupted due to the high cost of ethanol, while ethanol prices are fixed by the government, thereby making it difficult to earn profits. Furthermore, since ethanol distillers seem to receive a favourable price and assured demand from the beverage and chemical industries, they tend to find a better business opportunity in these industries over the oil marketing companies. Approximately 70~80 percent of ethanol supplied is consumed by chemical industries and potable liquor and the rest goes to transport fuels and others. Ethanol to be blended with gasoline is a minor part of the consumption.

Third, increased production capacity may be required to meet the higher blending target in the future. The production capacity increased to 2 billion litres in 2012 from 1.5 billion litres in recent years (Table 1.5-2). Current ethanol production capacity is estimated to be sufficient to meet the ethanol demand for the 5 percent blending with gasoline. However, this capacity level would not be adequate to implement the 10 percent and 20 percent blending targets in the future unless new capacity is added. Nevertheless, the actual blending level has been around 2 percent against the mandatory target of 5 percent.

Fourth, other than sugar molasses, nonfood crops that could make the ethanol production commercially feasible have not been secured fully yet in India. It is unlikely that the total quantity of molasses for ethanol is used as transport fuel due to its more favourable choices found in potable and industrial alcohol. Since molasses alone does not provide a viable option for achieving the target of 20 percent blending, alternative nonfood crops is necessary for ethanol production. For instance, there is potential for sweet sorghum and tropical sugar beet as biofuel feedstock. However, the production of tropical sugar beet and sweet sorghum are not commercially established like sugarcane and their cost competitiveness is not completely understood so far. Besides, since these crops use arable land, there is a possibility of competing with food crops for land and water resources. Therefore, these two nonfood crops are expected to play only a supplementary role in the ethanol industry until it is proven that yields can be adequate to meet commercial production level.[15]

[15] ADB (2011).

Table A.5.2 Ethanol Used as Fuel and Other Industrial Chemicals in India

unit: million liters

Calendar Year	2007	2008	2009	2010	2011	2012	2013	2014
Beginning Stocks	747	1,396	1,672	1,241	1,065	757	908	582
Production	2,398	2,150	1,073	1,522	1,681	2,154	2,064	1,906
Imports	15	70	280	92	39	34	35	40
Exports	14	4	4	14	29	22	20	30
Consumption	1,750	1,940	1,780	1,780	1,995	2,015	2,405	2,110
Fuel Consumption	200	280	100	50	365	305	650	500
Ending Stock	1,396	1,672	1,241	1,061	757	908	582	388
Production Capacity(Conventional Fuel)								
No.of Biorefineries	115	115	115	115	115	115	115	115
Nameplate Capacity	1,500	1,500	1,500	1,500	1,500	2,000	2,000	2,000
Capacity Use (%)	160	143	72	101	112	108	103	95
Feedstock Use(1,000MT)								
Molasses(000'tons)	9,992	8,958	4,469	6,342	7,004	8,975	8,602	7,940
Market Penetration								
Fuel Ethanol	200	280	100	50	365	305	650	500
Gasoline	13,056	15,829	18,022	19,954	21,080	22,132	22,510	23,703
Blend Rate (%)	1.5	1.8	0.6	0.3	1.7	1.4	2.9	2.1

Source: USDA GAIN Report (2013), p. 13.

Biodiesel Production

In India, feedstocks of biodiesel are non-edible oilseed crops, like jatropha and pongamia, and edible oil waste and animal fats. Approximately 1.2 million tonnes of tree-borne, non-edible seed oils are produced yearly in India. Among 400 non-edible oilseeds found in India, jatropha was specifically chosen as the major feedstock because of its high oil content (40% by weight) and low gestation period (2–3 years) compared with other oilseeds. Furthermore, jatropha is drought-tolerant and can be grown in less fertile and marginal lands with minimal care. Unlike other countries, India does not use vegetable oil derived from rapeseed, soybean, or oil palm for biodiesel production since it relies on imports of these vegetable oils to a large extent to meet domestic demand.

In spite of the government's focus on jatropha, progress of its plantations has been slow in India. It was promoted initially as India's Planning Commission had set an ambitious target of covering 11.2–13.4 million ha of land under jatropha cultivation by the end of the 11th Five-Year Plan (2007–2012).

However, at the time of this study, jatropha occupies merely 0.5 million ha of wastelands across the country.[16]

Consequently, biodiesel production from non-edible oilseeds is considered still at infancy on a commercial scale. Biodiesel production is estimated at 130 million litres in 2014 (Table A.5.3). Only six biorefineries in India produce biodiesel from multiple feedstock and most biodiesel companies seem to work at low capacity.

Table A.5.3 Biodiesel Production from Multiple Feedstocks in India

unit: million liters

Calendar Year	2009	2010	2011	2012	2013	2014
Beginning Stocks	0	45	38	42	45	45
Production	75	90	102	115	120	130
Imports	0	0	0	0	0	0
Exports	0	0	0	0	0	0
Consumption	30	52	60	70	75	80
Ending Stock	45	38	42	45	45	50
Production Capacity						
No.of Biorefineries	5	5	5	5	6	6
Nameplate Capacity	450	450	450	460	465	480
Capacity Use (%)	17	20	23	25	26	27
Feedstock Use(1,000MT)						
Used Cooking Oil	23	36	48	53	56	58
Animal Fats and Tallows	3	4	5	5	6	6
Other Oils	19	33	42	47	50	52
Market Penetration						
Biodiesel, on-road use	30	52	60	70	75	80
Diesel, on-road use	63,388	65,999	68,718	71,550	74,497	77,567
Blend Rate (%)	0.0	0.1	0.1	0.1	0.1	0.1
Diesel, total use	105,646	109,999	115,431	119,249	124,162	129,278

Source: USDA GAIN (2013), p 15.

There are obstacles that slow down the progress of the production and investments in biodiesel. Given the current environment, it seems that there is no incentive for the farmers to turn their fertile lands for jatropha cultivation. First of all, the current biodiesel production is not viable in economic terms. The biodiesel price set at Rs26.50 per litre remains lower than the cost of biodiesel production, which is estimated at Rs35–Rs40 per litre. The impeding factors of India's undeveloped biodiesel market, such as inadequate supply of jatropha seeds and inefficient marketing channels, also contribute to the higher production costs.

[16] Raju, *et al*. (2012).

The second impediment is associated with the ownership issues of wastelands that are encouraged to be used for the cultivation of biofuel crops. When local communities are involved, the use of wastelands for plantations of biofuel crops may not be easy unless land ownership is given to them. In addition, the utilisation of the privately owned wastelands would not be possible unless farmers are able to receive assured returns based on financial viability of the biodiesel plantations. There was also confusion regarding the extent of wastelands since various agencies used different definitions for wastelands.

Third, the very little progress in developing jatropha plantations deters biodiesel production on a commercial scale. The planned large-scale jatropha plantations have not been successfully implemented by state governments partially due to lack of coordination and linkage to research programs. Consequently, most of the newly raised seedlings are still from those of low-yielding cultivars. Good quality planting materials (jatropha seeds) have not yet been identified.

Diesel demand is projected to grow by 35 percent or 87.4 million tonnes during the 12th Five-Year Plan (2012–2016). This indicates that meeting a 5 percent blending target will require an additional 4.1 million ha planted with jatropha.[17] Apparently, India needs to increase biodiesel production by increasing jatropha plantations in order to meet the blending target.

(3) Development Program

The National Policy on Biofuels identifies several measures to promote biofuel production. Financial measures, such as subsidies and preferential financing, are proposed.

Minimum Support Price

Minimum Support Price (MSP) for the non-edible oilseeds is suggested to be established with a provision for its periodical revision so that a fair price would be ensured to the biodiesel oilseed growers. Careful consideration would be given to the implementation of MSP after consultation with stakeholders, including central and state governments and the Biofuel

[17] USDA GAIN Report (2013).

Steering Committee, followed by a decision of the National Biofuels Coordination Committee.

Minimum Purchase Price

In determining a biodiesel purchase price, the biofuel policy recommends that the entire value chain—from oilseeds production to distribution and marketing of biofuels—be taken into consideration. The Minimum Purchase Price (MPP) for the purchase of ethanol by the oil marketing companies (OMCs) would be based on the actual cost of production and import price of ethanol. In April 2010, the Empowered Group of Ministers decided to increase the ethanol price to Rs27 per litre, an increase from Rs21.50 per litre, which was fixed in 2007 as the MPP. Since fiscal year (FY)2012–2013, however, the procurement price of ethanol is being decided by the OMCs and suppliers of ethanol. The MPP for biodiesel should be linked to the prevailing retail diesel price. After the Biofuel Steering Committee determines the MPP for both ethanol and biodiesel, the National Biofuel Coordination Committee will decide on it. The biodiesel price has remained at the level of Rs26.50 per litre since October 2008 although it is perceived to be below the production cost.

Financial and Fiscal Incentives

While a concessional excise tax of 16 percent is imposed on bioethanol, biodiesel is exempted from excise duty. No other central taxes and duties are proposed to be levied on bioethanol and biodiesel.

The Government of India offers subsidised loans through sugarcane development funds to sugar mills for establishing an ethanol production unit. The loans would cover up to 40 percent of the project cost.[18] The biofuel policy proposes to set up a National Biofuel Fund if financial incentives are deemed necessary. Subsidies and grants may be considered upon merit for new and second-generation feedstocks, advanced technologies and conversion processes, and production units based on new and second-generation feedstocks. The policy does not specify what feedstock to be considered under this category.

[18] Ibid.

For research, development, and demonstration (RD&D) projects, the policy refers to grants, which would be provided to academic institutions, research organisations, specialised centres and industry.

(4) Information on Biofuel RD&D in India

RD&D is supported to cover all aspects, from feedstock production to biofuels processing for various end-use applications. A major objective of the biofuel policy is to undertake R&D on biofuel crops. It aims to put high priority on indigenous R&D and technology development based on local feedstocks and needs. Specifically, the policy identifies focus areas, such as (1) production and development of quality planting materials and high-sugar-containing varieties of sugarcane, sweet sorghum, sugar beet, and cassava; (2) advanced conversion technologies for first and second-generation biofuels, including conversion of lingo-cellulosic materials; (3) technologies for end-use applications, including modification and development of engines for the transport sector and for stationary applications for motive power and electricity production; and (4) utilisation of by-products of biodiesel and bioethanol production processes. The policy notes that demonstration projects will be set up for ethanol and biodiesel production, conversion, and applications based on state-of-the-art technologies through public–private partnership (PPP).[19]

As the National Biofuel Mission was initiated in 2003, several R&D programs were implemented. For instance, the National Oilseed and Vegetable Oils Development Board established a "National Network on Jatropha and Karanja" in 2004 by involving a number of research institutes, with research focus on issues such as identification of elite planting material, tree improvement to develop high-yielding variety seeds with better quality and reliable seed source, intercropping trails, developing a suitable package of practices, postharvest tools and technology, and detoxification of oil meal of important tree-borne oilseeds.[20]

---

[19] Ministry of New & Renewable Energy, Government of India (2009).

[20] Raju, *et al*. (2012). The institutes involved were the Indian Council of Agricultural Research, State Agricultural Universities, Council of Scientific and Industrial Research, Indian Council of Forestry Research and Education, Central Food Technological Research Institutes, Indian Institute of Technology, and the Energy Research Institute.

The Department of Biotechnology, Ministry of Science and Technology, initiated a "Micro Mission on Production and Demonstration of Quality Planting Material of Jatropha" with the aim of selecting good germplasm and developing quality planting material. With support from the Department of Biotechnology, the Energy Research Institute undertook a project entitled "Biofuel Micro-Mission Network Project on Jatropha" with the aim of screening various jatropha collections across the country for their oil content and composition.[21]

One of the recent developments is that the Indian Oil Corporation has developed a technology to produce bio-hydrogenated diesel by mixing and processing nonfood vegetable oil and petroleum-based feedstock in an oil refinery's diesel hydrotreater unit. The Central Salt and Marine Chemical Research Institute and the National Environmental Engineering Research Institute have also developed a technique for producing biodiesel fuel from microalgae, with driving tests carried out using B20 fuel.[22]

Despite some R&D efforts initiated, most of the R&D programs are still at the laboratory or field trial stage in India. There was dissatisfaction among the farmers in economic terms due to low-yielding cultivars from most of the newly raised seedlings. No research organisation has officially released improved kinds of jatropha so far.

(5) Way Forward

Notwithstanding the efforts that India has made for more than a decade, the country is still surrounded by a number of tasks to make biofuels available for blending with the transport fuels as planned. Such difficult situations result from various issues as described below:

Integrated Approach by the Central Government and State Governments

It is challenging for India to reduce discrepancy in policy and administrative matters concerning biofuel utilisation between the central government and the state governments. Although the central government is responsible for

[21] Ibid.
[22] Asia Biomass Office (2013), 'Status of Biodiesel Fuel in India', October.

strategic decisions on biofuel policies, the fact that agriculture is under the jurisdiction of the state governments empowers them to pursue their own strategy to encourage biofuel production. For this reason, different initiatives have been applied by the state governments, and as a result, there is a wide range of differences not only among the state policies but also between the central government and the state governments. Table A.5.4 exemplifies some major initiatives taken by several states. Apparently, these initiatives on biofuels are not uniform among the states. Such diverse structures are regarded as an obstacle to the implementation of procurement, blending, transport, and trade of biofuels. Therefore, it is critical for biofuel plantation programs to have an integrated approach across the various states of India.

Table A.5.4 State Biofuel Initiatives in India

Initiative	**Andhra Pradesh**	**Rajasthan**	**Tamil Nadu**	**Uttarakhand**
Feedstock explicitly favoured	Pongamia	Jatropha, Karanj and other oilseed plants	Jatropha, Pongamia	Jatropha
Allocation of government land for TBO plantation	Forestland managed by community committees	Wasteland allotted to government undertakings, companies and societies on the leasehold basis	No significant cultivation on government land (after failed project of cultivation on community land)	Forestland managed by community committees
Input subsidies/ distribution of input	On forestland, seedlings provided by	Government of India funded for 7.5 million of	50% government subsidy for jatropha	Seedlings financed by the government

	government. Free seedlings distributed to small and marginal farmers	seedlings in 2006–2007 and for 17.4 million of seedlings in 2007–2008.	seedlings	
Minimum support price	Pongamia seeds: Rs10/kg, adjusted soon Jatropha seeds: Rs6/kg	Jatropha: Rs7/kg	No	Jatropha seeds: Rs3/kg, SVO: Rs18/kg
Tax exemptions	Reduced VAT of 4% on biodiesel	Jatropha, crude biodiesel and B100 (100% biodiesel) biodiesel exempted from VAT	Exemption of jatropha seeds from purchase tax and jatropha SVO from VAT	Tax exemption of biodiesel from VAT

Note :TBO = tree-borne oilseeds, SVO = straight vegetable oil, VAT = value-added tax.
Source: ADB (2011).

Economic Viability

Establishing the appropriate investment environment is fundamental to facilitating biofuel production. However, in India, the biofuel market does not necessarily attract investors primarily because a government-fixed price of ethanol and biodiesel does not reflect the current market price, and could be set at a price level that would not yield profits. Ethanol production depends, to a large extent, on the price of its feedstock, molasses. The shortage of molasses could trigger a surge in price, which squeezes the profits for distillers. In addition, the distillers are forced to utilise less than their actual plant capacity due to inadequate amount of molasses. The recent ethanol policy change that enables the market to set the price is expected to improve this situation. For biodiesel, its current price of Rs26.50 per litre, which was set administratively, is not adequate to be remunerative. Hence, biodiesel price needs to be revised to meet financial costs.

Further Research on Biofuels

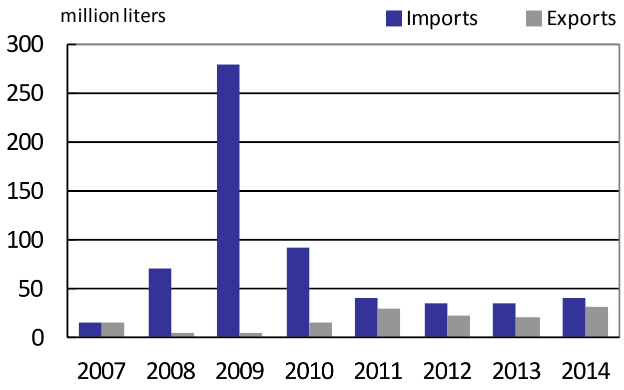
With current technologies available in India, the 20 percent blending target by 2017 does not seem feasible or sustainable for both ethanol and biodiesel. Deployment of improved technology and better management practices are means to bring down the ethanol production cost. Meanwhile, the current situation in which ethanol production is affected by the availability of molasses necessitates the search for alternative feedstocks, such as sweet sorghum and sugar beet. It is also important to expand research for second-generation biofuels.

Even if ethanol production is fully developed and feasible and reasonable prices are provided to producers, the biodiesel market is still in its infancy. More groundwork on R&D is necessary to produce biodiesel on a commercial scale. Since jatropha plantations have been slow due to the lack of good quality planting materials, it is essential to encourage oil seed research for the development of biodiesel production. Superior oil seeds with high-yielding characteristics will result in increased biodiesel production.

Trend of Biofuels Trade in India

India imports ethanol only when it falls short of supply— during years of low sugar production. Figure A.5.1 shows that ethanol imports significantly increased in 2009 when drought substantially reduced sugarcane production.

Figure A.5.1 Conventional Bioethanol Trade in India



Source: USDA GAIN Report (2013), p. 13.

The import tariff on ethanol from all countries was lowered from 28.64 percent to 7.55 percent in March 2012, except for Brazil, which enjoys a preferential rate of 6 percent.[23] Imported ethanol has become more economically viable and attractive due to lower import duty. There are no quantitative restrictions on imports of biofuels.

Table A.5.5 Import Duty on Biofuel in India

Denatured Ethyl Alcohol and Spirits (including ethanol)	7.55%
Chemical Products NES (including biodiesel)	25.85%

Source: USDA GAIN Report (2013), p. 14.

Indonesia

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

Biofuels development in Indonesia is one of the government's efforts to diversify energy, through the new National Energy Policy (2006), which has

[23] USDA GAIN Report (2013).

set a target of more than 5 percent biofuels share in the national energy mix by 2025. Biofuels development plan had also been incorporated in the government's planning document *National Energy Policy, 2025 & 2050*, and has been revised several times ever since.

(1.1) Regulation

Presidential Instruction on Biofuels Provision and Utilization as Alternative Fuels No. 1/2006 (PI No.1/2006) is the starting point for the basic policy on biofuels promotion in Indonesia. Under PI No.1/2006, several regulations relate to the provision of facilities and incentives for developing biofuels. These include the (i) Government Regulation No. 1/2007 on Income Tax Facility for Capital Investment in Certain Business Sectors and / or Areas, (ii) Government Regulation No 8/2007 on Government Investment, (iii) Minister of Finance Decree No. 117/PMK.06/2006 on Credit for Bio-energy Development and Revitalization of Plantations (KPEN-RP), and (iv) Minister of Finance Decree No. 79/PMK.05/2007 on Credit for Food and Energy Security (KKPE).

Below are government commitments on policies and incentives for supporting investments in biofuel development:

- Nominal stamp duties
- Agreement with 50 countries on the avoidance of double taxation
- Relief from import duties
- Investment tax allowance in the form of taxable income reduction of up to 30 percent of the realised investment, spread over 6 years
- Accelerated depreciation and amortization
- Loss carried forward facility for a period of no more than 10 years
- 10 percent income tax on dividends, possibly lower if stipulated in the provision of an existing applicable tax treaty
- Selected strategic goods exempt from value-added tax

(1.2) Coordination Team

In line with the PI No.1/2006, two coordination teams were established by the government of Indonesia. The first one is the "Coordination Team on Alternative Energy Provision and Utilization Action Program" through a decree by the coordinating Minister of Economic Affairs (No. KEP-11/M.EKON/02/2006). This regulation is a part of the economic policy package launched on 31 August 2005, which includes three main concerns: (i) Policy for oil fuels demand reduction, (ii) Policy for expanding oil and gas production, and (iii) Policy for promoting energy alternatives. This regulation was later revised by the Decree of the Coordinating Minister of Economic Affairs (No. KEP-11/M.EKON/03/2007) that changed the team's structure and stated their work period.

The second is a specific team called the National Team for Biofuels Development (TimNas BBN) established in July 24, 2006 to accelerate poverty alleviation and unemployment reduction through biofuels development. The team is responsible for the planning and implementation of biofuel development strategies, coordinate the efforts of relevant parties, and monitor and evaluate the implementation activities. As part of the team's duty, TimNas BBN had also established a blueprint for biofuels development, which included a road map toward favourable conditions to be achieved during 2006 ~ 2025.

(1.3) Implementing Regulations

During the initial period, biofuels development was supported by some implementing regulations, including the Regulation by the Minister of Ministry of Energy and Mineral Resource (DEMR) (No. 051/2006) on "Business License Requirements and References" (production, procurement, trading, export and/or import, transporting, storage, and marketing) on biofuels as alternative fuels. This regulation was followed by the issuance of National Biodiesel Standards (SNI 04-7182-2006) and Regulations by the Director General of Oil and Gas (No. 3675K/24/DJM/2006) on "Permit to Mix Biodiesel into Diesel Oil" with a maximum limit of 10 percent.

To accelerate biofuels development, the government issued a Regulation by the Minister of DEMR (No. 32/2008; September 2008) on "Supply, Utilization and Trading Scheme for Biofuels" as alternative fuels. This was a revision of the previous Regulation by the Minister of DEMR (No. 051/2006). This regulation includes biofuels (bioethanol, biodiesel, and bio-oil) mandatory utilisation for the transport, industry, commercial, and electricity sectors. However, the biofuels mandatory policy was not followed as the pricing policy had made it difficult to achieve the target. Hence, in October 2009, the government issued Presidential Regulation No. 45/2009, which was a revision of Presidential Regulation No. 71/2005, regarding the supply and distribution of specific fuels. The main issue of this regulation was the biofuels pricing policy.

(2) Target

In the biofuels development blueprint for accelerating poverty and reducing unemployment, the government divided the road map into two main periods—medium term from 2006 to 2010, and long term from 2010 to 2025. The target for the medium term was to create job opportunities and reduce poverty, while for the long term, the target was to achieve a 5 percent share of biofuels in the national energy mix by 2025. The government's targets for the medium term, until 2010, were as follows:[24]

- ✧ Create 3.5 million jobs
- ✧ Increase revenue with 3.5 million employments for on-farm and off-farm
- ✧ Develop biofuel plantations (in million ha): Palm oil (5.25), Jatropha (1.5), Cassava (1.5), and Sugarcane (0.75) on unutilised land
- ✧ Create 1,000 villages under the Energy Self-Sufficient Village Program (DME) and 12 special biofuel zones
- ✧ Reduce national oil fuel consumption by a minimum of 10 percent
- ✧ Enhance foreign exchange earnings to US$10 billion
- ✧ Meet the domestic and export needs of biofuels.

Unfortunately, there is not much information on the realisation of the targets that had been planned. The government has also required the mining industry sector to use biofuels not later than July 1, 2012. Basically, mining entrepreneurs agreed with the obligation to blend biofuel in their industrial activities, but there are some conditions that they proposed.

(2.1) Realisation of Biofuels Utilisation

Realisation of biofuels use has not been maximised. Although there is mandatory use of biofuels according to the DEMR Regulation No. 32/2008, its realisation has not met the mandatory requirements. Specifically, the

[24] Timnas BBN (2006).

utilisation of bioethanol has no progress because there is no feedstock supply for bioethanol.

Table A.6.1 Biofuel Mandatory Achievements on PSO Fossil Fuel Utilisation

Category	Unit	2011	2012*	2013**	2014***
Biodiesel Utilization					
Mandatory on PSO Transportation Fuel	kL	590,650	694,440	1,202,250	1,464,000
Realization	kL	358,812	669,398	930,561	250,234
Percentage of Utilization	%	60.75	96.39	77.40	17.09
Bioethanol Utilization					
Mandatory on PSO Transportation Fuel	kL	229,600	244,110	146,000	162,300
Realization	kL	0	0	0	0
Percentage of Utilization	%	0	0	0	0

Notes: * B7.5 since February 15, 2012
** B10 since September 1, 2013
*** Until March 31, 2014
Source: The Meeting of the ERIA Working Group for Asian Potential on Biofuel Market (3rd Phase), Tokyo, May 7, 2014.

Biofuels is mainly utilised in three sectors—the transport, industrial, and power generation sectors.

Transport Sector

PERTAMINA as a Public Service Obligation (PSO) and main distributor of transport fuel has utilised biofuels as a mix in several of its products since 2006. As of 15 February 2012, PERTAMINA had increased the content of fatty acid methyl ester (FAME) in biodiesel products originally from 5 percent to 7.5 percent and 10 percent. This step is part of the contribution to the increased use of renewable energy. In determining the suppliers, PERTAMINA prioritises national suppliers of FAME that utilise domestic resources so that PERTAMINA indirectly plays a role in supporting the growth of FAME producers and industry employment.[25] Table A.6.2 summarises the realisation on sales of PERTAMINA's biosolar, biopremium,

[25] See http://www.ebtke.esdm.go.id/energi/energi-terbarukan/bioenergi/501-pertamina-tingkatkan-penggunaan-biodiesel.html

and biopertamax—PERTAMINA's brand names for biofuel blended with high-grade gasoline.[26]

Table A.6.2 PERTAMINA's Sales Volume for Biosolar, Biopremium and Biopertamax (Indonesia)

No.	Commodity	Volume (kL)					
		2006	2007	2008	2009	2010	2011
1	Biosolar	217,048	555,609	931,179	2,398,234	4,460,825	2,328,969
2	Biopremium	1,624	3,776	44,016	105,816	-	-
3	Biopertamax	16	9,958	16,234	20,232	-	-

Source: Directorate of Marketing and Business, Pertamina, May 24, 2011.

Industrial Sector

The use of biodiesel by the industrial sector has yet to reach a maximum due to the lack of government's commitment to implement it, although the regulation that requires industry to use biodiesel has been in existence since 2008. To enhance biodiesel utilisation, experts believe that the use of biofuel should first be implemented in industries under state-owned enterprises so that it can be followed by industries in the private sector.

Power Generation

In addition to the transport and industrial sectors, biofuels have a potential use in power generation. In 2006, there were 12.5 megawatts (MW) of Perusahaan Umum Listrik Negara (PLN) power generated through the use of PPO (pure palm oil), which consisted of 11.0 MW in Lampung and 1.5 MW in Nusa Penida Bali.[27] Meanwhile, the National Team on Biofuels Development reported that until December 2007, installed capacities for PLN's power generation using biofuels was 96 MW. The installed capacities of 96 MW comprised North Sumatera (4.6 MW), Riau and Kepulauan Riau.[28] These numbers show a significant increase when compared to 2006 figures.

[26] Biosolar = Biodiesel blend fuel, Biopremium and Biopertamax = Bioethanol bland fuel
[27] National Team Report of Biofuels Development, 29 December 2006.
[28] Power generated in Riau (23.1 MW), Lampung (11.0 MW), Bali and West Nusa Tenggara (3.5 MW), West Kalimantan (4.0 MW), East Kalimantan (26.0 MW), South and Central Kalimantan (19.9 MW), and Maluku (3.9 MW).

Nevertheless, it was clear that biofuels utilisation by PLN's power plants was still limited.

(2.2) Realisation of Biofuels Production

The Biofuels Producers Association of Indonesia (Aprobi) reported that the production of biodiesel until 28 November 2011 was about 400,000 kilolitres (kL) or 30.84 percent of the mandatory program on the use of biofuels specified in the State Budget (Amendment 2011) at 1,297 million kL. The chairman of Aprobi said that the low production of biodiesel due to poor biofuel price formula is not relevant anymore.[29]

(2.3) Realisation on Absorption of Employment/ Poverty Reduction

The biofuels development had shown little impact on economic growth, despite the fact that it creates more job opportunities (The World Bank, 2010). Job opportunities in the biofuels agricultural sector absorbed more workforce than in the industrial sector. According to the Biofuels National Team report, the number of workers absorbed on-farm (599,000 people) and off-farm (1,040 people) until December 2007 were 17 percent of the target of 3.5 million people for 2010. However, it is suspected that the number is only a proxy of the plan and does not show actual facts in the field.

(2.4) Realisation of Credit Distribution for Biofuels Feedstock Development

At the moment, many private companies have funded their own developments. The credit distribution for the development of biofuel plants by the end of November 2007 was about Rp4 trillion consisting of 2.9 percent or Rp115.4 billion for oil palm, 96.7 percent or Rp3.9 trillion for sugarcane, and 0.4 percent or Rp15.7 billion for cassava. However, the total realisation was only 11.0 percent of the targeted plan for 2010 of about Rp38.0 trillion. Biofuels from jatropha faced the most challenges and barriers due to uncertainty in jatropha's market and its future development.

[29]http://www.indonesiafinancetoday.com/read/18817/Realisasi-Produksi-Biodiesel-Baru-308-dari-Target

(3) Development Program

The development of biofuels is one method used by the government of Indonesia to reduce poverty and unemployment. There were three fast-track approaches used in developing biofuels (Figure 1.1). The first fast-track approach developed by the government was the energy self-sufficient village program (DME). The program was launched in February 2007. DME are villages that have the potential to fulfill at least 60 percent of their energy needs for cooking, transport, and electricity from local renewable energy resources, namely, biofuel (jathropa, coconut, palm, cassava, sugarcane) and non-biofuel (microhydro, wind turbine, solar energy, biogas, and biomass). This program was aimed at encouraging rural economic activities by providing sufficient energy. The program was initiated by promoting biofuel from jatropha under the coordination of the National Team on Biofuels. The team only worked for two years, and the program failed to meet its target due to conflicting and inconsistent policies, poor planning, limited budget, weak institutional capacity, and lack of coordination.

(4) Information on Biofuel RD&D in Indonesia

Technology development has been carried out in Indonesia through institutions such as the Agency for the Assessment of Application and Technology (BPPT), Indonesian Institute of Sciences (LIPI), the Centre for Oil Palm Research (PPKS), and universities. BPPT, being a research and technology institution and also the pioneer in biodiesel production, has developed the first-generation biodiesel since 2000. Almost all biodiesel was produced by the transesterification method with alkaline catalyst because the process is economical and requires only low temperatures and pressures. A summary of existing biofuel technologies in Indonesia are presented in Table A.6.3.

Table A.6.3 Existing Biofuel Technologies in Indonesia

Institution	Feedstock	Technology Process	Fuel
Surabaya Institute of Technology	Cassava	Saccharification and Fermentation	Bioethanol
Surabaya Institute of Technology	Algae spirogyra	Hydrolisis, Fermentation, Distillation	Bioethanol
BPPT and Mitsubishi Heavy Industries, ltd (MHI)	Biomass (lignosellulossic bioethanol) from palm empty fruit bunches	Hydrolisis, Fermentation	Ethanol
BPPT	Palm oil	Hydrotreating	Biodiesel
Lemigas	Vegetable oil (CPO, jatropha, coconut, waste cooking oil)	Esterification, Transesterification, Purification, Glicerol, Recovery Methanol	Biodiesel
PT. Rekayasa Industri, Badan Riset Kelautan & Perikanan dan Bandung Institute of Technology	Micro-algae	Ultrafiltration	Biodiesel
Indonesian Institute of Sciences (LIPI)	Biomass (lignosellulossic)	na.	Biodiesel
University of Gadjah Mada	Vegetable Oil (CPO, jatropha)	Reactive Distillation	Biodiesel
Bogor Institute of Agriculture	Aquatic Microfungi	Acidimpregnasi, Fermentation	Bioethanol
Bogor Institute of Agriculture, SBRC	CPO, olein, stearin, PFAD, waste cooking oil, coconut, jatropha, nyamplung, rubber seed	Esterification, Transesterification	Biodiesel
Purworejo Government	Nyamplung	Esterification, Transesterification	Biodiesel
Ministry of Forestry	Nyamplung	Esterification, Transesterification	Biodiesel
Bandung Institute of Technology	Corn stalk	Grinding and Fermentation	Bioethanol
Indonesian Institute of Sciences (LIPI) & PT. Nusantara Tropocal Fruit	Banana stem	Grinding, hydrolisis and fermentation	Bioethanol
Diponegoro University	Bark, papaya	Saccharification, fermentation and distillation	Ethanol
Gadjah Muda University	Pineapple skin	Saccharification and Fermentation	Ethanol
University of Pembangunan Nasional "Veteran" Yogyakarta	Banana skin	Grinding, hydrolisis and fermentation	Ethanol

Sources: Compiled by the authors from various sources.

Second-generation biofuels are produced from nonfood cellulosic biomass, such as wood, rice straw, and grass. There are a number of second-generation biofuels being developed. Second-generation biofuel technology has been developed by the BPPT since early 2010 in cooperation with Japan. Second-generation biodiesel utilises biomass through liquefaction and gasification processes. Biodiesel is derived from biomass, including palm empty fruit bunches midribs and other agricultural wastes.

(5) Way Forward

(5.1) Biofuel Policy

In general, policies are required at all levels from down, mid, to upstream levels of the biofuels industry. Central and local governments should be consistent in implementing the mandatory policy and provide incentives and tax policies for imports from countries that are export-oriented. The government also needs to develop policies to attract investors, such as ease of use of land, infrastructure, easy procedures and licensing, community acceptance, farm supervisory support, and conditions that are safe and conducive to their operation.

In addition, notification by the Environmental Protection Agency of the United States (US EPA) on standards regarding fuel from renewable sources or the Renewable Fuel Standards (RFS) (27 January 2012, US EPA) will be a challenge for the Indonesian government. US EPA had stated that vegetable oil fuel or biofuel derived from Indonesian palm oil has not met the

Renewable Energy Standards. Thus, it will be a challenge for the government to issue a policy that supports the reduction of greenhouse gas (GHG) emissions from biofuels. There has been no standard policy on the regulation of emission reduction from the use of biofuels or biodiesel products in Indonesia.

(5.2) Competition among feedstock for food and fuel

The increase in the number of companies engaged in biofuels is a good sign. However, a competition to capture the raw materials (such as oil palm, cassava, and maize) among the food industries (such as cooking oil and sugar industries) does exist.

(5.3) Land availability for biofuel development

The accuracy of the field data needs to be confirmed. In the biofuels blueprint (2006–2025), the government had planned for 1.5 million ha of plantations with jatropha for biodiesel development by 2010. For the development of bioethanol, the government had planned for 2.25 million ha of land for sugarcane and cassava by 2010. However, to date, no such land was made available. The land provisioning becomes an obstacle for biofuels development in Indonesia. This was due to concession permissions delivered by the government without verification on land ownership, often causing social conflicts, where the general public has become the victims of land acquisition by corporate bodies.

(5.4) Subsidised Fuel Price

The high amount of subsidies given to the fossil fuel price has led to the situation where the price of biofuel is not competitive compared with fossil fuel. The low selling price of biofuel products does not commensurate the high production costs of biofuel.

Trend in Biofuel Trade

Indonesian biodiesel export increased very significantly from 20,000 kL in 2010 to 1.75 million kL in 2013. Most of the biodiesel exports were for the European market. Several factors contributed to this remarkable change in biodiesel trade. The increase of biodiesel demand from the Europe market was due to the decreasing trend of rapeseed production. The trend of crude palm oil (CPO) price remaining at a low level in the current market has reduced the production cost of biodiesel and offered palm oil-based biodiesel a competitive edge over conventional diesel. Differential export tax on palm oil products had made the price of palm oil-based biodiesel more attractive and a strong competitor at cheaper prices compared with Malaysian biodiesel producers.

Table A.6.4 Trend of Biodiesel Trade in Indonesia

	Unit	2009	2010	2011	2012	2013
Production	Thousand kL	191	243	1,812	2,221	2,805
Export	Thousand kL	70	20	1,453	1,552	1,757
Domestic	Thousand kL	121	223	359	669	1,048

Sources: Ministry of Energy and Mineral Resources, Directorate of Bioenergy.

Japan

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

To develop comprehensive measures for the utilisation of biomass, the "Biomass Nippon Strategy" was decided by the Cabinet in December 2002. This strategy was designed to develop a "Biomass Nippon" society that makes comprehensive use of biomass as energy and products from organic resources, derived from living organisms including agricultural and marine resources and organic waste materials. This strategy provides basic policies, goals, specific measures, and processes for "Biomass Nippon" in response to the program on the "Promotion of Utilization of Biomass Capable of Producing Energy Sources and Products out of Animals, Plants, Microorganisms, and Organic Waste Materials." Given the comprehensive utilisation of biomass, this strategy was also associated with a wide range of technologies, such as biotechnology, nanotechnology, and material engineering.

To facilitate coordination among the different ministries and agencies, it was decided that the Ministry of Agriculture, Forestry and Fisheries; Ministry of Environment; Ministry of Economy, Trade and Industry; Ministry of Education, Culture, Sports, Science and Technology; Ministry of Land; Infrastructure; Transport and Tourism; and the Cabinet Office would jointly address the utilisation of biomass. In December 2010, the "Basic Plan for the Promotion of Biomass Utilization" was approved by the Cabinet.

In 2006, a new national energy strategy until 2030 was enacted, setting a goal of increasing the use of alternative energy to 20 percent in the transport sector. Subsequently, a policy to promote E3 (3% of ethanol blending into gasoline) and B5 (5% of biodiesel blending into diesel) was announced in 2007.

In 2011, the following measures were taken to promote energy diversification in the transport sector:

- Subsidy to support the accelerated introduction of biofuels (\890 million)[30]

- Improvement and enforcement of a taxation system for biofuels (exemption on gasoline tax on bioethanol-blended gasoline; until March 31, 2013).

- Establishment of a "biomass commercialisation strategy study team."

- Initiatives on R&D and demonstration project of biomass energy (\16 billion).

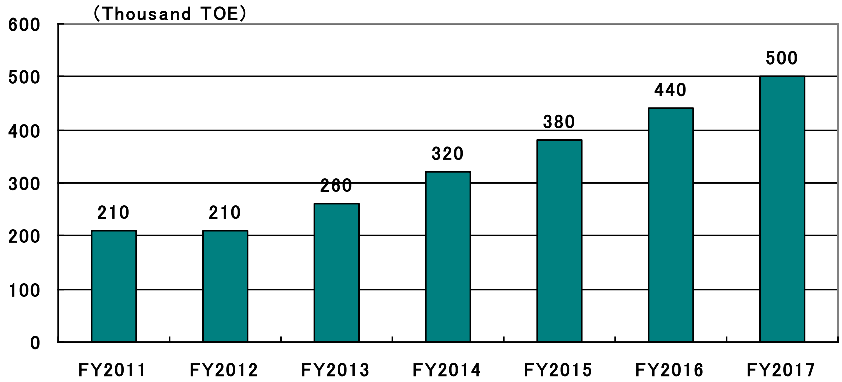
(2) Target

According to the Energy White Paper 2011, biomass energy used in Japan in 2009 was 4.54 million kL (in oil equivalent) and 10.91 million kL in 2010. It accounted for 0.81 percent of the domestic total supply volume of primary energy or 561.76 million kL in 2009 and 1.91 percent of the 569.95 million kL in 2010. As of October 2013, the installed capacity of biomass power generation is 2.3 gigawatts (GW).

[30] Under this category, \1.05 billion of subsidy is allotted in the FY2014 budget.

In 2009, the "Sophisticated Methods of Energy Supply Structures" was enacted to obligate oil and gas business operators to utilise biofuels and biogases. The targets for biofuels utilisation, which has been enforced since November 2010, are shown in Figure A.7.1.

Figure A.7.1 Total Target Volume of Bioethanol Utilisation in Japan (in oil equivalent)



Source: The Institute of Energy Economics, Japan.

(3) Development Program

Under the "Law for Sophisticated Methods of Energy Supply Structure" implemented in 2009, the government of Japan requested the oil industry to increase the use of biofuels to 500,000 kL in 2017.

The government launched the "Biomass Commercialisation Strategy Study Team" in February 2010. The study team published a draft of the biomass commercialisation strategy in June 2012. This was designed to achieve the goals mentioned in the "Basic Plan for the Promotion of Biomass Utilization" as decided by the Cabinet in 2010. This strategy was expected to facilitate 13 billion kilowatt-hours (kWh) of biomass power generation and 11.8 million kL of biofuel utilisation, reducing carbon dioxide (CO_2) emissions by 40.7 million tonnes. Current domestic potential of biomass is estimated at 255.5 million tonnes with an entire recycling rate of 74.8 percent, which will be raised to 88.5 percent in 2030.

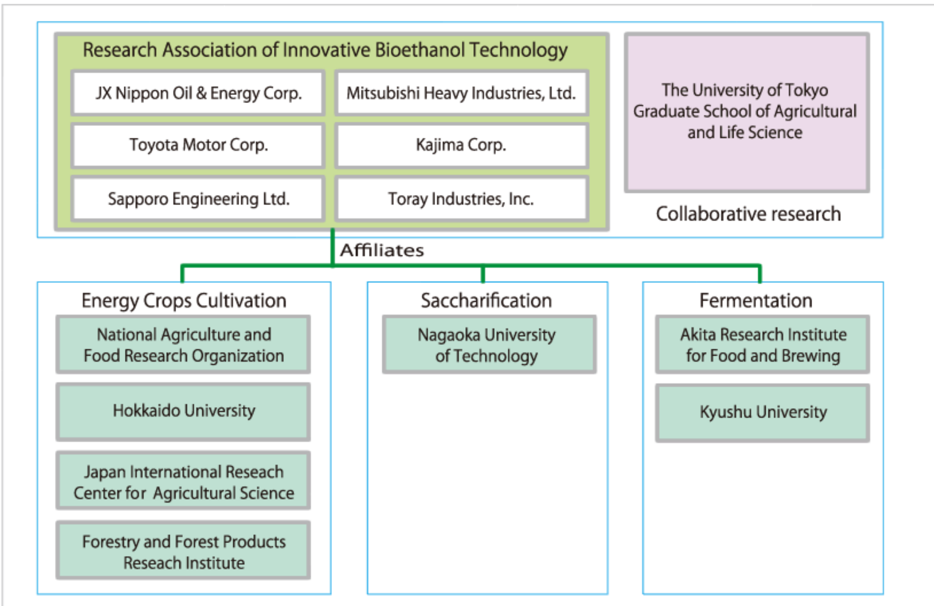
In September 2012, the "Innovative Energy and Environmental Strategy" was launched by the government's Energy and Environment Council, which defined the future introduction goals of renewable energy. According to the strategy, renewable power generation is planned to increase from 14.4 billion kWh in 2010 to 32.8 billion kWh in 2030, with capacity reaching 5.52 million kW in 2030 from 2.42 million kW in 2010.

The Japanese government announced a policy to back up the diffusion of bioethanol as automobile fuel on November 26, 2012. If small and medium-sized companies switch part of their gasoline to biofuels to reduce CO_2, they will be approved of emission rights equivalent to their reduced volume. Emission rights can be sold to major companies setting up a voluntary reduction goal. Small and medium-sized companies will be able to obtain emission rights if they use E3 in their cars or introduce E10 for flexible fuel vehicles (FFV).

(4) Information on Biofuel RD&D in Japan

Figure A.7.2 shows the composition of research associations in Japan.

Figure A.7.2 Research Association of Innovative Bioethanol in Japan



Source: The Institute of Energy Economics, Japan.

On December 17, 2012, the Research Institute of Innovative Technology for the Earth (RITE), Honda R&D Co., Ltd., a subsidiary of Honda Motor Co., Ltd. and the US Department of Energy announced the start of demonstration tests on jointly developed bioethanol in 2013. If everything goes smoothly, they will launch mass-production tests in the US in 2014. It is alleged that ethanol can be produced from inedible vegetable plants, such as stems and leaves, at the price equivalent to gasoline. New technology has been combined with the pretreatment technology of the US Department of Energy to extract sugar, and genetically modified germs developed by Hideaki Yukawa from RITE. These germs are resistant to fermentation inhibitors and capable of utilising sugar obtained by low-cost pretreatment.

In May 2013, the Kawasaki Heavy Industries, Ltd. established a new technology for the low-cost production of bioethanol from rice straw, a nonfood source of biomass. Kawasaki employed a new hydrothermal technique to saccharify cellulose in the process of producing bioethanol. The new process can be completed without sulfuric acid treatment that raised a cost issue in the existing technique.

In August 2013, a research team led by Prof. Hideki Kanda of Nagoya University developed a technology to extract the biofuel of algae by using half the amount of energy needed in the existing technology. The new technology removes the process to dry and destroy algae.

In October 2013, Hamada Kagaku (Hyogo Prefecture), Kobe University, and Bioenergy (Hyogo Prefecture) jointly developed a process to produce biodiesel from waste oil by means of enzyme. Production cost is expected to decline since effluent treatment applied in a current method with the use of alkali catalyst is no longer necessary.

Table A.7.1 lists other biomass projects being promoted in Japan.

Table A.7.1 Biomass Development Projects in Japan

Project	Operator	Technology	Capacity kL/year	Support	Feed	Schedule
Hyogo Pref. soft cellulose usage	Mitsubishi Heavy Ind.; Hakutsuru brewing; Kansai Chemical Machines	Continuous heating water decomposition Nontransgenic yeast	0.8	MAFF	Rice and wheat straw	2008～2010
Hokkaido soft cellulose usage	Taisei Construction, Sapporo Breweries	Alkaline treatment simultaneous hydrolysis and fermentation	1.04	MAFF	Rice and wheat straw	2008～2012
Akita Prefecture soft cellulose usage	Kawasaki Plant systems	Heating water decomposition Nontransgenic yeast	22.5	MAFF	Rice straw	2008～2012
Kashiwanoha soft cellulose usage	Kashiwanoha Bio-ethanol Production Demonstration Limited Liability Company (LLC)	Alkaline treatment GM E.coil	6.7	MAFF	Rice straw	2009～2012

Note : MAFF = Ministry of Agriculture, Forestry and Fisheries, Japan.
Source: The Institute of Energy, Economics, Japan

(5) Way Forward

Given the country’s limited land resources, the government’s strategy is to focus determinedly on cellulosic ethanol or algae-derived biodiesel as the future for Japan’s biofuel production.[31]

Trend of Biofuels Trade in Japan

[31] USDA Global GAIN Report (2012d).

Most of the bioethanol consumed in Japan is imported from Brazil in the form of ethyl tertiary butyl ether(ETBE). The absolute volume of biofuels import is low in Japan. Detailed statistics are not available. For tariffs on the import of ethanol, the petroleum and coal tax (\2,040/kL) is imposed, but the gasoline tax of \53,800/kL is exempted.

Lao People's Democratic Republic

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The "Renewable Energy Development Strategy" was developed in 2010 where the following issues were given high priority:[32]

-Promote the development of sustainable renewable energy to secure energy supply for social and economic development.

-Provide investors with financial incentives to encourage investment in renewable energies.

-Develop and revise laws and regulations to promote the development of renewable energy.

The goal was to increase the use of renewable energy to 30 percent of energy consumption by 2025. The target for biofuels utilisation was that it should account for 10 percent of energy consumption in the transport sector by 2020.

On agricultural policies, one of the significant issues of bioethanol production projects is to secure cultivated land for raw material crops. In the Lao People's Democratic Republic (Lao PDR), the implementation of large-scale cultivation of energy crops must satisfy at least the following two requirements: (i) it must be socially and economically beneficial, including benefiting farming communities; (ii) it must contribute to sustainable

[32] Sithideth (2011).

economic growth. The major considerations in a large-scale cultivation include whether or not it contributes to increased income among farmers, whether or not cultivated land has been obtained by unreasonable deforestation or forest destruction, and whether or not crop conversion has been conducted (which runs counter to food security).

On environmental policies, the Environmental Protection Law of 1999 is the basic law and the "Decree on Environmental Impact Assessment," enforced in 2000, provides the approval procedures for energy development projects.[33]In 2004, the "National Environment Strategy" (until 2020) was laid down, under which the "Second Environment Action Plan, 2006-2010" was formulated and sets the following six priority policies:[34]

- Stabilise the management of natural resources.
- Improve environmental management in the manufacturing industry, infrastructure development, and urban development.
- Enhance institutional framework for the improvement of environmental management capabilities.
- Encourage the involvement of the private sector in environmental management.
- Improve the fund-raising system.
- Enhance international cooperation.

(2) Target

To achieve the government's target for renewable energy utilisation by 2025 (30% in total energy consumption by 2025), the amount of biofuel use needs to reach the level shown in Table A.8.1. The government has also set a target to substitute the 10 percent energy consumption in the transport sector with biofuels by 2020.

[33] Japan Electric Power Information Center, Inc. (2010).
[34] Ibid.

Table A.8.1 Biofuel Introduction Goal in Renewable Energy Development Strategy of Lao PDR

	2015	**2020**	**2025**
Ethanol	10 ML	106 ML	150 ML
Biodiesel	15 ML	205 ML	300 ML

Note : ML = million litre
Source: Lao Institute for Renewable Energy (2011).

(3) Development Program

The Lao PDR government has been focusing on the development of biofuels since early 2006. In 2008, the government established a special committee for its development and launched the formulation of a national strategy and basic policies for developing biofuels. However, biofuels production in the Lao PDR is still in the initial phase, still far from commercial production. As the domestic economic and industrial infrastructure is fragile and the legal systems in the related fields have not been properly developed, it is difficult for the government to politically develop biofuels.

In the Lao PDR, there is no full-fledged commercial bioethanol (BE) or biodiesel fuel (BDF) manufacturing plant yet. For BDF, however, KOLAO[35] has reportedly run an experimental plant with an annual production capacity of about 730,000 litres. Actually, more companies have shown interest in acquisition of land for plantations to produce biofuels. Nevertheless, most of the projects are still in the planning or demonstration phase.

Biodiesel is produced from jatropha, coconuts, palm oil, and castor oil in the test phase.[36]Although foreign investors have attempted to build a jatropha plantation, they were not very successful due to various reasons including mismatch of business form, lack of understanding of local people, lack of experience of jatropha cultivation, and so on.[37] In the Lao PDR, a large

[35]KOLAO Group, named after South Korea and Lao PDR in 1996, is a firm that diversifies business from producing and selling cars and motorcycles to dealing with finance. It is franchised not only in the Lao PDR but also throughout Indo-Chinese and all over the world.
[36] ADB (2012).
[37] Lao Institute for Renewable Energy (2009).

portion of land is used for growing crops such as corn, cassava and sugar cane. However these crops are for edible use or export and not for fuels.

(4) Information on Biofuel RD&D in Lao PDR

Table A.8.2 lists the organisations that are involved in biofuel activities in the Lao PDR.

Table A.8.2 Governmental and Nongovernment Organisations

Related to Biofuel Activities in the Lao PDR

	Government Institute	Main Activities
1	Department of Electricity, Ministry of Energy and Mines	Policies and development plans
2	Prime Minister's Office	Support the plantation of Jatropha
3	Water Resources and Environment Agency	Support the plantation of Jatropha
4	National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry	R&D on the plantation of Jatropha
5	National Authority for Sciences and Technology (NAST)	Plantation of Jatropha, production of BDF, etc.
6	Lao State Fuel Co., Ltd	Pilot project of Jatropha plantation
7	Lao Institute for Renewable Energy (LIRE)	Pilot project of Jatropha plantation; Plantation, F/S research, GIS mapping, etc.

Source: Daiwa Institute of Research Holdings Ltd. (2012), 'Current Status and Issues of Biofuels Production in Lao PDR'. *Emerging Markets Newsletter*, (22).

(5) Way Forward

Compared with other neighbouring countries like Thailand, China, and Viet Nam, the yield of feedstoks for biofuel production is relatively low in the Lao PDR. According to an ADB study[38] that used FAO statistics, the average yield (tonne/hectare) of sugarcane in Lao PDR from 2005 to 2009 was 35.28, while that in Yunnan and Guangxi in China was 69.73, 60.83 in Thailand, and 58.31 in Viet Nam. Thus, much could be done to increase yields of biofuel feedstocks.

Like Cambodia, food security is a critical issue for decisionmakers in the Lao PDR. The food security issue might be exacerbated by various external

[38]ADB (2012). http://www.adb.org/publications/biofuels-greater-mekong-subregion

factors, such as increasing food price, extreme weather events, and the threat of climate change.

Trend of Biofuels Trade in the Lao PDR

The tariff rates for the export of crops are very low as the Lao PDR has signed a free trade agreement (FTA) or EPA with neighbouring countries.

Table A.8.3 Tariff Rate on the Export of Raw Material Crops from the Lao PDR

Item/Export Destination		**Viet Nam (%)**	**Thailand (%)**	**China (%)**
Cassava	Frozen	0	0	5
	Powder, Meal Pellet	0	0	0
	Fresh, Frozen	0	0	5
	Starch	0	0	5
Cornstarch		0	0	5
Molasses	Sugarcane	5	0	0
	Others	5	0	0

Source: Daiwa Institute of Research Holdings, Ltd.

Malaysia

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

(1.1) National Biofuel Policy
In 21 March 2006, the Malaysian government launched the National Biofuel Policy (NBP) under its "Five Fuel Diversification Strategy" with a view to developing the biofuels industry. The policy provides the overarching framework to develop biofuels as one of the five main energy sources for Malaysia. The policy aimed to encourage the production and usage of palm oil biofuel as an environmentally friendly alternative energy source and also to stabilise the palm oil price at a higher level through increased usage of palm oil.

Five strategic objectives underpin the NBP (Table A.9.1). The first two objectives refer to the institution of a 5 percent biofuel mandate, using palm oil as feedstock. The NBP does not specify whether the "processed palm oil" to be used in the blend would be palm olein ("Envodiesel") or palm methyl ester (PME). In this perspective, as noted in the table, "B5" should be considered a general term for a 5 percent blend palm-based biofuel, and not necessarily a direct blend of palm oil. The policy notes that a B5 mandate would create new demand for 500,000 tonnes of palm oil (assuming a national consumption of 10 million tonnes of diesel per year).

Table A.9.1 National Biofuel Policy–Strategic Objectives of Malaysia

Thrust	Objectives	Contents
Thrust 1	Biofuel for Transport	Diesel for land and sea transport will be a blend of 5% processed palm oil(1) and 95% petroleum diesel. This 'B5' would be made available throughout the country.
Thrust 2	Biofuel for Industry	Supply B5 diesel to the industrial sector, to be used as fuel in industrial boilers, construction machinery and diesel-powered generators.
Thrust 3	Biofuel Indigenous Technologies	Promote research, development and commercialization of biofuel technologies.
Thrust 4	Biofuel for Export	Encourage and facilitate the establishment of plants for producing biofuel for export.
Thrust 5	Biofuel for Cleaner Environment	Enhance the quality of the ambient air, reduce the use of fossil fuels and minimize emissions of greenhouse gases (mainly carbon dioxide), carbon monoxide, sulphur dioxide and particulates through increased use of

Note: The NBPM does not specify whether the "processed palm oil" would be palm methyl esters or direct blending of palm olien. In this context, "B5" can be considered a generic term referring to a 5 percent blend of a palm-based biofuel.
Source: Adapted from the National Biofuel Policy, March 21, 2006.

The NBP outlines more specific milestones for the development and use of palm methyl ester (PME)—the form of biodiesel most commonly used internationally. By the end of 2007, 28 months after the launching of the NBP, the government had completed trials in which a 5 percent blend of PME and 95 percent (PME B5) was used by selected government department fleets, and by selected users in the industry. The Malaysian Standard specifications for PME B5 were set, and some commercial biodiesel plants were established. However, the policy has yet to meet its medium- and long-term goals.

(1.2) Malaysia Biofuel Industry Act 2007 (Laws of Malaysia, Act 666)
The "Malaysian Biofuel Industries Act 2007," gazetted on 26 July 2007, provides for regulations to prescribe the type and percentage of biofuel to be blended in any fuel. In addition, the regulations for a 5 percent blend of biodiesel were made on 3 June 2011 and were being enforced in the Central region beginning 1 November 2011.

(1.3) Malaysian Biofuel Industry (Licensing) Regulations 2008
This Act was enforced on 1 August 2008, while the licensing activities under the Act, as stipulated under the "Malaysian Biofuel Industry (Licensing)

Regulations 2008," was enforced on 1 November 2008. According to Section 5 of the "Malaysian Biofuel Industry Act 2007 (Act 666)," the activities that need to be licensed are as follows:

Production of biofuel:

- commence to construct any biofuel plant or biofuel blending plant,
- produce any biofuel, or
- blend any biofuel with any other fuel or biofuel.

Trading of biofuel:

- export, import, transport, and store any biofuel and blended biofuel

Biofuel services:

- survey and test any biofuel and blended biofuel

Under Section 5(3) of the " Malaysian Biofuel Industry Act 2007 (Act 666)," anybody who conducts activities relating to biofuels without a valid license, shall, on conviction, be liable to a fine not exceeding 250,000 ringgit or imprisonment for a term not exceeding three years or both. In principle, the government had agreed to consider applications for biofuel license on a limited basis until 31 December 2009, subject to the fulfillment of the following conditions:

- applying companies, including new applicants, are required to show proof that they have a secure financial position and a stable feedstock to commence operations; and
- applying companies undertake capacity enhancement and have been in operation since 31 December 2007; or
- applying companies to produce phytonutrients from oil palm products as well as methyl ester as primary product or by-products through the Biofuel Manufacturing License.

For the existing biofuel manufacturing license holders, all applications shall be treated as a fresh application and not as an application for a renewal of license. This is in accordance with Section 56(1) of the "Malaysian Biofuel Industry Act 2007 (Act 666)." It says that applications must be made within six months from the date of the coming into operation of this Act. Hence, the closing date for applying for those with existing biofuel manufacturing licenses was 30 April 2009.

For companies that had applied for the biofuel manufacturing license, which had been frozen since June 29, 2006, they need to reapply for the license on activities related to biofuels as stipulated under Section 5 of the "Malaysian Biofuel Industry Act 2007 (Act 666)."

(1.4) Malaysian Standard on Biodiesel

The drafting of the Malaysian Standard on biodiesel was undertaken by the Standards and Industrial Research Institute of Malaysia (SIRIM), under Technical Committee 28 (TC 28) on Petroleum Fuels. Members and co-opted members included the following: oils and gas companies; Malaysian Automotive Association (MAA); Malaysia Palm Oil Board (MPOB); government agencies such as the Department of Environment Malaysia, Road Transport Department (or JPJ) and others; Malaysian Oleochemical Manufacturers Group (MOMG); and biodiesel manufacturers. The "Malaysian Standard on Biodiesel (Methyl Esters) MS 2008" (similar to EN 14214) was published in November 2008. This standard is incorporated in the biofuels regulation. The Malaysian Standard on petroleum diesel MS 123:2005 (amended in 2010) has been amended to include up to 5 percent of palm methyl ester.

By the end of March 2013, the Malaysian Provisional Standard for petroleum diesel MS2535:2013 was developed and published. These provisional standards allow a blending ratio of up to 10 percent of palm methyl ester.

(2) Target

Biodiesel Industry

The palm oil industry is a key component of the domestic economy, and an influential player in the global edible oils market. In 2013, the total oil palm cultivation in Malaysia was 5.23 million ha and the production of crude palm oil (CPO) was 19.22 million tonnes (excluding palm kernel oil, 4.86 million tonnes). Malaysia is the second-largest palm oil producer in the world, after Indonesia.

Malaysia's first commercial scale biodiesel plant commenced operations in August 2006. From August to December of that year, a total of 55,000 tonnes of biodiesel were produced in Malaysia. The production increased to 130,000 tonnes in 2007 and main feedstock used was refined, bleached, and deodorized (RBD) palm oil, accounting for 94 percent of the total palm oil processed by biodiesel plants. By the end of December 2013, a total of 54 biodiesel manufacturing licenses with a total annual capacity of 5.93 million tonnes were approved under the "Malaysian Biofuel Industry Act, 2007." From the total, 20 biodiesel plants were in commercial production (since 2006) with a production capacity of 2.65 million tonnes per year. In addition, there were 10 plants with a production capacity of 0.78 million tonnes per year, which have completed construction but have yet to commence production. Only 13 biodiesel plants were active in 2013 and most of the plants were partially operative.

Table A.9.2 Status of Approved Biodiesel Licenses in Malaysia (as of April 2013)

Status	No.	Production Capacity (Mil. Tonnes/Year)
Commercial Production	20	2.65
Completed Construction	10	0.78
Construction, Under Planning / Pre- Construction	24	2.50
Total	54	5.93

Source: Ministry of Plantation Industries & Commodities, Malaysia.

(3) Development Program

The B5 implementation program of Malaysia is a program of utilisation of a mixture of 5 percent palm biodiesel and 95 percent diesel fuel. The first phase of the B5 implementation program started in early 2009 in two selected government departments involving 3,900 vehicles. The expansion was set to occur during June 2011–November 2011. Only retail stations in central regions (Putrajaya, Melaka, Negeri Sembilan, Selangor, and Kuala Lumpur) were subjected to the expansion. In early 2012, the implementation of the B5 program in the Central region was extended to other sectors, such as fleet card, skid tanks, and fisheries. The utilisation of palm biodiesel from January to December 2012 was about 110,000 tonnes. The Malaysian government has funded RM55 million for capital expenditure (CAPEX) to set up in-line blending facilities at six petroleum depots in the Central region. After the complete implementation of B5 in the Central region, the program was expanded to the southern region in July 2013, to the eastern region in

February 2014, and to the northern region in March 2014, which will complete the nationwide implementation by the end of 2014. The annual palm biodiesel demand for the nationwide B5 implementation—covering the transport and industrial sectors for the whole of Malaysia—is estimated at 500,000 tonnes per year. The Economic Council Meeting on 3 December 2012 had made a decision to increase the blend rate to B7 or B10 after the B5 program.

(4) Information on Biofuel RD&D in Malaysia

(4.1) RD&D on Palm Biodiesel

There are two existing methods of producing biodiesel from palm oil in Malaysia. The main existing technology is through transesterification, which produces methyl esters that can be used in compression ignition engines (diesel engines) without any modification. Malaysia produces palm methyl esters (PME) primarily for the export market, although consideration is being given to increasing its use domestically. However, there are still some challenges that must be overcome in order to use PME in cold weather. These relate to the "low pour point" of PME, which means that it only solidifies at cold temperatures. Malaysia has developed its own national biodiesel standards for PME. The standards are likely to follow closely the European Union (EU) and US standards.

The second method is direct blending of straight vegetable oil (SVO) with diesel. In Malaysia, an SVO blend of 5 percent refined palm oil and 95 percent diesel is marketed under the name "Envodiesel." Envodiesel is facing resistance from automobile manufacturers, who are hesitant to extend engine warranties when palm oil rather than methyl ester is used in the blending.

R&D in the palm oil industry is conducted at company level, and by dedicated government agencies, such as the MPOB and universities. The MPOB relies mainly on funds generated through compulsory government taxes on the industry, and government grants. Biodiesel production, RD&D and the commercialisation of new technology have been undertaken by the MPOB, together with the government-owned corporation PETRONAS. In 2004, PETRONAS contributed RM12.0 million to build a pilot plant for biodiesel production.

(4.2) RD&D on Bioethanol

Ethanol for energy use is not currently produced in Malaysia because of the lack of feedstock supply. The R&D on bioethanol in Malaysia is not as active as palm oil-based biodiesel. Specifically, the first-generation bioethanol technology has not prospered. Although the palm oil biomass (trunks, fronds, empty fruit bunch (EFB), shells, roots, and fiber) can produce cellulosic ethanol and the volume is enough as a feedstock for ethanol production, the technology is not yet commercialised. However, R&D on second-generation bioethanol technologies are being promoted aggressively.

(4.3) Development of Second-Generation Biofuel Technologies

The development of second-generation biofuels technology is promoted by a few projects. All of these projects are at the research and development phase and have not reached commercial scale. Some of the projects are based on international cooperation supported by developed countries.

Trend of Biofuel Trade

Malaysia began to export biodiesel in 2006 with 47,987 tonnes. The quantity of export increased to 227,457 tonnes in 2009, but the export volume continued to decline rapidly until 2012. The palm oil biodiesel production has lost out to rival producing countries like Indonesia and Thailand due to weak domestic market and a relatively uncompetitive export tax structure. Export volumes in 2013 rose again to 175,032 tonnes, coupled with widespread adoption of domestic production in the same year. The decline in the international price of palm oil in 2013 led to the decrease in the biodiesel production cost, which relatively improved the competitiveness of biodiesel fuel.

Table A.9.3 Production and Exports of Biodiesel in Malaysia (tones)

	2006.8-12	2007	2008	2009	2010	2011	2012	2013
Production	54,981	129,715	171,555	222,217	117,173	173,220	249,213	472,129
Export	47,986	95,013	182,108	227,457	89,609	49,999	28,983	175,032

Sources: Malaysia Palm Oil Board (MPOB).

Myanmar

Policies and Programs to Promote the Utilisation of Biofuels

(1)Policy Overview

Despite the abundant fossil fuel resources, Myanmar's energy supply depends heavily on conventional (non-commercial) biomass resources (76%).[39]The Ministry of Energy (MOE) highlights the following items as basic energy policy guidelines: (i) maintain the energy self-sufficiency ratio, (ii) promote the use of renewable energies, (iii) promote the efficient use of energy and the awareness of energy conservation, and (iv) protect forest resources from excessive use for firewood and charcoal.

Different ministries have jurisdiction over renewable energy. The MOE develops comprehensive energy policies (especially policies on the upstream development of oil and gas). The Ministry of Agriculture and Irrigation (MAI) has jurisdiction over biofuels, and the Ministry of Science and Technology and the Ministry of Education have jurisdiction over the R&D of renewable energy.

No comprehensive renewable energy development plan has been formulated yet in Myanmar. As part of rural development, however, many small-scale hydroelectric power generation programs (after 2004), and biogas and biofuel programs (after 2005) have been carried out.

[39] IEA (2013), "Energy Balances of Non-OECD Countries".

(2) Target

The government conducted several test programs to formulate a biofuel standard. It seems that the government is also considering the introduction of E5 (regional level) and E15 (national level, fuel mixture by 15% ethanol and 85% gasoline) for gasoline and B5 to B20 (mix of 20% biodiesel and 80% diesel) for diesel,[40] but details were not available.

Consideration of production and commercialisation of biofuels in Myanmar started only in 2008.[41] As of 2010, Myanmar seemed to have developed a production capacity[42] of 100–200 tonnes/month for jatropha seeds, as raw material for biodiesel, and 10–20 tonnes/month for crude jatropha oil. The production[43] of jatropha in the 2010–2011 crop year was 5,498 tonnes (0.07 tonne/ha).[44]

As of 2010, there were six domestic pilot plants for biodiesel production (production capability of 400 gallons/day). For bioethanol, although the crops that can be used to produce bioethanol such as sugarcane and cassava are planted in large quantities in Myanmar, they are mainly consumed for food rather than for fuel. As of 2009, there were three production plants of dehydrated ethanol and their production capability[45] was estimated to be more than 660,000 litres (2.2 million gallons)/year. In addition, there were five or more 99.5 percent ethanol (for drinking) manufacturing plants.[46]

(3) Development Program

The government of Myanmar implemented a three-year jatropha tree-planting project from 2006 to 2008. However, the cultivation of jatropha failed to be commercialised because of insufficient understanding of planting, harvesting,

[40] ADB (2012). Fuel produced by blending E5 gasoline base material with 5% of bioethanol. Fuel produced by blending B5 diesel fuel base material with 5% of biodiesel fuel.
[41] Ibid.
[42] Japan Bio-Energy Development Corporation (JBEDC), http://www.jbedc.com/en/index.shtml
[43] From the presentation of Mr. Maung Maung Tar of the Ministry of Agriculture and Irrigation of Myanmar at the 11thAsia Biomass Seminar, July 2011.
[44] The potential oil yield of jatropha is 2.4 tons/ha.
[45] ADB (2012).
[46] From the presentation of Dr. Mya Mya Oo of Yangon Technological University at the 11thAsia Biomass Seminar, July 2011.

oil extraction of jatropha, fuel manufacturing process, marketing, and lack of legislation and standards.[47]

In 2006, the government of Myanmar signed an agreement with a Japanese private company, the Japan Bio-Energy Development Corporation (JBEDC), to build a jatropha fuel supply chain and to implement a biofuel project. In response to this, the government set a target[48] to expand the plantation area of jatropha to 850,000 ha by 2008 and to 4 million ha by 2015. According to the agreement, buying and selling of seeds, oil extraction and purification would be carried out as a joint venture[49] between JBEDC and a local private company, and technology development and guidance, while the improvement of policies, regulations, and standards would be implemented in cooperation with the Ministry of Agriculture and Irrigation.[50] Each public corporation under the Ministry of Agriculture and Irrigation had prepared their own jatropha growing manuals and distributed the manuals to the farmers interested in jatropha planting.[51] JBEDC also held seminars to share information on jatropha planting methods and on how to build the supply chain.

A company from Thailand, the Universal Adsorbents & Chemicals (UAC), announced that they would launch a biofuel plant by 2014 through a joint venture with one of the largest corporate groups in Myanmar[52] using palm oil as raw material. The total investment was expected to be THB800 million (approximately US$27 million). Biofuels were planned to be used for power generation and electricity would be sold to both Myanmar and Thailand.

In April 2013, the Nation First International Development Asia signed a memorandum of understanding with Myanmar's firm, Hisham Koh & Associates, to develop algae farms inland area and around Yangon.[53] Algae are expected to be a profitable source of biofuel or commercial animal feeds for aquaculture and agriculture.

[47] JBEDC, http://www.jbedc.com/en/index.shtml

[48] Kenji Iiyama (2012) Jatropha: Savior or Mediocrity? *(in Japanese)* https://www.jircas.affrc.go.jp/reports/2011/pdf/s20120321_shiryo.pdf

[49] JBEDC announced the establishment of a joint venture called "Japan-Myanmar Green Energy" on February 27, 2009 with an investment ratio of 60% by JBEDC and 40% by a local company.

[50] JBEDC. http://www.jbedc.com/projects-4.html *(in Japanese)* accessed on January 24, 2013.

[51] Ibid.

[52] Myanmar Business Network (2012).

[53] *Myanmar Times*, 'The rise, fall and rebirth of biofuels in Myanmar', 26 August 2013.

(4) Information on Biofuels RD&D in Myanmar

In Myanmar, the following R&D activities on biofuels are being implemented:[54]

-Technology development to increase jatropha seed yield and oil quantity,

- Improvement of the method for producing biodiesel, and

- Technology development of cellulosic and lignocellulosic ethanol (second generation).

(5) Way Forward[55]

It will be challenging for Myanmar to deal with the following issues to promote the use of biofuels:

- Improve the energy balance for biofuels (energy embedded in the fuel plus the energy required to produce and deliver it).

- Technology development of ethanol from cellulose and lignocellulose (second- and third-generation ethanol).

- Promote biofuel development to help mitigate rural poverty.

  -Encourage trade and investment.

  -Government support for the use of biofuel.

Trend of Biofuels Trade in Myanmar

It seems that jatropha seeds, a raw material for biodiesel, have been exported since 2009, but details such as trade volumes are not clear. JBEDC exported 400 tonnes of jatropha seeds from Myanmar in 2009 and 1,000 litres of crude jatropha oil to Japan for the first time in 2010.[56]

[54] Mr. Maung Maung Tar, op.cit., and Dr. Mya Mya Oo, op.cit.
[55] Ibid.
[56] JBEDC http://www.jbedc.com/index.shtml *(in Japanese)* (accessed January 24, 2013).

Myanmar's tariff system [57]

(1) Taxable objects

For all import items, the tax base is the import cargo Common Intermediate Format (CIF) price plus 0.5 percent. However, some items are tax-exempt. Imports of raw materials that are recognised as materials for contract manufacturing by the Myanmar Investment Committee (MIC) or other related government agency, or import items related to investments approved by the MIC, are eligible for exemption from tariffs.

(2) Tariff rate

In Myanmar, the tariff rate could change arbitrarily, but the customs schedule is not updated accordingly. As a result, the latest tariff rates of individual items are not known (one is required to confirm for each case). The latest customs schedule available was issued in January 2012.

New Zealand

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

In the "New Zealand Energy Strategy, 2011–2021 (NZES)" and "New Zealand Energy Efficiency and Conservation Strategy, 2011–2016 (NZEECS)" published in August 2011, the New Zealand government aims to reduce greenhouse gas emissions by 10–20 percent from the 1990 level by 2020, and by 50 percent from the 1990 level by 2050. For the transport sector, the government looks to marketing highly energy-efficient light vehicles improved from the 2010 level by 2016. One of the measures is to develop sustainable alternative fuel, but no specific numerical target has been indicated. The government sets a target of 90 percent of electricity generated

[57] Japan External Trade Organization (JETRO), Myanmar/Investment system http://www.jetro.go.jp/world/asia/mm/trade_03/ *(in Japanese)* (accessed January 24, 2013).

from renewable resources by 2025. In New Zealand, renewable energy accounts for about 40 percent of total primary energy demand, which indicates a substantial share among the developed countries.

The New Zealand government aims to expand biofuels utilisation. The Biofuel Act enacted in 2008 obligates the oil companies to supply biofuel: diesel with mixed 5 percent biodiesel, gasoline with mixed 3–10 percent bioethanol.

Table A.11.1 Biofuel Production/Utilisation

Biofuel	**Production/Utilisation**
Biodiesel	Feedstock is tallow, the animal fat by-product produced at meat processing facility, waste food oil, and rapeseed. Companies are marketing a 5% blend
Bioethanol	Feedstock is whey, a by-product of the milk processing industry Bioethanol is imported from Brazil Compan ies are marketing a 3%–10% blend as a premium product

Source: Asia Biomass Office (2013).

(2) Target

In New Zealand, raw materials used for bioethanol production include whey, which is a by-product of dairy farming. Bioethanol is also produced from sugarcane imported from Brazil. Materials used for biodiesel production include tallow, rapeseed, and used cooking oil. Whey, tallow, and used cooking oil are by-products of other industries, and rapeseed is planted as an intercrop to improve the soil condition of grain fields.

Table A.11.2 Major Biofuel Manufacturing Plants in New Zealand

Company	Biofuel	Feedstock	Capacity (kL/year)
Anchor Ethanol	Bioethanol	Whey	15000~20000
BioDiesel	Biodiesel	Tallow	40000
Ecodiesel	Biodiesel	Tallow	20000
Biodiesel New Zealand	Biodiesel	Waste oil, Rapeseed	4000
Flooooo-Dry Engineering	Biodiesel	Tallow	4000
New Zealand Easter Fuels	Biodiesel	Waste oil, Rapeseed	2000
Environfuel	Biodiesel	Waste oil	na
Kiwifuels	Biodiesel	Rapeseed	na

Source: USDA Gain Report (2010).

Table A.11.3 Transition of Biofuel Production Volume in New Zealand

Calendar Year	Biodiesel		Bioethanol		Total	
	million L	PJ	million L	PJ	million L	PJ
2007	1.20	0.04	0.30	0.01	1.50	0.05
2008	1.20	0.04	2.00	0.05	3.20	0.09
2009	1.07	0.04	3.70	0.09	4.77	0.12
2010	1.61	0.06	4.21	0.10	5.82	0.15
2011	2.35	0.08	4.81	0.11	7.16	0.19

Source: Ministry of Economic Development, New Zealand (2012).

According to the *New Zealand's Energy Outlook 2011* released by the Ministry of Economic Development, biofuels are projected to account for 8.5 percent of the total primary energy demand in 2030.

Table A.11.4 Energy Outlook in 2030 (Base Case)

		2010		**2030**	
		TPED (PJ)	**Share (%)**	**TPED (PJ)**	**Share (%)**
Fossil Fuel	Oil	274.0	33.5	315.4	29.8
	Natural Gas	173.4	21.2	167.4	15.8
	Coal	57.9	7.1	49.0	4.6
Renewable Energy	Hydro	89.0	10.9	96.9	9.2
	Geothermal	152.6	18.7	321.3	30.3
	Biofuel	62.5	7.7	90.2	8.5

	Others	6.3	0.8	16.6	1.6
Others	Waste heat	1.3	0.2	2.1	0.2
Total		816.9	100.0	1,058.9	100.0

Note: TPED = total primary energy demand, PJ = petajoules.
Source: Ministry of Economic Development, New Zealand (2012).

(3) Development Program

(3.1) Standards for automotive fuel

The latest quality standards for automotive fuel, "Engine Fuel Specification Regulation 2011", prescribe the following specifications of bioethanol and biodiesel at gas stations:

- Bioethanol: Up to 10 percent gasoline capacity (E10)
- Biodiesel: Up to 5 percent of diesel capacity (B5)

(3.2) Biofuels Sales Obligation

Target: By the end of 2012, 3.4 percent of the total annual sales of gasoline and diesel need to be biofuels.

Application period: April 2008 to December 2012

Support: Excise tax of NZ$0.505/litre is exempted for the use of bioethanol.

(3.3) Biodiesel Grants Scheme

Target: Diffusion of biodiesel use

Application period: Three years from July 2009 (completed in June 2012)

Support: Subsidy of NZ$0.425/litre for biodiesel, NZ$36 million in three years.

(4) Information on Biofuel RD&D in New Zealand

In New Zealand, it is becoming increasingly evident that liquid fuels from woody biomass could contribute to meeting future demand for sustainable transport fuels. Several new technologies are currently under development.

Three crown research institutes, the Institute of Geological and Nuclear Science (GNS), AgReserch, and Scionare members of the New Zealand Renewable Energy Transformation Research Science and Technology group. This group is sponsored by the Ministry of Research Science and Technology to accelerate the R&D efforts on renewable energy technologies and their integration into the New Zealand energy system.

In August 2010, the “New Zealand Bioenergy Strategy” was published by the Bioenergy Association of New Zealand (BANZ) and the Forest Owners Association (NZFOA. The strategy identifies bioenergy as potentially supplying more than 25 percent of New Zealand’s projected energy needs by 2040, including 30 percent of the country’s transport fuel.

(5) Way Forward

In 2008, a Biofuels Sales Obligation system was put in place but was recently abolished. The Biodiesel Grant Scheme was implemented in July 2009 to encourage domestic biofuels production, but was also removed. As commercialisation of demonstration projects takes time, 5–10 years, it implies that a long-term policy is necessary in order to make projects viable.

Trend of Biofuels Trade in New Zealand

An estimated 7 million litres (ML) of liquid biofuel was produced in 2011, a 22 percent increase from 2010. For comparison, imports of bioethanol were 1.18 ML in 2010 and 2.22 ML in 2011.Table 1.11-5 shows the taxes imposed on automobile fuels in New Zealand. Imported biofuels are dealt with in the same way.

Table A.11.5 List of Taxes on Automobile Fuels in New Zealand (After August 2012)

NZ￠/L

	A	B	C	D	Total
Gasoline	50.524	9.9	0.045	0.66	61.129
Biogasoline	0	9.9	0.045	0.66	10.605
Diesel	0	0	0.045	0.33	0.375
Biodiesel	0	0	0.045	0.33	0.375

Note : A ︰ Excise Duty on Motor Spirits
B ︰ Accident Compensation Corporation Levy
C ︰ Petroleum or Engine Fuel Monitoring Levy
D ︰ Local Authorities Fuel Tax
Source: Ministry of Business, Innovation, and Employment, Government of New Zealand (2012).

The excise duty on diesel (biodiesel included) is exempted because the road user charges are imposed on diesel cars. In addition, 15 percent goods and services tax (GTS) is imposed on automobile fuels across the board (commercial vehicles exempted).

Philippines

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The following table provides the list of agencies in the Philippines responsible for implementing the biofuel program:

Table A.12.1 List of Agencies and their Responsibility in the Philippine Biofuel Program

Institutional	Policy Formulation & Dissemination	Feedstock Production & Extension	Research, Development & Deployment	Investments, Incentives, & Promotions	Standards & Quality Assurance
Department of Energy (DOE)	✓		✓		✓
National Biofuel Board (NBB)	✓				
Department of Agriculture (DA)	✓	✓	✓	✓	✓
Sugar Regulatory Administration (SRA)	✓	✓	✓	✓	✓
Philippine Coconut Authority (PCA)	✓	✓	✓	✓	✓
Department of Science and Technology (DOST)	✓		✓		
Philippine Council for Industry and Energy Research and Development (PCIERD)			✓		
Department of Labor and Employment (DOLE)				✓	
Department of Environment and Natural Resources (DENR)		✓			✓
Department of Interior and Local Government (DILG)		✓		✓	
Department of Agrarian Reforms (DAR)		✓			
Board of Investments (BOI)				✓	
Department of Trade and Industry (DTI)				✓	✓
Tariff Commission				✓	
Department of Transportation and Communications (DOTC)	✓		✓		
National Power Corporation (NPC)	✓		✓		✓
Philippine National Oil Company-Alternative Fuels Corporation (PAFC)		✓			
Academe		✓	✓		
Independent Power Producers (IPPs)			✓		✓
Philippine Economic Zone Authority (PEZA)				✓	
Department of Finance (DOF)				✓	
National Development Company (NDC)				✓	
Government Financial Institutions (GFIs)				✓	

Source: Compiled by the authors.

In January 2007, the Philippine government ratified the Biofuels Act of 2006 (RA 9367).[58] The law mandates a minimum of 1 percent biodiesel blend into all diesel fuels within three months following the implementation of the law. In February 2009, it mandated a 2 percent blend of biodiesel, while the bioethanol mandate was a minimum of 5 percent bioethanol fuel blend. In 2011, the government postponed for six months the mandate for raising bioethanol to 10 percent.

To encourage investments in the biofuels industry, RA 9367 provides the following incentives:

- Zero specific tax per litre on local and imported biofuels.

- The sale of raw materials used in the production of biofuels shall be value-added tax (VAT).

- All water effluents considered as "re-useable" are exempt from wastewater charges.

- Government financial institutions shall, in accordance with their respective charters or applicable laws, accord high priority to extend financial support.

In December 2008, the Republic Act 9513 (RA 9513) (or the Renewable Energy Act of 2008) was adopted. RA 9513 sets the framework for the development, utilisation, and commercialisation of renewable energy (RE).

[58] See http://www.doe.gov.ph/AF/BioethanolPolicies.htm

RA 9513 also provides additional incentives for biofuel developers. Incentives for renewable energy projects and activities are as follows:

- Special Realty Tax Rates on equipment and machinery, civil works, and other improvements.

- Corporate tax rates of 10 percent on its net taxable income.

- Net operating loss carryover (NOLCO).

- Income tax holiday (ITH) during the first seven years of commercial operation for renewable energy developers.

- Accelerated depreciation if an RE fails to receive an ITH before full operation.

- Cash incentive of RE developers for missionary electrification.

- Tax exemption of carbon credits.

- Tax credits on domestic capital equipment.

- Duty-free importation of RE machinery equipment and materials.

Bioethanol feedstock used in the Philippines or being considered includes sugarcane, corn, cassava, and nipah.[59] Philippines bioethanol production remains to be based on sugarcane and molasses. As in other ASEAN countries, the first-generation technology is still widely used to produce bioethanol in the Philippines.

The Philippines currently produces biodiesel from coconut oil (CNO) called coco methyl ester (CME) and is expanding jatropha production. CME derived from CNO is the feedstock currently used in the Philippines for biodiesel production.

To ensure the sustainability of the biodiesel program, the government is presently studying other feedstocks such as jatropha or "tuba-tuba" as a potential source for local biodiesel production.

[59] See http://bioenergywiki.net/The_Philippines

(2) Target

The Department of Energy (DOE) of the Philippines is responsible for the Philippine Biofuels Program. The DOE's energy strategy for the country is outlined in the *Philippine Energy Plan, 2012–2030* (PEP 2012-30) and the *National Biofuels Plan* (NBP 2013-2030). The PEP is a plan for the country's whole energy sector while the NBP is a preliminary assessment of the previous NBP 2007–2012 and outlines the country's short-, medium-, and long-term biofuels plans set by the National Biofuels Board (NBB) chaired by the DOE.

Table A.12.2 Targeted Biofuels Blend of the Philippines

	2013~ 2015	2016	2020	2025	2030
Bioethanol	E10	E10	E20	E20	E20/E80
Biodiesel	B2 to B5	B5	B10	B20	B20

Source: Second Working Group Meeting at Tokyo, May 2014.

The NBB endorsed while the DOE approved the 10 percent ethanol mandated blend, but ethanol producers and oil companies were given a transition period of six months to attend to distribution and logistics infrastructure concerns. The E10 blend has been fully implemented since August 2011 and ethanol import is allowed to cover local production deficits through August 2015. At the time of this study, an estimated 90 percent of all local gasoline sold is E10.[60]

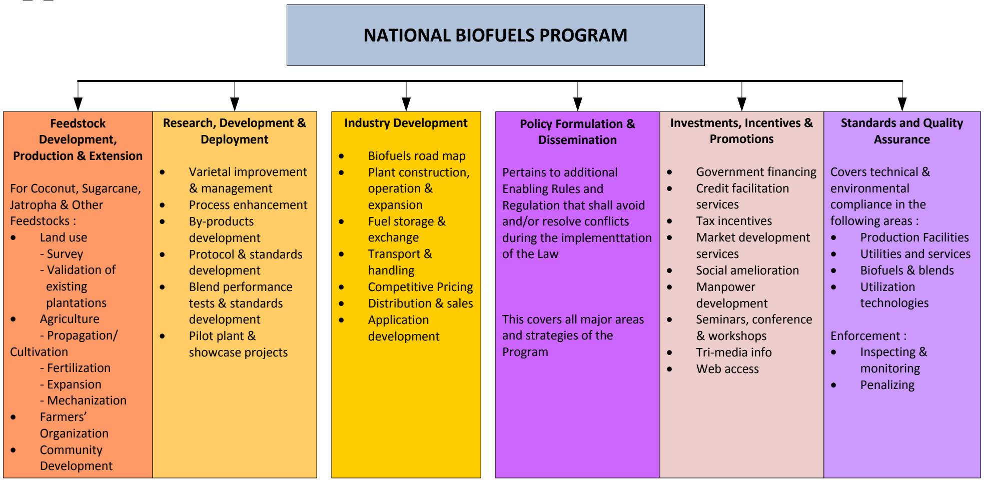
The 1 percent biodiesel blend mandate became effective on May 6, 2007 and the blending rate was increased to 2 percent on February 6, 2009. The biodiesel blend mandate is still at 2 percent, however, the DOE through the NBB will conduct further public consultations to determine the feasibility of further increasing the current biodiesel blend. The NBB is planning to increase biodiesel blend rate from 2 percent to 5 percent.

[60] USDA GAIN Report. (2013b)

(3) Development Program

In accordance with the “National Alternative Fuels Program Framework” and in consideration of the requirements of the Philippine Biofuels Road Map, the National Biofuels Program will help develop and utilise biofuels as an alternative to petroleum fuels. The framework of the national biofuels program development is summarised as follows:

Figure A.12.1 Framework of National Biofuels Program Development in the Philippines



Source: Department of Agriculture, Philippines, Biofuels Feedstock Program (undated).

(4) Information on Biofuel RD&D in the Philippines

In the Philippines, the development of alternative energy sources and innovative energy technologies using non-fossil-based energy resources, with emphasis on biofuels technology development, was initiated in the 1970s. Science and technology interventions for biofuels were geared toward the utilisation of indigenous feedstocks as alternative fuel substitutes. The Department of Science and Technology (DOST) supported and implemented research on the use of indigenous materials, such as coco-methyl ester for biodiesel and bioethanol-based fuel from sugarcane.

Evaluation of vehicle performance using alternative fuel substitutes were conducted using different biofuel blends. Both the government and private institutions such as DOST, Industrial Technology Development Institute

(ITDI), Philippine Coconut Authority (PCA), National Power Corporation (NPC), Philippine National Oil Company–Energy Research and Development Center (PNOC-ERDC), and Philippines Coconut Research Development Foundation (PCRDF) had initiated such studies on fuel application.

In 2007, R&D efforts on biofuel feedstock alternatives were undertaken at the UPLB. The study focused on the use of biodiesel derived from jatropha, and bioethanol from cassava and sweet sorghum. Second- and third-generation biofuel researches are new fields of study in the Philippines, and the current focus for ethanol is on pre-treatment of cellulosic materials, C-5 sugar fermentation, and low ethanol evaporation. There are ongoing research and development efforts on the use of sweet sorghum and cassava as alternative ethanol feedstocks. The University of Philippines at Visayas and Los Baños (UPV/UPLB) have also initiated studies on the viability of marine and freshwater micro algae and seaweed as potential biodiesel feedstock. The DOST-Philippine Council for Aquatic and Marine Research and Development (PCAMRD) monitors both these projects.

Advanced biodiesel research is currently focused on expanding jatropha. The DOST undertook a pilot project on the production and testing of biodiesel from jatropha from January 2007 until December 2011. The Philippine Council for Industry and Energy Research and Development (PCIERD) monitored this project. The UPLB also conducted an integrated RD&D program on jatropha, including germplasm management, varietal improvement, seed technology, and farming systems model development. Besides jatropha, there is a tree in the Philippines that can yield "petroleum" in five years. The tree is known as petroleum nut (*Pittosporum resineferum*) and is endemic in the northern Philippines. The tree is being mass-reared by Dr. Michael A. Bengwayan, an environmentalist who heads the Cordillera Ecological Center known as PINE TREE. This tree is the country's most promising biofuel treasure and perhaps, the best in the world. It has an octane rating of 54, which is higher than that of jatropha that has a rating of 41. It can totally replace liquefied petroleum gas (LPG) for cooking and lighting and it can run engines. PINE TREE has already produced thousands of seedlings and is training farmers on how to plant the trees.

(5) Way Forward

Though there are enough feedstocks for biodiesel production to meet domestic demand at present, with the rapid growth of its population, coconut consumption for food is expected to increase accordingly. As a result, the availability of coconut for biodiesel production is supposed to suffer a decline if there is no significant increase in total coconut production. Thus, attention is needed on how to increase and diversify the feedstock for biodiesel production. The issue on how to expand domestic feedstock supply and domestic production of bioethanol also needs to be addressed since the country has already been confronted with a shortage of bioethanol supply.

To promote the domestic development of the biofuel industry along the whole supply chain, support for infrastructure improvement such as farm-to-market roads, ports, terminals, and others are also needed.

Trend of Biofuels Trade in the Philippines[61]

Ethanol falls under the Harmonised Commodity Description and Coding System (HS) 2207.20.11 or Ethyl Alcohol Strength by Volume of Exceeding 99 percent, according to the Philippine Tariff Commission. There are no entries under HS 2207.20.11 in the Global Trade Atlas (GTA). However, the figures in the trade matrix represent imports under the general heading for alcohol of any strength (HS 2207.20).

Executive Order No. 61 signed in October 2011 modified tariffs for various products. Ethanol's Most Favoured Nation (MFN) tariffs were left unchanged at 10 percent, and will remain at this level through 2015. However, ethanol imports will be subject to a 1 percent MFN tariff if certified by the DOE that the imported ethanol will be used for fuel-blending purposes. If originating from ASEAN-member countries (i.e., Cambodia, Lao PDR, and Malaysia), ethanol imports will be levied a 5 percent duty.

[61] USDA Global Agriculture Information Network (GAIN) Report (2012).

Table A.12.3 Ethanol Import of the Philippines (million L)

Country of Origin	2011	2012
Singapore	17.8	23.0
Philippines (Subic)	67.3	93.0
Indonesia	3.2	-
USA	56.1	6.9
Vietnam	9.8	6.2
Korea	36.3	3.5
Australia	-	27.1
Thailand	24.4	88.8
Total	215.0	248.4

Source: Quoted from the USDA, *Philippine Biofuels Situation and Outlook*, 7/10/2013; Original data from the Philippine's Department of Energy as provided by the Sugar Regulatory Administration.

Chemrez Inc. had exported 500,000 litres of coconut-based biodiesel to Germany and to Asian markets including China, Chinese Taipei, South Korea, and Malaysia. Currently there is no coco methyl ester (CME) import for fuel use. However, if the government raises the biodiesel blend rate to 5 percent, there might be a need for biodiesel (not necessarily produced from CME) import to meet the regulation.

Singapore

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

Energy security is an extremely significant issue for Singapore because almost all the country's energy supply depends on import. In November 2007, the Ministry of Trade and Industry (MTI), Energy Market Authority (EMA), Economic Development Board, and the Ministry of the Environment and Water Resources (MEWR) jointly drafted a national energy strategy called "Energy for Growth." Basically, it includes the following six parts: (i) promotion of market competition, (ii) diversification of energy supply, (iii) enhancement of international cooperation, (iv) government-wide approach, (v) improvement of energy conservation, and (vi) R&D in the energy field and promotion of the energy industry. Based on these six strategies, the government aims to strengthen its position as Asia's no. 1 hub city of oil, to expand the scope of energy trade to liquefied natural gas (LNG), biofuels, and CO_2 emission credits, and to enhance the development of clean and renewable energies including solar energy, bioenergy, and fuel cells.[62] As part of the policy, the government developed a comprehensive policy[63] for the clean energy industry worth S$350 million in 2007. Clean energy industry is perceived as one of the strategic fields of the country's economic growth.

Energy administration in Singapore is implemented by multiple governmental ministries and agencies. The National Climate Change Committee (NCCC) is in charge of renewable energy which is part of energy conservation and environmental measures, while measures and supports are carried out by the National Environment Agency (NEA). Due to the increase in global renewable energy demand, the government is putting more weight on attracting renewable energy processing and manufacturing industries into the country. The Energy Innovation Program Office (EIPO)[64] is responsible for implementing this strategy. As a goal by 2015, the EIPO aims to create S$1.7 billion added value and employment for 7,000 skilled workers in the clean energy field. Specifically, the government intends to turn Singapore into a production and development centre[65] for the renewable energy industry and an export base for products and facilities.

With the completion of a biodiesel plant in Tuas on Jurong island, the government is considering to establish a worldwide biofuel terminal on Jurong island, which is currently a petrochemical hub.

There are few feedstocks (raw materials) for biofuel production in Singapore. Taking advantage of its geographic location and investment environment, Singapore is aiming to attract biofuel purification and processing investment from overseas. Most of the manufactured biofuels (diesel) are exported to the European Union and the United States, and they are domestically supplied only through two companies,[66] Fuelogical and Alpha Biofuels. Major raw materials used for biodiesel production are palm oil[67] from Malaysia and Indonesia, and waste oil and animal fats (tallow) from the food industry. Jatropha and microalgae have also been used.

---

[62] Ministry of Trade and Industry, Singapore (2007).
[63] Japan Petroleum Energy Center (2011a).
[64] Formerly called "CEPO: Clean Energy Program Office", set up in 2007.
[65] Ministry of Trade and Industry Singapore.
[66] Eco-Business.com, dated Jun. 7, 2010.
[67] Singaporean capital Temasek Group and Wilmar Group are financial cliques owning huge palm oil plantations in Malaysia and Indonesia and are instrumental in promoting the biofuel industry.

(2) Target

In Singapore, there is no plan to enact new standards for biofuels (diesel) in the near future. Meanwhile, to raise the emission control standards, the NEA announced[68] that the standards for automobile gasoline and diesel will comply with EuroIV and EuroV, respectively, (currently Euro II for gasoline and Euro IV [already adopted since 2006] for diesel) by January 2014 (detailed schedule undecided). The NEA says that the use of biofuels will be permitted if the automobile fuel emission standards are met. Production of biodiesel was expected to reach 3 million tonnes/year[69] by 2015 according to an estimate made by the Singapore Economic Development Board as of October 2007.

The NEA has set several goals to prevent air pollution: (i) maintain 85 percent "good" level and 15 percent "medium" level in terms of the Pollutant Standards Index (PSI), (ii) lower the annual average particulate matter (PM) level to 12μg/m^3 or less by 2020 and maintain this level until 2030, and (iii) maintain the annual average SO_2 level at 15μg/m^3 until 2030.[70]

In the downstream market, nine companies including Daimler Chrysler and Shell Eastern Petroleum have started a test project since 2007. The project use commercially available diesel cars to test the blending of biofuel.

As of the end of 2011, there were six biodiesel purification plants with a total capability of 1.3 million tonnes/year. As of 2010, biodiesel had been sold at eight gas stations on Jurong island.[71] Under the abovementioned biofuel test project, 13 diesel cars used B5 during the period Dec. 2007–Dec. 2009. Because of financial trouble caused by a price hike of palm oil, two companies—Australian Natural Fuel and German Peter Cremaer— have withdrawn from the production of biodiesel.[72]

[68] Eco-Business, dated Aug. 9, 2012.
[69] Asia Pacific Economic Cooperation (APEC) Biofuels.
[70] National Environment Agency of Singapore. http://app2.nea.gov.sg/anti-pollution-radiation-protection/air-pollution-control#aqt (accessed January 31, 2013).
[71] Eco-Business (2010).
[72] AsiaX, dated Feb. 11, 2011.

Table A.13.1 Capabilities of Biodiesel Purification Plants in Singapore

Company	**Country**	**Capacity(tonne/year)**	**Operating Condition**
Nature Fuel	Australia	600,000	Closed in 2009; Plan of expansion to 1.8 million tonne/year failed; No details cleared
Peter Cremer GmbH	Germany	200,000	Sold to Stepan Company based in the US (a major global supplier of surfactant technologies)
Neste Oil	Finland	800,000	November 2010-
ADM, Wilmar	US/Singapore	300,000	July 2007-
Continental Bioenergy	Singapore	150,000	September 2006-
Biofuel Research	Singapore	18,000	June 2003-
Fuelogical	Singapore	15,000	October 2010-
Alpha BIofuels	Singapore	2,000	September 2010-

Source: Prepared by the authors based on various documents.

(3) Development Program[73]

The Clean Energy Research Program (CERP)[74]is a comprehensive support program designed to financially support both basic research and applied research on innovative ideas about new processes, technology, and products that have commercial potential. The program covers corporations, research institutes, and higher education institutions based in Singapore, subsidising all the R&D expenses for public organisations and up to 70 percent of the expense for private corporations.

(4) Information on Biofuel RD&D in Singapore

At the time of this study, research institutes were working on second- and third-generation biofuels development in Singapore. These include the Temasek Life Science Laboratory (TLL), the Institute of Chemical and Engineering, and the Institute of Environmental Science & Engineering. TLL, jointly with Indian Tata Chemicals Biofuel Research and cooperating with Chinese scientists[75], have been developing jatropha as a raw material for biodiesel.

In May 2012, in order to produce high-quality biofuels used in automobiles, aircrafts, and power plants, the JOil (Singapore) Pte. Ltd. (JOil)[76], a bioenergy company in Singapore, announced the launching and development of the first commercial plant for genetically modified jatropha.[77] According to JOil, the company would use a 1.4-hectare farm in Singapore to experimentally produce genetically modified jatropha, which contains oil with an oleic acid content of over 75 percent as oleic acid is the fatty acid portion of the oil from the plant's seeds that contributes to the consistency and stability required for biofuels. Project cost is estimated to be approximately S$1 million. The

[73] JETRO Singapore.
[74] The application period for proposal expired in January 2008 https://rita.nrf.gov.sg/cerp/Guidelines%20and%20Templates/CERP_Guidelines%20for%20Submission.pdf (accessed on January 31, 2013)
[75] Eco-Business (2011a).
[76] 100% parent company of TLL; Japanese Toyota Tsusho Corporation has taken a stake in this project.
[77] Eco-Business (2012).

launching of this project required an approval from the Genetic Modification Advisory Committee.

In September 2013, the Singapore Airlines （SIA） and Civil Aviation Authority of Singapore (CAAS) revealed that they would jointly conduct feasibility study of airlines using biofuels instead of jet fuel to reduce greenhouse gas emissions.[78] They will look into biofuels used in aviation, which are typically extracted from plant sources that are not used in food, such as algae. The details including cost were not clear.

In September 2013, Concord Energy[79] and Cool Planet Energy Systems[80] signed an agreement to establish a joint venture in the Asia-Pacific Region that will develop commercial production facilities for the conversion of nonfood biomass into biofuels and soil-enhancing biochar.[81] Concord Energy believed that Cool Planet had developed a unique technology, which will revolutionise the production of biofuels. Cool Planet chose Concord Energy because the latter has the technological capability to deploy quickly the former's technology in East Asia and Oceania.

In February 2014, the Westin Singapore Hotel announced a pilot program, the Green Luxury project, under which waste cooking oil from its kitchens is converted into the biodiesel used to power its Jaguar limousines in collaboration with local renewable energy enterprise, the Alpha Biofuels.[82] Biodiesel accounts for 7 percent of the fuel mix and it is expected to reduce carbon gas emissions by 65 percent.

(5) Way Forward

To promote future the introduction of biofuels in Singapore, it is necessary to consider the following issues: (i) introduction of carbon tax, etc. on the use of fossil fuels; and (ii) demonstration of the possibility of producing high-value-added petrochemical products and polymers from raw materials for biofuels,

---

[78] Eco-Business (2013), 'CAAS, SIA to study alternative fuel use', September 6.

[79] Concord Energy is one of Singapore's leading crude oil and refined petroleum product trading companies, with businesses in Asia, Middle East, Europe, and North and West Africa.

[80] Cool Planet is deploying disruptive technology through capital-efficient, small-scale bio-refineries to economically convert nonfood biomass into high-octane, drop-in biofuels. Investors include BP, Google Ventures, Energy Technology Ventures (GE、 ConocoPhillips、 NRG Energy), and others.

[81] Biofuelsdigest, September 25, 2013

[82] Channel NewsAsia, February 6, 2014

and the expansion of production scale from laboratory level to commercial level.[83]

Trend of Biofuels Trade in Singapore

Singapore's tariff system[84] is a multiple tax system consisting of two types of tariffs—general and preferential. General tariffs are imposed on only six items, such as beers and medicinal liquors. However, preferential tariffs, theoretically zero, are applied to the FTA signatory countries. General tariffs refer to the customs duty.

Preferential tariffs

Preferential tariffs are applied to imports and exports with the signatory countries under (i) ASEAN Trade in Goods Agreement (ATIGA), (ii) Free Trade Agreement (FTA), (iii) Generalized System of Preferences (GSP), (iv) Commonwealth Preferences (CP) System, and (v) Global System of Trade Preferences (GSTP). The effects of import expansion by the application of the preferential tariffs are limited because the customs duty is imposed on only six items in Singapore, but they contribute to the promotion of exports. Excise duty imposed on some items is not included in the preferential tariff system.

After 1999, Singapore has enhanced its initiatives on FTA negotiations on both bilateral and multilateral basis. The FTAs have already been signed with New Zealand; Japan; European Free Trade Association or EFTA comprising Iceland, Liechtenstein, Norway, Switzerland; Australia; the United States; India; Jordan; South Korea; China; Panama; and Peru. Negotiations are now underway with Canada, Mexico, Pakistan, Ukraine, the European Union, and Taiwan.

Other taxes besides the customs duty include the excise duty. A specific duty system is applied to petroleum products (gasoline) (7 items) as follows:

[83] Eco-Business (2011b).
[84] JETRO Singapore.

a. Lead-free gasoline: S$3.7 to S$4.4/10 litres.

b. Leaded gasoline: S$6.3 to S$7.1/10 litres.

c. Natural gas use as automobile fuel: S$0.20/1 kg.

Industrial Exemption Factory Scheme

If an industrial exemption factory certificate is obtained under this system, a factory using or processing the target items of the excise duty—such as alcohol products and petroleum products as raw materials—is exempted from the excise duty. The relevant raw materials must not be resold, transferred, or disposed without permission of the Singapore customs, and their accurate inventory records must be held. In issuing the industrial exemption factory certificate, a fee of S$225 is charged per issue.

South Korea

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The fundamental policy for biofuels in South Korea is the "2nd Biodiesel Long-Term Supply Plan", which was released in 2010. Basically, biodiesel had been commercialised through a pilot test whereas bioethanol is still being reviewed and not yet commercialised.

(1.1) Background for introducing biodiesel

(a) Necessity for introducing biodiesel

- For energy diversification, coping up with an oil crisis, and improving environmental conditions

- There is an increasing interest in biodiesel in the EU and the US since the early 1990s.

(b) Fixing biodiesel long-term supply plan (the first plan was released in 2006)

- The blending rate of biodiesel had been increased since 2007 at the rate of 0.5 percent per year.

Table A.14.1 Blending Rate of Biodiesel in South Korea

Year	2007	2008	2009	2010	2011	2012
Blending rate of biodiesel	0.5%	1.0%	1.5%	2.0%	2.0%	2.0%

Note: Originally, the ratio was planned to be expanded to 3.0% by 2012, but as of the end of 2013, it remains at 2.0% due to the limited success of the expansion strategy.
Source: Japan Petroleum Energy Center (2011b).

- There has also been an exemption from petroleum tax for biodiesel.

(1.2) The 1st biodiesel long-term supply plan

(a) Biodiesel supply: The amount of supply increased gradually in accordance with the 1st biodiesel long-term supply plan (since 2006)

- BD5 was supplied universally in accordance with a voluntary agreement between the government of South Korea and four petroleum companies.

- BD20 was supplied restrictively in designated stations and its main use was limited to public transport.

(b) Outcome/effect of the plan for expanding biodiesel

- Tax incentive system

- Tax exemption on biodiesel amounted to K310 billion (from 2007 to 2010)
- Procuring raw materials

- Encouraged the collection of used cooking oil as raw materials for biodiesel and the recycling of resources.
-Developed foreign plantations of crop feedstocks, such as jatropha

(1.3) Summary of current biodiesel policy

The blending of biodiesel was based on a government notification and a voluntary agreement between biodiesel manufacturers and petroleum companies and was not based on legislation.

Table A.14.2 Government's Notifications on the Use of Biodiesel in South Korea

	Notification for the pilot project	**Notification for commercialisation**
Period	May 2002–December 2005	From January 2006
Contents of biodiesel	BD20	BD5, BD20
Selling channel	Biodiesel manufacturer -> Oil station	- BD5 : Biodiesel manufacturer -> Oil company - BD20 : Biodiesel manufacturer -> Bus, truck with own facilities
Supply region	Capital areas (Seoul, Kyunggi, Incheon) and Jeonbuk province	Whole country
Vehicle	General diesel vehicle	- BD5 : General diesel vehicle - BD20 : Bus, truck

Source: Prepared by the author based on various documents.

(2) Target

The fundamental energy policy directions are provided in the "1st National Energy Fundamental Plan" where it was announced that the target of new renewable energy would be 11 percent. (This proportion was actually 2 percent in 2006. This rate is considered to be low compared to the average rate for an OECD country).

To realise the target, it is necessary to expand financial resources for new and renewable energy and to strengthen the development and use of bioenergy and waste energy. The policy is supported by increasing blending rate of biodiesel and bioethanol, improving domestic feedstock of biomaterials, and promoting foreign plantations. One of the methods considered in developing a cogeneration plant is to effectively utilise household and livestock wastes.

(3) Development Program

The basic strategy for biofuel utilisation are discussed below:

(3.1) In view of the present condition of raw material supply, the blending rate of biodiesel is maintained at 2.0 percent.

- In spite of the expansion strategy for biofuels by the government, the private sector companies have not been competitive due to unfavourable circumstances. Actually, there has been a slowdown in the growth of these companies.
- After reinforcing the R&D innovation strategy, the government will try to raise the blending rate of biodiesel. Instead of a tax incentive policy, which expired at the end of 2011and had brought about the loss of competitiveness in the biodiesel industry, the Renewable Fuel Standard (RFS) was reviewed and will be introduced.
- In this regard, there was a public hearing on the RFS to gather opinion from stakeholders like K-Petro, petroleum companies, and from the associations of the bioenergy industry and the vehicle industry.
- Based on the RFS, blending of biodiesel will become mandatory through a legislation and there is possibility for adding both bioethanol and biogas as well.

(3.2) The biofuel industry will be promoted as a new growth engine by developing foreign plantations and making use of various types of materials.

(4) Information on Biofuel RD&D in South Korea

The first generation of biodiesel in South Korea was dependent on food and about 75–80 percent of the raw materials used in the country was imported. For this reason, South Korea is vulnerable to rising international price of foods and insufficient supply structure.

Under these circumstances, the government aims to strengthen the technology of producing biodiesel and to diversify raw materials. To achieve this, the government will focus on improvements in plant breeding and the development of next-generation technology. The government will pay attention to the development of marine algae, which can be utilised domestically.

(5) Way Forward

(5.1) Problem of maintaining price competitiveness

- Substantial increases in biodiesel price as compared to diesel oil

- Difficulties with stable supply without tax incentive or utilising obligation

(5.2) Problem with feedstock

- Dependence on the materials like palm oil or soybean, which could risk food security.

- High dependence on imports of feedstock, which could be as high as 75–80 percent.

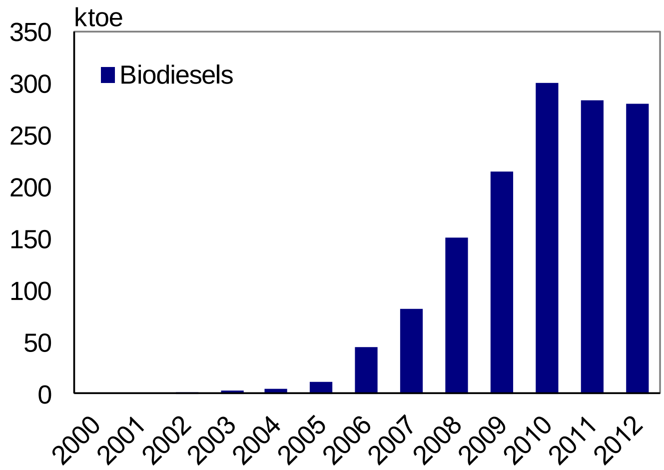
(5.3) Limitation of biofuel industry

- Almost all the companies in the biofuel industry are small and medium-sized ones, hence, it is difficult for them to invest in the long term. In fact, contracts between these companies and petroleum companies are for a single year, instead of multiple years.

Trend of Biofuels Trade in South Korea

Approximately 75–80 percent of biodiesel feedstock is imported soy and palm oil in South Korea.[85] As Figure A.14.1 shows, biodiesel production is at a declining trend after 2010.

Figure A.14.1 Output of Biodiesel in South Korea (in ktoe)



Source: IEA (2013), *Energy Balances of OECD 2013*.

Thailand

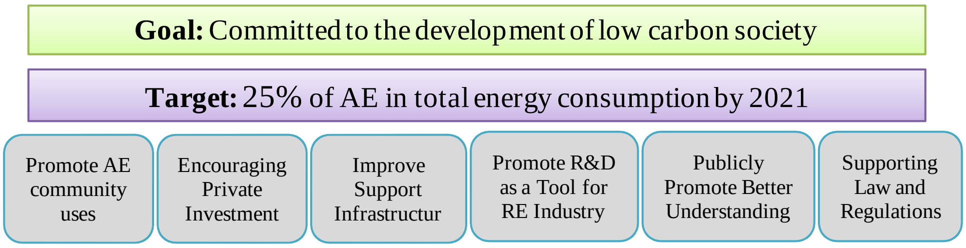
Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

For alternative energy as a whole, Thailand has an Alternative Energy Development Plan (AEDP), which has a clear target and mechanism to drive alternative energy consumption.

[85] USDA GAIN Report (2010).

Figure A.15.1 Thailand Alternative Energy Development Plan (2012–2021)



Solar		MW	2,000	3,200
Wind		MW	1,200	
Hydro Power Plant	Small	MW	324	1,608
	Micro	MW		
	Feedback	MW	1,284	
New Energy	Ocean	MW	2	3
	Geothermal	MW	1	
Bio-energy	Biomass	MW	3,630	4,390
	Biogas	MW	600	
	MSW	MW	160	
Biofuels	Ethanol	Million liter/day	9	Renewable Fuel 44%
	Biodiesel	Million liter/day	5.97	
	New Fuels	Million liter/day	25	

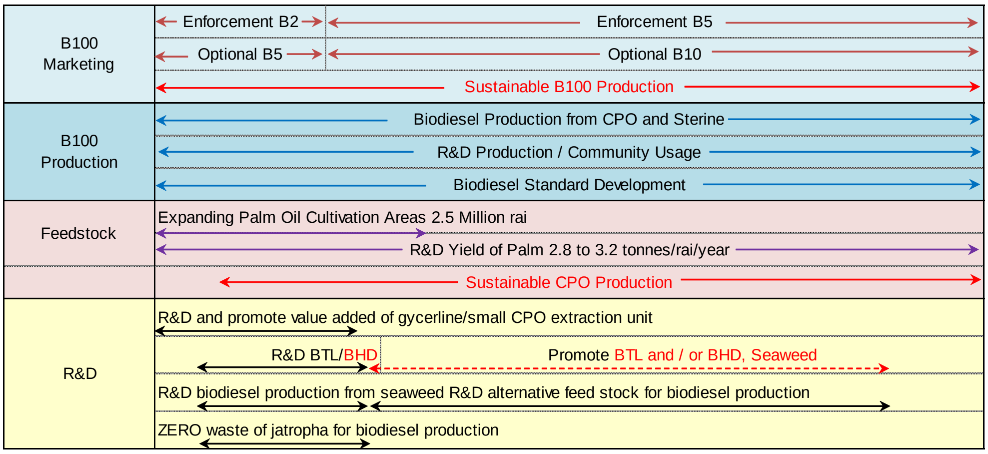
Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy

The target is to make alternative energy (5 alternative energy sources as shown in the figure above) 25 percent of total energy consumption by 2021.

Biodiesel Policy

Figure 1.15-2 provides the overall picture of Thailand's biodiesel policy. The mechanism is to increase biodiesel (B100) production to the targeted level of 7.20 million litres/day by 2021.

Figure A.15.2 Biodiesel Development Plan of Thailand (2008–2021)



Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy.

In 2007, the government, in collaboration with the Ministry of Energy, strongly supported biodiesel by selling B5 in Bangkok and some provinces in the southern part of the country. The implementation of B5 was put on hold in 2010 because of the short supply of palm oil. In November, 2012 the mandatory use of B5 was implemented. The government has announced new mandates that will increase blending requirements to B7 in 2014. However, due to the less-than-expected palm oil production, the government decided to implement B4 instead of B7 in 2014.

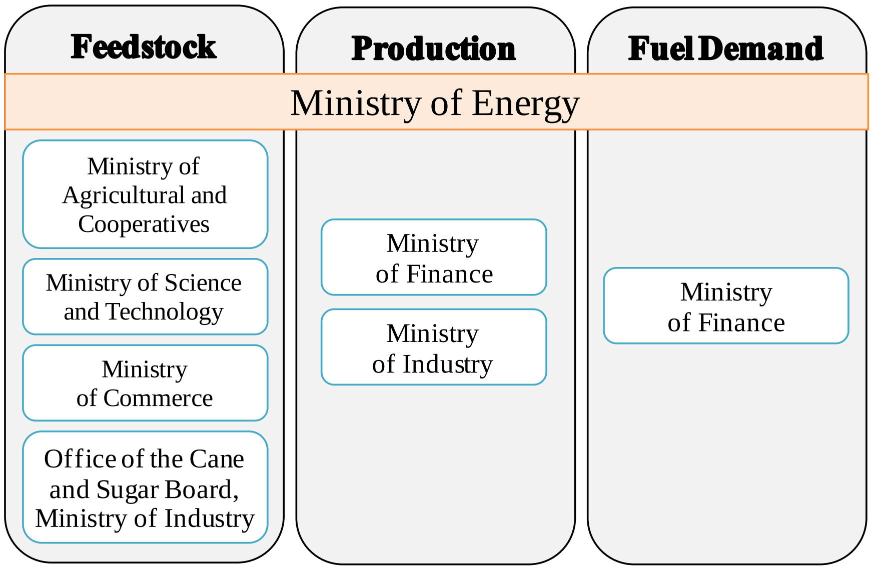
Since April 1, 2008, the government had set a regulation that all high-speed diesel oil (HSD) must be blended with 2 percent of biodiesel (as B2). This blend is still called diesel at the gas station.

At the time of this study, there is government support for the commercial use of biodiesel. For example, palm oil growing areas of 2.5 million *rais* (1 *rais* = 0.8 ha) have privileges under the Board of Investment, including tax relief on imported machinery, income tax relief for eight years, and incentives by lowering the retail biodiesel price, compared to diesel oil.

Bioethanol

For bioethanol/gasohol, Thailand has many policy bodies that participate in ethanol production and use cycles as shown in the figure below. The main responsibility of the Ministry of Energy is to oversee the whole process to make sure that each step is working collaboratively toward the same goal.

Figure A.15.3 Thailand Policy Body involved in Ethanol Processing



Source: Compiled by the authors.

To promote the production of ethanol, the supply policy concentrates on two aspects. The first is to the increase yield of both cassava and sugarcane without increasing the plantation area. The second is to explore alternative feedstocks for ethanol, such as sweet sorghum and cellulosic ethanol

In Thailand, it is clear that E10 is already well accepted by car drivers both at octane 95 and octant 91. The increase in gasohol consumption is due to the government's decision to phase octane 91, or ULG91, and the price advantage of gasohol (with government subsidy) over regular gasoline. To promote E20 usage, the government has set the price of E20 gasohol at 8–14 cents cheaper than E10 gasoline. The price subsidies are paid by the State Oil Fund. The government had also provided gasoline stations marketing subsidies totaling B0.5/litre (about US$0.06/gallon) and B6/litre (about US$0.76/gallon) to encourage them to expand sales of E20 and E85 gasohol.[86]

Different from the strategy to promote E20, E85 needs more support from the car manufacturing industry. Due to its higher concentration of ethanol, normal cars cannot readily use E85. Currently, there are four models of Flex fuel vehicles or FFV in Thailand. The Ministry of Energy is hoping to get supports from the Excise Department to give more tax incentives for FFV

[86] USDA (2013), *Thailand Biofuels Annual*. June 28.

cars. To boost E85 consumptions from existing non-FFV cars, the ministry will work on testing FFV conversion kit, which allows current cars to run on E85, and to make sure that it works properly. There will also be a project that aims to test E85's use in motorcycles.

The result of different funds and taxes on fuel is a complicated pricing structure with different charges on fuels (VAT, excise duties, municipal tax, Oil Fund, Conservation Fund, and so on). The charges vary according to the type of fuel and are changed from time to time as the authorities try to stabilise fuel prices (Table A.15.1).[87]

Table A.15.1 Price Structure of Petroleum Product in Bangkok (30 Sep 13)

Unit: Baht/Liter	Average Ex-Refin.	Tax	Municipal Tax	Oil Fund	Conservation Fund	Wholesale Price	VAT	Marketing Margin	VAT	Retail Price
ULG	**23.7046**	7.0000	0.7000	10.0000	0.2500	**41.6546**	2.9158	1.4762	0.1033	**46.15**
Gasohol 95 E10	**24.1967**	6.3000	0.6300	3.0000	0.2500	**34.3767**	2.4064	1.7261	0.1208	**38.63**
Gasohol 91 (E10)	**23.9771**	6.3000	0.6300	0.9000	0.2500	**32.0571**	2.2440	1.7560	0.1229	**36.18**
Gasohol E20	**24.6020**	5.6000	0.5600	-1.5000	0.2500	**29.5120**	2.0658	1.9647	0.1375	**33.68**
Gasohol 95 E85	**26.3782**	1.0500	0.1050	-11.6000	0.2500	**16.1832**	1.1328	5.2934	0.3705	**22.98**

Source: Presentation material at the 1st WG Meeting at Jakarta. October 2013.

Original data from World Trade Organization, WT/TPR/S/255. Geneva. "Thailand alternative energy development plan (2012-2021). http://www.eppo.go.th/petro/price/index.html (May 14, 2014)

(2) Target

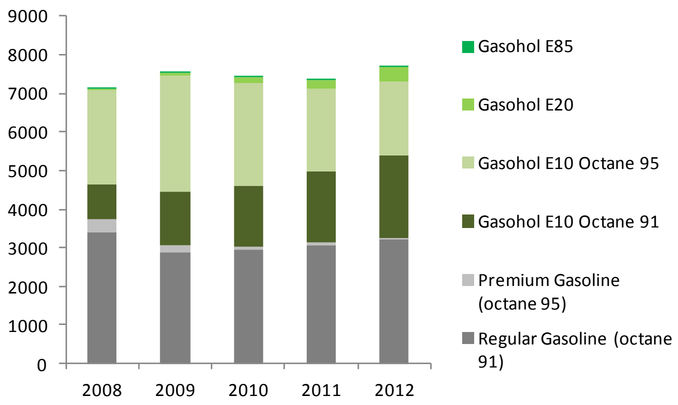
Ethanol

The number of ethanol producers increased remarkably after the blending obligation in 2007.As of February 2013, there were 21 ethanol plants operating with a total capacity of 3.89 million litres per day. The ethanol production for fuel use was 655 million litres in 2012.

The target set by The Renewable Energy Development Plan (REDP) is 9.0 million litres per day by 2021. According to the Ministry of Energy, the capacity of all registered plants has totalled 12.51 million litres/day as of 2013.

[87] WTO (2011a).

Figure A.15.4 Gasoline and Gasohol Consumption in Thailand



Source: Department of Energy Business, Ministry of Energy.

Table A.15.2 Ethanol Plants Operated in Thailand (as of February 2013)

	Number of Plants	Capacity (ML/day)
Sugarcane	1	0.2
Molasses	5	0.78
Cassava	6	1.28
Multi Feed Stock (1)	9	1.63
Total	21	3.89

Note: [1] Molasses is the main feed stocks.
Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy.

Biodiesel

In April 2007, two companies were selling biodiesel (B5) at the gas station. By the end of 2011, the total number of biodiesel gas stations increased to 560 with 141 in the area of Petroleum Authority of Thailand (PPT) and 419 in the Bangkok area. There were 15 biodiesel producers with government certificates ensuring the quality of production. All had production capacities of 5.26 million litres per day.

Table A.15.3 Biodiesel Plants in Thailand

Feedstock	Registered Capacity	
	No. of factories	Capacity (millionL/day)
CPO/RBDPO/Palm stearin	9	4.460
Palm stearin	4	0.750
Used cooking oil	1	0.004
Total	14	5.214

Source: Presentation material at the 1st WG Meeting in Jakarta, October 2013.

The target for biodiesel production set in the REDP is a production capacity of 7.20 million litres per day by 2021. The production of biodiesel was around 400 million litres per year in 2011.

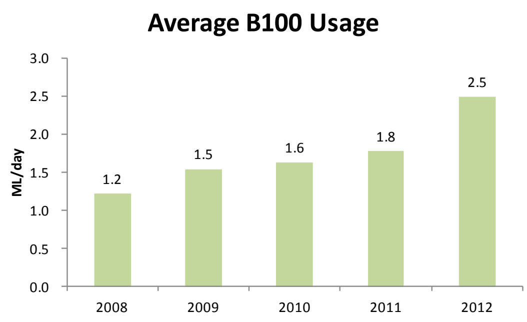
Table A.15.4 Biodiesel Production in Thailand (2006–2012)

1000 Liters	2006	2007	2008	2009	2010	2011	2012
Production	2	68	448	610	660	630	900

Source: USDA (2013), *Thailand Biofuels Annual*, June 28.

The B100 usage has increased steadily after January 2012 when the government mandated the 5 percent blend of B100 in all diesel fuels sold in Thailand.

Figure A.15.5 B2-B4, B5 and Diesel Sales Volume in Thailand (2003–2011)



Source: Department of Energy Business, Ministry of Energy.

(3) Development Program

The biodiesel community

The "biodiesel community" is a biodiesel support program providing knowledge and techniques on biodiesel production, as well as choosing high-potential raw materials in the field, personnel, and other readiness for setting up role model communities as an example for other communities to follow.

Supply side

The expansion of energy crop cultivation areas is the most urgent problem for Thailand. Plans for the cultivation of crops for biodiesel and bioethanol production are presented in the following tables. It should be noted that the use of agriculture land depends less on government plans than on crop prices, farmers' motivation, climate conditions, facilities, transport infrastructure, cultivation technologies, and environmental problems.

Table A.15.5 Development Program on Land Use to Expand the Feedstock Supply for Biodiesel in Thailand

Item		Unit	2011	2015	2020	2021	2022
1	Planting area	m.rai	4.5	5.7	6.0	6.0	6.0
2	FFB	mt	10.9	15.9	17.8	17.8	17.8
3	Crude Palm Oil (CPO)	mt	1.9	2.7	3.0	3.0	3.0
4	Stock	mt	0.2	0.2	0.2	0.2	0.2
5	Vetgetable oil consumption (Domestic + Export)	mt	1.0	1.1	1.2	1.2	1.2
7	Bioethanol demand (REDP)	ml/d	2.5	3.5	4.2	4.3	4.5
8	B100 from CPO+RBD	ml/d	1.9	2.9	3.5	3.7	3.8
9	Demand CPO for biodiesel (B100)	mt	0.7	1.0	1.2	1.2	1.3
10	Export CPO for national balance	mt	0.3	0.8	0.8	0.8	0.7
11	Stock at year end	mt	0.2	0.2	0.2	0.2	0.2

Notes:
(1) FFB&CPO planting area in 2010–2011 are from the Office of Agricultural Economics (OAE) estimation (Oct 2010).
(2) Figure in 2012–2022 is estimated by adjusting to proportion of OAE planting area (Prelim. est.)
(3) 2010 B100 estimation calculated from compulsory of B3 replacing B2 since June 1, 2010.
(4) CPO & RBD consumption is calculated by deducting 20 percent from the start of vegetable oil consumption.
(5) Stock at year end is 0.15 million tonnes.

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy.

Table A.15.6 Development Program on Land Use to Expand the Feedstock Supply for Bioethanol in Thailand

Item	2010	2015	2020	2021	2022
Ethanol demand (REDP) (ml/d)	2.1	5.4	8.5	8.8	9.0
Cassava*					
Planting area (m.rai)	7.5	7.2	7.2	7.2	7.2
Yield /rai (t/rai/yr)	3.1	3.6	4.0	4.0	4.0
Yield (mt)	22.9	25.9	28.8	28.8	28.8
Per cent consumption	0.5	0.8	0.9	0.9	0.9
Accounted to ethanol (ml/d)	1.1	4.1	7.2	7.5	7.7
The rest of cassava for producing ethanol (ml)	2.3	8.7	15.5	16.1	16.4
Domestic demand (mt)	9.2	9.7	10.1	10.2	10.3
Export demand (mt)	11.4	7.6	3.2	2.5	2.0
***Sugarcane** **					
Planting area (m.rai)	6.9	7.2	7.2	7.2	7.2
Yield /rai (t/rai/yr)	10.4	11.2	11.5	11.5	11.5
Yield (mt)	71.7	80.6	82.8	82.8	82.8
Molasses (mt)	3.2	3.6	3.7	3.7	3.7
Per cent consumption	0.5	0.3	0.2	0.2	0.2
Accounted to ethanol (ml/d)	1.1	1.4	1.3	1.3	1.4
The rest of molasses for producing ethanol (ml)	1.5	2.0	1.9	1.9	2.0
Domestic demand (mt)	1.3	1.4	1.4	1.4	1.5
Export demand (mt)	0.4	0.3	0.4	0.4	0.3

Notes: (1)* Data for 2010 refer to the Office of Agricultural Economics (OAE).
(2)** Data for 2010 refer to the Office of Cane and Sugar Board (OCSB). 2011–2022 are estimated from minimum yield/rai.
Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy

(4) Information on Biofuels RD&D in Thailand

Thailand has mastered the first-generation technology for converting raw materials to biodiesel and bioethanol, while second-generation technologies are still at the research stage.

Several institutions are involved in biofuel technology development in Thailand. The National Science and Technology Development Agency (NSTDA), Thailand Institute of Scientific and Technological Research (TISTR), and King Mongkut's University of Technology North Bangkok (KMUTNB) had been working mainly on R&D. These three institutions had carried out basic research on biofuel production technology, maintaining the research environment, and supporting the development of the country's biofuels industry.

TISTR as a research institute has been promoting both basic and applied research on bio-sciences, materials, energy, and the environment. Thailand began ethanol fuel production since November 2003 using sugarcane molasses and cassava starch as raw materials. The demonstration tests by TISTR on the “Royal Ethanol Project” had established basic techniques and had disseminated the experience in Thailand’s biofuel industry. NSTDA has expertise on catalyst technology, while KMUTNB has expertise on bio-oil reforming technology and both of these institutions play an important role on biofuel technology development in Thailand.

The research institutions mentioned above are also involved in the development of second-generation biofuel production technologies. However, many of the researches are in the experimental stages and are not ready for commercial application. Current research focuses on advanced second-generation bioethanol technology development that includes:

- Cellulosic ethanol
- FFV conversion kit
-ED95 [88]

Table A.15.7 Bioethanol Technology Development in Thailand

<table>
<tr><th></th><th>08</th><th>09</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th><th>21</th><th>22</th></tr>
<tr><td>Ethanol Demand (Million Liters/day)</td><td>1.24</td><td>1.34</td><td>2.11</td><td>2.96</td><td colspan="5">6.20</td><td colspan="6">9.00</td></tr>
<tr><td rowspan="3">R&D</td><td colspan="8">R&D 2nd generation of ethanol production (Cellulosic)</td><td colspan="7">Promote 2nd generation of ethanol production</td></tr>
<tr><td colspan="15">Value added ex. Sewage</td></tr>
<tr><td colspan="15">Study E85</td></tr>
</table>

Source: Bureau of Biofuel Development, Department of Alternative Energy Development and Efficiency.

The second-generation biodiesel technology development projects include:

- Bio-hydrogenated diesel
- Biomass to liquid
- Biodiesel from algae

[88] ED95 is an ethanol-based fuel for adapted diesel engines.

Table A.15.8 Biodiesel Technology Development in Thailand

	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
B100 Demand (Million Liters/day)	1.35	1.35	1.35	3.02	3.64					4.50					
R&D	R&D and promote value added of gycerline/small CPO extraction unit														
	R&D BTL/BHD				Promote BTL and / or BHD, Seaweed										
	R&D biodiesel production from seaweed R&D alternative feed stock for biodiesel production														
	ZERO waste of jatropha for biodiesel production														

Source: Bureau of Biofuel Development, Department of Alternative Energy Development and Efficiency

(5) Way Forward

In the national energy program, the promotion of biodiesel and ethanol plays an important role. Biodiesel was planned to be a local product in certain areas, and ethanol was targeted to be used nationwide. Cassava is the cheapest source of starch and based on the long experience of Thailand's cassava industry, this crop can support the national policy and strategy on biofuels, especially in the production and use of bioethanol. Future development faces several challenges.

Food vs. Fuel

There has been a lot of debates on the issue of food vs. fuel. However, the Ministry of Agriculture of Thailand has confidently announced a national program to increase the average yield of fresh roots by up to 30 tonnes/ha by promoting the use of newly released high-yielding varieties, along with good irrigation and fertilizer management. Thus, root productivity is expected to increase without an expansion of land area and without competition from the food sector. However, given that Thailand is among the world's largest producers and exporters of rice and an important global supplier of sugar, the impact of a switch from food to fuel cultivation raises concerns on not only the country's food security but also on the global food supply chain.

Environment issues

Usually, about 2,500 litres of water will be needed to produce 1 litre of biofuel. It is believed that the promotion of biofuels in Thailand will cause rivers to be polluted by the wastewater from the manufacturing activities. The methane gas recovery technology by anaerobic fermentation will probably become one of the measures to help prevent water pollution.

RD&D for Second-Generation Biofuel Technologies

Development of second-generation biofuel technologies is an important strategy for sustainable development of biofuels in the future. The development of bioethanol production technology using cellulose will have important implications for Thailand.

Trend of Biofuels Trade in Thailand[89],[90]

As of 2007, Thailand began to promote the export of ethanol as fuel. The government is contemplating on how to revise the current regulatory framework to enable greater flexibility to exporting ethanol. Alcohol production is strictly controlled under the Cane and Sugar Act (1984). Ethanol producers in Thailand must declare whether the ethanol produced is for fuel use or for liquor. Exports are under the review of Finance Ministry's Excise Department. Given the excess domestic supply, in 2008, approximately 71 million litres of ethanol were authorised for export to Singapore, the Philippines, Taiwan, South Korea, Australia, and the Netherlands. There are only five ethanol producers authorised to export in 2009 according to the Department of Alternative Energy Development and Efficiency.

Ethanol exports (HS2207.10.00) more than tripled in 2011 to 167 million litres, as compared to 48.2 million litres in the previous year. The increase reflected import demand from the Philippines to fulfill its E10 mandate that became effective on August 6, 2011. Ethanol exports continued to grow during January–March 2012 to 84.0 million litres, as compared to 22.7 million litres in the same period of the previous year, again, primarily to the demand from the Philippines where the operation of its new ethanol plants had been delayed.

[89] Morgera, Kulovesi, and Gobena (2009).
[90] USDA GAIN Report (2012f).

Currently, the Philippines is the main destination for Thailand's ethanol export. Ethanol exports to China are expected to increase significantly as a new Thai export-oriented ethanol plant with a production capacity of 400,000 litres/day will likely be fully operated after its commissioning in the last quarter of 2012. This ethanol plant is a cassava-based ethanol with an export contract of 100 million litres/year to China. Thailand does not import ethanol for fuel use given the country's abundant domestic supply.

Table A.15.9 Thailand's Export of Ethanol (in million litres)

	2009	2010	2011	2012
Philippines	-	5.5	61.3	142.3
Singapore	3.1	19.3	68.5	76.8
Japan	7.4	20.0	16.5	24.9
Australia	0.0	-	2.1	-
Taiwan	3.1	1.2	3.2	1.5
Indonesia	-	-	-	1.5
Europe	-	-	-	9.3
South Korea	-	2.1	12.8	45.5
Other	2.0	-	2.6	2.1
Total	15.6	48.1	167.0	303.9

Note: The number are based on 19 online ethanol plants exporting 95 percent purity ethanol.
Sources: Department of Alternative Energy Development and Efficiency, Ministry of Energy. Quoted in the USDA, Foreign Agricultural Service. *Thailand Biofuels Annual 2013*.

In January 2008, given the abrupt shortage of palm oil, both for cooking oil and as an input for biodiesel, the Ministry of Energy requested the Ministry of Commerce to allow, as an exceptional measure, increased imports of palm oil. Crude palm oil imports and exports are restricted under the Fuel Trade Act (2000). According to the latest Trade Policy Review undertaken by the World Trade Organization, Thailand has a tariff-rate quota regime for palm oil imports. Tariff quotas do not apply to imports from ASEAN countries, which may, upon legal enactment by the Ministry of Finance, supply items benefiting from the preferential ASEAN Free Trade Area (AFTA) duty rates. This was the case, for example, with palm oil imports.[91]

[91] WTO (2007).

Legislative authority for regulating imports is provided by the Export and Import Act (1979). The Act empowers the Minister of Commerce, with the approval of the Cabinet, to restrict imports for reasons of economic stability, public interest, public health, national security, peace and order, morals, or for any other reason in the nation's interest. Imports may be "absolutely" or "conditionally" prohibited; in the latter case (for example, those requiring non-automatic licensing), imports are allowed if specified conditions are satisfied. Palm oil is among the imports that may be prohibited under the various laws in place for health and safety reasons.

Viet Nam

Policies and Programs to Promote the Utilisation of Biofuels

(1) Policy Overview

The fundamental energy policy directions of Viet Nam are provided in "National Energy Development Strategy up to 2020, with 2050 Vision (the Strategy, hereinafter)" approved by the Viet Nam's Cabinet in December 2007. The strategy sets a long-term target for renewable energy's share in the total primary energy supply at 5 percent as of 2020 and 11 percent as of 2050. This strategy, however, did not specify how the country would meet this target with what kind of renewable energy sources, although these numerical targets were the supreme goals for the country's renewable energy policy. As a means to meet the targets, biofuels is considered as a major policy option by the government of Viet Nam. The country's first biofuels policy was provided in the Prime Minister's Decision No. 177 on November 20, 2007 (the 2007 Decision, hereinafter). The outline of this decision is provided later in this section.

(2) Target

The first numerical target for biofuels utilisation was provided in the 2007 Decision (details in Table A.16.1). The 2007 Decision aimed at attaining the goal that all motor gasoline and auto diesel oil consumed in Viet Nam should essentially be either E5 gasoline or B5 diesel by 2025.

Table A.16.1 Volume Target of Biofuels in Viet Nam

Item	2010	2015	2025
Volume of biofuels ('000 tonnes)	7.5	250	1,800
Volume of E5 and B5 ('000 tonnes)	150	5,000	36,000
Ratio of pure biofuel to the total petroleum product	0.04%	1.0%	5.0%
Ratio of E5/B5 to the total petroleum demand	Up to 1%	21%	100%

Note: E5 is blended motor gasoline with 5% ethanol; B5 is blended auto diesel oil with 5% biodiesel.
Source: Prime Minister's Decision No. 177.

It was reported that the government of Viet Nam had set another target specifically for E5 gasoline in November 2012.[92] According to the government, blending 5 percent of ethanol in motor gasoline will become mandatory from December 1, 2014 in seven provinces and cities, namely Ha Noi, Ho Chi Minh, Hai Phong, Da Nang, Can Tho, Quang Ngai, and Ba Ria–Vung Tau. For the remaining areas of the country, December 1, 2015 will be the deadline to adopt E5 gasoline. The government also set the target to raise the share of ethanol from 5 percent to 10 percent by December 1, 2016 in the seven provinces and cities, and by December 1, 2017 in the whole country.[93]As the 2007 Decision did not assume 10 percent blending of ethanol, the government in November 2012 set a tougher target for biofuel adoption for motor gasoline.

As for the actual production and consumption of biofuels in Viet Nam, official statistics is not available. Six ethanol plants are in operation as of November 2012 and the combined production capacity is 550,000

[92] VietnamNet (2012). http://english.vietnamnet.vn/fms/environment/53707/vietnam-vows-to-use-green-fuels-to-keep-air-fresh.html.
[93] VietnamNet (2012).

kL/year.[94]Approximately 80 percent of the production is exported.[95] Three of the six plants are jointly owned by PV Oil, a marketing subsidiary of state-owned PetroVietnam Group, and the total capacity of the three plants is approximately 300,000 kL/year.[96] Domestic ethanol production capacity has already exceeded the target set in the 2007 Decision, but the government has set a tougher target as mentioned above, and additional capacity investments as well as maintaining a higher utilisation will be required to meet the new target.

B5 is still at the experimental stage in Viet Nam. Test marketing of B5 has already started since August 2010, but E5 is prioritised over B5 as the primary means to expand biofuels adoption in the country.

(3) Development Program

The principal biofuels policy program of Viet Nam is the 2007 Decision. The decision provides short-term objectives through 2010, mid-term objectives through 2015, and a vision for 2025 as summarised in Table A.16.2. As of March 2014, it is unclear as to how much the road map has achieved because no formal review had been reported so far.

Table A.16.2 Objectives Provided in the Prime Minister's Decision, Viet Nam

Term	Objectives
To 2010	1. Building legal corridor to encourage industrial-scale biofuel product and using biofuel as replacement fuel in Viet Nam. Raising public awareness of the role and benefit of biofuel. 2. Building road map to use biofuel as a spare fuel in the transport and other industries, and constructing pilot distributing stations in some cities. 3. Approaching and mastering technology for biofuels

[94] Nam News Network (2012)..
[95] *Biofuels Digest*, July 15, 2013. http://www.biofuelsdigest.com/bdigest/2013/07/15/vietnam-biofuel-faces-poor-sales-government-to-implement-mandate/
[96] Petro Vietnam Oil. List of Biofuels plants. https://www.pvoil.com.vn/en-US/pvoil/plants-products/303.

	production from biomass, including blending technology; and improving the efficiency of transforming biomass into fuel. 4. Planning and developing raw material zones for biofuels production. 5. Training of human resources to handle the initial stage of biofuels development. 6. Building and developing trial models for producing and using biofuels with capacity of 100,000 tonnes of E5 and 50,000 tonnes of B5 per year; ensuring supply of 0.4% of total demand for E5 and B5. 7. Approaching and mastering high-yield variety technology for biofuels production.
2011–2015	1. Research, mastering, and production of materials, and additives for biofuel production. 2. Developing and using biofuel for replacing part of conventional fuel. Expanding scale of biofuel production and network of distribution for transport and other industries. 3. Developing material zones according to plan; planning on a large scale for new varieties, which have high yield and pests and disease resistance, to ensure enough supply input for biomass transformation. 4. Successful application of modern fermentation technology to diversify feedstock sources for transforming biomass to biofuel. 5. Building and developing mills and using biofuel nationwide. By 2015, output of ethanol and oil-plants-based biofuel will be 250,000 tonnes (blending of 5 million tonnes E5 and B5), meeting 1% of total demand for gasoline and diesel. 6. Training of human resources in areas related to biofuels production and training of technical workers to meet human resources needed for biofuels production.

Vision as for 2025	Technology for biofuels production in Viet Nam will be at an advanced level. Output of ethanol and biodiesel fuel will reach 1.8 million tonnes, meeting 5% of total demand for gasoline and diesel in the country.

Source: Government of Viet Nam (2007), Prime Minister's Decision No. 177.

The decision provides the necessary mechanisms as follows:

- As the government funding to support biofuels program, VND259.2 billion during 2007–2015, equal to VND28.8 billion per year, is allocated.
- Government funds for fundamental scientific research and technology development.
- Private enterprises are expected to take care of capital investment for developing the biofuels production industry.

Although it is not the government's policy, the ADB published its review of Viet Nam's biofuels policy and deployment in 2009.[97] ADB's review included market outlook of biofuels in Viet Nam, assessment of potential resources to produce biofuels, and policy recommendations. ADB recommended that the government needed to (i) provide the best political and economic environment rather than direct subsidies to avoid conflicts under the World Trade Organization framework, (ii) identify the primary feedstock for biofuels to streamline policy efforts across different ministries, and (iii) set up an organisation that oversees the biofuels industry.[98]

(4) Information on Biofuel RD&D in Viet Nam

Research, development, and dissemination (RD&D) activities of biofuels in Viet Nam are undertaken by the state-owned PetroVietnam group and through other governmental organisations' initiatives. Vietnam Petroleum Institute (VPI), a research institute of PetroVietnam group, is pursuing R&D activities based on the group's R&D road map as illustrated in the following table.

[97] ADB (2009).
[98] Ibid, p. 51.

Table A.16.3 PetroVietnam's Biofuel R&D Road Map

Item	2011–2015	2016–2025
Feedstock	Developing another biomass for biofuels production; Planning raw material areas for third-generation biofuels production (algae and microalgae).	Establishing technological process for cultivating algae and microalgae.
Technology	Approaching and researching the modern technologies for biodiesel production; Deploying trial production of bioethanol, bio-butanol, and liquid fuels from biomass.	Deploying trial production of bioethanol and biodiesel from algae, microalgae; Approaching and researching new technologies for producing third-generation biofuels.
Blending, Storage, Transport, and Distribution	Conducting research on establishment and mastering of technology for blending biodiesel (fossil diesel, biodiesel and additives) and technology for storage, transport and distribution of pure biodiesel and biodiesel.	-
Environment	Developing the technology for treating by-products and wastewater from biofuel plants of VPI	-
Additives, Chemicals, and Catalyst	Trial production of the additives for gasohol, biodiesel;	-

	Conducting research on additives from glycerin derived from biodiesel production as well as catalysts for F-T synthesis.	
Application	•Large-scale on-road test (B2, B5) in some provinces and cities; •Distribution of E5, B5 on a national scale; •Large-scale on-road test of E10 & B10.	Large-scale on-road test of E25 (Fuel mixture by 25% ethanol and 75% gasoline) & B25 (Mix of 25% biodiesel and 75% diesel) or higher blends

Source: Vietnam Petroleum Institute

As another R&D activity, the Vietnam Academy of Science and Technology Institute of Tropical Biology and Algen Sustainables, a research initiative funded by the Danish and Dutch governments, are researching biofuel production possibility using seaweed. The project is currently examining the viability of biofuel production process by using traditional acid/enzyme to extract cellulosic sugar that can be fermented to produce ethanol. The project is also studying a biofuel production process based on rice straw.[99]

(5) Way Forward

The biggest challenge to expanding biofuels use in Viet Nam is how to attract consumers' as well as petroleum product marketers' interest. It is reported that E5 gasoline is sold at VND100 discount to conventional motor gasoline A92.[100] Yet, given the ethanol's lower calorific value compared with that of conventional gasoline, the discount is not sufficient to make up the calorific deficit.[101] In addition to such insufficient price incentive, consumers are

[99] Algen Sustainables, (www.algensustainables.com/) (accessed April 9, 2013).
[100] Nam News Network (2012).
[101] Because ethanol's calorific value is approximately 60% of conventional gasoline, E5 has a 2% calorific deficit compared to the conventional gasoline. The A92 gasoline price as of April 2013 is VND24,000 and, thus, VND100 is just 0.4% of the total price.

concerned about the potential quality problem using E5 in their vehicles. Petroleum product distributors are also not willing to market E5 gasoline because they need additional investments at their gas stations. Only three out of more than 10 marketers are dealing with E5 gasoline in Viet Nam, and Petrolimex—the largest petroleum product marketer in Viet Nam—has not shown interest in selling E5 gasoline. Without sufficient financial support from the government or large petroleum products suppliers such as PetroVietnam, small agents may not be able to afford to invest in separate pillars or tanks for E5 gasoline.

Trend of Biofuels Trade in Viet Nam

Viet Nam does not import biofuels from abroad. Instead, it is reported that the country exports ethanol to Asian countries like the Philippines, South Korea, and China. This is because Viet Nam cannot find buyers in the domestic market due to the marketers' reluctance to adopt E5 gasoline as mentioned above.[102]

[102] Nam News Network (2012).