ERIA Research Project Report 2012, No.25

STUDY ON ASIA POTENTIAL OF BIOFUEL MARKET

Edited by

KAORU YAMAGUCHI

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LIST OF ABBREVIATIONS AND ACRONYMS

ABRI	= the Australian Biofuels Research Institute
ADB	= Asia Development Bank
AEDP	= Alternative Energy Development Plan
AFTA	= ASEAN Free Trade Area
APEC	= Asia Pacific Economic Cooperation
Aprobi	= Biofuels Producers Association of Indonesia
ARENA	= Australian Renewable Energy Agency
ASEAN	= Association of Southeast Asian Nations
ASTM	= American Society for Testing and Materials
ATIGA	= ASEAN Trade in Goods Agreement
B1	= Mix of 1% Biodiesel and 99% Diesel
B2	= Mix of 2% Biodiesel and 98% Diesel
B5	= Mix of 5% Biodiesel and 95% Diesel
B10	= Mix of 10% Biodiesel and 90% Diesel
B20	= Mix of 20% Biodiesel and 80% Diesel
B25	= Mix of 25% Biodiesel and 75% Diesel
B100	= 100% biodiesel
BAA	= Biofuel Association of Australia
BANZ	= Bioenergy Association of New Zealand
BDF	= Biodiesel Fuel
BE	= Bioethanol
BPPT	= Agency for the Assessment of Application and Technology
CAAC	= Civil Aviation Administration of China
CAPEX	= Capital Expenditure
CEPO	= Clean Energy Program Office, Singapore
CERP	= Clean Energy Research Program
CIF	= Common Intermediate Format
CME	= Coco Methyl Ester
CNG	= Compressed Natural Gas
CNO	= Coconut Oil
CO_2	= Carbon Dioxide
CP	= Commonwealth Preferences
CPO	= Crude Palm Oil

DEDE	= Department of Alternative Energy Development and Efficiency, Ministry of Energy of Thailand
DEMR	= Ministry of Energy and Mineral Resource
DME	= Energy Self Sufficient Village Program
DOEM	= Department of Environment Malaysia
DOE	= Department of Energy, Philippines
DOST	= Department of Science and Technology, Philippines
E3	= Fuel Mixture by 3% Ethanol and 97% Gasoline
E5	= Fuel Mixture by 5% Ethanol and 95% Gasoline
E10	= Fuel Mixture by 10% Ethanol and 90% Gasoline
E15	= Fuel Mixture by 15% Ethanol and 85% Gasoline
E20	= Fuel Mixture by 20% Ethanol and 80% Gasoline
E25	= Fuel Mixture by 25% Ethanol and 75% Gasoline
E85	= Fuel Mixture by 85% Ethanol and 15% Gasoline
EFB	= Empty Fruit Bunch
EFTA	= European Free Trade Association
EIPO	= the Energy Innovation Program Office, Singapore
EMA	= Energy Market Authority, Singapore
EPA.US	= Environmental Protection Agency of United States
EPA	= Economic Partnership Agreement
EPPO	= Energy Policy and Planning Office, Thailand
ERIA	= Economic Research Institute for ASEAN and East Asia
ESP WG	= Energy Saving Potential Working Group of ERIA
ETBE	= Ethyl Tertiary Butyl Ether
EU	= European Union
EV	= Electricity Vehicle
FAME	= Fatty Acid Methyl Esters
FAO	= Food and Agriculture Organization
FFV	= Flexible Fuel Vehicle
FIT	= Feed-in Tariff
F/S	= Feasibility Study
FTA	= Free Trade Agreement
GAIN	= Global Agriculture Information Network
GDP	= Gross Domestic Product
GEN 2	= Second Generation Biofuels
GHG	= Greenhouse Gas
GMAC	= Genetic Modification Advisory Committee

GNS	= the Institute of Geological and Nuclear Science
GOI	= Government of Indonesia
GSP	= Generalized System of Preferences
GST	= Goods and Services Tax
GSTP	= Global System of Trade Preferences
GTA	= Global Trade Atlas
HS	= Harmonised Commodity Description and Coding System
HSD	= High Speed Diesel Oil
ICRIER	= Indian Council for Research on International Economic Relations
IEA	= International Energy Agency
IEEJ	= the Institute for Energy Economics, Japan
ITDI	= Industrial Technology Development Institute
ITH	= Income Tax Holiday
JBEDC	= Japan Bio-Energy Development Corporation
JDI	= Japan Development Institute
JETRO	= Japan External Trade Organization
JOil	= JOil (Singapore) Pte. Ltd.
JPJ	= Road Transport Department, Malaysia
KEN	= National Energy Policy
KKPE	= Credit for Food and Energy Security
KMUTNB	= King Mongkut's University of Technology North Bangkok
KPEN-RP	= Bio-energy Development and Revitalization of Plantations
KPPK	= Ministry of plantation Industries and Commodities, Malaysia
LIPI	= Indonesian Institute of Sciences
LIRE	= Lao Institute for Renewable Energy
LLC	= Limited Liability Company
LNG	= Liquefied Natural Gas
LPG	= Liquefied Petroleum Gas
MAA	= Malaysian Automotive Association
MAFF	= Ministry of Agriculture, Forestry and Fisheries, Japan
MAI	= Ministry of Agriculture and Irrigation, Myanmar
MEWR	= Ministry of the Environment and Water Resources, Singapore
MFN	= Most Favoured Nation
MIC	= Myanmar Investment Committee
MOE	= Ministry of Energy, Myanmar
MOMG	= Malaysian Oleochemical Manufacturers Group
MPOB	= Malaysia Palm Oil Board

MPP = Minimum Purchase Price
MS = Methyl Esters (Malaysian Standard on Biodiesel)
MSP = Minimum Support Price
MTI = Ministry of Trade and Industry, Singapore
NBB = National Biofuel Board, Philippines
NBPM = National Biofuel Policy, Malaysia
NBPP = National Biofuel Policy, Philippines
NCCC = The National Climate Change Committee, Singapore
NDRC = National Development and Reform Commission, China
NEA = National Environment Agency, Singapore
NES = New Zealand Energy Strategy 2011-2021
NOLCO = Net Operating Loss Carry Over
NPC = National Power Corporation
NSTDA = National Science and Technology Development Agency
NZEECS = New Zealand Energy Efficiency and Conservation Strategy 2011-2016
NZES = New Zealand Energy Strategy 2011-2021
NZFOA = New Zealand Forest Owners Association
OAM = Office of Agricultural Economics
OCSB = Office of Cane and Sugar Board
OECD = Organization for Economic Cooperation and Development
OMC = Oil Marketing Companies
PCA = Philippine Coconut Authority
PCAMRD = Philippine Council for Aquatic and Marine Research and Development
PCIERD = Philippine Council for Industry and Energy Research and Development
PCRDF = Philippine Coconut Research Development Foundation
PDR = People's Democratic Republic
PEN = Blueprint for National Energy Plan; PEN 2005 ~ 2025
PETRONAS = Petroliam Nasional Berhad
PI = Presidential Instruction
PLN = Perusahaan Umum Listrik Negara
PM = Particulate Matter
PME = Palm Methyl Esters
PMK = Regulation of the Ministry of Finance
PNOC-ERDC = Philippine National Oil Company-Energy Research and

Development Center

PNS	= Philippine National Standards
PPKS	= Centre for Oil Palm Research, Medan
PPO	= Pure Plant Oil
PPP	= Public Private Partnership
PSI	= Pollutant Standards Index
PSO	= Public Service Obligation
PTC	= Philippine Tariff Commission
PTT	= Petroleum Authority of Thailand
PV Oil	= Petro Vietnam Oil
RA	= Republic Act of Philippines
RBD	= Refined, Bleached and Deodorised
RD & D	= Research, Development and Demonstration
RE	= Renewable Energy
REDP	= Renewable Energy Development Plan
RFS	= Renewable Fuel Standards
RITE	= Research Institute of Innovative Technology for the Earth
SIRIM	= Standards and Industrial Research Institute of Malaysia
SNI	= Standar Nasional Indonesia
SO_2	= Sulfur Dioxide
STL	= Shale-to-Liquids
SVO	= Straight Vegetable Oil
TBO	= Tree-Borne Oilseeds
TCPPA	= Technical Committee on Petroleum Products and Additives
TimNas BBN	= National Team for Biofuels Development
TISTR	= Thailand Institute of Scientific and Technological Research
TLL	= Temasek Life Science Laboratory
UAC	= Universal Adsorbents & Chemicals
UGR91	= Gasoline Octane 91
UPV	= University of Philippines at Visayas
UPLB	= University of Philippines in Los Banos
U.S.	= United State
US	= United State
USDA	= United States Department of Agriculture
VAT	= Value Added Tax
VPI	= Vietnam Petroleum Institute
WG	= Working group

WTO = World Trade Organization

UNIT

Ha	= Hectares
kg	= Kilogram
kL	= Kiloliters
ktoe	= Thousand tonnes of oil equivalent
kW	= Kilowatts
kWh	= Kilowatts hour
L	= Liters
ML	= Million Liters
Mtoe	= Million tonnes of oil equivalent
MW	= Megawatt
PJ	= petajoules
toe	= Tonnes of oil equivalent
$\mu g/m^3$	= Microgram/cubic meter

Currency

RM	= Ringgit Malaysia
Rs	= India Rupees
NZ	= New Zealand Dollars
VND	= Vietnamese Dong

EXECUTIVE SUMMARY

Given growing population, rising income level, and expanding urbanization, Asia's demand for oil is expected to keep increasing rapidly. However, with limited resource reserves, most of the countries in this region are heavily dependent on import for their oil supply, which is a major, if not the most critical, concern in the countries energy policies. Though it has been debated intensively, biofuel is perceived as one of the possible options to address the oil security issue since expanding the use of biofuel will not only result to oil demand reduction but also contribute to diversification of liquid fuels' import sources. Moreover, biofuel production also provides an additional way to increase farmer's income.

This study is on the Asian potential in the biofuels market. The study is endorsed and supported by the Economic Research Institute for Association of Southeast Asian Nations (ASEAN) and East Asia (ERIA). Under this ERIA's study, a Working Group was established. The WG is comprised with biofuel policy makers from Indonesia, Malaysia, the Philippines, and Thailand, and researchers from The Institute of Energy Economics, Japan (IEEJ), with IEEJ also working as the coordinator. The 1st phase of the study was carried out from August 2011 to June 2012. In the 1st phase, the study was focused on biofuel development status and future biofuel demand and supply potentials in the 4 ASEAN countries including Indonesia, Malaysia, the Philippines, and Thailand. From June 2012 the 2nd phase of the study was started. In the 2nd phase, though the WG members remained unchanged, the scope of the study was expanded to 16 countries including all the ASEAN countries, as well as Australia, China, India, Japan, New Zealand, and South Korea.

In both the 1st and the 2nd phases, the studies were focused on conventional (or 1st generation) biofuels (bioethnol and biodiesel), though advanced biofuel technologies were discussed during the WG meetings.

In the 2nd phase, biofuel related policies were surveyed for the 16 countries. Based on current policies, future biofuel demands and supply potentials in the 16 countries were estimated and projected. Total bioethanol demand of the 16 countries in 2035 was projected to be 49 million toe and biodiesel 37 million toe, while the supply potential of bioethanol and biodiesel was estimated to be 70 million toe and 57 million toe respectively. The results indicate that the region as a whole would hold enough supply potential to cover biofuel demand driven by the countries biofuel policies to promote use of biofuels. In the demand projection, the constraint of supply was not considered, assuming that the demand was supposed to be met either by domestic production or import (which also means free trade across country). However, mismatches of supply potentials and market sizes (demand) were also found. Countries with large biofuel supply potential may have a small domestic biofuel market, and vise versa. Because of the constraints of supply potential in some countries, if the countries were to fulfill their domestic biofuel consumption (that were supposed to be driven by biofuel policies) solely by domestic production, bioethanol and biodiesel consumptions in the region in 2035 would significantly shrink, both down to about half of the market integration case—26.3 million toe and 16.7 million toe respectively. The differences suggest that a regional integrated market for biofuel trade across countries could help to maximize the region's biofuel use.

However, market integration will be a very complex process. A common market will require common standards for biofuels. Moreover, in Asian countries because of the higher cost of biofuels compared with oil products, national biofuel market is currently totally policy driven, which makes it extremely challenging to further open domestic biofuel market. However, previous studies suggest that if the price of biofuels goes below that of oil products, barriers in cross country biofuel trade will be reduced.

CHAPTER 1
Introduction

Biofuels began to be produced in the late 19th century and until the 1940s, biofuels were seen as viable transport fuels, but falling fossil fuel prices stopped their further development[1]. Interest in commercial production of biofuels for transport rose again in the mid-1970s, when ethanol began to be produced from sugarcane in Brazil and then from corn in the United States.

Nowadays, the United States, Europe, and Brazil are the leading players in the world biofuels market. According to the International Energy Agency (IEA)[2], from 2000 to 2010 world biofuels consumption increased from 10.8 million ton oil equivalent (MTOE) to 50.6 MTOE. In 2010, biofuels provided about 2.4% of world's total transport fuel demand. The United States and Brazil together accounted for 82.9% of the global bio-gasoline consumption in 2010. Europe leads the use of biodiesel, and 67.5% of world biodiesel was consumed in OECD Europe in 2010. The Asia and the Pacific region accounted for only 5.2% of world total biofuels production in 2010 and 4.9% of biofuels use. Within the region, China and India are the biggest two players, with 43.1% of the regions production and 48.4% of consumption in 2010 attributed to the two members.

Driven by energy security concerns, coupled with the desire to sustain the agricultural sector and revitalise the rural economy[3], most Asian countries[4] are

[1] IEA. 2011. *Technology Roadmap Biofuels for Transport*.

[2] IEA World Energy Balances and Statistics 2012

[3] IEA. 2011. *Technology Roadmap Biofuels for Transport*.

[4] ASEAN countries, China, India, Australia, Japan, New Zealand, and South Korea

showing increasing interests in biofuel production and utilization. However, Asian countries vary greatly in biofuel feedstock resources and the scale of biofuel market. For example, Indonesia and Malaysia, as the world two largest palm oil (from which biodiesel can be produced) producers and exporters, have huge potential of biodiesel production. However, there are very few bioethanol productions in the two countries. On the other hand, Thailand has abundant bioethanol production potential and a relatively large domestic market. But the country's potential for biodiesel production is limited (only a limited area in south Thailand has palm plantation). Therefore, a regional integrated market for biofuel trade cross countries is supposed to optimize the biofuel supply and demand in the region.

Built on this background, under the support and endorsement of the Economic Research Institute for ASEAN and East Asia (ERIA) a Working Group was established in 2011 to study Asian Potential of Biofuel Market. The WG is comprised of biofuel policy makers from Indonesia, Malaysia, the Philippines, and Thailand as well as the Institute of Energy Economics, Japan working as the coordinator.

The first phase of the WG's study was completed in June, 2012. In the WG's first phase study, information on the development status of biofuel in the 4 ASEAN countries was collected and analyzed, based on which the 4 countries's future market scale (which is demand) and supply potential of biofuels were estimated. The analysis and discussions at WG meetings led to the finding that given their differences in geographical, social, and economic characteristics coupled with different biofuel policies the 4 countries vary a lot in bioethanol and biodiesel supply potentials and future demands. The projection results suggested that countries with large supply potential in bioethanol or biodiesel not necessarily had big domestic markets in the future and countries that were expected to have a large future demands for bioethanol or biodiesel might not be with sufficient supply potential. This implicated that a regional integrated biofuel market had its rational to be formed.

The second phase of the WG's study started from the summer of 2012. The scope of the second phase was expanded from 4 countries to 16 countries that include the 10 ASEAN countries, China, India, Australia, Japan, New Zealand, and South Korea. Moreover, issues with regional market integration were given deeper and more detailed analysis.

The outcomes of the second phase of the WG's study are summarized in this report, which is structured as follows: Chapter 1 comprises the status of biofuel development and projection and estimation of future biofuel demand and supply potential in each of the 16 countries; The methodology for demand and supply projection and the analysis of the aggregation of the results are put in Chapter 2; Based on the projection results, the potential of the region's biofuel market will be analyzed and discussed in Chapter 3.

CHAPTER 2

Biofuel Promotion and Development in East Asia Countries

2.1. Australia

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

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

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

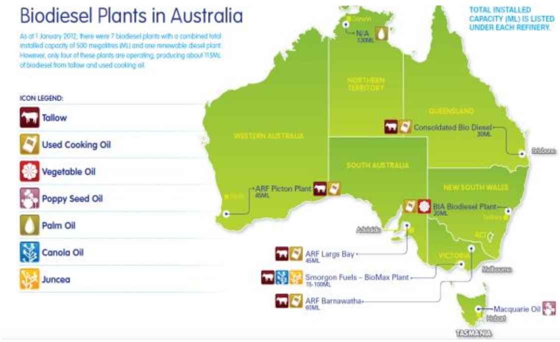
As of Jan. 1, 2012, there were 3 ethanol manufacturers (3 plants, manufacturing capacity of 440,000,000 liters) and 4 major biodiesel manufacturers (manufacturing capacity of 500,000,000 liters). However, as of Jan. 1, 2012, only 4 biodiesel plants were running with production capacity of approx. 100,001,500 liters. The following figures and tables show the locations and the lists of biofuel manufacturing plants.

Figure 1.1-1 Locations and List of Ethanol Plants in Australia

ETHANOL PLANT	LOCATION	OWNER (* BAA MEMBER)	TOTAL INSTALLED CAPACITY (ML) (AT 01.01.12)	FEEDSTOCK	STATUS (AT 01.01.12)
Dalby Bio-Refinery	South, QLD	Dalby Bio-Refinery Pty Ltd*	80	Red Sorghum	In production
Manildra Ethanol Plant	Coastal, NSW	Manildra Group*	300	Waste Starch	In production, plant expansion continuing
Sarina Distillery	Central, QLD	Sucrogen*	60	Molasses (by product from sugar processing)	In production
TOTAL CAPACITY (ML)			440		

Source: Website of Biofuel Association of Australia (BAA).

Figure 1.1-2 Locations and List of Biodiesel Plants in Australia



BIODIESEL PLANT	LOCATION	OWNER (* BAA MEMBER)	TOTAL INSTALLED CAPACITY (ML) (AT 01.01.12)	FEEDSTOCK	STATUS (AT 01.01.12)
ARF Largs Bay	Adelaide, SA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	In production
ARF Picton	Picton, WA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	In production
BIA Biodiesel Plant	Maitland, NSW	Biodiesel Industries Australia*	20	Used cooking oil, Vegetable oil	In production
ARF Barnawatha	Wodonga, VIC	Biodiesel Producers Limited*	60	Tallow, Used cooking oil	In production
Consolidated Bio Diesel	Narangba, QLD	Gull Group*	30	Tallow, Used cooking oil	In production
Smorgon Fuels – BioMax Plant	Melbourne, VIC	Smorgon Fuels Pty Ltd*	15-100	Tallow, Canola Oil and Juncea Oil	In production, possible expansion
N/A	Darwin, NT	Vopak*	130	Palm Oil	Not in production
TOTAL CAPACITY (ML)			500		

Source: Website of Biofuel Association of Australia (BAA).

The following table shows the historical trend of biofuel production and consumption in Australia. During the past 6 years bioethanol experienced a smooth increase in its production and consumption, but the growth of biodiesel was quite moderate.

Table 1.1-1 Historical Trend of Biofuel Production in Australia

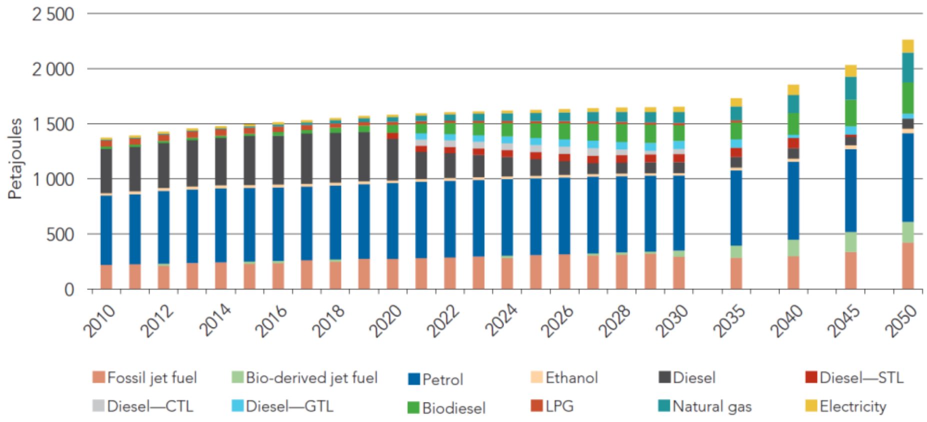
million L

Year End July		2007	2008	2009	2010	2011	2012
Bioethanol	Production	84	149	203	380	440	440
	Consumption	84	149	203	380	440	440
Biodiesel	Production	43	54	98	80	80	115
	Consumption	47	58	109	88.5	105	125

Source: USDA Global Agriculture Information Network (GAIN) Report. 2012. *Australia Biofuels Annual 2012*

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

Figure 1.1-3 Transport fuel mix projection to 2050, by fuel type (PJ)



GTL = gas-to-liquids; CTL = coal-to-liquids; STL = shale-to-liquids.
Source: CSIRO (2011c: Scenario 2).

Source: Australia Energy White Paper 2012

(3) Development Program

(3.1) The Fuel Quality Standards Act 2000

With regard to the 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% or less.
- Diesel: The biodiesel content of diesel is 5% or less.

(3.2) The Ethanol Production Grants Program (Sep. 2002 to end of Jun. 2021)

This program was introduced in Sep. 2002 to subsidize ethanol producers by granting an amount equivalent to the excise duty, which is 0.38143 Australian Dollar per liter of ethanol. The program is ongoing and scheduled for review after 30 Jun. 2021.

(3.3) The Energy Grants (Cleaner Fuels) Scheme (Dec. 2011 to end of Jun. 2021)

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

(3.4) The Ethanol Distribution Program (Finished)

In order to increase the number of retailers (service stations) selling 10% ethanol blended gasoline (E10), the following subsidies were introduced:

- To compensate the cost of installing E10 sales equipment, up to 10,000 Australian Dollars were provided to each retailer who installed such equipment. (From Oct. 2006 to end of Mar. 2008)
- Up to 10,000 Australian Dollars were provided to each retailer who achieved the E10 sales goal within 12 months after installation of E10 sales equipment.

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

The Program is a competitive grants program which 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 closed in January 2009 and the scheme expired in June 2012 [For details, see (4) RD & D Information on Biofuels in Australia].

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

(4) Information on Biofuel RD & D

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

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

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

(ii) Algal Fuels Consortium ($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 ($2.5 million): The project is investigating 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 ($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 ($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 ($2.288 million): Licella will examine the commercial demonstration of lignocellulosics to stable bio-crude.

(4.2) The Australian Biofuels Research Institute (ABRI)

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

(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.

Trend of Biofuel Trade of Australia

The following table shows the historical trend of import and export volumes of biofuels in Australia. Bioethanol is currently not imported.

Table 1.1-2 Transition of Import and Export Volumes of Biofuels in Australia

million L

Year End July		2007	2008	2009	2010	2011	2012
Bioethanol	Imports	0	0	0	0	0	0
	Exports	0	0	0	0	0	0
Biodiesel	Imports	5	4	1	8.5	25	20
	Exports	0	0	0	0	0	0

Source: USDA GAIN Report. 2012. *Australia Biofuels Annual 2012*

In Australia, 1) the 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. 38.143 Australian cents/liter.

2) Excise Tax: Tax imposed on the petroleum products manufactured in Australia. 38.143 Australian cents/liter.

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

Biodiesel is exempted from the 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.

Projection of Biofuel Demand and Supply Potential in Australia[1]

There is no clear policy on target of biofuel use in Australia. In The Fuel Quality Standards Act 2000 the standard for biofuels is set as: the ethanol content of gasoline is 10% or less (E10); and the biodiesel content of diesel is 5% or less (B5). It is assumed that use of E10 and B5 will be fully penetrated by 2035.Bioethanol

[1] The methodology of demand projection and supply potential estimation will be discussed in more details in Chapter 2

demand in Australia is projected to grow to 1667.8ktoe in 2035 from 223.0ktoe in 2010 while biodiesel demand is expected to reach 1067.7ktoe at the end of the projection period from 55.0ktoe in 2010.

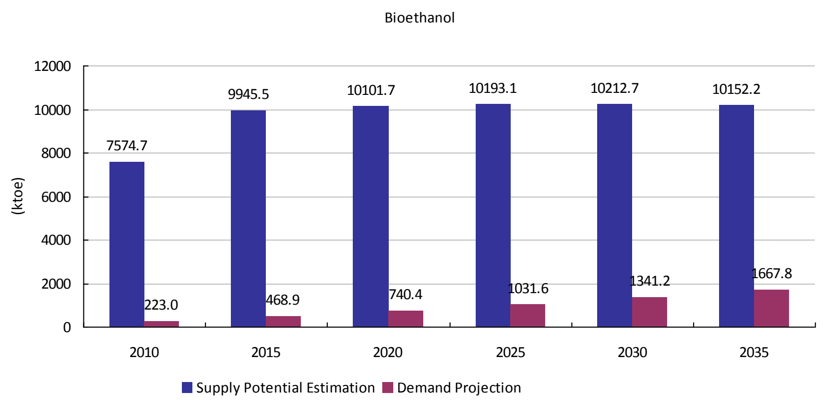
Bioethanol Supply Potential

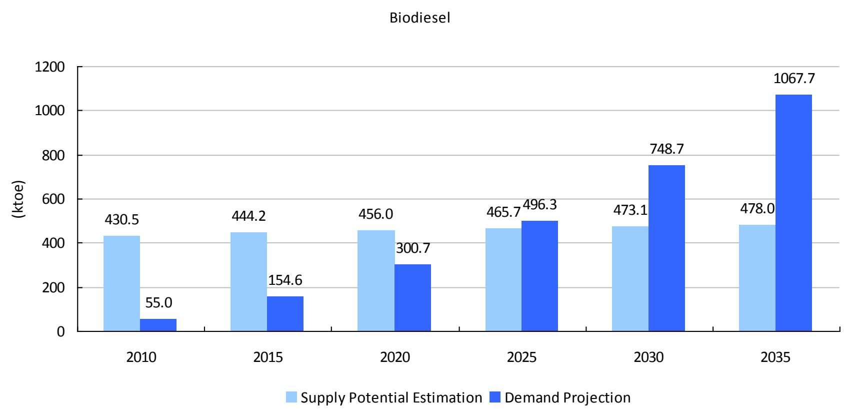
Australia is an exporter of sugar and wheat, which account for a large share in the international market. The country's supply potential of bioethanol is estimated basing on these two crops. In this study, the amount of export (whether as food or not) was also counted as part of the biofuel supply potential. As a result, Australia is supposed to have significant potential of raw materials that can be converted into biofuel after domestic consumption. Australia's supply potential of bioethanol is estimated to be 10152.2 kilo tons oil equivalent (ktoe) in 2035, compared to 7574.7 ktoe in 2010.

Biodiesel Supply Potential

When it comes to biodiesel, animal fat and rapeseed are main potential feedstocks. Supply potential for biodiesel is estimated to be 478.0 Mtoe (biodiesel equivalent) in 2035 expanding slightly from 430.5 ktoe in 2010.

Figure 1.1-4 Biofuel Demand and Supply Potential through 2035 in Australia





Australia has the second largest agriculture land following China in the East Asian region. According to the FAO's (Food and Agriculture Organization) statistics, the agriculture land in Australia is 4.1 million square kilometers, 10 times larger than the land area of Japan. Therefore, the supply potential of energy crops that can be converted into biofuel is high. According to the projection results, Australia is expected to have more than enough supply potential to cover domestic bioethanol demand if E10 were to be fully penetrated in the market. Moreover, Australia also has the potential export bioethanol in the international market. On the other hand, under the assumption that B5 be fully launched by 2035, Australia may face a shortage of domestic biodiesel supply from around 2025.

Australia is a premier supplier of food in the world market, especially in wheat, rapeseed oil and animal fat. The boost of introduction of biofuels in the country will have impact on international food supply.

2.2. Brunei Darussalam

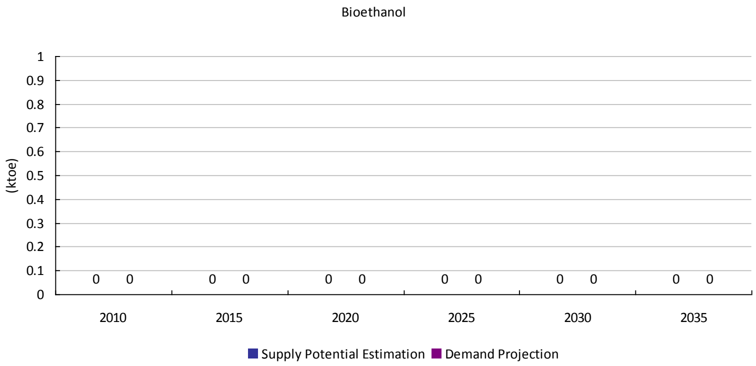
There is no official activity regarding biofuel utilization in Brunei. No information was found.

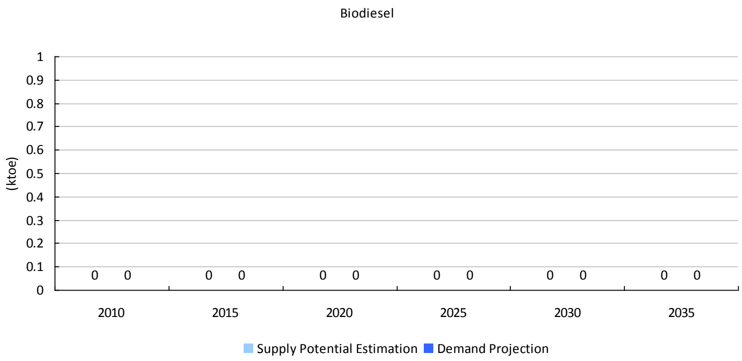
Projection of Biofuel Demand and Supply Potential in Brunei Darussalam

No biofuel use is expected in Brunei Darussalam.

Brunei Darussalam has promoted the production activities of cassava and rice by policy support, but the production are not enough to meet domestic consumption. At present, Brunei Darussalam is dependent on imports for most of the food supply. In this study, it is assumed that the country do not have the spare feedstock to produce biofuel.

Figure 1.2-1 Biofuel Demand and Supply Potential through 2035 in Brunei Darussalam





2.3. Cambodia

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

Until now, the Cambodian government has not established any policies or initiatives for the development of biofuels. It has started a series of discussions to promote the development of biofuel but final results have not been announced yet.

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 institutes like Asian Development Bank (ADB) and Japan Development Institute (JDI), the bio energy policy in Cambodia is expected to follow the precedent in Thailand.

(The Thailand Cabinet adopted the guidelines for promoting the production and utilization of ethanol as a motor fuel in 2000.) The JDI report suggests that both bio-ethanol and bio-diesel plans for Cambodia can be developed using the same raw materials used in Thailand. As in the case of Thailand, palm oil and sugar 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, but there has been some plans according to an ADB report.

Table 1.3-1 Biofuel Development Plans and Targets in the Mekong Region

Year	Plans and Targets
2008	Formal declaration of support by the government
2009~2015	Biofuel production based on Jatropha and cassava for export.
Up to 2020	Domestic biofuel production and blending for local consumption

Source: ADB. Biofuels in the Greater Mekong Subregion January 2012.

(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 bio ethanol 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 ha of oil palms near Sihanoukville. The project is the first commercially motivated attempt to develop a vegetable oil plantation in Cambodia.

After that, a Korean bio energy company (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 also signed a memorandum of understanding with the Cambodian government to promote biofuel production in the country in December 2012. Idemitsu has also been promoting its biofuel business in Vietnam, where the company has begun producing biomass on a test basis.

(4) Information on Biofuel RD & D in Cambodia

There is no information which has been released yet.

(5) Way Forward

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 can not be used as food is very suitable for cultivation in Cambodia. However, the economical viability of producing biodiesel from Jatropha still needs to be established.

Trend of Biofuel Trade of Cambodia

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

Table 1.3-2 Biofuel Production Capacity in Cambodia

Biofuels in Cambodia	Possible Production Capacity	Consumption
Bio diesel	193.2 million liters	No data available
Bio ethanol	93.9 million liters	No data available

Source: Christina Schott. 2009. *Socio-economic Dynamics of Biofuel Development in Asia Pacific*. Published by Friedrich Ebert Stiftung (FES) Indonesia Office. Jakarta. 2009

Projection of Biofuel Demand and Supply Potential in Cambodia

Though there is no clear policy on biofuel development in Cambodia currently, given the government's intention to promote biofuel production and utilization to reduce the country's reliance on import petroleum fuels it is assumed that 5% of the country's liquid fuel demand for road transport will be substitute by biofuels in 2035. Under this assumption Cambodia's demand for bioethanol and biodiesel is projected to reach 19.4ktoe and 30.1ktoe respectively.

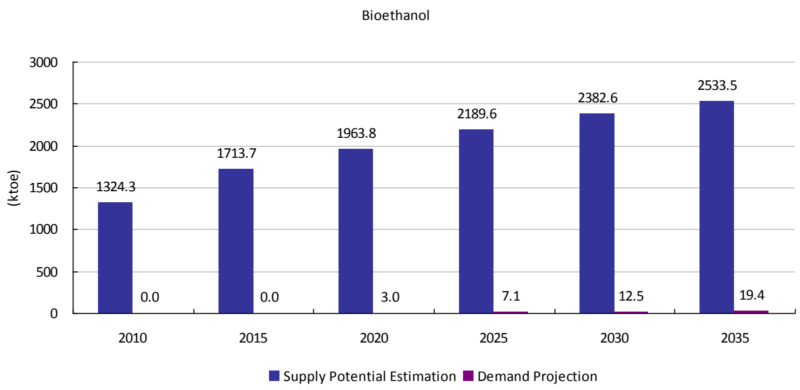
Bioethanol Supply Potential

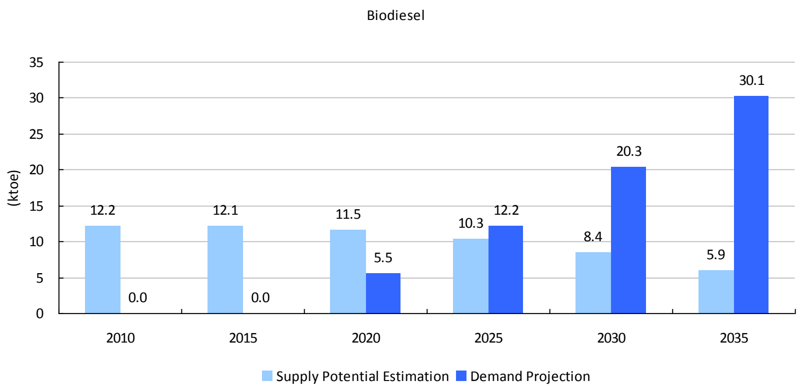
Cassava, maize, rice and sugarcane (molasses) are supposed to be the main feedstocks for bioethanol production in Cambodia. In the case of cassava, because it is not a major crop for food in Cambodia, a lot of foreign capital has been invested to cassava plantation to produce bioethanol, making it an potential export industry of the country. The supply potential of bioethanol is estimated to be 2533.5 ktoe in 2035 expanding from 1324.3 ktoe in 2010.

Biodiesel Supply Potential

Currently the major oilseed crop in Cambodia is soybean. Soybean production have a slightly spare capacity after domestic consumption and export. However, given the rapidly growth of population, demand for edible oil is expected to increase accordingly, leaving little potential for export. Supply potential of biodiesel is estimated to be 5.9 ktoe in 2035 decreasing from 12.2 ktoe in 2010.

Figure 1.3-1 Biofuel Demand and Supply Potential through 2035 in Cambodia





Since the end of years of civil conflicts, agricultural activity in Cambodia has recovered significantly and crop production has increased rapidly. The country's cultivation land is large but its population is relatively small. This condition indicates that Cambodia might have a good potential to export crops in the future. The government has formulated a plan to promote use of biodiesel, but there is no mandatory. At present, production of oil crops is low, and imports of edible oil is required. However, the government's intention to promote biodiesel use is largely built on its perception of Jatropha, which is not edible but could be used to produce diesel. The Cambodian government is planning to attract more foreign investment in the cultivation of Jatropha, but significant results have not been observed.

On the other hand, production of rice, cassava, corn and sugar cane has expanded rapidly and the export is increasing steadily driven mainly by demand (both for domestic consumption and re-export) from Thailand. Among them, foreign investment to cassava cultivation to produce bioethanol has increased. Cambodia has the potential to become a bioethanol exporter in future.

2.4. China

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

The Chinese government adopted the "National Economy and Social Development - 12th 5-Year Plan Outline (mention as 12th 5-Year-Plan hereafter)" (2011 to 2015) at the 4th Congress of China's 11th-Period National People's Congress in Mar. 2011. One of the targets set in the 12th 5-Year-Plan was to increase the share of clean energy in total primary energy supply to 11.4% by 2015.

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

(2) Target

According to the "12th 5-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% by 2015, within which the target for biofuels is: 3,500,000 tons of annual bioethanol consumption and 1,500,000 tons of annual biodiesel consumption by 2015.

Table 1.4-1 Renewable Energy Development 12th 5-Year Project in China

	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.

(3) Development Program

China's bioethanol fuel introduction project began with the "Ethanol-Blended Gasoline Development Program" under the 10th 5-Year Plan starting from 2001. In March 2002, the "Bill for Testing 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 in order to develop legislation, set up a governmental competent department, and establish raw material procurement, production, transportation and sales systems.

In February 2004, the “Act for Testing Expansion of Ethanol-Blended Gasoline for Cars” and the “Administrative Instructions for Testing Expansion of Ethanol-Blended Gasoline for Cars” were announced to launch expanded introduction of bioethanol fuels. Within the expansion program, 4 bioethanol producing companies were designated and the region of biofuel introduction was expanded to 5 provinces and 27 cities. By the end of 2005, bioethanol consumption reached 1,020,000 tons, and about 20% of national gasoline consumption was E10.

While, 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 expanding 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 bio-ethanol producer in the world after the United States and Brazil. There are five ethanol plants in China: four 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 2,103,000 kl of ethanol. The plant using 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 to approve further land use for facility expansion. The blend rate of ethanol was 8 to 12%, changing depending on the market price of oil.

China’s production volume of fuel ethanol was estimated at 2,433,000 kl in 2012, an 8% increase from the 2011 level. There is no change to the government’s policy that biofuel should be developed on the precondition that the nation’s 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, but sweet sorghum has not been grown on a large scale yet.

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

Because of soaring food prices after 2008, the Chinese government has been forced to tighten management of the grain handling department including production of ethanol. As a result, financial support for production of grain based ethanol was reduced and the subsidy for ethanol production was dropped to 6 cents per liter in 2011. By 2015, the Ministry of Finance of China intends to abolish refund of the value added tax and impose a 5% consumption tax on production of grain based ethanol.

Table 4-2 Government Subsidy for Production of Fuel Ethanol in China (In cents/liter)

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

Notice: U.S. $1 = 6.8 yuan

Source: USDA.

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

After 2008, the Chinese government has implemented mandatory blending of ethanol in 6 provinces (Heilongjiang, Jilin, Liaoning, Henan, Anhui, and Guangxi) and 27 cities in Hubei, Hebei, Shandong and Jiangsu provinces. These districts and cities were chosen because they were close to the grain production areas, and PetroChina and Sinopec were mandated to blend 10% ethanol into gasoline. Production of fuel ethanol is premised on use based mandatory blend or consumption planning 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 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 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 the U.S.-China energy cooperation program in 2011, the United States and China launched 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 focused on some non-grain sweet sorghums which 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 subsidize this scheme, and the provincial government has not made clear when to impose the mandatory blend.

(5) Way Forward

Aircraft jet fuel consumption in China is currently 20,000,000 tons and is projected to reach 40,000,000 tons in 2020. In May 2012, the Civil Aviation Administration of China, (CAAC) announced a plan to substitute 12,000,000 tons (30%) of jet fuel with biofuels by 2020.

Development was initiated on biofuel production using algae. In September 2010, U.S. Boeing Company and 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 5 years and its commercialization within 10 years.

Trend of Biofuel Trade of China

Tentatively, China imposes a 5% import duty on imports of denatured alcohol. The duty rate has been greatly lowered from 30% 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%. Both non-denatured alcohol and denatured alcohol are subject to 17% value added tax and 5% consumption tax.

Table 1.4-3 Import Volume of Ethanol in China (In kiloliters)

	2007	2008	2009	2010	2011
Non-denatured alcohol	154	293	28	392	160
Denatured alcohol	524	109	130	3,220	5,145
Total	678	402	158	3,612	5,305

Source: USDA.

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 1.4-4 Supply and Demand of Bioethanol (In 1,000 kiloliters)

	2006	2007	2008	2009	2010	2011	2012
Production	1,647	1,736	2,002	2,179	2,128	2,255	2,433
Export	0	0	0	0	0	0	0
Import	0	0	0	0	0	0	0
Consumption	1,647	1,736	2,002	2,179	2,128	2,255	2,433
Number of Plants	4	4	4	5	5	5	5
Capacity	1,824	1,824	2,065	2,243	2,178	2,255	2,433
Main Feedstock (1000 ton)							
Corn	3,200	3,200	3,700	4,000	3,900	4,284	4,599
Wheat	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Cassava	0	0	340	470	392	336	448

Source: USDA.

Table 1.4-5 Supply and Demand of Biodiesel in China (In 1,000 kiloliters)

	2007	2008	2009	2010	2011	2012
Production			341	341	454	568
Export	0	0	0	0	0	0
Import	0	0	0	0	0	0
Consumption	0	0	>170	>150	>200	>250
Number of Plants				20	20	20
Capacity			n.a.	n.a.	3408	3408

Source: USDA.

Projection of Biofuel Demand and Supply Potential in China

Biofuel utilization in China is expected to reach the government's target in its 12th

Five-Year-Plan (4million liter of bioethanol and 1million liter of biodiesel till 2015). From 2016 to 2035, the blending rate for both bioethanol and biodiesel is assumed to stay the same as that of 2015, which will translate into a demand for 6923.5ktoe of bioethanol and 4003.9ktoe of biodiesel in 2035.

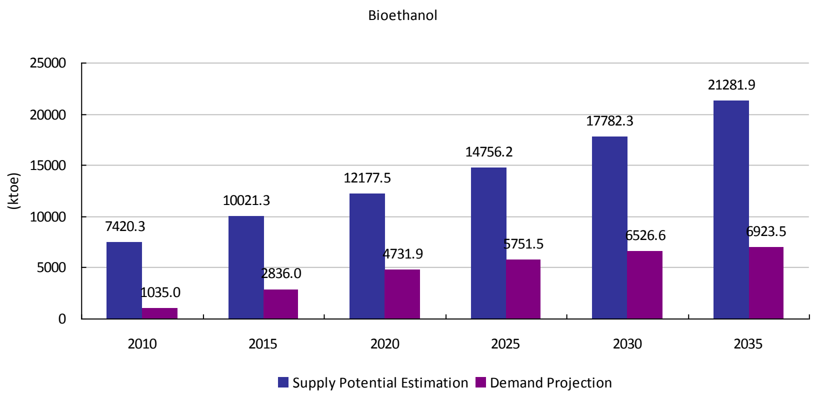
Bioethanol Supply Potential

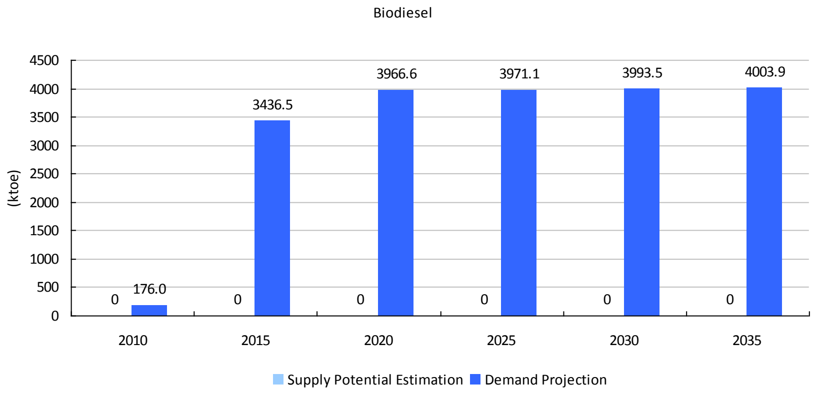
Potential feedstock crops for bioethanol production in China are maize, sugar cane (molasses), rice and cassava. Among them, cassava and molasses are expected to become major feedstocks for bioethanol production because they are not main food crops for Chinese consumer. A few state enterprises are allowed to use the old storage of rice and corn to produce bioethanol. Supply potential of bioethanol is estimated to expand from 7420.3 ktoe in 2010 to 21281.9 ktoe in 2035.

Biodiesel Supply Potential

China's rapeseed production is one of the largest in the world. According to the FAO statistics, China produced 13.43 million tonnes of rapeseed in 2011 accounting for 21.5% of the world's total. Although China is also one of the largest producer of cooking oil including soybean oil and cotton oil currently, the country is a net importer of cooking oil. Therefore, in this study it is assumed that China does not have the spare feedstock to produce biodiesel.

Figure 1.4-1 Biofuel Demand and Supply Potential through 2035 in China





China is a country with high self-sufficiency of food supply in Asia. FAO data shows food self-sufficiency in China maintained more than 95% in 2011. Nevertheless food supply security is on top of the government's policy agenda given the country's large population and its history of social chaos caused by food shortage. The use of crops to produce biofuel is tightly regulated by the government. Only a few state-own enterprises have the permission to use the old storage of maize to produce bioethanol. Meanwhile, the cultivation area of cassava is expanding rapidly in the southern region of the country, driving up feedstock supply for bioethanol.

As to biodiesel, because domestic production of cooking oil is not enough to meet the consumption China is importing cooking oil. Under this condition, spare feedstock for biodiesel production is hardly expected. There are some programs on biodiesel production from used cooking oil, but they are not spread to nationwide.

2.5. India

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

It has been longer than a decade since a biofuel policy was put on India's policy agenda. India implemented a biofuel 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.[2] As India needs to strengthen energy security, it is important for India to

[2] Based on International Energy Agency's Energy Balances of Non-OECD 2012, demand for crude oil in India grew at an annual rate of 6.4% between 2001 and 2010.

identify indigenous energy sources in order to meet domestic energy demand and reduce oil imports.

Furthermore, being the world's third largest emitter of carbon dioxide (CO_2), India has implemented policies such as automotive fuel economy policy as well as biofuel policy, since they are expected to contribute to reductions of greenhouse gas emissions. For instance, in 2003, India introduced the Auto Fuel Policy. Under this policy, Bharat Stage IV (Euro IV equivalent) norms for fuels and vehicles were in effect from April 1, 2010 in 13 cities of India, and Bharat Stage III (Euro III equivalent) was applied to the rest of the country.[3]

National Biofuel Mission

In 2003, under the aegis of the Planning Commission, 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 objective of these programs were to initiate blending of biofuels with transport fuels on a commercial scale.[4]

Before the National Biofuel Mission started, an ethanol pilot program which proposed to blend 5% 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 in January 1, 2003.[5] 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

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[3] 13 cities include Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Lucknow, Camper, Agra, Surat, Ahmedabad, Pune, and Sholapur.

[4] S. Raju, *et al.* 2012. Biofuels in India: Potential, Policy and Emerging Paradigms. National Centre for Agricultural Economics and Policy Research. Policy Paper 27.

[5] Asian Development Bank. 2011. *India: Study on Cross-Sectoral Implications of Biofuel Production and Use*. Manila.

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.

recommendation for increasing the ethanol blending mandate to 10%, the Cabinet Committee on Economic Affairs implemented E5 blends nationwide in September 2007.

For biodiesel, India started a biodiesel program in 2003 with a target of a mandatory 20% biodiesel blending by 2011-2012, identifying *Jatropha curcas* as the most suitable tree-borne oilseed for biodiesel production. In order to support the program, the Ministry of Petroleum and Natural Gas enacted a National Biodiesel Purchase Policy and set a price of 25 rupees (Rs.) per liter, which took effect on November 1, 2006 and was raised to Rs. 26.50 per liter in October 2008.[6]

National Policy on Biofuel

In December 2009, India adopted the National Policy on Biofuels (the Biofuel Policy hereafter) with a target of 20% blending of biofuels by 2017. The 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 increasing demand for food associated with its vast population and stagnate agricultural productivity. Hence, the Biofuel Policy specifies that the program is to be carried out based on non-food feedstocks raised on degraded or wastelands which are not suited to agriculture in order to avoid conflict with food security.[7] In addition, the 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 implementation and coordination of the policy with regards to biofuels, several other Ministries are also involved in biofuel development and promotion e.g., Ministry of Environment and Forests, Ministry of Petroleum and Natural Gas, and Ministry of Rural Development, to name a few. 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. In addition, the Biofuel Policy suggests establishing a Biofuel Steering Committee to provide effective guidance and to oversee implementation of this policy on a regular basis.

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[6] Ibid.

[7] S. Raju, *et al*. 2012. Biolfuels in India: Potential, Policy and Emerging Paradigms. National Centre for Agricultural Economics and Policy Research. Policy Paper 27.

In February 2011, the Ministry of New and Renewable Energy issued a Strategic Plan for the New and Renewable Energy Sector for the Period 2011-17. In the medium term, second generation biofuels are expected to have potential.

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% ethanol blending into gasoline. In other words, starting from 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% blending of biofuels both for ethanol and biodiesel by 2017. Currently, there is no mandatory blending target for biodiesel. The target is planned to be phased in over time; 5% blending by 2012, 10% by 2017 and 20% after 2017. The noticeable feature of India's biofuel policy is that the country focuses on non-food products as biofuel feedstocks, which are raised on degraded or wastelands that are unsuitable for agricultural cultivation, in order to avoid conflict with food security.

Ethanol Production

In India, ethanol is produced from sugar molasses for blending with gasoline. Approximately 90% 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% of sugarcane produced in India is used for sugar production and the remaining is for alternative sweetners and seeds. About 85 – 100 kg of sugar (8.5% – 10%) and 40 kg (4%) of molasses can be produced from one ton of sugarcane. Sugarcane is subject to periodic and alternate cycles of surplus and shortages with a typical 6 to 8 year cycle; 3 to 4 years of higher production are followed by 2 to 3 years of lower production.[8] The Table below shows that the level of sugarcane production in the year 2009-2010 did not reach that of the year 2000-2001, and the yields were stagnant for the last decade.

[8] Ibid.

Table 1.5-1 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

Source: (Before 2005-2006) S. Ray et al. Ethanol Blending Policy in India: Demand and Supply Issues. Indian Council for Research on International Economic Relations (ICRIER) Policy Studies No.9. December 2011. p7. (After 2006-2007) S. Raju, et al. 2012. Biofuels in India: Potential, Policy and Emerging Paradigms. National Centre for Agricultural Economics and Policy Research. Policy Paper 27. p34.

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

Second, instability in ethanol prices caused by the high degree of unstable ethanol production renders uncertainty to both the oil marketing companies and the 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. At the time of low availability of sugar molasses, its price goes up, which results in increased cost of ethanol production. Hence, the ethanol production may be disrupted due to the high cost of ethanol production, while ethanol prices are fixed by the government, thereby making it difficult to earn profits. Furthermore, since the ethanol distillers seem to receive a favorable 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. As the Table below shows, approximately 70~80% 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, the production capacity may be required to meet the higher blending target in the future. The production capacity increased to 2 billion liters in 2012 from 1.5 billion liters in recent years (Table 1.5-2). Similarly, the number of bio-refineries increased to 140 in 2012 from 115. Current ethanol production capacity is estimated to be sufficient to meet the ethanol demand for the 5% blending with gasoline. However, this capacity level would not be adequate to implement the 10 and 20% blending targets in the future unless new capacity is added. Nevertheless, the actual blending level has been around 2% against the mandatory target of 5%.

Fourth, other than sugar molasses, non-food 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 favorable choices found in potable and industrial alcohol. Since molasses alone does not provide a viable option for achieving the target of 20% blending, alternative non-food crops is necessary for ethanol production. For instance, there is potential for sweet sorghum and tropical sugar beet as biofuel feedstock. However, 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 the possibility of competing with food crops for land and water resources. Therefore, these two non-food crops are expected to play only a supplementary role in the ethanol industry until it is proved that yields can be adequate to meet commercial production level.[9]

Table 1.5-2 Conventional Bioethanol Production and Distribution in India

unit: million liters

Calendar Year	2006	2007	2008	2009	2010	2011	2012	2013
Beginning Stocks	483	747	1,396	1,672	1,241	1,065	756	911
Production	1,898	2,398	2,150	1,073	1,522	1,681	2,170	2,239
Imports	29	15	70	280	92	20	80	50
Total Supply	2,410	3,160	3,616	3,025	2,855	2,766	2,901	2,995
Exports	24	14	3	4	10	15	10	15
Consumption								
Industrial Use	619	650	700	700	720	700	720	740
Potable Liquor	745	800	850	880	900	850	880	910
Blended Gasoline	200	200	280	100	50	365	400	450
Other Use	75	100	110	100	110	80	85	85
Total Consumption	1,639	1,750	1,940	1,780	1,780	1,995	2,085	2,135
Ending Stocks	747	1,396	1,673	1,241	1,065	756	911	1,000
Total Distribution	2,410	3,160	3,616	3,025	2,855	2,766	3,006	3,200
Production Capacity(Conventional Fuel)								
No.of Biorefineries	115	115	115	115	115	115	140	140
Capacity(billion liters)	1.5	1.5	1.5	1.5	1.5	1.5	2	2
Feedstock Use(1,000MT)								
Feedstock A(000'tons)	7,910	9,992	8,958	4,469	6,342	7,004	9,041	9,330

Note: Feedstock A is molasses.

Source: USDA GAIN Report. 2012. *India Biofuels Annual 2012*. Pp 11-12.

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 tons 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)

[9] Asian Development Bank. 2011. *India: Study on Cross-Sectoral Implications of Biofuel Production and Use*. Manila.

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 set an ambitious target of covering 11.2 to 13.4 million hectares of land under Jatropha cultivation by the end of the 11th Five-Year Plan (2007-2012). However, currently, Jatropha occupies merely around 0.5 million hectares of wastelands across the country.[10]

Consequently, biodiesel production from non-edible oilseeds is considered still at infancy on a commercial scale. Commercial production and marketing of Jatropha-based biodiesel is estimated at 140 to 300 million liters per year. There are about 20 large-capacity biodiesel plants (10,000 to 200,000 metric tons per year) in India that produce biodiesel from alternative feed stocks. Yet, it is reported that most biodiesel companies work at low capacity and some are idle.[11]

There are obstacles that slow down 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 Rs. 26.50 per liter remains lower than the cost of biodiesel production which is estimated

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[10] S. Raju, *et al*. 2012. Biofuels in India: Potential, Policy and Emerging Paradigms. National Centre for Agricultural Economics and Policy Research. Policy Paper 27.

[11] USDA GAIN Report. 2012. *India Biofuels Annual 2012*.

at Rs. 35 to Rs. 40 per liter. The impeding factors of India's undeveloped biodiesel market such as inadequate supply of Jatropha seeds and inefficient marketing channels would also contribute to the higher production costs.

The second impediment is associated with the ownership issues of wastelands which 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 utilization of the privately owned wastelands would not be possible unless the 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, very little progress on Jatropha plantations deters biodiesel production on a commercial scale. The large scale Jatropha plantations have not been successfully implemented by state governments partially due to lack of coordination of 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 been identified yet.

Diesel demand is projected to grow by 35% to 87.4 million tons during the 12th Five-year plan (2012-2016). This indicates that meeting a 5% blending target will require an additional 4.1 million hectares under Jatropha.[12] Apparently, India needs to increase biodiesel production by increasing Jatropha plantations in order to meet the blending target.

[12] Ibid.

(3) Development Program

The Biofuel Policy identifies several measures to promote biofuel production. Financial measures such as subsidies and preferential financing are proposed in the policy.

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 implementation of MSP after consultation with stakeholders including central and state governments and the Biofuel 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 (OMC) would be based on the actual cost of production and import price of ethanol. On the other hand, 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 make a decision on it.

In April 2010, the Empowered Group of Ministers decided to increase the ethanol price to Rs. 27 per liter, an increase from Rs 21.50 per liter which was fixed in 2007 as the MPP. Meanwhile, the biodiesel price has remained at the level of Rs. 26.50 per liter since October 2008 although it is perceived to be below the production cost.

Financial and Fiscal Incentives

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

Currently, the Government of India offers subsidized loans through sugarcane development funds to sugar mills for establishing an ethanol production unit. The loans would cover up to 40% of the project cost.[13] 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.

For research, development and demonstration (RD&D) projects, the policy refers grants which would be provided to academic institutions, research organizations, specialized centers 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 research and development on biofuel crops. The Biofuel Policy aims to put high priority on indigenous R&D and technology development based on the local feedstocks and needs. Specifically, the policy identifies areas to focus, i.e.

[13] Ibid.

production and development of quality planting materials and high sugar containing varieties of sugarcane, sweet sorghum, sugar beet and cassava; advanced conversion technologies for first and second generation biofuels including conversion of lingo-cellulosic materials; technologies for end-use applications including modification and development of engines for the transportation sector and for stationary applications for motive power and electricity production; and utilization of by-products of bio-diesel and bio-ethanol production processes. Furthermore, 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).[14]

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 of reliable seed source, intercropping trails, developing suitable package of practices, post-harvest tools and technology and detoxification of oil meal of important tree-borne oilseeds.[15]

The Department of Biotechnology, Ministry of Science and Technology, initiated

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[14] Ministry of New & Renewable Energy, Government of India. 2009. *National Policy on Biofuels.* New Delhi.

[15] S. Raju, *et al*. 2012. Biofuels in India: Potential, Policy and Emerging Paradigms. National Centre for Agricultural Economics and Policy Research. Policy Paper 27.

The institutes involved were 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.

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. Given the 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.[16]

In spite of some R&D efforts initiated, however, 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 organization 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 Central Government and State Governments

It is challenging for India to reduce discrepancy in policy and administrative matters concerning biofuel utilization between the central government and the state governments. Although the central government is responsible for strategic decisions over biofuel policies, the fact that agriculture is under the jurisdiction of the state

[16] Ibid.

governments renders 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. The following Table 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, transportation and trade of biofuels. Therefore, it is critical for biofuel plantation programs to have an integrated approach across various states.

Table 1.5-3 State Biofuel Initiatives in India

Initiative	Andhra Pradesh	Rajasthan	Tamil Nadu	Uttarakhand
Feedstock explicitly favored	Pongamia	Jatropha, Karanj and other oil seed 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. Free seedlings distributed to small and marginal farmers	Government of India funded for 75 lakhs of seedlings in 2006-07 and for 174 lakhs of seedlings in 2007-08.	50% government subsidy for Jatropha seedlings	Seedlings financed by the government
Minimum support price	Pongamia seeds: Rs. 10/kg, adjusted soon Jatropha seeds: Rs.	Jatropha: Rs. 7/kg	No	Jatropha seeds: Rs. 3/kg, SVO: Rs. 18/kg

	6/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

TBO: tree-borne oilseeds, SVO: straight vegetable oil, VAT: value-added tax

Source: Asian Development Bank. 2011. *India: Study on Cross-Sectoral Implications of Biofuel Production and Use*. Manila.

Economic Viability

Establishing the appropriate investment environment is fundamental to facilitate biofuel production. However, in India the biofuel market does not necessarily intrigue the investors primarily because a government fixed price of ethanol and biodiesel does not reflect the market and could be set at a price level which would not yield profits. As mentioned earlier, 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 the distillers. In addition, the distillers are forced to utilize less than their actual plant capacity due to inadequate amount of molasses. Recent aforementioned ethanol policy change that enables the market to set the price is expected to improve the situation. In the case of biodiesel, its current price at Rs. 26.50 per liter which was set administratively is not adequate to be remunerative. The biodiesel price needs revision to meet financial costs.

Further Research on Biofuels

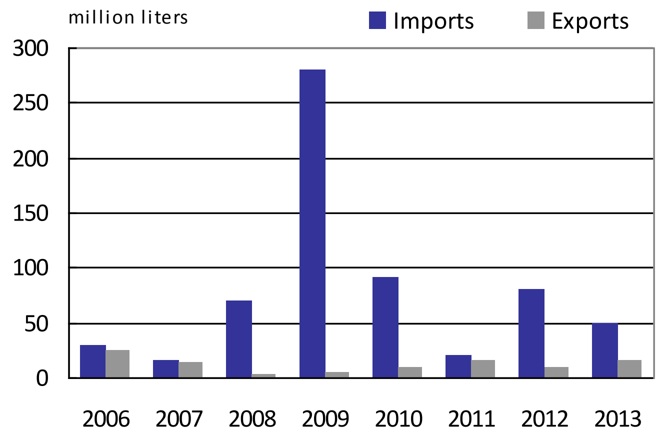
With current technologies available in India, the 20% blending target by 2017 does not seem feasible or sustainable for both ethanol and biodiesel. Deployment of improved technology and better management practices are means to bring down the ethanol production cost. Meanwhile, the current situation in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

Even when the ethanol production is fully developed and feasible if reasonable prices are provided to producers, the biodiesel market is still in its infancy. More groundwork on research and development is necessary to produce biodiesel on a commercial scale. For instance, 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 enable the biodiesel production to increase.

Trend of Biofuel Trade of India

India usually imports ethanol only when it falls short during years of low sugar production. The following Figure shows that ethanol imports significantly increased in 2009 when the drought resulted in a substantial reduction in sugarcane production.

Figure 1.5-1 Conventional Bioethanol Trade in India



Source: USDA GAIN Report. 2012. *India Biofuels Annual 2012*. Pp 11-12.

Although there are no quantitative restrictions on imports of biofuels, high duties make imports economically unviable. The Indian government does not provide any financial assistance for exports of biofuels.[17]

Table 1.5-4 Import Duty on Biofuel in India

Denatured Ethyl Alcohol and Spirits (including ethanol)	28.64%
Chemical Products NES (including biodiesel)	28.64%

Source: USDA GAIN Report. 2012. *India Biofuels Annual 2012*. P 13

Projection of Biofuel Demand and Supply Potential in India

The Biofuel Policy sets out an indicative target of achieving 20% blending of both bioethanol and biodiesel. If the target was to be realized, the annual demands for bioethanol and biodiesel are projected to reach 21043.2ktoe and 17030.8ktoe respectively in 2035.

Bioethanol Supply Potential

Although there are several kinds of energy crops planted in India, due to domestic consumption of these crops for food most of the crops are not available for fuel production. Among them, only sugar cane (molasses) and a small amount of maize have the potential to become feedstock for bioethanol production. Based on this situation, it is estimated that the supply potential of bioethanol in 2035 will reach 11711.2 ktoe, increasing from 7314.0 ktoe in 2010.

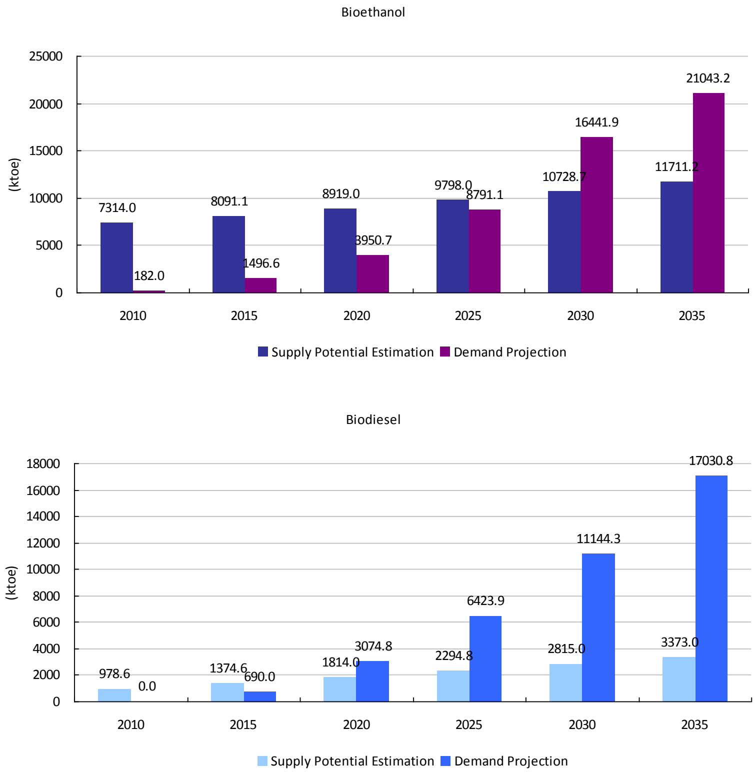
Biodiesel Supply Potentiall

Coconut, rapeseed and soybean are the major oilseed crops in India. India's production of rapeseed accounted for 13.1% of the world's total in 2011. However, given the country's large and growing population, demand for cooking oil in India will continue to increase in the future thus spare capacity of oilseed crop that can be converted into biodiesel can hardly be expected to expand significantly. The supply potential of biodisel is estimated to reach 3373.0 ktoe in 2035 from 978.6 ktoe in

[17] USDA GAIN Report. 2012. India Biofuels Annual 2012.

2010.

Figure 1.5-2 Biofuel Demand and Supply Potential through 2035 in India



India is a country that has maintained a higher than 90% food self-sufficiency. However, the country relies on import are wheat, cooking oil, and animal fat used as cooking oil. The projection results indicate that if the target for biodiesel use were to be fulfilled by domestic supply alone it will have a negative impact on domestic supply of cooking oil. The Government of India has trying to develop the non-edible crop like Jatropha, but the program does not raise a clear outcome. To realize the penetration of B5 (5%), it is necessary to rebuild the biodiesel feedstock supply system.

On the other hand, maize and sugar cane has a production surplus after the domestic consumption. The surplus could be used as a feedstock for bioethanol production. However, the results show that around 2025 there is expected to be a shortage of bioethanol supply to meet the domestic demand (driven by government biofuel policy) and thus extra measures to promote domestic production of bioethanol feedstock is required in the medium- to long- term.

2.6. Indonesia

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

Biofuels development in Indonesia is one of the government efforts towards energy diversification by the new National Energy Policy (KEN, 2006) which has set a target of more than 5% biofuels share in the national energy mix by 2025. Biofuels development plan had also been socialized in the Government Planning Document (Blueprint for National Energy Plan; PEN 2005 ~ 2025) 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 basic policy on biofuel promotion in Indonesia. Under PI No.1/2006, several regulations relate to the provision of facilities and incentives for developing biofuels. These include: Government Regulation No. 1/2007 on Income Tax Facility for Capital Investment in Certain Business Sectors and / or Areas; Government Regulation No 8/2007 on Government Investment; Minister of Finance Decree No. 117/PMK.06/2006 on Credit for Bio-energy Development and Revitalization of Plantations (KPEN-RP); and 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 up to 30% of the realized investment spread over 6 years
- Accelerated depreciation and amortization
- Loss carried forward facility for a period of no more than 10 years
- 10% 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 (GOI). The first one is the "Coordination Team on Alternative Energy Provision and Utilization Action Program" through the 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 that includes 3 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 structure of the team and stated the work period of the team.

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 as well as co-ordinate the efforts of relevant parties, and also monitor and evaluate the implementation activities. As part of their duty, TimNas BBN had also established a blueprint for biofuels development, which included a roadmap towards favorable conditions to be achieved during the period 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 an 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 limitation of 10%.

To accelerate biofuels development, the GOI had 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) utilization mandatory for transportation, 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 GOI issued a 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 unemployment reduction, the GOI divided the roadmap into two main periods - medium term from 2006 ~ 2010 and long term from 2010 ~ 2025. The GOI's target for the medium term was for creating job opportunities and reducing poverty, while for the long term the target was to achieve 5% share of biofuels in the national energy mix by 2025. The GOI's targets for the medium term until 2010 were as follows[18]:

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

Unfortunately, there is not much information on the realization of the targets that had been planned. The government has also required the mining industry sector to use biofuels no 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.

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[18] Timnas BBN. 2006. Blueprint of Biofuels Development for Accelerating Poverty Alleviation and Unemployment Reduction.

(2.1) Realization of Biofuels Utilization

Realization of biofuels has not been maximized. Although there is mandatory use of biofuels according to the DEMR Regulation (No 32/2008), but its realization has not met the mandatory requirements .

Table 1.6-1 Biofuel Utilization in Indonesia

Category	Unit	2009	2010	2011	2012*
Biodiesel Utilization					
Mandatory	kL	775,941	1,076,051	1,297,000	1,400,000
Realization	kL	119,348	223,041	358,812	480,359
Percentage of Utilization	%	15.38	20.73	27.67	34.31
Bioethanol Utilization					
Mandatory	kL	215,842	660,980	694,000	244,000
Realization	kL	1,058	0	0	0
Percentage of Utilization	%	0.49	0	0	0

Note: * Status on 30 October 2012
Source: Ministry of Energy and Mineral Resources

Biofuels is mainly utilized in three sectors, which are transportation sector, industrial sector and power generation.

Transportation Sector

PERTAMINA as a Public Service Obligation (PSO) and main distributor of transportation fuel has utilized biofuels as a mix in several of their 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% to 7.5%. This step is part of the contribution to increase the use of renewable energy. In determining the suppliers of FAME, PERTAMINA prioritizes national suppliers of FAME who utilize domestic resources so that PERTAMINA indirectly plays a role in supporting the growth of FAME producers and industry employment[19]. The table below summarizes the realization on sales of PERTAMINA's biosolar, biopremium and biopertamax

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

(PERTAMINA's brand names for biofuel blended with high grade gasoline)[20].

Table 1.6-2 PERTAMINA's Sales Volume for Biosolar, Biopremium & Biopertamax (Indonesia)[21]

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: PERTAMINA

Industrial Sector

The utilization 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 the biodiesel utilization, experts believe that the use of biofuel should first be implemented in industries under state owned enterprises so that it can be followed by private industry.

Power Generation

In addition to the transportation and industrial sectors, biofuels have the potential for utilization in power generation. In 2006, there were 12.5 MW of PLN power generated with the use of PPO (Pure Palm Oil), which consisted of 11 MW in Lampung and 1.5 MW in Nusa Penida Bali[22]. Meanwhile, the National Team on Biofuels Development reported that until December 2007, installed capacities for PLN power generation using biofuels was about 96 MW. The installed capacities of

[20] Biosolar = Biodiesel blend fuel, Biopremium and Biopertamax = Bioethanol bland fuel
[21] Directorate of Marketing and Business, Pertamina, May 24, 2011
[22] National Team Report of Biofuels Development, 29 December 2006

96 MW consisted of North Sumatera (4.6 MW), Riau and Kepulauan Riau[23]. These numbers show a significant increase compared to the year 2006. Nevertheless it was clear that biofuels utilization by PLN's power plants was still limited.

(2.2) Realization of Biofuels Production

Biofuels Producers Association of Indonesia (Aprobi) recorded that the realization of the production of biodiesel until 28 November 2011 was about 400 thousand kiloliters or 30.84% of the mandatory program on the use of biofuels specified in the State Budget (Amendment 2011) at 1,297 million kiloliters. The chairman of Aprobi said that the low production of biodiesel due to poor biofuel price formula is not relevant anymore[24].

(2.3) Realization 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 (World Bank, 2008). Especially job opportunities in the biofuels agricultural sector absorbed more workforce than in the industrial sector. According to the Biofuels National Team report, realization of workers absorbed on farm and off farm until December 2007 were respectively 599 thousand and 1,040 people, or 17% 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.

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[23] Riau (23.1 MW), Lampung (11 MW), Bali and West Nusa Tenggara (3.5 MW), West Kalimantan (4 MW), East Kalimantan (26.0 MW), South and Central Kalimantan (19.9 MW) and Maluku (3.9 MW)

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

(2.4) Realization 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 4 trillion rupiah consisting of 2.9% or 115.4 billion rupiah for oil palm, 96.7% or 3.9 trillion rupiah for sugarcane and 0.4% or 15.7 billion rupiah for cassava. However, the total realization was only 11.0% of the targeted plan for 2010 of about 38.0 trillion rupiah. Biofuels from Jatropha faced the most challenges and barriers, due to uncertainty regarding Jatropha's market and its future development.

(3) Development Program

The development of biofuel 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 which have potential to fulfill at least 60% of their energy needs for cooking, transportation and electricity from local renewable energy resources namely, biofuel (Jathropa, coconut, palm, cassava, sugar cane) 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 2 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 the Table below.

Table 1.6-3 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 from various sources

Second generation biofuels are produced from non-food cellulosic biomass, e.g. wood, rice straw and grass. There are a number of second generation biofuels under development. Second generation biofuel technology has been developed by BPPT since early 2010 in cooperation with Japan. Second generation biodiesel utilizes biomass through liquefaction and gasification process. The 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, and upstream levels of the biofuel 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 the operation.

In addition, notification by the Environmental Protection Agency of United states (EPA.US) on standards regarding fuel from renewable sources or Renewable Fuel Standards (RFS; January 27, 2012; EPA.USA) will be a challenge for the Indonesian government. EPA.US 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 of Indonesia 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 Feedstocks for Food and Fuel

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

(5.3) Land Availability for Biofuel Development

The accuracy of the field data needs to be confirmed. In the biofuels blue print (2006 ~ 2025), the government had planned for 1.5 million ha of plantations with Jatropha for biodiesel development by 2010, while for the development of bioethanol, the government had planned for 2.25 million ha of land for sugar cane 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) Subsidized Fuel Price

The high amount of subsidies given to the fossil fuel price has lead 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 with the high production costs of biofuel.

Trend of Biofuel Trade

Indonesian biodiesel export increased very significantly from 20,000 kL in 2010 to 1.45 million kL in 2011. Most of the biodiesel exports were to the European market. There were several factors contributing to this remarkable change on biodiesel trade. The increase of biodiesel demand from the Europe market because of 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 compare to Malaysian biodiesel producers.

Table 1.6-4 The Trend of Biodiesel Trade in Indonesia

	Unit	2009	2010	2011	2012
Production	Thousand kL	191	243	1,812	2,211
Exsport	Thousand kL	70	20	1,453	1,542
Domestic	Thousand kL	121	223	359	669

Sources: Ministry of Energy and Mineral Resources, Directorate of Bioenergy, May 2013

Projection of Biofuel Demand and Supply Potential in Indonesia

Based on the government target for biofuels, it is projected that bioethanol and biodiesel demand will reach 13621.2ktoe and 8298.3ktoe respectively in 2035. However, it should be noticed that since the projected demand is only that from road transport, the real demand might be bigger because biofuels are also likely to be used in other sectors including industry sector and power generation.

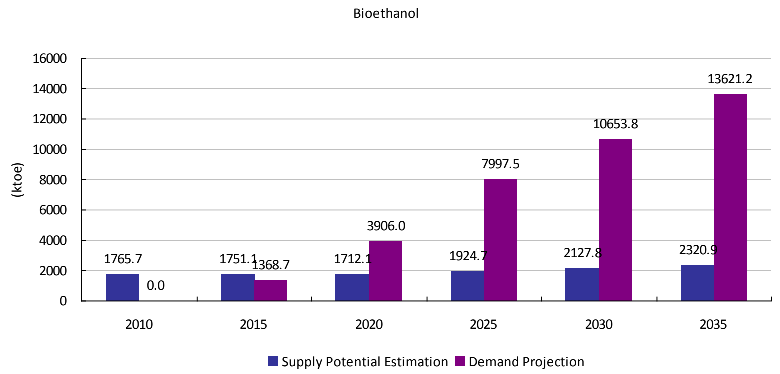
Bioethanol Supply Potential

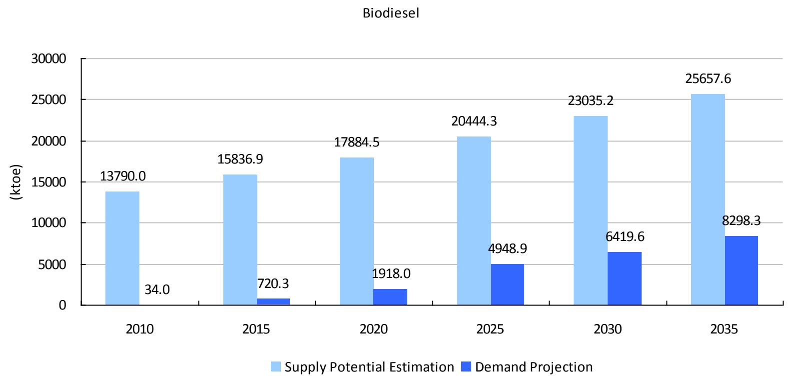
In Indonesia, cassava and sugar cane (molasses) are the major feedstocks for bioethanol production. Based on these two crops, the supply potential of bioethanol in 2035 is estimated to reach 2320.9 ktoe rising moderately from 1765.7 ktoe in 2010.

Biodiesel Supply Potential

Feedstock of biodiesel is mainly from palm oil. Indonesia is one of the largest palm oil producer in the world. Crude palm oil production in 2011 reached 2,145 million tonnes accounting for 44.2% of the global total. The supply potential of biodiesel from palm oil is estimated to be 25657.6 ktoe in 2035 from 13790.0 ktoe in 2010.

Figure 1.6-1 Biofuel Demand and Supply Potential through 2035 in Indonesia





The Indonesian government is getting more active on the promotion of biofuel's production and utilization driven by concerns on energy security, climate change, and poverty mitigation in the rural areas. Given the country's rapidly increasing demand for liquid fuels and the government's ambitious target for biofuel blend, Indonesia's demand for both bioethanol and biodiesel is expected to grow fast in the future.

According to the estimation results, the domestic production of bioethanol in

Indonesia will not be enough to meet the national target. One of the possible solution is cassava, which is less demanding in terms of the quality of soil. Cassava has the potential to be cultivated in a broader variety of lands, even on scattered small scale lands with low investment using existing technology. As for biodiesel, Indonesia has more than enough feedstock, palm oil, to achieve the target. Policies should be focused on biodiesel manufacturing, distribution infrastructure, and price issues. Forest protection is supposed to became the main issues in the future. The development of new land should be carried out with careful management.

2.7. Japan

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

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

To facilitate coordination among 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 utilization of biomass. In Dec. 2010, the Basic Plan for Promotion of Biomass Utilization was decided 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% 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 for promoting energy diversification in the transport sector:

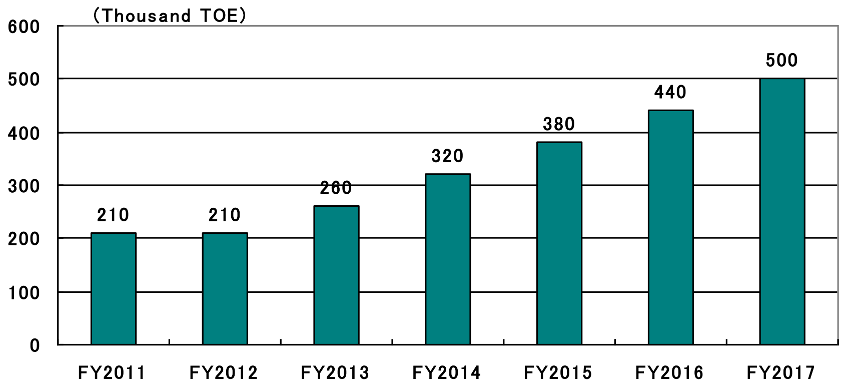
- Subsidy to support accelerated introduction of biofuels (\890,000,000).
- Improvement and enforcement of a taxation system for biofuels (exemption of gasoline tax on bioethanol blended gasoline; until Mar. 31, 2013).
- Establishment of a "biomass commercialization strategy study team."
- Initiatives on R&D and demonstration project of biomass energy (\16,000,000,000).

(2) Target

According to the Energy White Paper 2011, biomass energy used in Japan was 4,540,000 kl (in oil equivalent) in 2009 and 10,910,000 kl in 2010. It accounted for 0.81% of the domestic total supply volume of primary energy or 561,760,000 kl, in 2009 and 1.91% of 569,950,000 kl in 2010. On the other hand, according to the Natural Energy White Paper 2012, the cumulative introduction volume of biomass power generation plant capacity was 3,255,000 kW at the end of 2010.

In 2009, the Sophisticated Methods of Energy Supply Structures was enacted to obligate oil and gas business operators to utilize biofuels and biogases. The targets for biofuels utilization, which has been enforced since Nov. 2010, are shown in the following figure.

Figure 1.7-1 Total Target Volume of Bioethanol Utilization in Japan (In Oil Equivalent)



Source: The Institute of Energy Economics, Japan.

(3) Development Program

The Japanese government launched the "biomass commercialization strategy study team" in Feb. 2010. The study team published a draft of the biomass commercialization strategy in Jun. 2012. This was designed for achieving the goals mentioned in the "Basic Plan for Promotion of Biomass Utilization" decided by the cabinet in 2010. This was expected to facilitate 13,000,000,000 kWh of biomass power generation and 11,800,000 kl of biofuel utilization, reducing CO_2 emissions by 40,700,000 tons. Current domestic potential of biomass is estimated at 255,500,000 tons with an entire recycling rate of 74.8%, which will be raised to 88.5% in 2030.

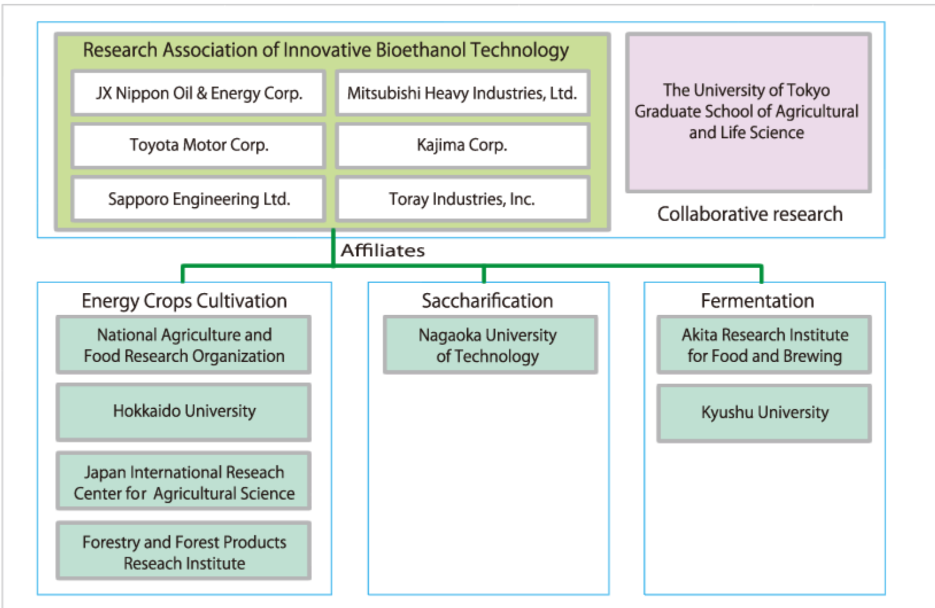
In Sep. 2012, the “Innovative Energy and Environmental Strategy” was decided by the Japanese government’s Energy and Environment Council, which defines the future introduction goals of renewable energy. According to the strategy, renewable power generation is planned to increase from 14,400,000,000 kWh in 2010 to 32,800,000,000 kWh in 2030, with the capacity reaching 5,520,000 kW in 2030 from 2,420,000 kW in 2010.

The Japanese government announced a policy to back up diffusion of bioethanol as automobile fuel on Nov. 26, 2012. If small- and medium-sized companies switch part of gasoline to biofuels to reduce carbon dioxide (CO_2), they will be approved of emission rights equivalent to the reduced volume. The 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

The following figure shows the composition of research associations in Japan.

Figure 1.7-2 Research Association of Innovative Bioethanol in Japan



Source: The Institute of Energy Economics, Japan.

On Dec. 17, 2012, Research Institute of Innovative Technology for the Earth (RITE), Honda R&D Co., Ltd., a subsidiary of Honda Motor Co., Ltd. and the U.S. 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 United States 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 U.S. 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 utilizing sugar obtained by low-cost pretreatment.

The following table lists other biomass projects being promoted in Japan.

Table 1.7-1 Biomass Development Projects in Japan

project	Operater	technology	Capacity Kl/year	Support	Feed	Schedule
Hyogo Pref. soft cellulose usage	Mitsubishi Heavy Ind.; Hakutsuru brewing;Kansai Chemical Machines	Contenious heating water decomposition Nontransgenic yeast	0.8	MAFF	Rice & Wheat Straw	2008～2010
Hokkaido soft cellulose usage	Taisei Construction, Sapporo Breweries	Alkaline Treatment Simultaneous hydrolysis & fermentation	1.04	MAFF	Rice & Wheat Straw	2008～2012
Akita Pref. 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

Notice: 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 Japanese government's strategy,is to focus determinedly on cellulosic ethanol or algae derived biodiesel as the future for Japan's biofuel production.[25]

[25] USDA Global Agriculture Information Network (GAIN) Report. 2012. *Japan Focuses on Next Generation Biofuels*.

Trend of Biofuel Trade of Japan

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, However, detailed statistics are not available.

For tariffs on import of ethanol, the petroleum and coal tax (\2,040/kl) is imposed, but the gasoline tax of \53,800/kl is exempted.

Projection of Biofuel Demand and Supply Potential in Japan

It is assumed that bioethanol blending will reach 3% in 2035, which will require 1373.2ktoe of bioehtanol in the same year. Since diesel demand in road transport is declining and will continue to decrease in the future, no biodiesel use is expected through the projection period.

Bioethanol Supply Potential

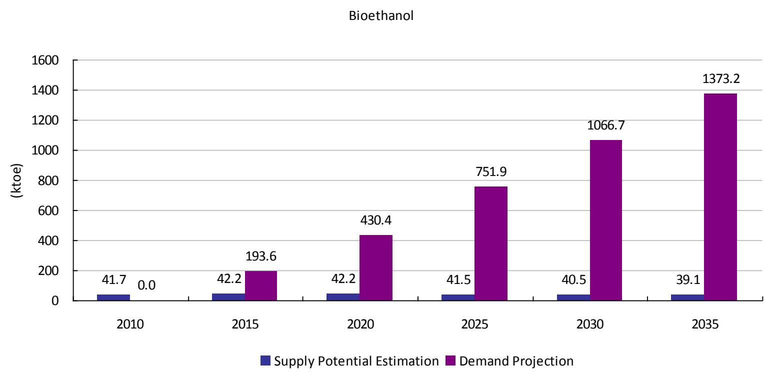
The food self-sufficiency of Japan is only about 42%. Japan is a net importer of rice, maize and sugar and generally the country has little feedstock supply potential for bioethanol. However, there are still small domestic potential of bioethanil supply, for example the cultivation of sugarcane in Okinawa, which subsidized by government. The byproduct of molasses, though in small quantity, could be used to produce bioethanol. In this study, it is estimated that bioethanol supply potential will be decreased 39.1 ktoe in 2035 from 41.7 ktoe in 2010.

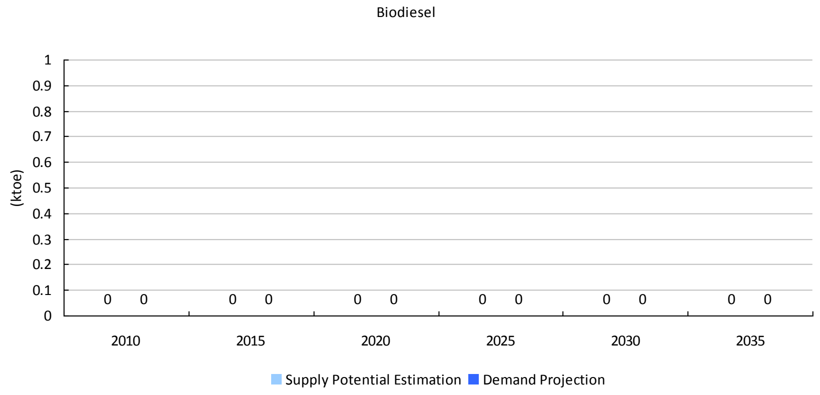
Biodiesel Supply Potential

Japan has no oilseed crops for feedstock supply of biodiesel except some scattered small-scale biodiesel production using waste cooking oil in local area.

And the practice is not expected to scale-up given the country's declining population.

Figure 1.7-3 Biofuel Demand and Supply Potential through 2035 in Japan





The oil industry in Japan carried out a voluntary biofuel program targeting the use of 500,000 kL of E3. Supply to meet the target is dependent on imports because there is little feedstock potential in the country. For biodiesel, the situation is similar because Japan has to rely on import. Therefore, economic benefits associated with biofuels utilization in Japan is low. However, Japan has advantage in R&D of second generation biofuel production in Asia.

2.8. Lao PDR

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

The "Renewable Energy Development Strategy" was developed in 2010, in which the following issues were given high priority.[26]

- 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 development of renewable energy.

The goal was to increase the use of renewable energy to 30% of energy consumption by 2025. The target for biofuels utilization was that biofuels should account for 10% of energy consumption in the transportation sector by 2020.

Regarding agricultural policies, one of significant issues of bioethanol production projects is to secure cultivated land for raw material crops. In Laos, implementation of large-scale cultivation of energy crops must satisfy at least the following two requirements: Firstly, it must be socially and economically beneficial, including contribution to farming communities. Secondly, it must contribute to sustainable economic growth. In particular, major considerations for large-scale cultivation include whether or not it contributes to increased income of 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

[26] Sithideth. 2011. *Energy Policy in Lao PDR*. presented at IEEJ in May 2011.

runs counter to food security).

Regarding 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 development projects.[27]

In 2004, the "National Environment Strategy" till 2020 was laid down, under which the "Second Environment Action Plan, 2006-2010" was formulated and set the following six priority policies[28].

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

(2) Target

In Lao PDR, there is no full-fledged commercial bioethanol (BE) or biodiesel (BDF) manufacturing plant yet. For BDF, however, it is said that KOLAO[29] has run an experimental plant with an annual production capacity of about 730,000 liters.

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[27] Japan Electric Power Information Center, Inc. 2010. *Electric Power Industry in Overseas Countries 2010, Volume 2.*

[28] Japan Electric Power Information Center, Inc. 2010. Electric Power Industry in Overseas Countries 2010, Volume 2.

[29] KOLAO Group began with name of KOLAO made from Korea and Laos in 1996. The company producing and selling cars and motorcycles. Franchise not only in Laos but also throughout Indo-Chinese and all over the world.

Actually, more companies have shown interest in acquisition of land for plantations to produce biofuels. However, 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.[30] Foreign investors have attempted to build a Jatropha plantation, but 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.[31] In Lao PDR, a large 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.

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

Table 1.8-1 Biofuel Introduction Goal in Renewable Energy Development Strategy of Lao PDR

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

Source: Lao Institute for Renewable Energy. 2011. *Renewable Energy Development Strategy in Lao PDR*.

[30] Asian Development Bank (2012). Biofuels in the Greater Mekong Subregion: Energy Sufficiency, Food Security, and Environmental Management.

[31] Lao Institute for Renewable Energy. 2009. Biofuel Assessment Study in Lao PDR – Inception Report.

(3) Development Program

The Laotian government has been focusing on development of biofuels since early 2006. In 2008 the Laotian government established a special committee for development and launched formulation of a national strategy and basic policies for development of biofuels. As with neighboring Cambodia, however, biofuel production in Laos is still in the initial phase of development, 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 Laotian government to politically develop biofuels.

(4) Information on Biofuel RD & D in Laos

The following table lists the organizations which are involved in biofuel activities in Lao PDR.

Table 1.8-2 Governmental and Non-Governmental Organizations Related to Biofuel Activities in 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: Lao Institute for Renewable Energy (LIRE) and ADB.

(5) Way Forward

Compared with other neighboring countries like Thailand, China, and Vietnam, the yield of feedstoks for biofuel production is relatively low in Lao PDR. According to an ADB study[32] that used FAO statistics, the average yield (ton/hectare) of sugarcane in Lao PDR from 2005 to 2009 was 35.28, while that in Yunnan and Guangxi in China was 69.73, and 60.83 and 58.31 in Thailand and Vietnam respectively. Thus much could be done to increase yields of biofuel feedstocks.

For Lao PDR, like Cambodia, food security is a critical issue for decision makers. And the food security issue might be deteriorated by various external factors such as increasing food price, extreme weather events and the threat of climate change.

Trend of Biofuel Trade of Lao PDR

The tariff rates for export of crops are very low as Lao PDR has signed a FTA or EPA with neighboring countries.

Table 1.8-3 Tariff Rate on Export of Raw Material Crops from Lao PDR

Item / Export Destination		Vietnam	Thailand	China
Cassava	Freeze	0%	0%	5%
	Powder, Milk	0%	0%	0%
	Fresh; Cold Storage	0%	0%	5%
	Starch	0%	0%	5%
Corn Starch		0%	0%	5%
Molasses	Sugar cane	5%	0%	0%
	Others	5%	0%	0%

Source: Daiwa Institute of Research Holdings Ltd.

[32] ADB. 2012. Biofuels in the Greater Mekong Subregion. http://www.adb.org/publications/biofuels-greater-mekong-subregion

Projection of Biofuel Demand and Supply Potential in LAO PDR

It is assumed that the government's target of substituting 10% transport energy demand by biofuels by 2020 will be realized (which means 10% of bioethanol blending and 10% of biodiesel blending till 2020). And it is also assumed that the blending will stay the same through 2035. Under the assumptions, annual bioethanol demand is projected to reach 20.8ktoe and annual biodiesel demand is projected to grow to 177.7ktoe in 2035.

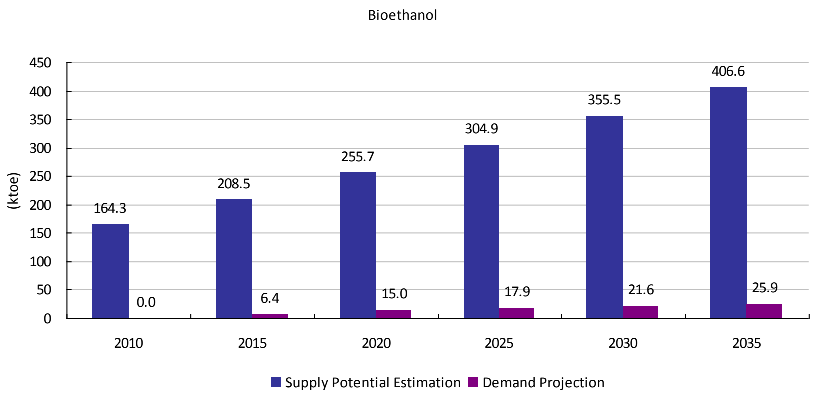
Bioethanol

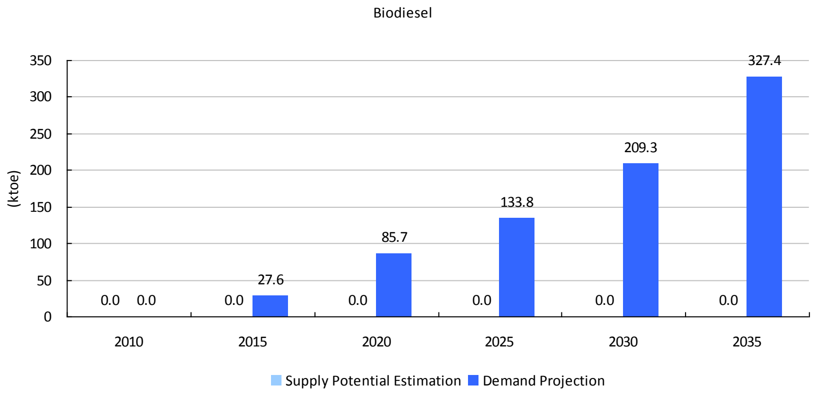
In Laos, cassava, maize, and sugar cane (molasses) are the major feedstocks for bioethanol. In the case of cassava, foreign companies have entered the market aggressively in cassava plantation for export, and the cultivation area is expanding rapidly in recent years. The supply potential of bioethanol in Laos is estimated to expand from 164.3 ktoe in 2010 to 406.6 ktoe in 2035.

Biodiesel

On the other hand, soybean is the only oilseed crop growing in Laos, and the cultivation area is relatively small. Because Lao PDR is an net importer of cooking oil it is supposed that the country has little feedstock for biodiesel production.

Figure 1.8-1 Biofuel Demand and Supply Potential through 2035 in Lao PDR





Lao PDR is a country with a land area of 237,000 square kilometers and a population of about 6.2 million people. According to the statistics of FAO, developed agricultural land in the country is 2.4 million hectares accounting for 10.3% of the total land area. In the future, agricultural development for the purpose of exports is expected to expand. Foreign companies have been investing in LAO PDR's agricultural sector, some of whom not only invest in cultivation activities but also production of bioethanol for export.

Meanwhile, cultivation of oilseed crops is not popular in Lao PDR. Lao PDR has a small population and thus the consumption of cooking oil is not high, which has been covered with small amounts of import and domestic consumption. However, the government is looking for new oilseed crops, like Jatropha, to supply the feedstock for biodiesel to meet the possible demand driven by national biofuel program.

2.9. Malaysia

Policies and Program to Promote the Utilization of Biofuels

(1) Policy Overview

In 2001 the Government defined renewable energy as the fifth fuel, and the "fifth fuel policy" was announced. Prime Minister Najib had launched in the COP 15[33] held in Copenhagen, that the reduction target for greenhouse gas emissions for Malaysia was set at 40% by year 2020 (base year 2005; with prerequisites of technology transfer and assistance of developed countries). The Tenth Malaysia plan (2011 ~ 2015) was a national renewable energy strategy and action plan for renewable energy promotion. Biofuel is one of the renewable energy sources in the action plan, and the Malaysia Palm Oil Board (MPOB) is one of the government agencies under the Ministry of Plantation Industries and Commodities (KPPK) responsible for all activities on biofuel promotion.

(1.1) National Biofuel Policy

In March 2006, the Malaysian Government launched the National Biofuel Policy of Malaysia (NBPM) 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 objective of the policy was to encourage the production and usage of palm oil biofuel as an environmentally friendly alternative energy source and also to stabilize the palm oil

[33] The 15th Conference of the Parties to the UN Framework Convention on Climate Change

price at a higher level through increased usage of palm oil.

Five strategic objectives underpin the NBPM (Table 1.9-1). The first two objectives refer to the institution of a 5% biofuel mandate, using palm oil as the feedstock. The NBPM 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 below, "B5" should be considered a general term for a 5% 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 national consumption of 10 million tonnes of diesel per year).

The NBPM 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 NBPM, the government had completed trials in which a 5% blend of PME and 95% (PME B5) was used by selected government department fleets as well as 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.

Table 1.9-1 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

Notes: 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 per cent blend of a palm-based biofuel.

Source: Adapted from the National Biofuel Policy

Table 1.9-2 National Biofuel Policy Implementation Milestones of Malaysia

Short-term	Medium-term	Long-term
The Malaysian Standard specifications for palm methyl ester biodiesel (PME B5) will be established.	The Malaysian Standard specifications for PME biofuel for domestic use and export will be established.	The proportion of processed palm oil added to the diesel blend will be gradually increased.
Selected government departments having fleets of diesel vehicles will participate in trials using PME B5.	Efforts will be made to encourage engine manufacturers to extend their warranties to the use of PME B5 diesel. Extensive PME B5 diesel testing will be carried out to facilitate the granting of such engine warranties.	
PME B5 diesel pumps for the public will be installed at selected stations.	Legislation to mandate the use of PME B5 diesel will be passed and enforced.	Greater uptake of biofuel technology by Malaysian and foreign companies.
Voluntary trials on PME B5 will be run by the MPOB for selected users in the industrial sector.	To meet strategic thrust for exporting biofuel, establishment of commercial methyl esters plants will be encouraged. In this regard, the MPOB will act as a catalyst by pioneering the establishment of palm biodiesel plants in Malaysia in collaboration with the private sector.	

Source: Adapted from the National Biofuel Policy.

(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 & percentage of biofuel to be blended in any fuel. In addition, the regulations for a 5% 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

The 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 any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel;
- import any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel;
- transport any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel; or
- store any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel.

Biofuel Services:

- survey any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel; or
- test any biofuel, biofuel blended with any other fuel or biofuel blended with any other biofuel.

Under Section 5(3), Malaysian Biofuel Industry Act 2007 (Act 666), anybody who conducts the activities relating to biofuel without a valid license, shall, on conviction, be liable to a fine not exceeding two hundred and fifty thousand 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 secured financial position as well as stable feedstock to commence operations; and
- applying companies undertake capacity enhancement and have been in operation since 31 December 2007; or
- applying companies produce phytonutrients from oil palm products as well as methyl ester as primary product or byproducts 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 renewal of a license. This is in accordance with Section 56(1), Malaysian Biofuel Industry Act 2007 (Act 666). According to the Section also, applications must be made within six months from the date of the coming into operation of this Act. Hence, the closing date for the application of the existing biofuel manufacturing license holders was 30 April 2009.

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

(1.4) Malaysian Standard on Biodiesel

Drafting of the Malaysian Standard on biodiesel is undertaken by SIRIM, under Technical Committee 28 (TC 28) on Petroleum Fuels. Members and co-opted members include: Oils & Gas Companies, Malaysian Automotive Association (MAA), MPOB, Government Agencies (Department of Environment Malaysia

(DOEM), Road Transport Department (JPJ), etc), Malaysian Oleochemical Manufacturers Group (MOMG) and biodiesel manufacturers. Malaysian Standard on Biodiesel (Methyl Esters) MS 2008: (similar to EN 14214) was published on November 2008. This standard is incorporated in the biofuel regulation. The Malaysian Standard on petroleum diesel MS 123:2005 (amended 2010) has been amended to include up to 5% of palm methyl ester.

By end of March 2013, a Malaysian Provisional Standard for petroleum diesel MS2535:2013 was developed and published. These provisional standards allow blending ratio of up to 10% 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 2011, the total oil palm cultivation in Malaysia was 5.0 million hectares and the production of crude palm oil (CPO) amounted to 18.9 million tonnes. Malaysia was 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. This increased to 130,000 tonnes in 2007. The main feedstock used was Refined, Bleached and Deodorized (RBD) palm oil, accounting for 94% of the total palm oil processed by biodiesel plants. As of April 2013, a total of 58 biodiesel manufacturing licenses with a total annual capacity of 6.38 million tonnes were approved under the Malaysian Biofuel Industry Act, 2007. From the total, 21 biodiesel plants were in commercial production (since 2006) with a production capacity of 2.66 million tonnes per year. In addition, there were 12 plants with a production capacity of 1.15 million tonnes per year that have completed construction but yet to commence production.

Table 1.9-3 Status of Approved Biodiesel Licenses in Malaysia (as at April 2013)

Status	No.	Production Capacity (Mil. Tonnes/Year)
Commercial Production	21	2.66
Completed Construction	12	1.15
Construction	5	0.81
Under Planning / Pre- Construction	20	1.75
TOTAL	58	6.38

Sources: The 2nd Meeting of the ERIA Working Group for Asian Potential on Biofuel Market, May 9th 2013

(3) Development Program

B5 implementation program in Malaysia is a program of utilization of a mixture of 5% palm biodiesel and 95% diesel fuel. The first phase of B5 implementation program started in early 2009 involving selected Government Departments.

This was followed by the B5 implementation program by phases in the Central regions of Peninsular Malaysia. The B5 program which started in June 2011 and completed in November 2011 involved only retail stations in Putrajaya, Melaka, Negeri Sembilan, Selangor and Kuala Lumpur. 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 utilization of palm biodiesel from January to December 2012 was about 110,000 tonnes. The Government has funded RM 55 million for CAPEX of setting up in-line blending facilities at 6 petroleum depots in the Central Region. The B5 program involving industrial sector will be implemented once the nationwide implementation takes effect which is expected in 1 July 2014. The annual palm biodiesel requirement for nationwide B5 implementation; covering the transportation 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 Mix of 10% biodiesel and 90% diesel (B10) after the B5 program. The government will also expand the use of biodiesel on industrial and power generating sectors with subsidies to cover the difference in price between pure diesel and B10.

(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 standard for PME. The standard is likely to follow closely the European Union (EU) and US standards.

The second method is by direct blending of straight vegetable oil (SVO) with diesel. In Malaysia, an SVO blend of 5% refined palm oil and 95% 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 blending.

Malaysia’s palm oil biofuel program began in 1982, funded by a research and development levy on the palm oil industry, with the government providing policy support for the program. Over a period of 20 years, the Malaysian government supported the development and commercialization of industry technology to bring palm oil biofuels to domestic and international markets. Malaysia had taken extensive RD & D measures for the utilization of palm oil since 1980s. Biodiesel is one of the targets to make a new product. Malaysia’s MPOB RD&D on biodiesel had successfully conducted tests on diesel engines of different types and models during 1986 ~ 1994.

Research and development 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 as well as government grants. Biodiesel production, RD&D and the commercialization of new technology, has been undertaken by MPOB together with the government-owned corporation PETRONAS. In 2004, PETRONAS contributed Ringgit Malaysia (RM) 12.0 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 research and development on bioethanol in Malaysia is not as active as palm oil based biodiesel. Especially the first generation bioethanol technology is not prosperous. 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 commercialized yet. But research and development on second generation bioethanol technologies are being promoted aggressively.

(4.3) Second Generation of Biofuel Technologies Development

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 advanced countries.

(5) Way Forward

The implementation of the B5 program in Malaysia is in line with the National Biofuel Policy. The B5 program will help the country in terms of environmental protection; energy security and the oil palm industry through reduction of palm oil stocks and improve the palm oil prices.

(5.1) Second Generation Biofuels from Oil Palm Biomass

- Types of biomass / quality
- Biomass availability & supply
- Sustainable development
- Cost of renewable energy development

(5.2) Technology Roadmap for Biomass Energy

RE Target from biomass energy to assist in climate change mitigation efforts in the country was in line with the Prime Minister's announcement of 40% carbon intensity reduction based on Gross domestic product (GDP) at COP 15 (2009).

- Viable biomass technologies that are ‘exportable’
- Research base to cover both energy and non-energy bio-economy
- Co-product development from energy feedstock
- Integrated bio-refineries
- Demonstration and long-term operation of large and small-scale pilot plants to reduce risks and uncertainties for commercialization

Trend of Biofuel Trade

In May 2003, the European Commission issued a directive promoting the use of biofuels. It proposed a plan to eventually replace 5.75% of petroleum fuel in the transport sector with biofuels by 2010. This move was expected to create a total demand of 10.2 million tonnes of biodiesel per year by 2010, approximately 4.5 million tonnes above current production levels. Assuming that second generation biofuels are not commercially viable at that time, a large proportion of this is expected to be met by imported palm oil. This presents a major opportunity for Malaysia, as the world’s top palm oil exporter. Other potential markets are primarily developed countries that are net oil importers, including the United States, Japan, South Korea and Australia.

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.

Table 1.9-4 Production and Exports of Biodiesel of Malaysia

	2006. 8-12	2007	2008	2009	2010	2011	2012	2013. 1-3
Production	54,981	129,715	171,555	222,217	117,173	173,220	249,213	88,665
Export	47,986	95,013	182,108	227,457	89,609	49,999	28,983	31,163

Sources: MPOB

Projection of Biofuel Demand and Supply Potential in Malaysia

The B5 program is currently on-going in Malaysia and the B10 program is expected to roll-out nationwide in 2014. It is assumed that the B10 program will continue through out the projection period. Under this assumption, annual biodiesel demand is projected to reach 1118.0ktoe in 2035. On the other hand, there is no bioehanol use in Malaysia at present and with no government intention to promote use of bioethanol the situation is expected to persist in the future.

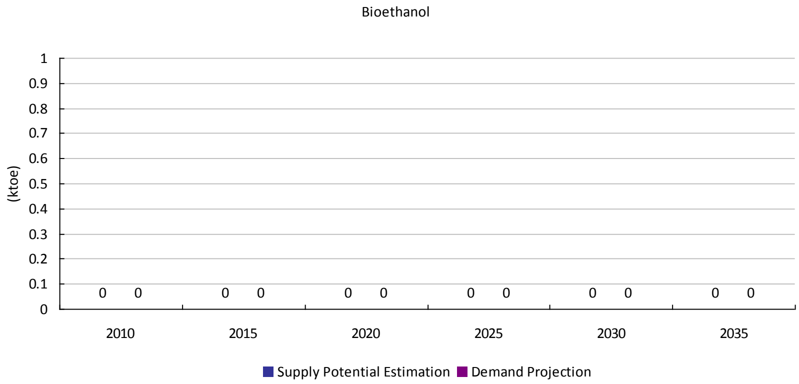
Bioethanol

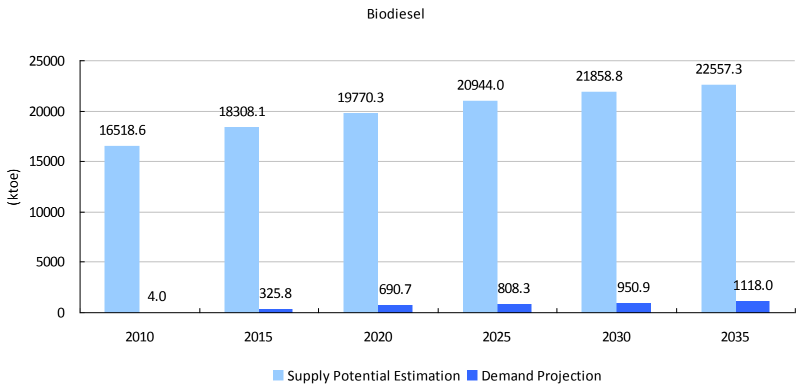
In Malaysia there is little cultivation of crops that can be used as feedstock for bioethanol production. In this study, it is assumed that Malaysia has little feedstock supply for bioethanol.

Biodiesel

On the other hand, Malaysia’s palm oil production accounted for 40.0% of world total in 2011, and Malaysia is the world's largest palm oil exporter. In this analysis palm oil is supposed to be the major biodiesel feedstock in Malaysia. The supply potential of biodiesel of Malaysia is estimated to be 22557.3 ktoe in 2035 from 16518.6 ktoe in 2010.

Figure 1.9-1 Biofuel Demand and Supply Potential through 2035 in Malaysia





It is assumed that Malaysia will have no bioethanol demand and supply in the projection period because of the lack of feedstock supply. On the other hand, the country has a huge potential on biodiesel supply. The Government of Malaysia is planning to raise the blending rate of biodiesel to B10 by 2014. But to promote domestic market, policy should be focued on the pricing system to support the expansion of biofuels. The availablity of land for palm oil plantation will be the major issue in the future. To reduce forest exploitation, there should be policies to support replanting, use of land used for other crops, and so on.

2.10. Myanmar

Policies and Program to Promote the Utilization of Biofuels

(1) Policy Overview

Despite the abundant fossil fuel resources, Myanmar's energy supply depends heavily on conventional (non-commercial) biomass resources (75%).[34] The Ministry of Energy (MOE) has chosen the following items as basic energy policy guidelines: (a) maintain the energy self-sufficiency ratio, (b) promote the use of renewable energies, (c) promote the efficient use of energy and the awareness of energy conservation, and (d) protect forest resources from excessive use for firewood and charcoal. Myanmar is now conducting an experimental program on biofuel development.

Different ministries have jurisdiction over renewable energy. The MOE develops comprehensive energy policies (especially policies on the up-stream 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 research and development 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.

[34] IEA "Energy Balances of Non-OECD Countries" 2012 Edition

(2) Target

Several test programs have been carried out by the government to formulate a biofuel standard. It seems that the government is also considering 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,[35] but details were not available.

Consideration of production and commercialization of biofuels in Myanmar only started since 2008[36]. As of 2010, Myanmar seemed to have developed a production capacity[37] of 100 to 200 tons/month for Jatropha seeds, as raw material for biodiesel, and 10 to 20 tons/month for crude Jatropha oil. The production[38] of Jatropha in the 2010/2011 crop year was 5,498 tons (0.07 ton/ha[39]).

As of 2010, there were 6 domestic pilot plants for biodiesel production (production capability of 400 gallons/day). With regard to bioethanol, though the crops that could be used to produce bioethanol such as sugar cane and cassava are planted in large quantity in Myanmar, they are mainly consumed for food rather than for fuel. As of 2009, there were 3 production plants of dehydrated ethanol, and their production capability[40] was estimated to be more than 660,000 liters (2,200,000 gallons)/year. In addition, there were five or more 99.5% ethanol (for drinking)

[35] Asian Development Bank, 2012, Biofuels in the Greater Mekon Subregion: Energy Sufficiency, Food Security, and Environmental Management. *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.

[36] ADB documents

[37] Website of Japan Bio-Energy Development Corporation (JBEDC)

[38] Documents of the Ministry of Agriculture and Irrigation of Myanmar

[39] A potential oil yield of Jatropha is 2.4 tons/ha.

[40] Asian Development Bank. 2012. *Biofuels in the Greater Mekon Subregion: Energy Sufficiency, Food Security, and Environmental Management*.

manufacturing plants[41].

(3) Development Program

A 3-year Jatropha tree-planting project was implemented from 2006 to 2008 by the government of Myanmar. However, cultivation of Jatropha failed to be commercialized because of insufficient understanding of planting, harvesting, oil extraction of Jatropha, fuel manufacturing process, marketing, and lack of legislation and standards.[42]

In 2006, Myanmar's government signed an agreement with a Japanese private company, Japan Bio-Energy Development Corporation (JBEDC), to build a Jetropha fuel supply chain as well as to implement a biofuel project. In response to this, the Myanmar's government set a target[43] to expand the plantation area of Jatropha to 2,000,000 hectares by 2008 and to 4,000,000 hectares by 2015. According to the agreement, buying and selling of seeds, oil extraction and purification would be carried out by a joint venture[44] between JBEDC and a local private company, and technology development and guidance, as well as the improvement of policies, regulations and standards would be implemented in cooperation with the Ministry of Agriculture and Irrigation[45].

Each public corporation under the Ministry of Agriculture and Irrigation had prepared their own Jatropha growing manuals and distributed the manuals to the

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[41] Dr. Mya Mya Oo Rector: Yangon Technological University (Jul. 2011) at the 11th Asia Biomass Seminar
[42] Website of JBEDC
[43] Jatropha Workshop Report 20120312
[44] JBEDC publicized establishment of a joint venture "Japan-Myanmar Green Energy" on Feb. 27, 2009. An investment ratio is 60% by JBEDC and 40% by a local company.
[45] Website of JBEDC

farmers interested in Jatropha planting[46]. JBEDC has also held seminars to share information on Jatropha planting methods as well as on how to build the supply chain.

A company from Thailand, UAC (Universal Adsorbents & Chemicals), announced that they would launch a biofuel plant by 2014 through a joint venture with one of the largest corporate groups in Myanmar[47] using palm oil as raw material. The total investment amount was expected to be 800,000,000 bahts (approx. $27,000,000). The biofuels were planned to be used for power generation, and electricity would be sold to both Myanmar and Thailand.

(4) Information on Biofuel RD&D in Myanmar

In Myanmar, the following R&D activities on biofuels are being implemented:[48]

- Technology development to increase Jatropha seed yield and oil quantity
- Improvement of the method for producing biodiesel
- Technology development of cellulosic and lignocellulosic ethanol (second generation)

(5) Way Forward[49]

- Improve the energy balance for biofuels (energy embedded in the fuel plus the energy required to produce & deliver it)
- Technology development of ethanol from cellulose and lignocellulose (second- and third-generation ethanol)
- Promote biofuel development to help mitigate rural poverty

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[46] Website of JBEDC

[47] Myanmar Business Network.*2012. Biofuel Plant for Myanmar*. http://www.myanmar-business.org/2012/12/biofuel-plant-for-myanmar.html

[48] 11th Asia Biomass Seminar

[49] 11th Asia Biomass Seminar/Documents of the Ministry of Agriculture and Irrigation of Myanmar

- Encourage trade and investment
- Government support for use of biofuel

Trend of Biofuels Trade of Myanmar

It seems that Jatropha seeds, a raw material for biodiesel, have been exported abroad since 2009, but the details such as trade volumes are not clear. JBEDC exported 400 tons of Jatropha seeds from Myanmar in 2009 and 1,000 liters of crude Jatropha oil to Japan for the first time in 2010[50].

Myanmar's tariff system:[51]

(1) Taxable objects

On all import items the tax base is the import cargo Common Intermediate Format (CIF) price plus 0.5%. However, some items are tax-exempt. Imports of raw materials that are recognized as materials for contract manufacturing by the Myanmar Investment Committee (MIC) or other related government agency, or the import items related to investments approved by the MIC, are eligible to be exempted 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 (required to confirm in each case). The latest customs schedule available was

[50] Website of JBEDC
[51] Website of Japan External Trade Organization (JETRO), Myanmar/Investment system

issued in Jan. 2012.

Projection of Biofuel Demand and Supply Potential in Myanmar

Though the Government of Myanmar has put forward a plan to replace petroleum fuels with bioethanol and biodiesel, the details of the plan is not clear. However, based on the plan it is assumed that Myanmar would achieved national wide use of E15 (15% of bioethanol blending) and B5 (5% of biodiesel blending). Under this assumption, the annual demands for bioethanol and biodiesel will reach 233.5ktoe and 142.3ktoe respectively in 2035.

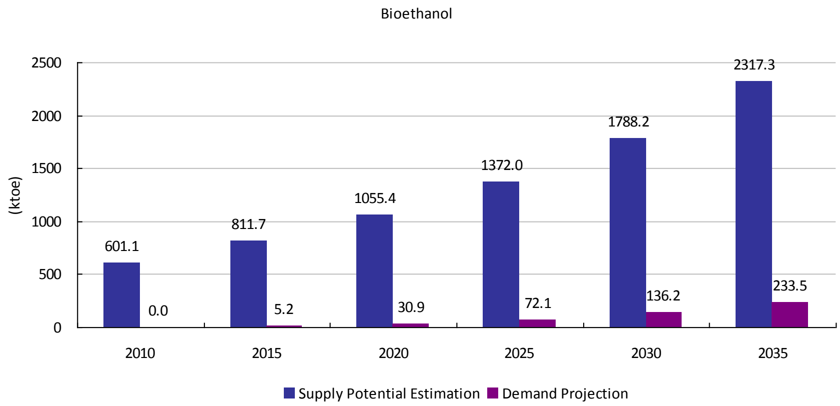
Bioethanol Supply Potential

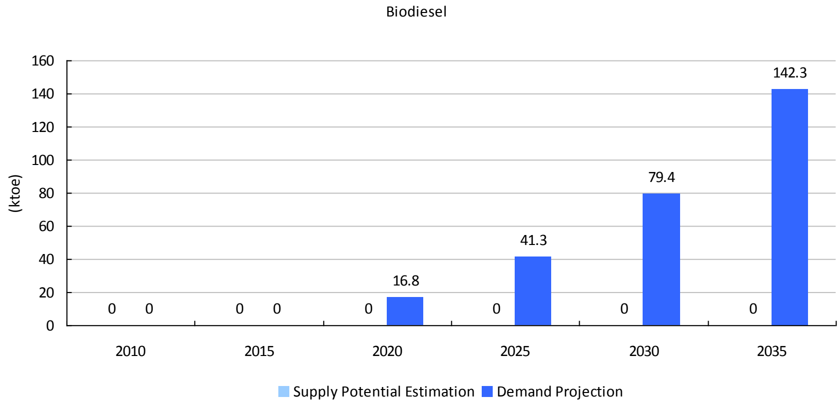
Rice, maize, cassava and sugar cane, which can used to produce bioethnol, are being planted in large area in Myanmar. Myanmar has a production surplus of all these crops and the country is exporting the crops to other contries. In this study, it is estimatd that the supply potential of bioethanol in Myanmar would increase from 601.1 ktoe in 2010 to 2317.3 ktoe in 2035.

Biodiesel Supply Potential

The cultivation area of oilseed crops is relatively small in scale in Myanmar. In this study, it is assmued that there is little feedstock of biodiesel procution in Myanmar.

Figure 1.10-1 Biofuel Demand and Supply Potential through 2035 in Myanmar





Although there has been little bioethanol consumption in Myanmar, the country has a feedstock supply potential of bioethanol. The country also has the potential to export bioethanol in the future.

At present, the mandatory blend of biodiesel is not implemented, but the target on biodiesel use was set by the government. And the government has drafted a plan of the plantation of Jatropha in several million hectares scale. However, more than 5 years have passed since the plan and no significant results were obtained.

2.11. New Zealand

Policies and Program to Promote the Utilization of Biofuel

(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 green house gas (GHG) emissions by 10 to 20% from the 1990 level by 2020 and by 50% from the 1990 level by 2050. With regard to the transport sector the government looks to market highly energy-efficient light vehicles improved from the 2010 level by 2016. One of the measures was to develop sustainable alternative fuel, but no specific numerical target has been indicated.

(2) Target

In New Zealand, raw materials used for bioethanol production include: whey which is a by-product of dairy farming. Besides, 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 in order to improve the soil conditions of grain fields.

Table 1.11-1 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, Website of Bioenergy Association of New Zealand; BANZ

Table 1.11-2 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 Business, Innovation, and Employment, the Government of New Zealand. 2012. *New Zealand Energy Data File 2012*. Available at http://www.med.govt.nz/sectors-industries/energy/energy-modelling/publications/energy-data-file/new-zealand-energy-data-file-2012

(3) Development Program

(3.1) Standards for Automotive Fuel

The latest quality standards for automotive fuel "Engine Fuel Specification Regulation 2011" prescribe the specifications of bioethanol and biodiesel at the gas stations as follows.

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

(3.2) Biofuels Sales Obligation

Target: by the end of 2012 3.4% of the total annual sales of gasoline and diesel need to be biofuels.

Application period: Apr. 2008 to Dec. 2012

Support: Excise tax of 50.5 NZ cents/liter is exempted for the use of bioethanol.

(3.3) Biodiesel Grants Scheme

Target: Diffusion of biodiesel use

Application period: 3 years from Jul. 2009 (Completed in Jun. 2012)

Support: Subsidy of 42.5 NZ cents/liter for biodiesel

(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 Scion, are members of the New Zealand Renewable Energy Transformation Research Science and Technology group. This group is sponsored by the Ministry Research Science and Technology to accelerate the research and development effort on renewable energy technologies and their integration into the New Zealand energy system.

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

(5) Way Forward

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

Trend of Biofuel Trade of New Zealand

An estimated 7 million litres (ML) of liquid biofuel was produced in 2011, a 22% increase from 2010. For comparison, imports of bioethanol were 1.18 ML in 2010 and 2.22 ML in 2011.

The following table shows the taxes imposed on automobile fuels in New Zealand. Imported biofuels are dealt with in the same way.

Table 1.11-3 List of Taxes on Automobile Fuels in New Zealand (After Aug. 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

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, the Government of New Zealand. 2012. *NewZealand Energy Data File 2012*. Available at http://www.med.govt.nz/sectors-industries/energy/energy-modelling/publications/energy-data-file/new-zealand-energy-data-file-2012

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

Projection of Biofuel Demand and Supply Potential in New Zealand

There is no clear policy on target of biofuel use in New Zealand. In the Engine Fuel Specification Regulation 2011 the standard for biofuels is set as: blend of bioethanol up to 10% of gasoline (E10) and blend of biodiesel up to 5% of diesel (B5). It is assumed that use of E10 and B5 will be fully penetrated by 2035. Under this condition, the annual demand for bioehantol and biodiesel is projected to reach 282.9ktoe and 90.4ktoe in 2035.

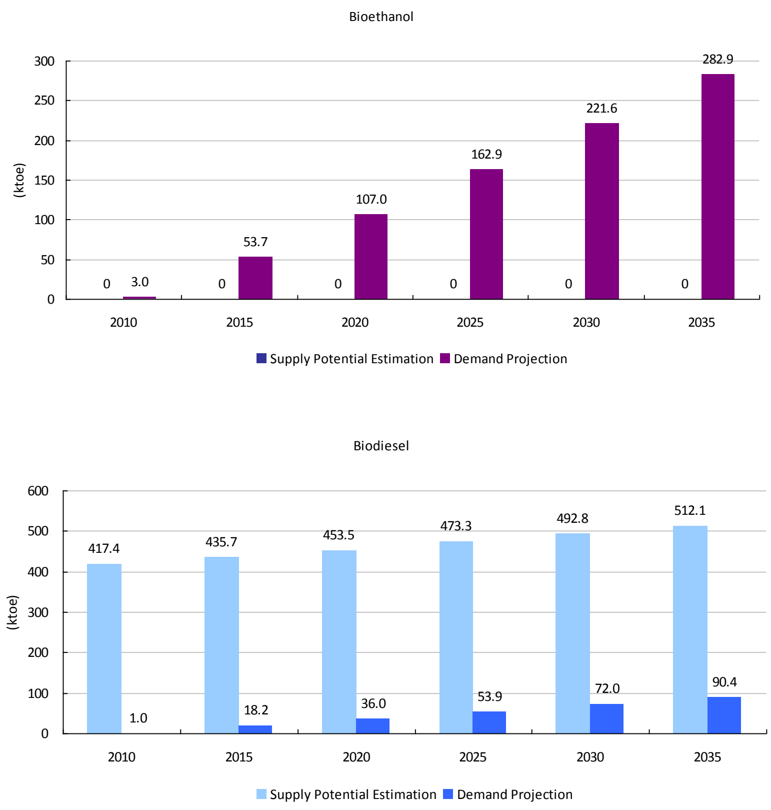
Bioethanol Supply Potential

Due to limit of crop production it is assumed that New Zealand have little potential on feedstock supply for bioethanol.

Biodiesel Supply Potential

Meanwhile, the country has a potential in supply of livestock fat that could be used to produce biodiesel. It is estimated that supply potential of biodiesel will expand from 417.4 ktoe in 2010 to 512.1 ktoe in 2035.

Figure 1.11-1 Biofuel Demand and Supply Potential through 2035 in New Zealand



There is not much cultivation of energy crops that can be converted into biofuels in New Zealand. New Zealand needs to import bioethanol to meet its domestic bioethanol demand.

New Zealand's economy is heavily dependent on agriculture and associated food processing. Dairy is an important export industry in New Zealand. Producing biodiesel from livestock fat would bring the industrial added value and a hedge against price fluctuation.

2.12. The Philippines

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

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

Table 1.12-1: List of Agencies and the 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)				✓	

In January 2007, the Philippines government ratified the Biofuels Act of 2006 (RA 9367)[52]. The law mandates a minimum one percent biodiesel blend into all diesel fuels within 3 months following the implementation of the law. In February 2009, it mandated a two percent (2%) blend of biodiesel, while the bioethanol mandate was a minimum of five percent (5%) bioethanol fuel blend. In 2011, the

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

bioethanol fuel blend was mandated to increase to 10 percent of the total volume of gasoline sold in the country.

In order to encourage investments in the biofuels industry, RA 9367 provides the following incentives:

- Specific tax per liter on local and imported biofuels is zero
- 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 set the framework for the development, utilization and commercialization of renewable energy (RE). RA 9513 also provided additional incentives for biofuel developers. Incentives for renewable energy projects and activities are as follow:

- Special Realty Tax Rates on equipment and machinery, civil works and other improvements
- Corporate tax rates of 10% on its net taxable income
- Net operating loss carry-over (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[53]. Philippines bioethanol production remains to be sugarcane and molasses based. 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 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.

(2) Target

Targets and realization of biofuel development for the period 2007 ~ 2014 are as follows:

Table 1.12-2 Target and Realization of Biodiesel Development of the Philippines

Year	Mandated Blend (%)	Diesel Demand* (Million Liters)	Biodiesel Requirement (Million Liters)
2007	1	6,209.74	62.10
2008	1	6,442.60	64.43
2009	2	6,684.20	133.68
2010	2	6,934.86	138.70
2011	2	7,194.92	143.90
2012	2	7,464.73	149.29
2013	2	7,744.65	154.89
2014	2	8,035.08	160.70

Notes: *Based on DOE Demand Estimates for Diesel (2007-2014 Philippine Energy Plan)
**Based on 2007 average import price of refined diesel at US$0.55/liter

[53] http://bioenergywiki.net/The_Philippines

Table 1.12-3: Target and Realization of Bioethanol Development of the Philippines

Year	Mandated Blend (%)	Gasoline Demand* (Million Liters)	Bioethanol Requirement (Million Liters)
2007	0	3,760.86	-
2008	0	3,956.43	-
2009	5	4,162.16	208.11
2010	5	4,378.59	218.93
2011	10	4,606.28	460.63
2012	10	4,845.80	484.58
2013	10	5,097.79	509.78
2014	10	5,362.87	536.29

Notes: *Based on DOE Demand Estimates for Gasoline (2007-2014 Philippine Energy Plan)
**Based on 2007 average import price for refined gasoline at US$0.52/liter

In the National Renewable Energy Program launched on June 14, 2011, the targets for biofuels were set as follows:

Short Term: Mandatory E10 to all Gasoline by 2012; Mandatory B5 to all Diesel by 2015

Medium Term: Target on B10 and E20 (Fuel mixture by 20% ethanol and 80% gasoline) by 2020; Available of B20 & E85 (Fuel mixture by 85% ethanol and 15% gasoline) by 2020;

Long term: Target on B20 and E85 by 2025

However, the Ministry of Energy is reviewing the targets for biofuels. According to the Ministry's study, one the road-map for biofuels is as follows

Table 1.12-4 Measurable Biofuel Roadmap of the Philippines

Target Blend	2013-15	2016	2020	2025	2030
Biodiesel	B5	B5	B10	B20	B20
Bioethanol	E10	E10	E20	E20	E20/E85

Source: 1st WG Meeting at Jakarta, November 2012.

Biofuel utilization in the Philippines is mainly in the transport sector and this sector accounts for almost 90% of the total petroleum fuel demand. However, industrial and other sectors are also in focus but in minor proportions.

Currently, B1 (1% biodiesel and 99% petroleum diesel) and E10 (10% ethanol and 90% gasoline) are available nationwide. B1 is available at all service stations in the Philippines, and has been successfully used by thousands of vehicles in the Philippines since 2002. E10 is currently offered by all Sea oil stations nationwide. More gas stations were expected to offer E10 (Biofuels Philippines 2007)[54].

The National Biofuel Board (NBB) endorsed and the Department of Energy (DOE) has approved the 10% ethanol mandated blend, but ethanol producers and oil companies were given a transition period of 6 months to attend to distribution and logistics infrastructure concerns. The E10 blend has been fully implemented since August 2011 and ethanol imports will be allowed to cover local production deficits through August 2015.

The 1% biodiesel-blend mandate became effective on May 6, 2007 and blending ratio was increased to 2% on February 6, 2009. The biodiesel blend mandate is still at 2%; however, the DOE through the NBB will conduct further public consultations to determine the feasibility of further increasing the current biodiesel blend. The total volume of diesel displaced from May 2007 to December 2011 amounted to about 500 million liters.

Table 1.12-5 Sales Volume of Biofuel in the Philippines

	2007	2008	2009	2010	2011
Biodiesel	48.48	64.48	130.93	124.51	117.18*
Bioethanol	-	0.42	23.11	9.17	2.58

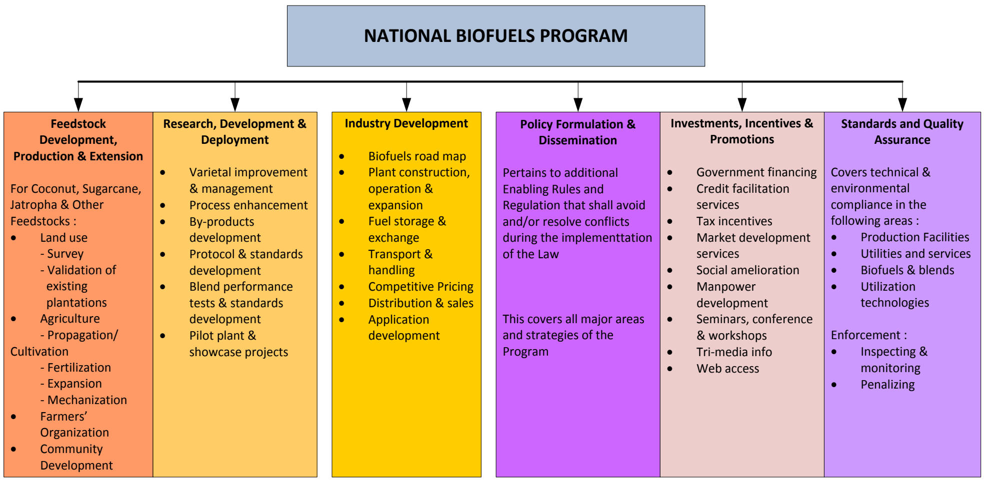
[54] http://www.biofuels.apec.org/me_philippines.html

Notes: Volume in million liters
*-2 production plants temporary stopped operations starting August 2011

(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 utilize biofuels as an alternative to petroleum fuels. The framework of the national biofuels program development is summarized as follows:

Figure 1.12-1 The Framework of National Biofuels Program Development in the Philippines



Source: Da Biofuels Feedstock Program (undated).

Feedstock Development, Production and Extension – Coconut shall be the initial feedstock for biodiesel. A fertilization program for 282,000 hectares of coconut plantation is expected to yield an average of 114.4 million liters of CME between 2008 and 2012. Expansion of the plantation by 350,000 hectares between 2011 and 2016 would yield an average of 269.5 million liters per year; and an additional 175,000 hectares from 2012 ~ 2016 is expected to yield an average of 117.6 million liters per year of CME. The total average projected yield from 525,000 hectares is 387.1 million liters per year from 2012 ~ 2016. Sugarcane and cassava shall be the initial feedstocks for bioethanol. This was supplemented by sweet sorghum in 2010.

Research, Development and Deployment – Primary RD&D requisites in the National Biofuel Policy of Philippines (NBPP) are categorized as follows: studies on crops that may be used in the production of fuels; knowledge and technology generation related to biofuels production and utilization; market research on feedstocks and fuels; economic research including crop production impact to industry and agriculture; impact study on the application of fuel and biofuel tagging for more efficient monitoring and testing; and studies on advantages and disadvantages to societies and the environment.

Biofuel Industry Developments – It is important that biofuels conversion plants are established and accredited. In 2007, there were six biodiesel conversion plants with a combined capacity of 252.9 million liters, adequate to produce the required amount of the fuel until the end of 2012. A number of similar companies have applied for accreditation with DOE. Ethanol distilleries operational in 2009 had a combined capacity of 243 million liters per year. Additional plants that were operational in 2011 processed 390 million liters of ethanol per year. In relation to the anticipated ethanol requirements, the conversion capacities of the plants are adequate.

Table 1.12-6: Bioethanol Producers in the Philippines(as of April 30, 2013)

Item	Bioethanol Producer	Project Location	Production Capacity (million liters)	Feedstock	Date Awarded	Progress
Awarded	San Carlos Bioenergy, Inc.	San Carlos City, Negros Occ.	40	Sugarcane	13-Jul-09	Operational
	Leyte Agri Corp.	Omoc City, Leyte	9	Molasses	23-Oct-09	Operational
	Roxol Bioenergy Corporation	La Carlota, Negros Occ.	30	Molasses	1-Feb-10	Operational
	Green Future Innavation, Inc.	San Mariano, Isabela	54	Sugarcane	13-Aug-12	Operational
	Total		133			
Registration with notice to proceed	Cavite Biofuels Producers Inc.	Magallanes, Cavite	34.4	Sugarcane	23-Oct-09	for construction
	Canlaon Alcogreen Agro Industrial Corp.	Bago City, Negros Occ.	45	Sugarcane	25-Nov-10	for construction
	Universal Robina Corporation	Brgy. Tamisu, Bais, Negros Oriental	30	Molasses	29-Apr-13	for construction
	Total		109.4			

Source: Presentation at the 2nd GW meeting at Tokyo, Japan. May, 2013.

Table 1.12-7: Biodiesel Producers in the Philippines (as of April 30, 2013)

Item	Bioethanol Producer	Project Location	Production Capacity (million liters)	Feedstock	Date Awarded	Progress
Awarded	Chemrez Technologies, Inc.	Bagumbayan, Quezon City	75	CNO	26-Apr-11	Operational
	Mt. Holly Coco Industrial Co., Ltd.	Lucena City, Quezon	50	CNO/Copra	16-Jun-11	Operational
	Pure Essence International, Inc.	Bagong Ilog. Pasig City	60	CNO	7-Jun-10	Operational
	Golden Asian Oil International, Inc.	Bagong Ilog, Pasig City	60	CNO	29-Jul-11	Operational
	Bioenergy 8 Corporation	Sasa, Davao City	30	CNO	29-Jul-11	Operational
	Tantuco Enterprises	Tayabas, Quezon	30	CNO/Copra	23-Jun-10	Operational
	Phil. Biochem Products, Inc.	Barangay Buli, Muntinlupa City	12	CNO	7-May-12	Operational
	Freyvonne Milling Services	Toril, Davao City	15.6	Copra	22-Sep-11	Operational
	JNJ OLEOCHEMICALS, INC (Formerly Senbel Fine Chemicals, Inc.)	Lucena City, Quezon	60	CNO/Copra	6-Jul-11	Operational
	Total		392.6			

Source: Presentation at the 2nd GW meeting at Tokyo, Japan. May, 2013.

Policy Formulation and Dissemination – The Department of Energy, through its role in the National Biofuels Board, formulates and recommends to the Office of the President of Philippines and other agencies concerned, pertinent policies and guidelines other than those included in RA 9367 and resolves problems or concerns that shall prevent the smooth implementation of the law and the National Biofuels Program. Immediate concerns are those pertaining to the use of land for food and energy purposes, and the allocation of the land for various fuel feedstocks. Importation and/or exportation policies, pricing mechanism for the feedstock, and the collection scheme of incentives for the biofuels workers shall be formulated.

Investments, Promotions and Incentives – Investments in the production, distribution, and use of locally-produced biofuels are encouraged, with entitlement to applicable incentives and benefits under existing laws, rules and regulations.

Standards and Quality Assurance – The Philippine National Standards (PNS) on biofuels and their related systems shall be evolved and institutionalized by DOE and NBB member agencies to ensure the smooth implementation and achievement of the objectives of the biofuels program. Enforcement of the laws, rules and regulations shall be strengthened for the duration of the NBPP.

(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 biofuel technology development was initiated in the 1970s. Science and technology interventions for biofuel were geared towards the utilization 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 May 2003, the specification for CME (B100) prepared by the DOE's Technical Committee on Petroleum Products and Additives (TCPPA), was adopted as the Coconut Biodiesel Standard and approved by the Bureau of Product Standard as the Philippines National Standard specification for CME or coconut biodiesel.

In 2007, research and development efforts on biofuel feedstock alternatives were undertaken at the University of Philippines in Los Banos (UPLB). Specifically, the study focused on the use of biodiesel derived from Jatropha, and bioethanol from cassava and sweet sorghum. Studies on these alternatives were likely being pursued to free volumes earmarked for the sugar and coconut oil domestic and export markets.

Second and third generation biofuels research 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 on-going research and development efforts on the use of sweet sorghum and cassava as alternative ethanol feedstocks. Besides that, The University of Philippines at Visayas and Los Banos (UPV/UPLB) have initiated studies on the viability of marine and fresh water 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. DOST undertook a pilot project on the production and testing of biodiesel from Jatropha during January 2007 until December 2011. The Philippines Council for Industry and Energy Research and Development (PCIERD) monitored this project. UPLB had 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, known as petroleum nut (*Pittosporum resineferum*), is endemic in the northern Philippines. The tree is being mass-reared by Dr. Michael A. Bengwayan, who is an environmentalist and 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 which 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 available supply of coconut for biodiesel production is supposed to suffer a decline if there was no significant increase in total coconut production. Therefore, attention should be paid on how to increase and diversify the feedstocks for biodiesel production. 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 domestic development of the biofuel industry along the whole supply chain, supports for infrastructure improvement such as farm-to-market roads, ports, terminals, etc are also needed.

Trend of Biofuel Trade of the Philippines[55]

Ethanol falls under Harmonised Commodity Description and Coding System (HS) 2207.20.11 or Ethyl Alcohol Strength by Volume of Exceeding 99 percent, according to contacts from the Philippine Tariff Commission (PTC). There are no entries under HS 2207.20.11 in the Global Trade Atlas (GTA), however, the figure in the trade matrix represent imports under the general heading for alcohol of any strength (HS 2207.20). Imports under HS 2207.20 in 2011 reached 140,831 MT, slightly down from the imports in 2010.

Executive Order No. 61 signed in October 2011 modified tariffs for various products. However, ethanol Most Favoured Nation (MFN) tariffs were left unchanged at ten percent, and will remain at this level through 2015. Ethanol imports will be subject to an additional one percent MFN tariff if certified by the DOE that the imported ethanol will be used for fuel-blending purposes. If originating from

[55] USDA Global Agriculture Information Network (GAIN) Report. 2012. *Philippine Biofuel Industry Situation and Outlook 2012*.

ASEAN-member countries (i.e., Cambodia, Laos & Malaysia), imports will be levied a five percent duty.

Chemrez Inc. had exported 500,000 liters of coconut-based biodiesel to Germany and to Asian markets including China, Chinese Taipei, South Korea, and Malaysia. If the mandated biodiesel blend increases to 2% in the next two years, as specified in the Biofuels Act, biodiesel companies in the Philippines may concentrate on supplying the domestic market and export only excess volumes.

Projection of Biofuel Demand and Supply Potential in the Philippines

The assumption for future biofuel blend rate is made based on the DOE study, the result of which is shown Table 1.12-4. The blend rates for both bioethanol and biodiesel are assumed to stay unchanged from 2030 to 2035. It is projected that annual demand for bioethanol and biodiesel will reach 1172.9ktoe and 1607.8ktoe respectively in 2035.

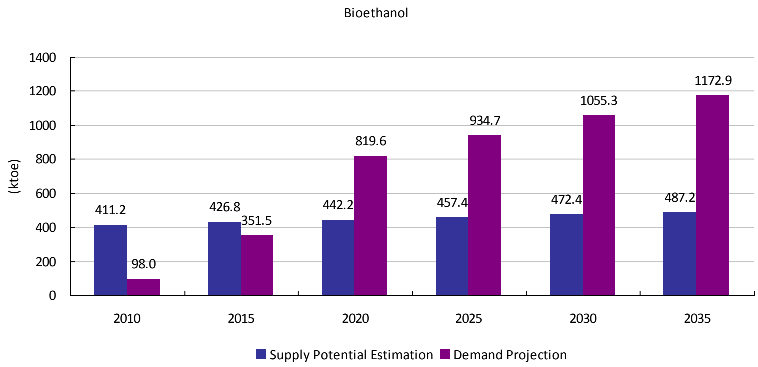
Bioethanol Supply Potential

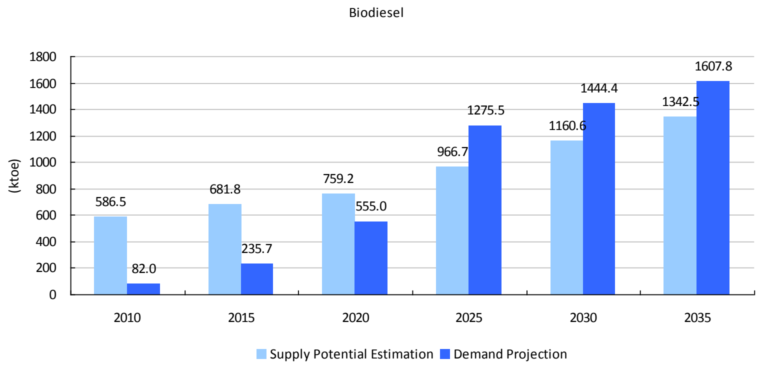
In Philippines, only sugar cane (molasses) has the potential to be a major feedstock for bioethanol production. However, because it is a net importer of sugar, only molasses is expected to be used to produce bioethanol. Supply potential of bioethanol is estimated to expand slightly from 411.2 ktoe in 2010 to 487.2 ktoe in 2035.

Biodiesel Supply Potential

Coconut is the main feedstock for biodiesel production in the Philippines. The country is one of the world's largest coconut producer and is also a major exporter of coconut products. Through promoting use of biodiesel, the income of coconut farmers and coconut industries is expected to be increased. In this study, the coconut production is estimated base on the government’s promotion program on coconut cultivation. As a result, supply potential of biodiesel is expected to incrase from 586.5 ktoe in 2010 to 1342.5 ktoe in 2035.

Figure 1.12-2 Biofuel Demand and Supply Potential through 2035 in the Philippines





Driven by concerns on energy security coupled with intention to increase the farmers' income, the Government of the Philippines is very active on promotion of biofuels' production and utilization. The government is planning to raise the mandating blend rate of bioethanol to 20% till year 2035, while allowing consumers option for E85 (85% of bioethanol). The supply and demand gap is anticipated for both bioethanol and biodiesel in the Philippines. However, domestic feedstock supply is unlikely to be enough to cover the demand driven by the mandatory blending target. Under competitive pressure from other crops as well as imports, sugar cane is becoming less attractive to farmers. Cassava plantation using marginal lands is another feedstock option now under discussion. As for biodiesel, the expansion in coconut cultivation is too slow in contrast to the rapid increase of domestic consumption of coconut for food driven by growing population. In this regard, biodiesel from coconut will not be enough in the long term. Alternative crops such as oil palm in Mindanao and other islands in the south of the Philippines should be taken into consideration.

2.13. Singapore

Policies and Program to Promote the Utilization 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: (a) promotion of market competition, (b) diversification of energy supply, (c) enhancement of international cooperation, (d) government-wide approach, (e) improvement of energy conservation, and (f) research and development in the energy field and promotion of the energy industry. Based on these six strategies, the government looks to strengthen its position as the Asian 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.[56] As part of the policy, the government developed a comprehensive policy[57] for the clean energy industry worth a total amount of 350,000,000 Singapore dollars 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). Recently, due to the increase of global renewable energy demand, the government is putting more weight to attract renewable energy processing and manufacturing industries to the country. The Energy Innovation Program Office (EIPO)[58] is responsible to implement this strategy. As a goal by 2015, the EIPO aims to create 1,700,000,000 Singapore dollars added value and employment of 7,000 skilled workers in the clean energy field. Specifically, the government intends to turn Singapore into a production and development center[59] 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.

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[56] Ministry of Trade and Industry Singapore

[57] Japan Petroleum Energy Center. 2011. *Energy Policies and Industry of Singapore, a Resourceless Country*.

[58] Formerly called "CEPO: Clean Energy Program Office" set up 2007.

[59] Ministry of Trade and Industry Singapore

Taking the advantages 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 EU and the United States, and they are domestically supplied only through two companies[60], Fuelogical and Alpha Biofuels. Major raw materials used for biodiesel production are palm oil[61] from Malaysia and Indonesia, and waste oil and animal fats (tallow) from the food industry. Recently, Jatropha and microalgae have also been used.

(2) Target

In Singapore, there is no plan to enact new standards for biofuels (diesel) in the near future. Meanwhile, in order to raise the emission control standards, the NEA announced[62] that the standards for automobile gasoline and diesel will comply with Euro IV (currently Euro II for gasoline and Euro IV (already adopted since 2006) for diesel) by Jan. 2014 (detailed schedule undecided). The NEA says that use of biofuels will be permitted if they meet the automobile fuel emission standards. Production of biodiesel was expected to reach 3,000,000 tons/year[63] 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; 1) maintain 85% “good” level and 15% “medium” level in terms of the PSI (Pollutant Standards Index), 2)

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[60] Eco-Business.com, dated Jun. 7, 2010

[61] Singaporean capital Temasek Group and Wilmar Group are financial cliques owning huge palm oil plantations in Malaysia and Indonesia and instrumental in promoting the biofuel industry.

[62] Eco-Business, dated Aug. 9, 2012

[63] Asia Pacific Economic Cooperation (APEC) Biofuels

lower the annual average PM (Particulate Matter) level to 12 μg/m^3 or less by 2020 and maintain this level until 2030, and 3) maintain the annual average SO_2 level at 15 μg/m^3 until 2030[64].

In the downstream market, 9 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 6 biodiesel purification plants with a total capability of approx. 1,300,000 tons/year. As of 2010, biodiesel had been sold at 8 gas stations on Jurong island[65]. Under the above-mentioned biofuel test project, 13 diesel cars used B5 during the period of Dec. 2007 to 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 production of biodiesel.[66]

Table 1.13-1: Capabilities of Biodiesel Purification Plants in Singapore

Company	Country	Capacity (Ton/Year)	Operating Condition
Nature Fuel	Australia	1,800,000	Closed in 2009; Will be sold
Peter Cremer GmbH	Germany	200,000	Sold to Stepan Company based in the US (which is 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 based on different documents

64 Website of the NEA (National Environment Agency of Singapore)

65 Eco-Business. 2010. *Biofuels get hotter as green choice in Singapore*.

66 AsiaX, dated Feb. 11, 2011

(3) Development Program[67]

The CERP[68] (Clean Energy Research Program) 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, subsidizing all the R&D expenses for public organizations and up to 70% of the expense for private corporations.

(4) Information on Biofuel RD&D in Singapore

Currently, research institutes engaged in research on 2nd- and 3rd-generation biofuel development in Singapore include TLL (Temasek Life Science Laboratory), The Institute of Chemical and Engineering, and The Institute of Environmental Science & Engineering. TLL jointly with Indian Tata Chemicals Biofuel Research, cooperating with Chinese scientists[69], 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, JOil (Singapore) Pte. Ltd. (JOil)[70], a bioenergy company in Singapore, announced launching of development of the first commercial plant for

[67] JETRO Singapore
[68] Application period for proposal expired in Jan. 2008 (website of the Singaporean government).
[69] Eco-Business. 2011. Year of reckoning for Singapore biofuel investments.
[70] 100% parent company of TLL; Japanese Toyota Tsusho Corporation has taken a stake in this project.

genetically modified Jatropha.[71] According to JOil, the company would use a 1.4-hectare farm in Singapore to experimentally produce genetically modified Jatropha. Project cost is estimated to be approx. 1,000,000 Singapore dollars. Launching of this project required approval from the "GMAC (Genetic Modification Advisory Committee)."

(5) Way Forward

In order to promote future introduction of biofuels in Singapore, it is necessary to consider the following issues: 1) introduction of carbon tax, etc. on the use of fossil fuels, and 2) demonstration of possibility of producing high-value added petrochemical products and polymers from raw materials for biofuels, and expansion of production scale from laboratory level to commercial level.[72]

Trend of Biofuels Trade of Singapore

Singapore's tariff system[73] is a multiple tax system consisting of two types of tariffs: general and preferential. General tariffs are imposed on only 6 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

[71] Eco-Business. 2012. Singapore firm reveals new GM biofuel corp..
[72] Eco-Business. 2011.Biofuels Development: Singapore Powering ahead.
[73] JETRO Singapore

under (1) ASEAN Trade in Goods Agreement (ATIGA), (2) Free Trade Agreement (FTA), (3) Generalized System of Preferences (GSP), (4) Commonwealth Preferences (CP) System, and (5) Global System of Trade Preferences (GSTP). The effects of import expansion by application of the preferential tariffs are limited because the customs duty is imposed on only 6 items in Singapore, but they contribute to 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 (EFTA: Iceland, Liechtenstein, Norway, Switzerland), Australia, the United States, India, Jordan, South Korea, China, Panama and Peru. Negotiations are now under way with Canada, Mexico, Pakistan, Ukraine, 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.

a. Lead-free gasoline: 3.7 to 4.4 Singapore dollars/10 liters.

b. Leaded gasoline: 6.3 to 7.1 Singapore dollars/10 liters.

c. Natural gas use as automobile fuel: 0.20 Singapore dollar/1 kg.

Industrial Exemption Factory Scheme

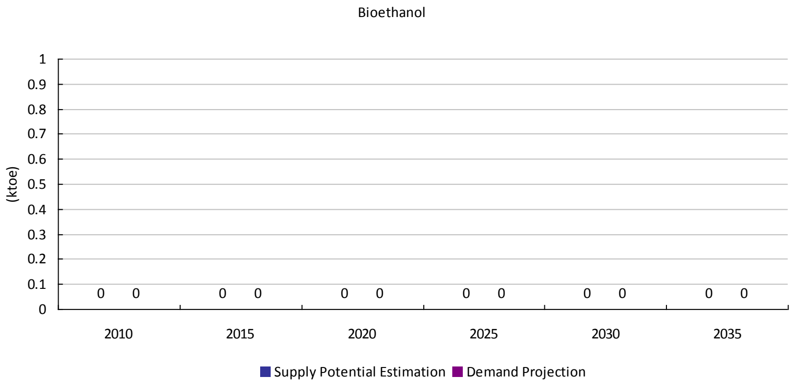
If an industrial exemption factory certificate is obtained under this system, a factory using or processing the target items of the excise duty, such as alcohol products and petroleum products as raw materials is exempted from the excise duty. The relevant raw materials must not be resold, transferred 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 225 Singapore dollars is charged per issue.

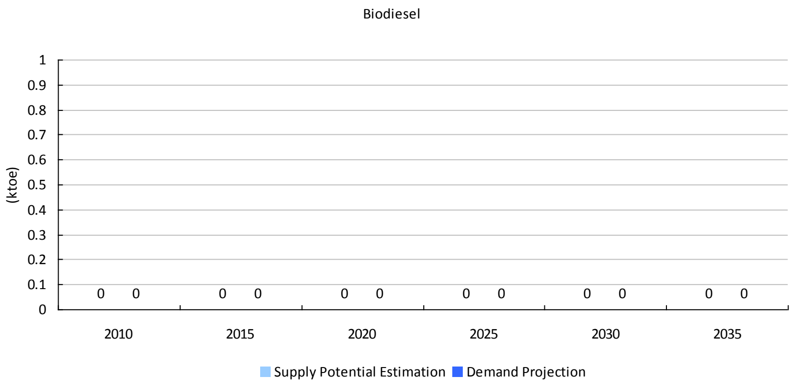
Projection of Biofuel Demand and Supply Potential in Singapore

Though the Singaporean government has carried out several initiatives on R&D of biofuel aiming to develop a national biofuel industry, little intention was showed on promoting the utilization of biofuel. Therefore, it is assumed that there will be no biofuel demand in Singapore over the projection period.

Singapore has no potential in biofuel feedstock supply from domestic production because of limitation of agricultural land. Almost 100% of the country's food supply is dependent on import, most from Malaysia and Indonesia.

Figure 1.13-1 Biofuel Demand and Supply Potential through 2035 in Singapore





Although Singapore has no domestic feedstock for biofuel production, Singapore is targeting to become one of the main exporters of biodiesel and the biofuel trade center in Asia. The government is also trying to promote the infrastructure development aiming to become the hub of biodiesel refinery in this region. Nestle Oil is one of the biggest investors in Singapore in biodiesel industry with a production capacity of 800,000 tonnes per year.

2.14. South Korea

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

The fundamental policy for biofuel in South Korea is currently based on the "2nd Bio Diesel Long-term Supply Plan" which was released in 2010.

Basically, biodiesel has been commercialized through a pilot test whereas bioethanol is still being reviewed (not commercialized yet).

(1.1) Background for introducing biodiesel

(a) Necessity for introducing biodiesel

- For the purpose of energy diversification, coping with an oil crisis and improving environmental conditions
- Increasing interest in biodiesel in EU and America since the early 1990s

(b) Fixing biodiesel long-term supply plan (1st plan was released in 2006)

- The blending rate of biodiesel has been increased since 2007 and it has been expanded at the rate of 0.5% per year.

Table 1.14-1 Blending Rate of Biodiesel in South Korea

Year	2007	2008	2009	2010
Blending rate of bio diesel	0.5%	1.0%	1.5%	2.0%

Notice: Originally, the ratio was supposed to be expanded to 3.0% by 2012, but up to now it has been maintained at 2.0% due to the limited success of expansion strategy.

- In addition, there has been exemption from petroleum tax for biodiesel.

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

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

- BD5 has been supplied universally in accordance with a voluntary agreement between the Korean government and four petroleum companies.
- On the other hand, BD20 has been supplied restrictively in designated stations and the main use of it is limited to public transportation.

(b) The outcome/effect of the plan for expanding biodiesel

- Tax incentive system
  - Tax exemption on biodiesel amounts to 310 billion won (from 2007 to 2010)
- Procuring raw materials
  - Encouraging collecting of used frying oil for the purpose of procuring raw materials of biodiesel and recycling resources.
  - Developing foreign plantations of crop feedstocks such as Jatropha

(1.3) Summary of current biodiesel policy

Blending of biodiesel is based on notification by the government and a voluntary agreement between biodiesel manufacturers and petroleum companies (not based on legislation)

Table 1.14-2 Government's Notifications on Use of Biodiesel in South Korea

	Notification regarding pilot project	Notification regarding commercialization
Period	2002.5 ~ 2005.12	2006.1~
Contents of bio diesel	BD20	BD5, BD20
Selling channel	Bio diesel manufacturer -> Oil station	- BD5 : Bio diesel manufacturer -> Oil company - BD20 : Bio diesel manufacturer -> Bus, truck with self facilities
Supply region	Capital area (Seoul, Kyunggi, Incheon) and Jeonbuk province	Whole country
Vehicle	General diesel vehicle	- BD5 : General diesel vehicle - BD20 : Bus, truck

(2) Target

The fundamental energy policy directions are provided in the "1st National Energy Fundamental Plan" and a portion of new renewable energy would be 11% as a target as finally announced. (The portion was actually about 2% in 2006. This rate is considered to be low based on the average for an OECD country)

To realize the above mentioned target, it is necessary to expand financial resources for new and renewable energy and strengthen the development and use of bioenergy and waste energy. Specifically, the policy is supported by increasing blending rate of biodiesel and bioethanol, improving domestic species of biomaterials and promoting foreign plantations. In addition, it is considered to be one of the methods to develop a cogeneration plant to effectively utilize household waste and livestock waste.

(3) Development Program

The basic strategy for biofuel consists of the items shown below.

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

- In spite of the expansion strategy for biofuel by the government, the private companies have not been competitive because of unfriendly circumstances. Actually there has been a slowdown in the growth of these companies.
- After reinforcing a 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 2011, the introduction of RFS (Renewable Fuel Standard) was reviewed and implemented.
- The temporary tax incentive policy had brought about the loss of competitiveness in the biodiesel industry, so the standard of mandatory blending rate of biodiesel obligatorily has been reviewed. This standard is called “RFS (Renewable Fuel Standard)”.
- With regard to RFS, there was a recent public hearing to gather opinion from stakeholders like K-Petro, petroleum companies and the associations of the bioenergy industry and the vehicle industry.
- RFS is expected to be legislated by 2013 and included in the “2nd National Energy Fundamental Plan” which is to be released in 2013.
- According to the RFS, blending of biodiesel will become mandatory based on 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 based on food and almost all of the raw materials used in the country have been imported (The rate of dependence on imported raw materials amounts to about 70 %.). With these problems, Korea has been vulnerable to rising international price of foods and insufficient supplying structure.

Under these circumstances, the government is strengthening the technology of producing biodiesel and diversifying raw materials. To achieve this, it is also focusing on improvements in plant breeding and development of next generation technology. Specifically, it is paying attention to development of marine algae which can be utilized domestically.

(5) Way Forward

(5.1) Problem with maintaining price competitiveness

- Remarkable rise of biodiesel price in comparison with that of diesel oil
- Difficulties with stable supply without tax incentive or utilizing obligation

(5.2) Problem with feedstock

- Dependence on the materials based on food like oilpalm or soybean.
- High dependence on imports of feedstock (It amounts to about 70 %.)

(5.3) Limitation of biofuel industry

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

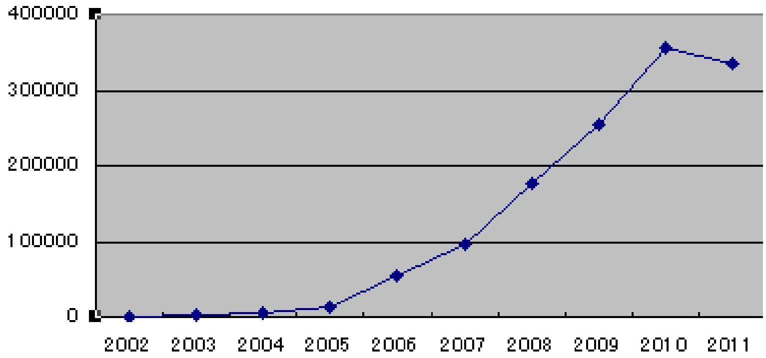
Trend of Biofuel Trade of South Korea

According to the government's biofuel policy (effective since 2006), the utilization of biodiesel has been increasing. The output of biodiesel was on the rise until 2010 as the blending rate of biodiesel was expanded by 2.0%. Originally the final target was set at 3.0% in 2012 but so far it has been maintained at 2.0% for various reasons such as limitations of sourcing raw materials. Hence, the rate of utilization has been stagnant since 2010.

Moreover, it became even more stagnant as the government announced the policy last year that a petroleum importing company should be exempted from the biofuel blending duty temporarily.

Eventually, the Korean government will raise the mixing rate of biodiesel in the future only after the issues on price competitiveness and conditions of raw material supply are addressed.

Figure 1.14-1 Output of Biodiesel in South Korea (unit: toe)



Source: Energy statistics released by Korea Energy Management Corporation

Based on the government's biofuel policy it is assumed that B5 (5% blend of biodiesel) will be fully penetrated in the country till 2035. However, since there is no clear policy on the utilization of bioethanol, no use of bioethanol is expected during the projection period. According to the assumption, it is projected that the annual demand for biodiesel will growth to 706.8ktoe in 2035.

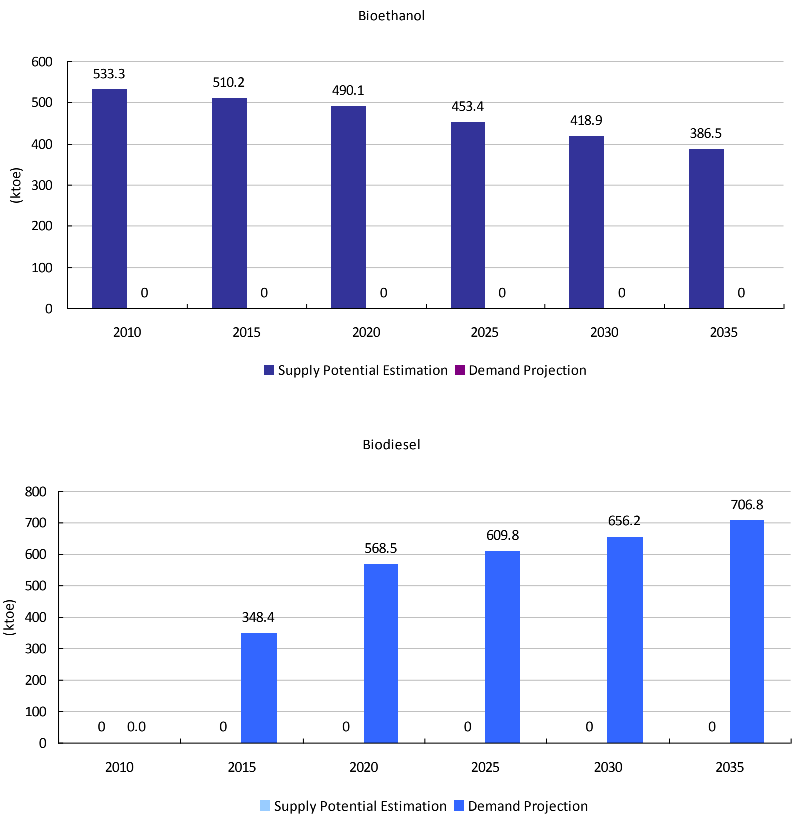
Bioethanol Supply Potential

The food self-sufficiency in South Korea is only about 20 percent. The country is a net importer of sugar and maize, which could be used to produce bioethanol. Only rice production have surplus after domestic consumption. But the excessive capacity of rice production is small. In this study, it is estimated that bioethanol supply potential will decline from 533.3 ktoe in 2010 to 386.5 ktoe in 2035.

Biodiesel Supply Potential

South Korea has no oilseed crops for biodiesel production. Small-scale biodiesel production using waste cooking oil are being carried out in some area. Although the mandatory biodiesel blending plan is being promoted currently, South Korea will have to import feedstock for biodiesel production or biodiesel itself to meet the target.

Figure 1.14-2 Biofuel Demand and Supply Potential through 2035 in South Korea



Lacking feedstock supply for bioethanol production, no plan of bioethanol mandate is conducted in South Korea at present. However, the program of mandatory blending of biodiesel is underway. With few domestic feedstock supply, the country has to rely on import to meet domestic demand. The major force behind the biofuel promotion policy is environmental concerns. Many South Korean companies are moving actively to secure feedstock supply by investing in the cultivation of oil crops in Southeast Asian countries.

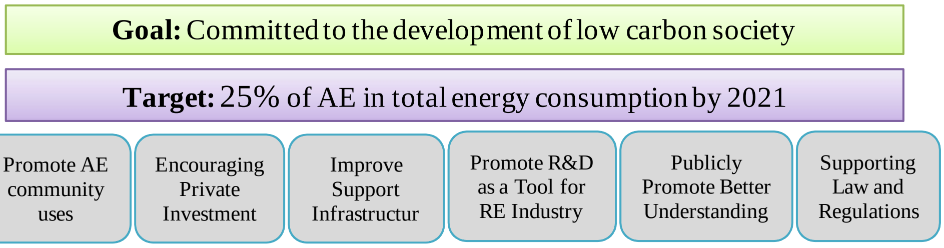
2.15. Thailand

Policies and Program to Promote the Utilization of Biofuel

(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.

Figure 1.15-1 Thailand Alternative Energy Development Plan (2012 ~ 2021)



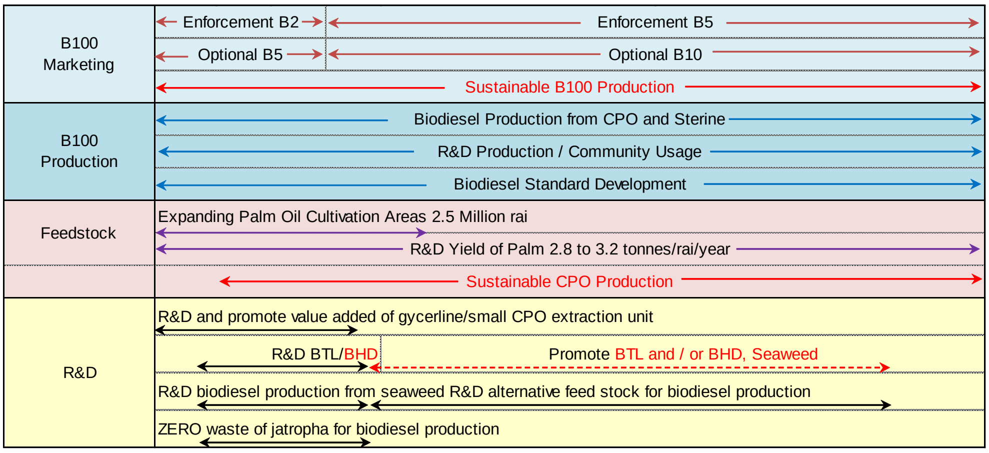
Solar		MW	2,000	3,200
Wind		MW	1,200	
Hydro Power Plant	Small	MW	324	1,608
	Micro	MW		
	Feedback	MW	1,284	
New Energy	Ocean	MW	2	3
	Geothermal	MW	1	
Bio-energy	Biomass	MW	3,630	4,390
	Biogas	MW	600	
	MSW	MW	160	
Biofuels	Ethanol	Million liter/day	9	Renewable Fuel 44%
	Biodiesel	Million liter/day	5.97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

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

Biodiesel Policy

The figure below gives the overall picture of Thailand's biodiesel policy. The mechanism is to increase biodiesel (B100) usage to the targeted level of 5.97 Million liter a day by 2021.

Figure 1.15-2 Biodiesel Development Plan of Thailand (2008-2021)



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

In the year 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 Government's aim was to spread biodiesel sales all over the country by the year 2011, and subsequently develop the B10 formula to be marketed in the year 2012.

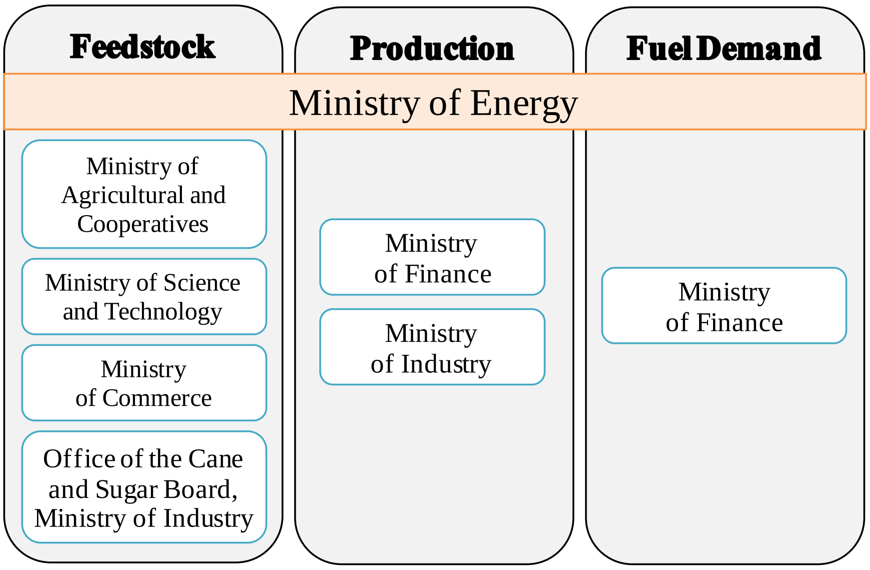
Moreover, since April 1st 2008, the government had set a regulation that all high speed diesel oil (HSD) must be blended with 2% of biodiesel (as B2). This blend is still called diesel at the gas station.

Currently there is government support for commercial use of biodiesel. For example oil palm growing areas of 2.5 million rais (1 rai = 0.8 ha) have privileges under the Board of Investment including tax relief on imported machinery, income tax relief for 8 years, and incentives by lowering of the retail biodiesel price compared to diesel oil.

Bioethanol

With regard to 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 1.15-3 Thailand Policy Body Involved in Ethanol Process



To promote production of ethanol, the supply policy concentrates on 2 aspects. First is to increase yield of both cassava and sugar cane without increasing plantation area. 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. By October of 2012, once Thailand has terminated the sale of gasoline octane 91 or ULG 91, a large portion of current ULG91 users had turned toward E10 as well as motorcycle drivers due to price advantages. To promote E20 usage, the first step is to increase E20 awareness among the drivers of approximately 1 million E20 cars. Simultaneously, the government will keep the E20 price competitive while increasing E20 gas station's coverage, which is now more than 700.

Different from the tactics to promote E20, E85 needs more support from the car manufacturing industry. Because of its higher concentration of ethanol, normal cars cannot readily use E85. Currently, there are 4 models of Flex fuel vehicles or FFV in Thailand. The Ministry of Energy is hoping to get support from the Excise department to give more tax incentives for FFV cars. To boost E85 consumptions from the 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. Additionally, there will 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 five different charges on fuels (VAT, excise duties, municipal tax, Oil Fund, and Conservation Fund) and only one of which is *ad valorem* (VAT) and the same for all fuel types. The other charges as shown in the table below are in baht per litre (or kg for gas), and vary according to the type of fuel, and are changed from time to time as the authorities try to stabilize fuel prices (Table 1.15-1).[74]

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[74] WTO. 2011. *Trade Policy Review: Thailand.* WT/TPR/S/255. Geneva: World Trade Organization.

Table 1.15-1 Taxes and Duties on Fuel in Thailand

Bt/litre (except LPG Bt/kg)

	Apr-07					Apr-08				
	Excise Duty	Municipal Tax	Oil Fund	Conservation Fund	VAT	Excise Duty	Municipal Tax	Oil Fund	Conservation Fund	VAT
Unleaded 95	3.685	0.369	3.46	0.07	7%	3.685	0.369	3.45	0.75	7%
Gasohol91	3.317	0.332	1	0.063	7%	3.317	0.332	-0.25	0.25	7%
Gasohol95 E20						3.317	0.332	-0.3	0.25	7%
Gasohol95 E85										
Biodiesel B5	2.19	0.219	0.3	0.067	7%	2.19	0.219	-1.5	0.25	7%
LPG	2.17	0.217	-1.251	0	7%	2.17	0.217	0.303	0	7%

	Apr-09					Apr-10				
	Excise Duty	Municipal Tax	Oil Fund	Conservation Fund	VAT	Excise Duty	Municipal Tax	Oil Fund	Conservation Fund	VAT
Unleaded petrol 95	5	0.5	7	0.75	7%	7	0.7	7.5	0.25	7%
Gasohol91	4.5	0.45	2.35	0.25	7%	6.3	0.63	1.4	0.25	7%
Gasohol95 E20	4	0.4	-0.3	0.25	7%	5.6	0.56	-0.4	0.25	7%
Gasohol95 E85	0.75	0.075	-5.7	0.25	7%	1.05	0.105	-11	0.25	7%
Biodiesel B5	2.19	0.219	-0.2	0.25	7%	5.04	0.504	-0.8	0.25	7%
LPG	2.17	0.217	0.303	0	7%	2.17	0.217	0.435	0	7%

	Apr-11				
	Excise Duty	Municipal Tax	Oil Fund	Conservation Fund	VAT
Unleaded petrol 95	7	0.7	7.5	0.25	7%
Gasohol91	6.3	0.63	0.1	0.25	7%
Gasohol95 E20	5.6	0.56	-1.3	0.25	7%
Gasohol95 E85	1.05	0.105	-13.5	0.25	7%
Biodiesel B5	0.005	0.001	1.489	0.25	7%
LPG	2.17	0.217	1.147	0	7%

Source: Energy Policy and Planning Office, Thailand (EPPO). Quoted in WTO. 2011. *Trade Policy Review: Thailand.* WT/TPR/S/255. Geneva: World Trade Organization.

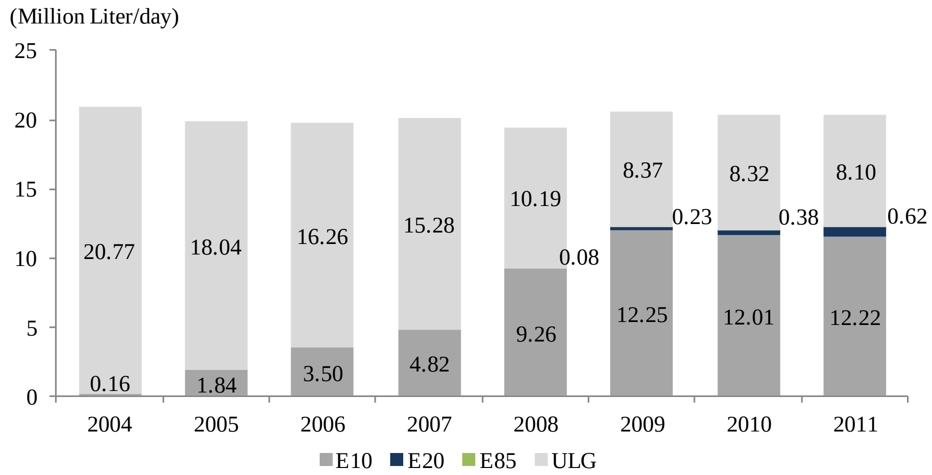
(2) Target

Ethanol

The number of ethanol producers increased remarkably after the blending obligation in the year 2007. At the end of year 2011, there were 20 ethanol plants operating with a total capacity of 3.27 million liter per day. In the same year, the total production of ethanol was 402.2 million liter, which was only 37.6% of total capacity.

The target set by The Renewable Energy Development Plan (REDP) is 9.0 million liter per day by the year 2021. This increase in production capacity to achieve the target will be a major challenge for Thailand to secure feedstock supplies and will involve issues relating to land use and the environment impact.

Table 1.15-2 Gasohol Sales Volume from 2004 ~ 2011 in Thailand



Notes: (1) Gasohol Volume Sale: 12.22 million liter/day. (2) Demand of ethanol: 1.30 million liter/day

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

Table 1.15-3 Ethanol Plants Operated in Thailand until 2011

No.	Material	Operated	
		No. of Plant	Total Capacity (Million Liter/day)
1	Molasses/Sugar cane	9	1.3
2	Cassava	5	0.83
3	Molasses/Sugar cane/Cassava	6	1.08
	Total	20	3.27

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

Table 1.15-4 Ethanol Production in Thailand (2007 ~ 2011)

Year	2007	2008	2009	2010	2011
Quantity (Million Liter)	191.8	335.3	400.7	425.7	402.2

Notes: (1) Average ethanol produce in 2001 (January-September) = 1.47 Million Liters/day, (2) Ethanol 99.5% (Gasohol E10, E20, E85)

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

Table 1.15-5 Thailand's Ethanol Exports (2007 ~ 2011)

Year	2007	2008	2009	2010	2011	2012 (Jan~Apr)
Quantity (Million Liters)	14.9	65.8	15.6	48.2	139	106.8

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

Table 1.15-6 The Ethanol Producers List until 2011 in Thailand

No.	Name	Available Feedstock	Feedstock	Capacity (Liter/day)	Operation
1	Pornvilia International Group Trading Co. Ltd.	Molasses / Cassava	Molasses	25,000	Oct 2003
2	Thai Agro Energy PLC.	Molasses	Molasses	150,000	Jan 2005
3	Thai Alcohol Co. Ltd.	Molasses	Molasses	200,000	Aug 2004
4	Khon Haen Alcohol Co. Ltd.	Sugar Cane / Starch Tapioka	Molasses	150,000	Jan 2006
5	Thai Nguan Ethanol PLC.	Cassava Chip	Cassava	130,000	Aug 2005
6	Thai Sugar Ethanol Co. Ltd.	Molasses	Molasses	100,000	Apr 2007
7	K.I. Ethanol Co. Ltd.	Molasses	Molasses	100,000	Jun 2007
8	Petro Green Co. Ltd	Sugar Juice / Molasses	Molasses	230,000	Jan 2008
9	Petro Green Co. Ltd	Sugar Juice / Molasses	Molasses	230,000	Dec 2006
10	Ekarat Pattana Co. Ltd.	Molasses	Molasses	230,000	Mar 2008
11	Thai Roong Ruang Energy Co. Ltd.	Molasses / Baggase	Molasses	120,000	Mar 2008
12	Ratchaburi Ethanol Co. Ltd.	Cassava Chip / Molasses	Cassava Chip	150,000	Jan 2009
13	ES Power Co. Ltd.	Cassava Chip / Molasses	Molasses	150,000	Jan 2009
14	Measod Palunggan SA-AD Co. Ltd.	Sugar Juice	Sugar Cane	200,000	Jan 2009
15	Sapthp Co. Ltd.	Cassava Chip	Cassava Chip	200,000	May 2009
16	Taiping Ethanol Co. Ltd.	Cassava Chip	Cassava	150,000	Jul 2009
17	P.S.C. Starch Products PCL	Cassava Chip	Cassava Chip	150,000	Aug 2009
18	Petro Green Co. Ltd	Sugar Cane / Molasses	Molasses	200,000	Dec 2009
19	Khon Haen Alcohol Co. Ltd.	Sugar Cane / Molasses	Molasses	200,000	Dec 2012
20	Thai Agro Energy PLC. (Dan Chang) Phase 2	Cassava Chip / Molasses	Cassava Chip	200,000	Dec 2012
			Total	3,265,000	

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

Biodiesel

In April 2007, there were 2 companies 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 PTT area and 419 in the Bangkok area. There were 15 biodiesel producers with government certificates on the quality of production. All had production capacities of 5.26 million liters per day.

Table 1.15-7 Biodiesel Plants Operated in Thailand until year 2011

No.	Material	Operated	
		No. of Plant	Total Capacity (Million Liter/day)
1	CPO/RBDPO	5	2.36
2	Palm Stearine	2	0.25
3	CPO/RBDPO/Palm Stearine	8	2.65
	Total	15	5.26

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

The target for biodiesel production set in the REDP is a production capacity of 5.95 million liters per day by 2021. The production of biodiesel was around 400 million liters per year in 2011.

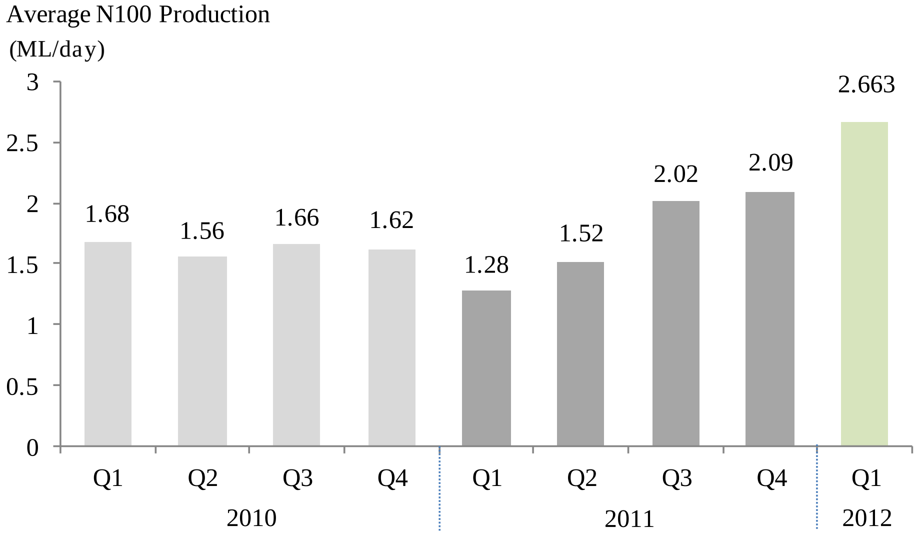
The B100 usage has increased steadily after January 2012 when Thailand mandated the 5% blend of B100 in all diesel fuel sold in Thailand.

Table 1.15-8 Biodiesel Production in Thailand (2007-2011)

Year	2007	2008	2009	2010	2011 (Jan~Aug)
Quantity (Million Liters)	191.8	335.3	400.7	425.7	402.2

Notes: (1) Average B100 produce in 2001 (Jan ~ Aug) = 1.60 Million Liters/day
Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy

Figure 1.15-4 B2-B4, B5 & Diesel Sales Volume in Thailand (2003 ~ 2011)



Source: Department of Alternative Energy Development and Efficiency, 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 crops cultivation area is the most urgent problem for Thailand. The cultivation plans of raw material crops for biodiesel and bioethanol production are presented in the following tables. It should be noticed 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 1.15-9: 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 2010-11 are from the Office of Agricultural Economics (OAE) estimation (Oct 2010)
(2) Figure in 2012-22 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 1st, 2010
(4) CPO & RBD consumption calculated by deducting 20 % from starting of Vegetable oil consumption
(5) Stock at year end is 0.15 million tones.
Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy

Table 1.15-10 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 2010 refer to the Office of Agricultural Economics (OAE)
(2)** Data 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 in research and development. These three institutions had carried out basic research on biofuel production technology, maintenance of the research environment, and support the development of the country's biofuels industry.

TISTR as a research institute has been promoting both basic and applied domestic research in accordance with bio-sciences, materials, energy, and the environment. Thailand has put into practical use ethanol fuel production from 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 the dissemination of 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 in the foregoing paragraph were also involved in the development of second generation biofuel production technologies. However, many of these were in the experimental stages and not ready for commercial application. Current focus on advanced second generation bioethanol technology development projects include:

- Cellulosic ethanol
- FFV conversion kit
- ED95

Table 1.15-11 Bioethanol Technology Development in Thailand

	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Ethanol Demand (Million Liters/day)	1.24	1.34	2.11	2.96	6.20					9.00					
R&D	R&D 2nd generation of ethanol production (Cellulosic)								Promote 2nd generation of ethanol production						
	Value added ex. Sewage														
	Study E85														

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

Table 1.15-12 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

Under the national energy program, the promotion of biodiesel and ethanol are important plans. The biodiesel was planned to be a community product in certain areas, and ethanol was targeted to serve nationwide. The cassava plant is the cheapest source of starch and based on the long experience of the Thai cassava industry the cassava can support the national policy and strategy on biofuel, especially in the production and use of bioethanol. Future development faces several challenges.

Food VS Fuel

Many have argued between food and fuel. However, the Thai Ministry of Agricultural 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, and good irrigation and fertilizer management. Thus, root productivity is expected to increase without an increase in the land area and without competition from the food sector. However, given that Thailand is among the global largest producers and exporters of rice, and sugar the impact of a switch from food to fuel cultivation raises concerns on not only the country's food security but also the global food supply chain.

Environment Issues

Usually about 2,500 liters of water will be needed to produce 1 liter of biofuel. It is believed that the promotion of biofuel 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 Biofuel Trade of Thailand[75][76]

As of 2007, Thailand began to promote exports of ethanol as fuel. The government is contemplating how to revise the current regulatory framework to enable greater flexibility to export ethanol. Alcohol production is strictly controlled under the Cane and Sugar Act (1984). Ethanol producers in Thailand must declare whether the ethanol they produce is for biofuel use or for liquor. The export of ethanol for liquor is allowed although export of Thai-produced ethanol for energy purposes to foreign consumers is currently prohibited. Given the excess domestic supply, in 2008 approximately 71 million litres of ethanol were authorized for export to Singapore, the Philippines, Taiwan, Korea, Australia and the Netherlands. There are only five ethanol producers authorized 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 liters, as compared to 48.2 million liters in the previous year. The increase reflected import demand from the Philippines to fulfill its E10 gasohol mandate that became effective August 6, 2011. Ethanol exports continued to grow during January – March 2012 to 84.0 million liters, as compared to 22.7 million liters in the same period of the previous year again primarily to the Philippines where the operation of its new ethanol plants had been delayed.

In 2013, ethanol exports will likely increase to 350 million tons in anticipation of strong import demand from the Philippines and China. Ethanol exports to China are

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[75] Elisa Morgera, Kati Kulovesi, and Ambra Gobena. For the Development Law Service - FAO Legal Office. 2009. *FAO Legislative 102 Case studies on bioenergy policy and law: options for sustainability*. Rome. 2009

[76] USDA, Global Agriculture Information Network (GAIN) Report. *Thailand Biofuels Annual 2012*.

expected to increase significantly as a new Thai export-oriented ethanol plant with a production capacity of 400,000 Liters/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 liter/year to China.

Table 1.15-13 Thailand's Export of Ethanol

Million Liters

	2008	2009	2010	2011	2012 (Q1)
Philippines	1.5	-	5.5	61.3	36.5
Singapore	12.3	3.1	19.3	68.5	19.6
Japan	10.4	7.4	20	16.5	8.6
Australia	2.5	-	-	2.1	-
Taiwan	3.2	3.1	1.2	3.2	1.5
Indonesia	2	-	-	0	-
Europe	25.8	0	-	-	-
South Korea	-	-	2.1	12.8	16
Other	8.1	2	0	2.6	2.1
Total	65.8	15.6	48.2	167	84.3

Notice: based on 19 on-line ethanol plants exporting 95% purity ethanol

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy. Quoted in USDA, Foreign Agricultural Service. *Thailand Biofuels Annual 2012*.

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 preferential ASEAN Free Trade Area (AFTA) duty rates; this was the case, for example, with palm oil imports.[77]

[77] WTO. 2007. *Trade Policy Review: Thailand.* WT/TPR/S/191. Geneva: World Trade Organization.

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 national 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.

Projection of Biofuel Demand and Supply Potential in Thailand

The biofuel utilization in Thailand is assumed to reach the government's target set till 2022, after which the blend rates are assumed to stay the same till the end of the projection period. The annual demand for bioethanol and biodiesel is projected to increase to 4315.5ktoe and 2538.5ktoe respectively in 2035.

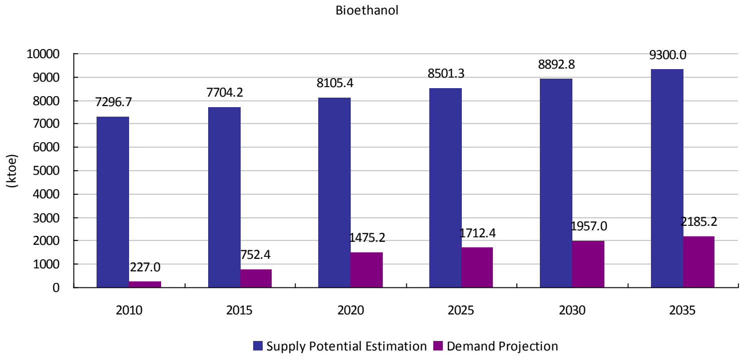
Bioethanol Supply Potential

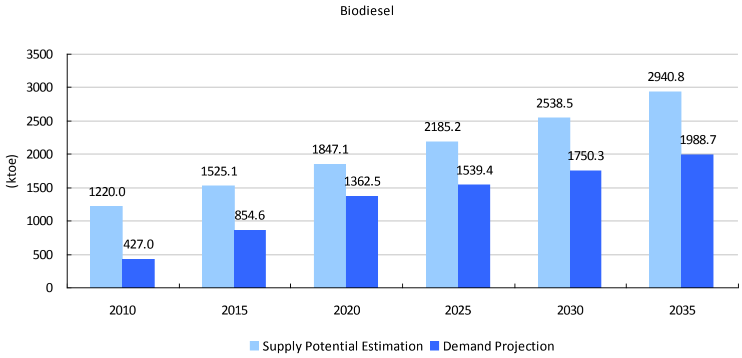
Thailand has a good potential on feedstock (mainly sugarcane and molasses) resources for bioethanol production. The supply potential of bioethanol is estimated to reach 9300.0 ktoe in 2035 from 7296.7 ktoe in 2010.

Biodiesel Supply Potential

The major biodiesel feedstock is palm oil. Thailand is the world's third largest palm oil producer. It is projected that the Thailand's supply potential of biodiesel will increase from 1220.0 ktoe in 2010 to 2940.8 ktoe in 2035.

Figure 1.15-5 Biofuel Demand and Supply Potential through 2035 in Thailand





Among the ASEAN countries Thailand is the most advanced country in terms of production and utilization of bioethanol. With abundant domestic supply and the government's support, it is expected that the country's demand for bioethanol will remain strong over the projection period. As an exporter of sugar and cassava, the country has enough capacity to provide raw materials for domestic bioethanol production. However, for biodiesel, although Thailand has the potential to supply palm oil as feedstock for biodiesel in the short- to medium- term, depending on international price of palm oil the producers might be more interested in exporting palm oil because of higher profits. Therefore, more price incentives for attracting domestic palm oil producers to biodiesel production will be required. However, as suitable land for oil palm cultivation is limited to the southern area of Thailand, alternative crops or second generation technologies would be necessary in the long-term.

2.16. Vietnam

Policies and Program to Promote the Utilization of Biofuel

(1) Policy Overview

The fundamental energy policy directions of Vietnam are provided in “National Energy Development Strategy up to 2020, with 2050 Vision (the Strategy, hereinafter)” approved by the Vietnamese Cabinet in December 2007. The Strategy set a long-term target for renewable energy’s share in the total primary energy supply at 5% as of 2020 and 11% 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 Vietnamese government. The country’s first biofuels policy was provided as the Prime Minister’s decision No. 177 on November 20, 2007 (the 2007 Decision, hereinafter). The outline of the Decision is provided in the later section.

(2) Target

The first numerical target for biofuels utilizaiton was provided in the 2007 Decision. Details are as shown in the following Table). The 2007 Decision aimed at attaining the goal that all motor gasoline and auto diesel oil consumed in Vietnam should essentially be either E5 gasoline or B5 diesel by 2025.

Table 1.16-1 Volume Target of Biofuels in Vietnam

Item	2010	2015	2025
Volume of biofuels ('000 tons)	7.5	250	1,800
Volume of E5 and B5 ('000 tons)	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% bio diesel.
Source: Prime Minister's Decision No. 177

It was reported that the Vietnamese government had set another target specifically for E5 gasoline in November 2012.[78] According to the government decision, blending 5% of ethanol to 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% to 10% by December 1 2016 in the seven provinces and cities and by December 1 2017 in the whole country.[79] As the 2007 Decision did not assume 10% 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 Vietnam, official statistics is not available. Six ethanol plants are in operation as of November 2012 and the combined production capacity is 550,000 kl/year.[80] Three of the six plants are

[78] VietnamNet. 2012. *Vietnam vows to use green fuels to keep air fresh.* http://english.vietnamnet.vn/fms/environment/53707/vietnam-vows-to-use-green-fuels-to-keep-air-fresh.html.

[79] VietnamNet. 2012. *Vietnam vows to use green fuels to keep air fresh.* http://english.vietnamnet.vn/fms/environment/53707/vietnam-vows-to-use-green-fuels-to-keep-air-fresh.html.

[80] Nam News Network. 2012. *Vietnam Targets for Biofuel Project* . http://www.namnewsnetwork.org/v3/read.php?id=MjEzNjQz.

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.[81] 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 utilization will be required to meet the new target.

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

(3) Development Program

The principal biofuels policy program of Vietnam is the 2007 Decision. The decision provides short term objectives through 2010, mid-term objectives through 2015, and a vision for 2025 as summarized in the following Table.

Table 1.16-2 Objectives Provided in the Prime Minister's Decision of Vietnam

Term	**Objectives**
To 2010	1. Building legal corridor to encourage industrial-scale biofuel product and using biofuel as replacement fuel in Vietnam. Raising public awareness of the role and benefit of biofuel. 2. Building road map to use biofuel as a spare fuel in transportation and other industries, and constructing pilot distributing stations in some cities. 3. Approaching and mastering technology for biofuel production from biomass, including blending technology; and improving the efficiency of transforming biomass into fuel. 4. Planning and developing raw material zones for biofuel production. 5. Training of human resources to handle the initial stage of biofuels development. 6. Building and developing trial models for producing and using biofuel with capacity of 100,000 tons of E5 and 50,000 tons 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 biofuel production.
2011-2015	1. Research, mastering, and production of materials, and additives for biofuel

[81] Petro Vietnam Oil. List of Bio-fuels plants. Available at https://www.pvoil.com.vn/en-US/pvoil/plants-products/303.

	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 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 tons (blending of 5 million tons E5 and B5), meeting 1% of total demand for gasoline and diesel. 6. Training of human resources in areas related to biofuel production and training of technical workers to meet human resources needed for biofuels production.
Vision as for 2025	Technology for biofuel production in Vietnam will be at an advanced level. Output of ethanol and biodiesel fuel will reach 1.8 million tons, meeting 5% of total demand for gasoline and diesel in the country.

Source: Prime Minister's decision No. 177

The decision then provides the necessary mechanisms as follows:

- As the government funding to support biofuels program, D259.2 billion during 2007–2015, equal to D28.8 billion per year, is allocated.
- Government funds fundamental scientific research and technology development.
- Private enterprises on the other hand are expected to take care of capital investment for developing the biofuels production industry.

Although it is not the Vietnamese government's policy, Asian Development Bank (ADB) published its review of the Vietnamese biofuels policy and deployment in 2009.[82] The ADB's review includes market outlook of biofuels in Vietnam, assessment of potential resources to produce biofuels, and policy recommendations. ADB recommended that the Vietnamese government needed to: provide the best political and economic environment rather than direct subsidies to avoid conflicts under the World Trade Organization framework, identify the primary feed stock for biofuels to streamline policy efforts across different ministries, and set up an

[82] Asian Development Bank. *Status and Potential for the Development of Biofuels in Vietnam*. 2009.

organization that oversees the biofuels industry.[83]

(4) Information on Biofuel RD & D in Vietnam

Research and Development (R&D) activities of biofuel in Vietnam are undertaken by the state-owned PetroVietnam group and other governmental organizations' initiatives. Vietnam Petroleum Institute (VPI), a research institute of PetroVietnam group, is pursuing R&D activities based on the group's R&D roadmap as illustrated in the following Table.

Table 1.16-3 PetroVietnam's Biofuel R&D Roadmap

Item	2011-2015	2016-2025
Feedstock	Developing another biomass for biofuels production; Planning raw material areas for 3rd generation biofuels production (algae and microalgae).	Establishing technological process for cultivating algae and microalgae.
Technology	Approaching and researching the modern technologies for biodiesel production; Deplying trial production of bio ethanol, bio butanol, and liquid fuels from biomass.	Deploying trial production of bio ethanol and biodiesel from algae, microalgae; Approaching and researching new technologies for producing 3rdgeneration biofuels.
Blending, Storage, Transportation & Distribution	Conducting research on establishment and mastering of technology for blending biodiesel (fossil diesel, bio diesel and additives) and technology for storage, transportation 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; Conducing 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	Large scale on road test of E25 (Fuel mixture by 25% ethanol and 75% gasoline) & B25 (Mix of 25%

[83] Ibid, p51.

	national scale; •Large scale on road test of E10 & B10.	biodiesel and 75% diesel) or higher blends

Source: Vietnam Petroleum Institute

As another R&D activity, 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.[84]

(5) Way Forward

The biggest challenge to expand biofuels use in Vietnam is how to attract consumers' as well as petroleum product marketers' interest. It is reported that E5 gasoline is sold at 100 Vietnamese Dong (VND) discount to conventional motor gasoline A92.[85] 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.[86] In addition to such insufficient price incentive, consumers are 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

[84] Algen Sustainables' web-site (www.algensustainables.com/). Accessed on April 9 2013.

[85] Nam News Network. 2012. *Vietnam Targets for Biofuel Project* . http://www.namnewsnetwork.org/v3/read.php?id=MjEzNjQz.

[86] 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 24,000 VND ,and thus 100VND is just 0.4% of the total price.

at their gas stations. Only three out of more than ten marketers are dealing with E5 gasoline in Vietnam, and Petrolimex, the largest petroleum product marketer in Vietnam, 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 Biofuel Trade of Vietnam

Vietnam 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 Vietnam cannot find buyers in the domestic market due to the marketers' reluctance to adopt E5 gasoline as mentioned above. [87]

Projection of Biofuel Demand and Supply Potential in Vietnam

The Government of Vietnam set a target to substitute 1% of total transport fuel by 2015 and 5% by 2025. If the target were to be realized, Vietnam is expected to see an annual demand of 478.1ktoe of bioethanol and 677.7ktoe of biodiesel in 2025. It is assumed that the blend rates of both bioethanol and biodiesel would stay the same after 2025. Annual demand of bioethanol is projected to grow to 876.6ktoe in 2035 and biodiesel reach to 1067.0ktoe in the same year.

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[87] Nam News Network. 2012. *Vietnam Targets for Biofuel Project* . http://www.namnewsnetwork.org/v3/read.php?id=MjEzNjQz.

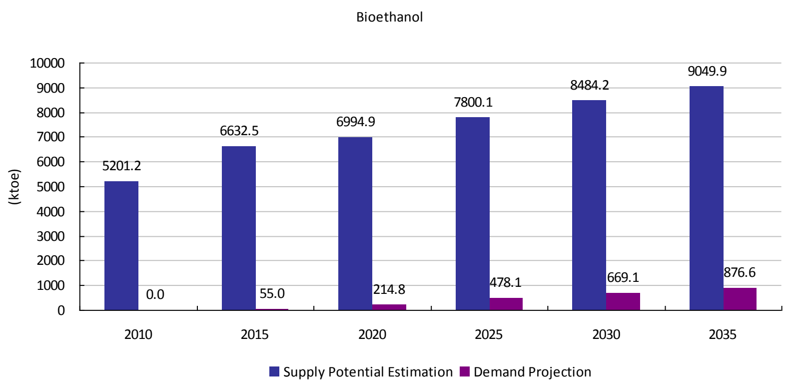
Bioethanol Supply Potential

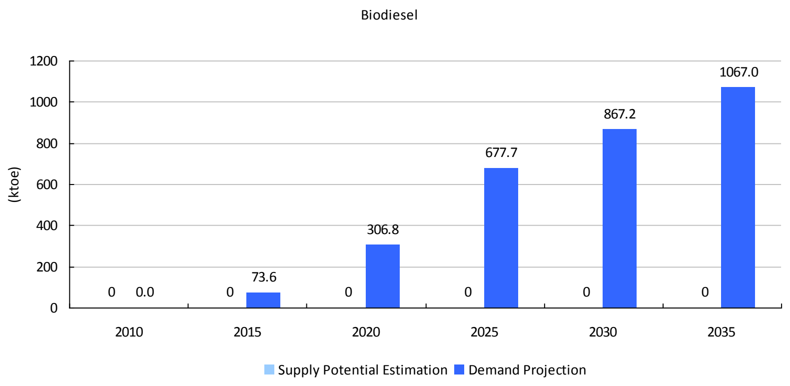
The potential feedstocks for bioethanol production in Viet Nam are rice and sugarcane (molasses). It is estimated that supply potential bioethanol will increase from 5201.2 ktoe in 2010 to 9049.9 ktoe in 2035.

Biodiesel Supply Potential

Because Viet Nam is a net importer of cooking oil, it is assumed that the country has little potential on feedstock supply for biodiesel production.

Figure 1.16-1 Biofuel Demand and Supply Potential through 2035 in Vietnam





Vietnam is slowly pushing forward plans to promote use of bioethanol. There is enough feedstock (sugar cane, rice, and cassava) supply potential for bioethanol in the country. For the long term, the country has the potential to export bioethanol.

Currently, some cassava plantation projects invested by foreign companies are underway, the purpose of which is for export.

Although there is no mandatory blending of biodiesel in Viet Nam yet, the target for biodiesel use was set. The government has launched a plan for the cultivation of Jatropha as a source of new feedstock. Most of the projects are promoted by foreign companies. However, the feasibility of producing biodiesel from Jatropha still needs to proof.

CHAPTER 3

Biofuel Market and Supply Potential in East Asia Countries

1.1. Methodology of Demand Projection

(1) Methodologies

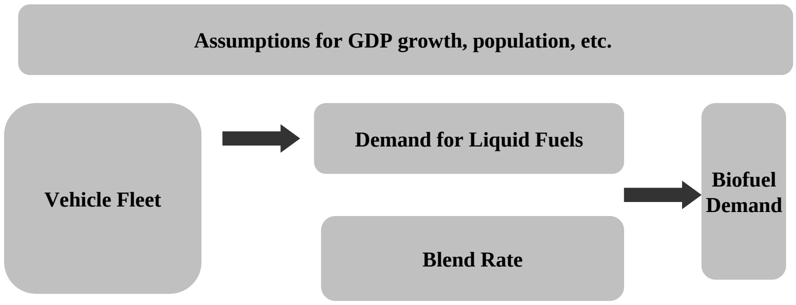
Biofuels could be used in various sectors, including industry sector, power generation, and the transport sector. Within the transport sector, biofuels can be used as vehicle fuels, fuels in marine, as well as aviation fuels. However, since road transport is currently the largest market for biofuels (and for petroleum fuels as well), for most countries road transport is the primary sector to promote biofuels use (as an alternative to petroleum fuels), the projection of future biofuels demand was focused on road transport. The basic formula used for calculating biofuel consumption for road transport is:

$$Biofuel = TotalDemandofCertainLiquidFuel \times BlendRate$$

Most governments have their targets for biofuels utilization and the targets are always in the form of blend rates. Usually, biofuel is blended into petroleum fuels for use (ethanol blended into gasoline, biodiesel blended with diesel). The percentage of biofuel in the fuel mixture is the blend rate, which is calculated in terms of heat value rather than volume.

Demands for two types of biofuels are projected in this study, bioethanol and biodiesel. Bioethanol is used for blending with gasoline and biodiesel with diesel, thus the demand for gasoline equivalent and diesel equivalent will be projected. Since liquid fuel consumption depends significantly on the number of vehicles on the road, ownership of vehicles is projected first to calculate the liquids demand.

Figure 1.1-1 Framework to Forecast Biofuels Demand



Joyce Dargay (2007)[1] found that the relationship between ownership of passenger cars and income (GDP/Capita) level can be represented by a 'S' shaped curve. There are a number of different functions that can describe such a curve. In this paper the Gompertz function is used (which is also the function used in the study though the function form used in this paper is more simple). The Gompertz model can be written as:

$$P=K*\exp(\alpha*\exp(\beta*(GDP/Capita)))$$

Where P is the passenger cars per 1000 persons

K is the saturation level of passenger cars per 1000 persons

α and β are negative parameters defining the shape or curvature of the curve

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[1] Joyce Dargay, Dermot Gately and Martin Sommer. 2007. *Vehicle Ownership and Income Growth, Worldwide: 1960-2030*. http://www.xesc.cat/pashmina/attachments/Imp_Vehicles_per_capita_2030.pdf

Each country's parameters α and β can be estimated by regression analysis using history data of the respective country. The saturation level of passenger cars ownership per capita (constant K, the unit of which is passenger cars per 1000 persons) of each country needs to be decided exogenously. The constant K is estimated by considering the population density and urbanization rate.

The future passenger car ownership is the product of passenger car ownership per capita and total population. Apart from passenger cars, to project future gasoline (equivalent) and diesel (equivalent) consumption, buses and trucks also need to be considered. Buses and Trucks are put under one category because the statistics used in this paper counts trucks and buses as one category 'Truck & Bus'. Different from passenger cars, projection of future 'Truck & Bus' is done by time series regressions using GDP and/or population as drivers (independent variables).

The projection of fuel demand from road transport was carried out through two approaches: the top-down approach and the bottom-up approach. The top-down approach in this study is a time series regression using the stock of cars and fuel price as independent variables. In the bottom-up approach, the annual fuel demand is the product of car stock and stock average fuel intensity (average annual fuel consumption per car per year).

Bottom-up Approach

For the 'Truck & Bus', the stock average fuel intensity was assumed primarily from the IEA SMP Transport Model[2] and adjusted depending on the fuel consumption characteristics of each country. The share of each kind of fuel (gasoline, diesel, natural

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[2] The spreadsheet model is available at http://www.wbcsd.ch/plugins/DocSearch/details.asp?type=DocDet&ObjectId=MTE0Njc

gas) in total fuel demand was assumed (mainly based on history trends) to calculate demand for each kind of fuel. For the passenger cars, the fleet was further disaggregated into 4 categories: gasoline consumption cars, diesel consumption cars, Compressed Natural Gas (CNG) cars, and Electricity Vehicle (EV) cars. To simplify calculation it was assumed that each type of car consumes only one kind of fuel (e.g. gasoline consumption cars only burn gasoline). At the core of the bottom-up approach for passenger cars is an stock counting module by which the stock turnover (service life was considered) and the stock average fuel intensity for each type of cars were calculated. The stock for the whole passenger car fleet was calculated by using Gompertz function, and the stock for each category of cars would be calculated in the stock counting module. In the calculation of stock turnover the vintage (category and year start using) of each car and its fuel intensity were recorded and annual sales of cars of each vintage was counted, through which the annual stock and stock average fuel intensity of each category of cars were calculated and then the annual demand for each kind of fuel was estimated. Similar to that of 'Truck & Bus', the fuel intensity of new car of each type was set primarily from the IEA SMP Transport Model and adjusted depending on the fuel consumption characteristics of each country.

(2) Assumptions

The macro social and economic assumptions, i.e. the GDP and population growth, was in line with that of the Energy Saving Potential Working Group of ERIA. The assumptions for biofuel blending were made based on government policies and the analyst's judgment, while for the 4 countries in the WG the WG member from each country was consulted on the future prospect of biofuel use in the country concerned.

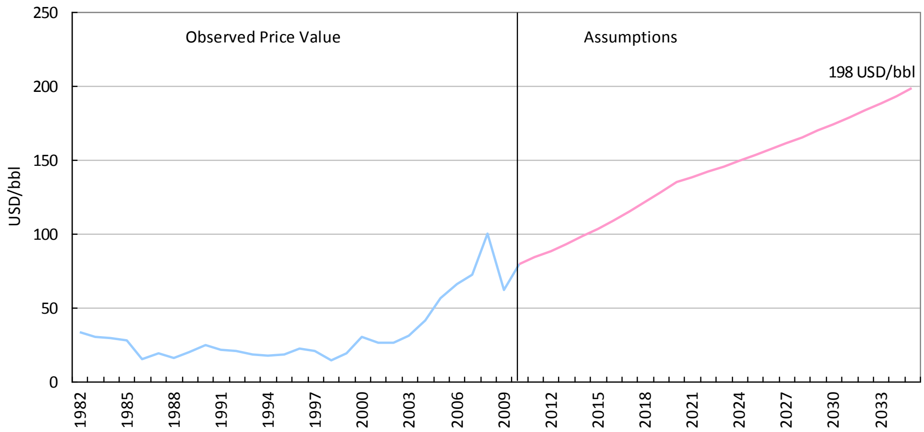
Table 1.1-1 Assumptions for GDP Growth

	2000~2010	2010~2020	2020~2035	2010~2035
Australia	3.1	4.1	3.7	3.9
Brunei Darussalam	1.4	2.9	2.6	2.7
Cambodia	8.0	5.1	5.1	5.1
China	10.5	8	4.3	5.8
India	7.7	8.1	6.2	7.0
Indonesia	5.2	5.8	5.1	5.4
Japan	0.7	1.4	1.1	1.2
Laos	7.2	7.1	7	7.0
Malaysia	4.6	4.4	3.4	3.8
Myanmar	11.5	7	7	7.0
New Zealand	2.4	2.6	1.8	2.1
Philippines	4.8	6.6	5.1	5.7
Singapore	5.6	5.2	3.1	3.9
South Korea	4.1	4	2.5	3.1
Thailand	4.3	4.5	3.5	3.9
Vietnam	7.3	7.0	7.1	7.1

Table 1.1-2 Assumptions for Population Growth

	2000~2010	2010~2020	2020~2035	2010~2035
Australia	1.5	1.5	1.3	1.4
Brunei Darussalam	2.0	2.0	1.6	1.8
Cambodia	1.3	1.8	1.8	1.8
China	0.6	0.4	0.0	0.1
India	1.5	1.3	0.9	1.0
Indonesia	1.2	1.2	0.1	0.5
Japan	0.1	-0.4	-0.7	-0.6
Laos	1.5	1.5	1.5	1.5
Malaysia	1.9	1.5	1.1	1.3
Myanmar	0.6	1.0	1.0	1.0
New Zealand	1.2	1.0	0.7	0.8
Philippines	1.9	1.9	1.4	1.6
Singapore	2.6	1.3	0.7	0.9
South Korea	0.5	0.4	0.1	0.2
Thailand	0.9	0.3	0.3	0.3
Vietnam	1.1	1.0	0.6	0.8

Figure 1.1-2 Assumption for Crude Oil Price



Notice: WTI for historical data.

1.2. Methodology of Supply Potential Estimation

Model framework

There have been differences in investigations on the production function in different parts of the world in both developing and developed countries. In this study, the Cobb-Douglas Production Function was used for calculating the production of Energy Crops in each country. The basic formula for calculating production of energy crops was as shown below:

$Y = aA^{\alpha}L^{\beta}K^{\gamma}$

A double log equation was used and the estimated formulas were as follows:

$LN\ (Y) = LN\ (aA^{\alpha}L^{\beta}K^{\gamma})$

Where;

Y = Output (Production of Energy crops)

A = Land (Cultivation Area)

L = Labor

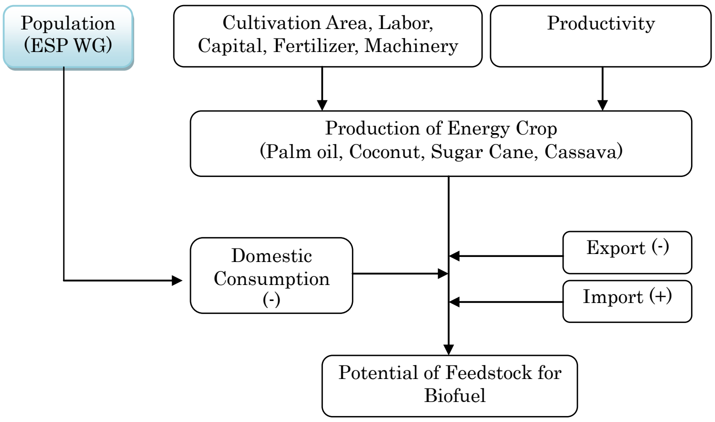
K = Capital Stock, or I = Input (Machinery, Fertilizer)

The time variant (TREND) was used in this calculation because the production was explicitly dependent on time.

The purpose for this analysis was to estimate the potential feedstock supply for biofuel, rather than the capacity for biofuel supply (production). Biofuel production capacity has more complex prerequisites with respect to construction of plans, policy, technology and data, which this study will not cover. The definition of potential feedstock supply in this analysis implies the redundant production after domestic consumption. The structure of the model is as shown in the diagram below.

Notice should be paid that though domestic consumptions of the feedstocks (which are: cassava, sugar cane, molasses, maize, rice, coconut oil, palm oil, rapeseed, waste oil, and livestock fat) for food and industrial material were subtracted from the biofuel supply potential, the export of the feedstocks (whether they are for food or for other use) was counted as part the biofuel supply potential.

Figure 1.2-1 Model Framework for Biofuel Supply



The history statistics for crop production, land area, and labor were obtained from the FAO. The assumptions for GDP and Population are the same with that used in the demand projection.

<u>Agriculture activity</u>

➢ Palm oil, soy, coconut, sunflower, canola, peanuts, jatropha, rice, maize, cassava, sugar cane, and sorghum were available as raw materials for biofuel in these four countries.

- Maize and rice are important grain crops that should be secured from the perspective of security of food supplies, and hence both of these crops are difficult to become feedstock for biofuel conversion.
- The short term crops such as sorghum, soy, sunflower, canola and peanut are not suitable as energy crops because our target countries rely on imports for consumption as a food.
- Only jatropha as a non-food plant is noted for its high potential. However, jatropha is not suitable as an energy crops in the short term due to its shorter history as a crop and lack of cultivation experiences,.
- Energy crops available as raw material for biofuels under present production conditions will be palm oil, coconut, sugar cane (molasses) and cassava.

1.3. Demand and Supply Balance of Asia

Total bioethanol demand in the 16 countries is projected to reach 49425.3ktoe in 2035 while the total supply potential is estimated to be 69986.4ktoe in 2035. Total biodiesel demand in the 16 countries in 2035 is projected to be 37479.2ktoe and the total supply potential is estimated at 56867.2ktoe. The results indicate that the region as a whole holds enough potential to full fill all the countries' biofuel targets. In the demand projection constraints of domestic supply was not considered, assuming that the demand would be met either by domestic production or import. Also, as mentioned above, though domestic consumption of crops was exclude from biofuel supply counting, current exports of crops were counted as part of the biofuel supply potential. This implies that though the regional biofuel target could be met without imposing issues on food security in biofuel exporting countries, it might negatively impact the regional or global food supply depending on the (biofuel exporting) country's importance in global food supply chain.

Figure 1.3-1 Bioethanol Demand and Supply Potential

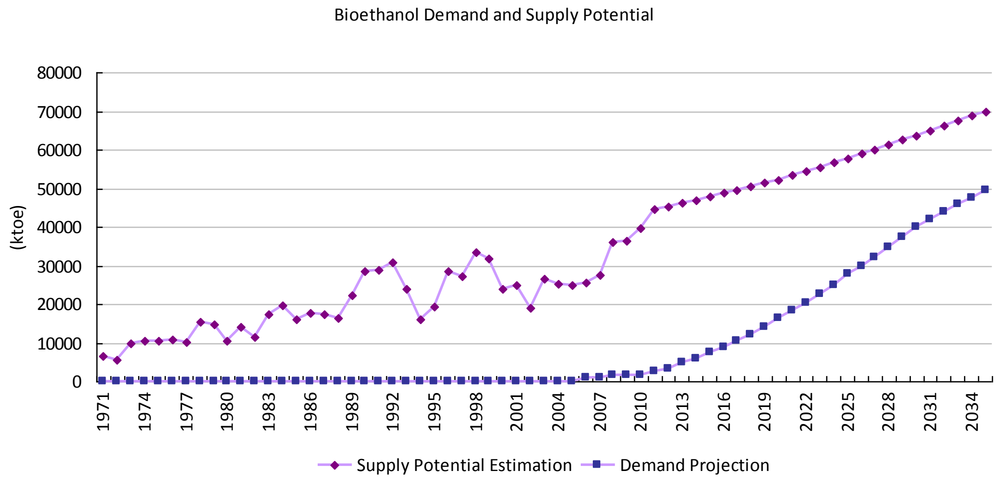
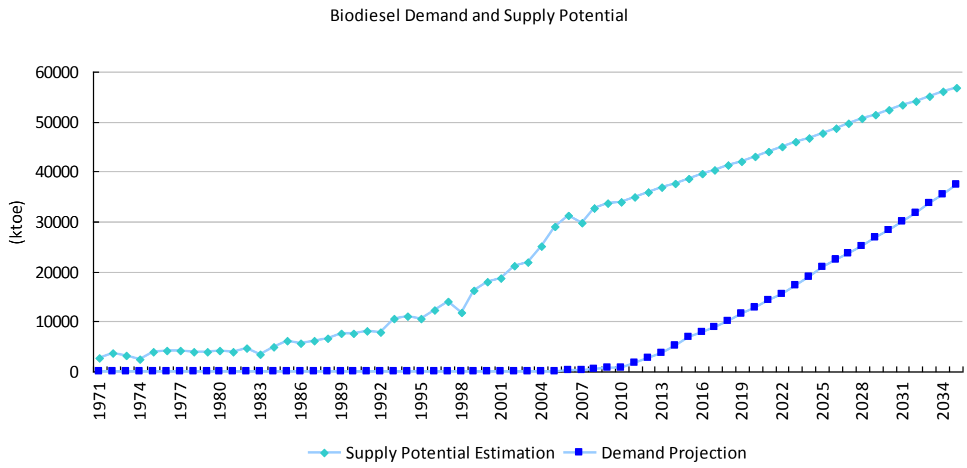
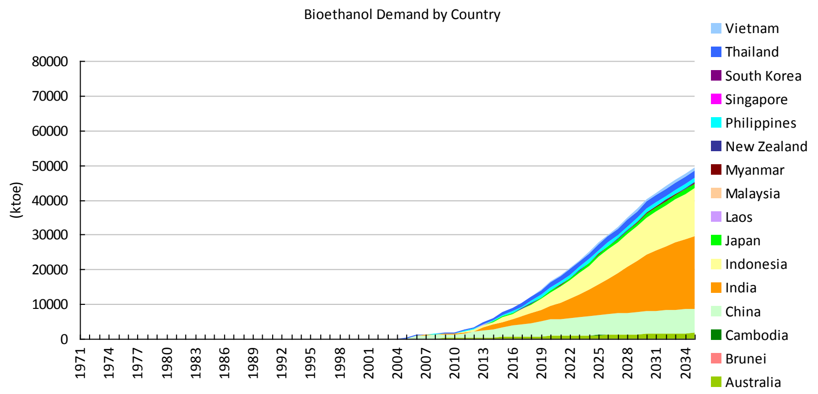


Figure 1.3-2 Biodiesel Demand and Supply Potential



When look at the demand and supply potential of bioethanol and biodiesel by country it could be observed that the country with large biofuel demand in the future not necessarily has sufficient potential of supply, and vise versa. For example, Indonesia is expected to be country with the second largest bioethanol demand accounting for 27.6% (13621.2ktoe) of the region's total bioethanol demand in 2035 while is supply potential of bioethanol is estimated to be only 3.3% (2320.9ktoe) of the region's total. On the other hand, while Malaysia is supposed to be the region's second largest biodiesel supplier with 39.7% (22557.3ktoe) of the region's total supply in 2035, its domestic biodiesel demand is projected to account for only 3.0% (1118.0ktoe) of the region's total. This mismatch of future biofuel demand and supply potential indicates that cross country biofuel trade is necessary to optimize the region's biofuel utilization. The details about the issues on regional biofuel market integration will be discussed on the next chapter.

Figure 1.3-3 Bioethanol Demand and Supply Potential by Country



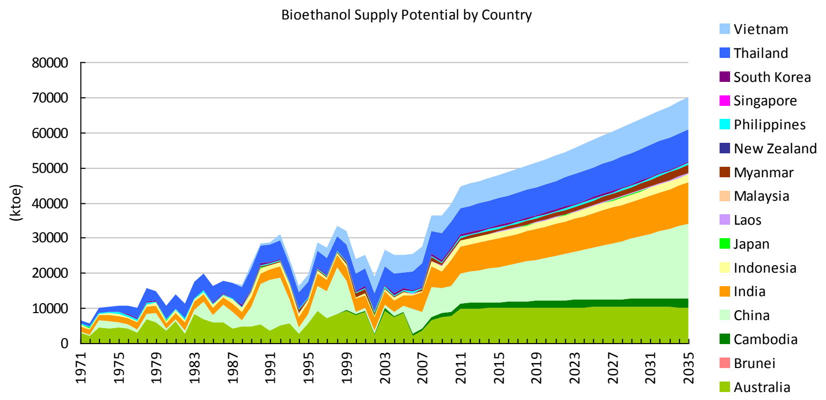
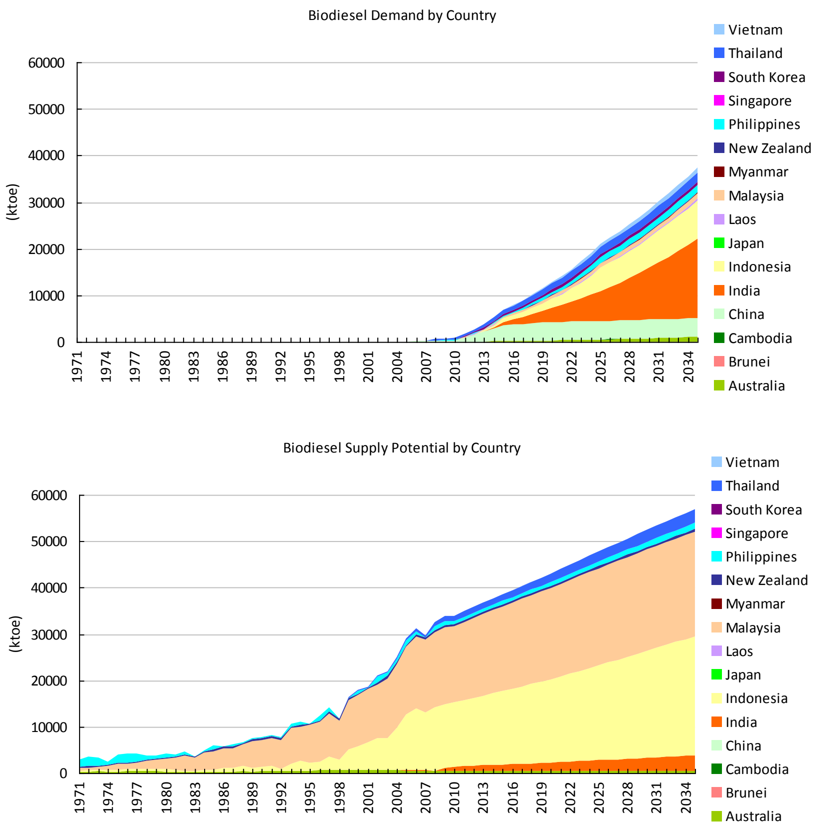


Figure 1.3-4 Biodiesel Demand and Supply Potential by Country



CHAPTER 4

Biofuel Market Outlook for Integration: Case of ASEAN

The above demand/supply analysis shows the limitations of the market of individual countries and the region. This limitation is expected to be mitigated through the integration of the market. This section addresses the benefit of the integration in terms of potential increase of biofuel market. Although the advantage of integration of market seems clear from the point of regional demand and supply, the reality is much more complex because the prerequisites of market integration must be considered, which include regional common standards and meeting different objectives for biofuels, and so on. In this chapter, the complexity is analyzed from the point of potential increase of the biofuel market from integration to the impact of competing objectives in policies.

Firstly, the magnitude of the benefit from integration against market isolation is estimated. Next, the factors to reduce the barriers to market integration are analyzed.

Analysis 1: What is the benefit of market integration or cost of non-integration? Case of ASEAN major four.

In Chapter 3, we showed the potential of the market of the 16 countries if integrated. But if the market cannot be integrated, the market equilibrium cannot surpass demand or supply. Therefore, the maximum potential of the market of each country without import and export is the smaller number of either demand or supply. This constrained market potentials of bioethanol and biodiesel are calculated as such in the upper bar "Integration Benefit" of the graph shown below. The benefit is the difference between the integrated potential and the constrained potential by border.

The formula for the estimation of the gap between markets with and without borders is as follows.

Sum of the market constrained by the national border

$=\Sigma$ Min (country demand, country supply)

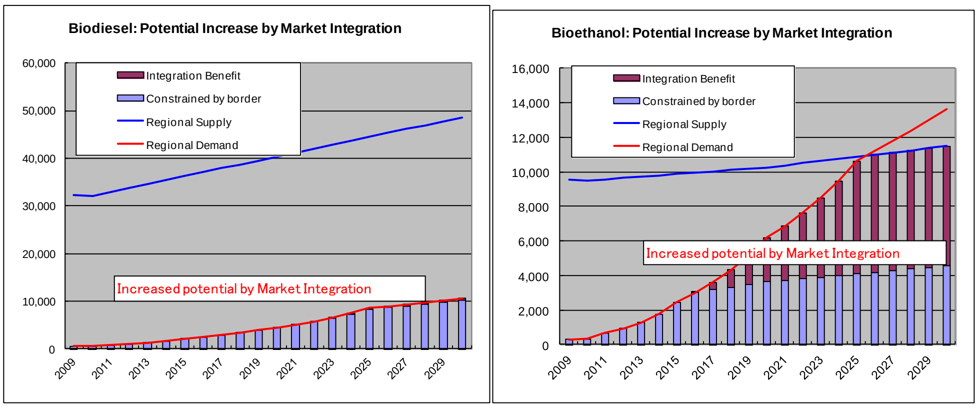
Market of the sum of the four countries

=Min (Σ country demand, Σ country supply)

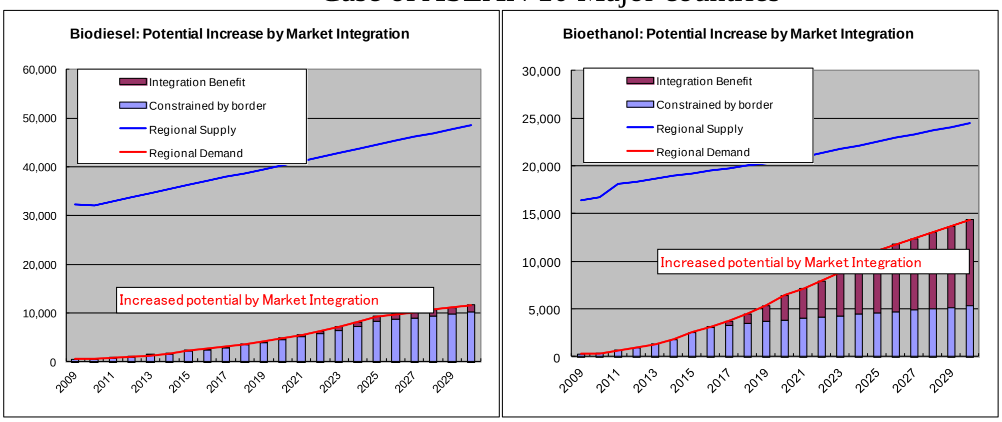
The Figure below shows the increased potential by market integration for the cases of ASEAN 4 countries (which including Indonesia, Malaysia, the Philippines, and Thailand), ASEAN 10 countries, and Asia 16 countries. The benefit for market potential increases as the market expands from ASEAN 4 countries, ASEAN 10 countries to Asia 16 countries. The pattern also changes. The benefit for bioethanol is especially large for the case of ASEAN 4 countries, while the benefit for biodiesel does not appear until the market expands beyond ASEAN region. The magnitude of increased potential will reach to double the original maket scale by 2030 for both bioethanol and biodiesel.

Figure 3.1-1 Increase of Market Potential by Market Integration (ktoe)

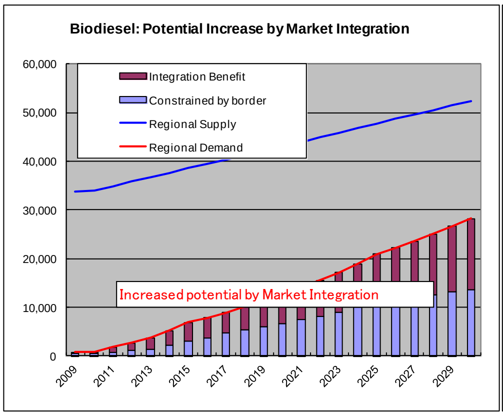
Case of ASEAN 4 Countries

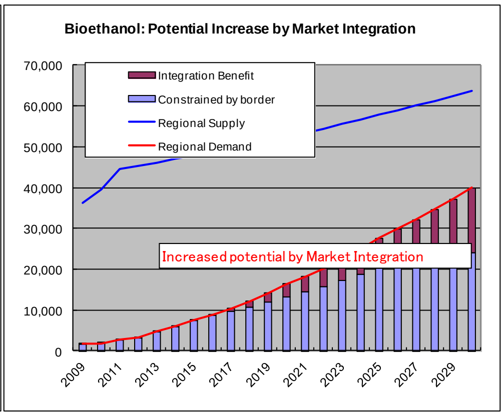


Case of ASEAN 10 Major countries



Case of Asia 16 Countries





Analysis 2: What polices could lead to market integration?

Even common standards for biofuels are established in the region, the integration of the market still depends on the intention of each individual country (whether the country wants to open the market or not). In the case of biofuels, a government's intention on market integration with foreign countries is shaped by the drivers and objectives of biofuels promotion in the country. In Asia, the objectives for the utilization of biofuels include: 1) energy security, 2) trade balance, 3) economic development, 4) rural development, 5) agricultural development (job and income for farmers), and 6) climate change mitigation (Zhou, 2009).

The priorities of the drivers and objectives to promote biofuel production and consumption may vary from country to country depending on the individual country's endowment of energy resources and social and economic development circumstances. For oil importing countries, like Philippines and Thailand, energy security, trade balance, and economy are the critical drivers behind government's support for biofuel utilization. For energy producing countries like Indonesia and Malaysia, objective such as agricultural development becomes critically important.

The integration of the markets therefore has to meet various interests of different countries. For example, one critical element is the economic value of biofuels. If biofuels cannot compete with other fuels such as gasoline and mineral diesel, trades across national borders would be difficult. Moreover, the integration of the market can have a negative impact on one objective, but positive impact on another and the degree of the impacts may differ by country depending on the extent of the market integration. For example, in the Philippines, biofuels are perceived as alternatives to oil products and the Philippines Biofuel Act of 2006 was intended to promote local production but not imports in the future. On the other hand, the less populated Malaysia has huge potential for biodiesel export while the domestic demand is limited. The primary intention of Malaysian government's move on biofuels is to promote export rather than domestic consumption.

What is the optimal level of market integration to fulfill the interests of different countries to the maximum? In fact, this is the subject of framework of regional trade resulted from negotiations among countries. The issue of trade is beyond the scope of this study.

The method of market integration is export and import. Most countries can achieve the objectives mentioned above through export. However, the export potential is limited to only a few countries. Therefore, the imbalance will make market integration be very difficult even if there are regional benefits. The issue lies in the conflict of national and regional interests.

How can we bridge the gap between national and regional benefit? The key is on the collective benefit. One example is the agenda of East Asia Summit of 2007 hosted by the Philippines. The Summit is a response to the increasing crude oil price. One of the purposes of the summit is on the feasibility of replacing imported oil and oil products with regional biomass and biofuel. The message is clear that the key is the price. If biofuel could be produced at lower cost than those of oil products from the middle East, the oil importing countries will have strong incentive to import biofuels, although this may not directly contribute to the industry development or job creation.

In the light of the collective interests of ASEAN countries and their historical responses to energy prices, the most practical action to cooperate is, as mentioned above, to reduce the cost of biofuel production. Analysis 1 showed that the huge potential of market creation by regional market integration. To release the potential cooperative effort for biofuel productivity need to be strengthen.

Conclusion

Total bioethanol demand in the 16 countries is projected to reach 49425.3ktoe in

2035 while the total supply potential is estimated to be 69986.4ktoe in 2035. Total biodiesel demand in the 16 countries in 2035 is projected to be 37,479.2ktoe and the total supply potential is estimated at 56,867.2ktoe. The results indicate that the region as a whole holds enough potential to fulfill all the countries' biofuel targets. However, the conclusion is under the precondition that biofuels be traded cross countries.

When look at the demand and supply potential of bioethanol and biodiesel by country it could be observed that the country with large biofuel demand in the future not necessarily has sufficient potential of supply, and vise versa. Under the market isolation scenario, the national market size can not surpass the minimum of supply and demand. In this case, the region's bioethanol and biodiesel consumption in 2035 would be 16,720ktoe and 26,296ktoe respectively. The differences of biofuel consumptions under market integration and market isolation suggest that a regional integrated market for biofuel trade across countries would help to maximize the region's biofuel consumption, which means maximize the substitute of oil products.

However, the process of establishing a regional integrated biofuel market is very complex. The prerequisite include a regional common standard for biofuels as well as a framework meeting individual country's various interests. Because of the higher cost compared with oil products, national biofuel market is currently policy driven, which makes it extremely challenging to further open domestic biofuel market. However, previous studies suggest that if the price of biofuels goes below that of oil products, barriers in cross country biofuel trade will be reduced.

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Appendix

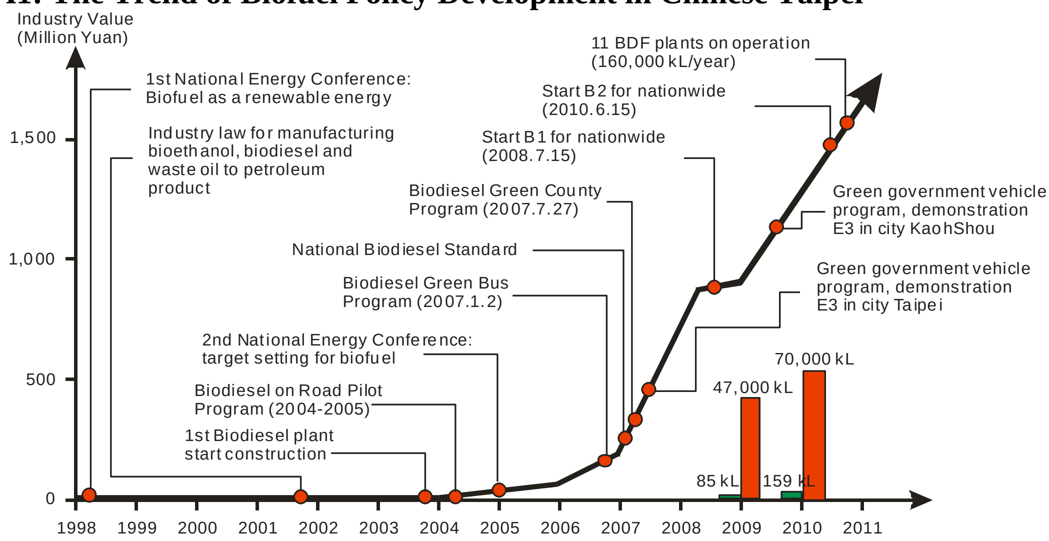
Development of Biofuels in Chinese Taipei

Policies

Chinese Taipei's biofuel development is built on government policy for recycled energy development statute and greenhouse gas reduction. The biofuel policy has also significantly become very apparent in the wake of a green energy industry development trend and rising oil price.

Chinese Taipei has recognized biofuel as a renewable energy at the first "National Energy Conference" in May 1998. Subsequently, the promotion of biofuel as an initial activity was centered on research and development. The first biofuel industry law has promulgated in 2001; the law was a provision for manufacturing and utilization of bioethanol, biodiesel and petroleum product fuel from waste oil. One small pilot project call "Biodiesel on Road Program" was conducted in the early part of 2004. Based on the results from the pilot project, Chinese Taipei had set their first biofuel target for the transportation sector at the second "National Energy Conference" in 2005. The first biofuel target was focused on biodiesel industry chain development from feedstock, manufacture and utilization (impact on vehicle). The national biofuel standard was implemented in 2007 to complete the law and regulations on biofuel promotion.

Figure A1: The Trend of Biofuel Policy Development in Chinese Taipei



Sources: Bureau of Energy, Ministry of Economic Affairs, Chinese Taipei.

Existing Policies and Regulations

1) Renewable Energy Development (8th July 2009)

The Renewable Energy Development was passed right after the "National Energy Council" of 2009. The objective of the Act was to promote the utilization of renewable energy, increase energy diversification, improve environment quality, energize related industries and enhance the national sustainable development. Feed in tariffs (FIT) has become the main measure to implement the policy to promote the utilization of renewable energy. Biodiesel has mandated the mixture obligation of 2%, but bioethanol by a voluntary program has mandated a mixture obligation of 3%.

2) Petroleum Administration Act (Article 38 and Article 57)(11 October 2001)

Article 38:

A business engaging in the production, import, blending, sales of alcohol gasoline, biodiesel, or renewable oil products must apply for prior approval of the central competent authority for operating the business. Other than petroleum products used for blending, rules related to the security stockpile and Petroleum Fund do not apply to renewable energy sold by businesses. The central competent authority will stipulate measures for the administration of businesses engaging in the production of the renewable energies of alcohol gasoline, biodiesel, or renewable oil products.

Article 57:

Prior to the enforcement of the amendment of this Law, any business engaged in alcohol gasoline, bio-diesel, or renewable oil products granted the permit(s) of establishment in accordance with Article 38 will be regarded as already granted the valid approval for the production and sales of alcohol gasoline, bio-diesel, or renewable oilproducts.

3) Administration Act for Manufacture, Import, Mixture and selling of Bioethanol, Biodiesel, and Recycled Oil Production

The law was conducted with the desired provisions on administrative legislation for biofuel manufacture, import, mix, sales based on the Petroleum Administration

Act, Article 38-3. The biofuel developers are requested to submit the details of the project and receive permits for each stage from related administrative departments. The law also clarifies that biomass liquid fuel that does not meet national standards for biodiesel fuel is available to the industrial and power generation sectors.

4) Standards for the Composition of Automobile Gasoline and Diesel Fuels

For the effective regulation of biodiesel quality, Chinese Taipei had announced on March 2, 2007 the biodiesel (fatty acid methyl ester) standard (CNS-15072). According to the project of norms and standards, Taiwan basically refers to the norms of the European biodiesel standards, including the EN14214:2003 and the American Society for Testing and Materials (ASTM) D6751 standard from the United States.

Target

<u>Target</u>

Chinese Taipei has set up a target for biodiesel B2 by 2011 and B5 by 2016. As planned, the mandatory B2 target nationwide was successfully enforced in June 2010, and the construction was underway for following the B5 target by the year 2016. Although there was feedstock shortage for biodiesel in the domestic market, they successfully completed the biodiesel industry chain by using waste edible oil.

The early target for the bioethanol E3 nationwide was set for 2011, but was finally postponed to 2018. The current introduction of bioethanol is behind schedule because of uncertainty of feedstock supply in the domestic market, where the program has affected the food supply system in the country. In 2010, only 159 kL was used in the pilot projects “Green Public Service Vehicles” at Kaohsiung and Taipei.

Table A1: Current Status and Target of Biofuel Promotion

	Unit	Actual		Target	
		2009	2010	2016	2018
Biodiesel	kL	47,000	70,000 (B2)	250,000 (B5)	-
Bioethanol	kL	85	159 (E3)	-	300,000 (E3)

Sources: Bureau of Energy, Ministry of Economic Affairs, Chinese Taipei.

Production

Currently, Chinese Taipei biodiesel feedstock supply is mainly from waste edible oil in the domestic market and a small amount feedstock imports from the international palm oil market. At the end of 2011, 11 biodiesel refinery plants were operating with the total capacity 160,000 kL per year. But when we look at the domestic biodiesel production in 2012, the utilization of the facility is around 50% with 83,000 kL per year. This is because the import of biodiesel or import of feedstock is cheaper than domestic manufacturing of biodiesel. Meanwhile, stricter environmental regulations on the disposal of waste edible oil and recycling and refinery of waste oil has been successful, from securing the biodiesel raw materials, biodiesel refinery sector, distribution and retail sector until the final consumption sector, the biodiesel industry chain has been completed. The focus on future policy is appropriated to the expansion of the supply of feedstock whether the feedstock comes from domestic sources or abroad.

Table A2: Production Trend of Bioethanol and Biodiesel in Chinese Taipei

Year	Bioethanol (kL)	Biodiesel (kL)
2005	-	679
2006	-	1,876
2007	123	3,717
2008	23	19,088
2009	93	31,620
2010	215	43,774
2011	115	56,939
2012	235	82,872
2013.1-3	24	22,155

Sources: Bureau of Energy, Ministry of Economic Affairs, Chinese Taipei.

Development Program

Biodiesel

1) Biodiesel on Road Pilot Program (2004-2005)

This was the first biofuel program conducted by Chinese Taipei on biofuel promotion activities. The program was carried out from 2004 to 2005 by introduced a biodiesel target of B20 in 780 units of municipal waste collecting trucks at 13 cities and counties. The source of biodiesel in this pilot program was from waste cooking oil in the domestic market. This program had consumed about 1,300 kL biodiesel

(3,195 kL from different sources) and the government had paid out 100 million Yuan for the activity.

2) Green Bus Program (2007.1.2)

This program was promoted at Kaohsiung City and Chiayi County and limited to selected public buses. Kaohsiung city had started the B5 program since January 2007 with 428 city buses. However, Chiayi County had started the B2 program since December 2007 with 79 city buses. Most of the feedstock came from recycled cooking oil and small amounts were from soybean.

3) Green County Program (2007.7.27)

The B1 Green County program was conducted at 297 gas stations own by Chinese Petroleum Corp. and Formosa Petrochemical Corp. in Taoyuan and Chiayi County since July 2007. Until June 2008, the program consumed around 330 kL and more than 1,500 trucks from 13 major fleet operators were fueled by B1 without any incidents being reported.

4) Establishment of Energy Crops Production and Marketing System Plan

The Agriculture and Food Agency, Council of Agriculture had promoted an energy crops cultivation plan of fallow lands to increase the domestic biofuel feedstock supply. Soybean and sunflower were selected as a biodiesel feedstock to increase the additional cultivation area in 2009 to 14,000 Ha of soybean and 6,000 Ha of sunflower. The farmers will be subsidized with 45,000 Yuan per hectare in one year for those works on energy crops cultivation. The Agricultural Union had signed a contract with the farmers to purchase all of their products.

Table A3: Chinese Taipei's Energy Crops Cultivation Plan for Year 2009

Energy Crops	Spring Crop (Jan-May)	Fallow Period	Autumn Crop (Sep-Dec)
Soybean	4,000	Soil Management	10,000
Sunflower	2,000		4,000
Total	6,000		14,000

Sources: Agriculture and Food Agency, Council of Agriculture.

5) Mandatory Targets for B1 Nationwide (2008.7.15) and B2 Nationwide (2010.6.15)

The introduction of B1 was mandated in the main island on the 15th July 2008 (Isolated Islands had carried out from 1st Jan 2010) and increased to B2 nationwide on the 15th June 2010. However, all oil retail companies were given six months to complete the transition. The distributing company was allowed to arrange their biodiesel supply from the free market without any restraints from the government.

Bioethanol

1) Green Public Service Vehicle

A pilot project on using E3 in public service vehicles was carried out in Taipei city and Kaohsiung city from 2nd July 2009 to 30th June 2011. The subsidies were given to gas stations which completed their application before 31st July 2009. The contents of the subsidy were as follow;

- The difference in cost between bioethanol and gasoline
- Additional investment cost on facility for bioethanol
- Additional subsidy on retail selling price
- Promotion cost for selling bioethanol (pamphlet, postal service cost, others)

RD & D Information on Biofuel

Basically, the first generation biofuel technology has been established in Chinese Taipei. Currently the government is focusing on second-generation and third-generation biofuel technology development. Recently, Taiwan Motor Cosmo Co., LTD. and Japanese manufacturers had set up an ethanol demonstration plant at Changpin by technical cooperation in cellulosic base technology. The installation was the first cellulosic based ethanol plant in Chinese Taipei where they imported the technology from Japan. The refinery plant had succeeded in converting cellulose to ethanol by a 20% conversion rate. The company claims its technology can process 30,000 tonnes (dry weight) of cellulose per year, and produce about 6,000 tonnes of alcohol, as well as 1,500 tonnes of organic fertilizer byproducts. Third-generation biofuel technology development is still in the academic stage.

Way Forward

Domestic Feedstock Supply

Domestic feedstock supply is dependent on policy grants to reduce costs because of the lack of agriculture land and low production of energy crops. Many local industries have been actively looking at Southeast Asian countries for a large number of first generation biomass raw materials cultivation.

Second Generation Biofuel Technology Development

High investment costs for second generation biofuel technology had resulted in most of the domestic industry to exercise great care and maintain a wait-and-see attitude. Even though the coming second generation cellulosic technology has great prospects and potential for industrial development, there are still a lot of restrictions and obstacles leading to industrial development falling short of expectations.

Trend of Biofuel Trade

The B5 mandate requiring biodiesel supply in 2016 is not expected to gain from the domestic feedstock supply. Some manufacturers had begun importing raw materials from abroad, and among them were companies that had invested directly in feedstock production overseas. Currently, they are importing the palm oil based biodiesel from Malaysia and Indonesia.

Table A4: Biodiesel Import in Chinese Taipei

	2008	2009	2010	2011
Import from Malaysia (kL)	3,081	5,571	159	9,223

Sources: Malaysia Palm Oil Board.

Conclusion

Chinese Taipei has a scarcity of domestic resources and 98% of the energy supply is dependent on imports. The introduction of biofuels must rely on imports eventually, because of the difficulty in establishing feedstock supply system due to the limited agriculture land. The economic effects are not expected to be high for the industry. Therefore, the promotion of biofuels policy goals should focus on environmental improvement like air pollution improvement, reduced emissions of global warming gases and waste oil recycling.