BIOETHANOL AS A MAJOR SOURCE OF ENERGY:

Bioethanol has taken precedence as Prime Biofuel after lot of controversy erupted on international food shortages and spiraling food prices. In spite of all the controversy Shrouding Biofuels, there has been understanding that we need to continually look at alternate sources of fuels and feedstock's which are non food and this has seen visible interest for Sugarcane based Bioethanol to wheat, Maize and other food crops. Also Biodiesel too has Feedstock problems as Palm oil, Rapeseed, Soya are also edible and Non food Crops like Jatropha, Karanjia have not seen visible success and are also viewed as invasive species by certain nations.

Here we shall Cover Bioethanol as a Major source of Energy (Fuel Oxygenate) and also other advantages that accrue with Ethanol Distillation.

The two major fuels for source of Fuel energy are diesel and petrol. Bioethanol when blended with Petrol acts as oxygenate to burn Hydrocarbons completely reducing emissions, particulates and noxious gases.

Feedstock availability and Scale is critical for successful blending, Sugarcane has proven to be the most successful feedstock.

With little controversy of Food Diversion to Fuel and Sugarcane Distillation moving towards second generation, Technological advancements, Carbon, Energy and Water foot print models being worked out we foresee Optimization deriving Enhanced Yields.

Most of SAARC/ ASEAN nations have successfully cultivated Sugarcane for Centuries and have known all aspects and Implications of this Crop on Soil, water, Air and Animal Husbandry unlike other Crops. Recent New Developments in Agronomy, Harvesting, Crushing whole Cane, Improved Distillation Practices using better Enzymes, catalysts have been Improving Capacities of Ethanol Production. Governmental Support & Incentives are very much essential to Mandate and successfully implement Blending Targets.

Apart to Price of Ethanol Commodity, factors of Carbon Footprint of Hydrocarbons, Logistic Implications of Transporting Hydrocarbons and its Distillation, Particulate emissions from using Hydrocarbons either leaded or using MTBE oxygenate which has shown impacts on Water bodies in leakages need to be seriously looked in to. We have to adhere to Kyoto Protocol to reduce CHG Emissions.

Visible was effect of dependence on Hydrocarbons and its Impact on Economies which is swift and Unpredictable, making life of Ordinary populace more miserable. Renewable like Bioethanol minimize such Risks, apart to generating Rural Employment and improving Rural Livelihoods manifoldly. They also reduce Emissions and enable a platform to avail Clean Development Mechanism (CDM) in reducing Methanation, also on Co2 reductions and also in generating CNG out of Distillation Sludge.

Sugarcane Crop is believed to be Sequestering Co2. New Cultivars and Methodologies are being studied at Southern Cross University of AU on Sugarcane Sequestration. Dedini of Brazil has Developed Rapid Hydrolysis Method (DHR) and as it has been entering Indonesia we could see Technology flow to our Neighborhood.

With Targets’ of 5% and 10% blending mechanisms of most of Nations we could see thousand of Crores of each nation Currencies being saved moving away from Hydrocarbons or minimizing its usage. The other Economic benefit of Local Employment, infrastructure Development, 3PLLogistics, CDM all accrue to Millions/ Billions of USD.
With International Trade and Shipping becoming dearer each day Self dependence for Energy Needs is a must. Energy Needs of each Nation keeps enhancing and to cater to them each nation should have its own Energy/ Biofuel Policy in Place. 

Other form Energy in this Sector is Power from Cogen, i.e. burning Bagasse the biomass along with Coal in a Boiler to cater to Industry’s usage and sale of excess to Grid. 

The Energy / Emission savings in Cogen also Generate CDM, but this is applicable for Higher Boiler Capacities and there is no fixed Methodology at UNFCCC and is evolving all the time.

Biomass is becoming precious alike Metals each year with prices spiraling and Sugarcane with almost double Cellulose content Compared to other Crops and also with Whole Cane Crushing including Trash and Biotechnology modifications in cane would see better yields of Bagasse per Ton of Cane Crushed. Bagasse has apart to Cogen is seeing utilization in 2nd Generation Distillation of C6/ C12 where Lignocellulosic material is broken and converted to Sugars. Bagasse is also being used to produce Bioplastics which Compost and Degrade below 100 days and a possible CDM Template.

Sugarcane has seen an Unlimited Potential and to encourage farmers Derive advantage they need to be taught to better existent practices and move towards automating Agronomy, harvesting, Mapping, Optimizing use of water, fertiliser and other Crop management techniques.

Asia Can not only replicate Brazil & Australia, but can also naturalise their own and to an extent Indonesia, Vietnam, Thailand have been doing. 

**Key to Success of Future energy needs is to achieve energy without conflict of Interests for water, land, food and such initiatives to develop guidelines have been initiated at BSI/RSB/RSPO/BCI.**

The Biofuels industry in the APEC region consists of two distinct sectors, ethanol and biodiesel. Fuel ethanol production within the region in 2007 was estimated at approximately 27,600 million liters, mainly produced in the United States; China; Canada; Australia; and Thailand.

Biodiesel production in 2007 was approximately 4,400 million liters with the majority of the production coming from the United States; Indonesia; Malaysia; China; Australia; and Canada.

Biofuels in the APEC region are produced from a variety of first-generation feedstock using well-established conversion technologies. For ethanol production, these include: starches from grains (cereals, feed, and grains), tubers (cassava and sweet potatoes), sugars from crops (sugar beets, sugarcane, and sweet sorghum), and food-processing byproducts (molasses, cheese whey, and beverage waste).

First-generation biodiesel feedstocks used in the APEC economies include vegetable oil (mainly soybean, rapeseed, and palm oil), used cooking oil, and animal fat (tallow and cat fish oil). Second-generation feedstocks for ethanol production include lignocellulosic material, such as crop and forest residues.

Economies with large-scale agriculture and forestry operations such as Canada; the United States; and China have set up demonstration projects using lignocellulosic biomass for ethanol production. An advanced biodiesel feedstock includes microalgae, and few companies in the United States and New Zealand have started pilot projects to grow algae.

**Biofuels production in Vietnam** is in its very early stage of development. Although Viet Nam has been producing ethyl alcohol for many years (76 million liters in 2005), it has been consumed primarily by the alcoholic beverage and pharmaceutical industries. Just recently, in November 2007, the government approved the production and use of Biofuels as it seeks to diversify its energy portfolio. Its target is 500 million liters of fuel ethanol and 50 million liters of biodiesel by 2020. The government plans to create favorable conditions for the development of Biofuels and promote investments,
including tax incentives and low-interest loans. The priority for Biofuels R&D in Viet Nam is increasing crop productivity and development of advanced conversion technologies.

Viet Nam is rich in biomass resources and it has great potential for Biofuels production. The existing ethyl alcohol industry is already using cane molasses and starches as feedstock. Estimates show that if Viet Nam uses all cane molasses and 10% of cassava and corn production, it could produce about 320 million liters of fuel ethanol. Sugarcane production has been consistent during the past six years, about 15 million tones annually; while cassava production has grown rapidly from 2 million tones in 2000 to about 8 million in 2006. Viet Nam is also rich in cellulosic biomass, such as agricultural residues (rice husk, straw, bagasse, and cane leaf) at 45.6 million tones, and woody residues at 1.6 million tones (Tran Dinh Man 2007). Dedicated energy crops, particularly elephant grass, are also seen as an opportunity. Pilot elephant grass plantations have been set up in Dongthap province (67 hectare - ha), BacKan (100 ha), and TuyenQuang (200 ha). Viet Nam has also expressed interest in production of ethanol from seaweed.

Two fuel ethanol plants are expected to come online in Viet Nam during 2008-2009: Viet Nam's Bien Hoa Sugar Company and Singapore's Fair Energy Asia Ltd. have signed a memorandum of understanding for the construction of an ethanol plant capable of producing 63 million liters a year. The plant will be built in an industrial zone in Ninh Dien village, Chau Thanh district, in the southwestern province of Tay Ninh, and it will use sugarcane molasses (Biopact 2007). Petrosetco, a subsidiary of state-run oil monopoly Petrovietnam, has teamed up with Japan’s Itochu Corp. to build a biorefinery in Ho Chi Minh City's Hiep Phuoc Industrial Park. The facility will use cassava as a feedstock, and it is expected to produce 100 million liters of ethanol annually. The company plans to build three additional ethanol plants using cassava, sugarcane, and rice as feedstock. Potential biodiesel feedstock in Viet Nam includes animal fat (catfish oil), used cooking oil, rubber seed, and Jatropha oil.

After two years of experimentation, the Vietnamese catfish processor and exporter Agifish announced in 2006 that it had successfully produced biodiesel using catfish oil. The company is building a 10,000 tonnes/year biodiesel facility in the southern Mekong delta province of An Giang. The company notes that a kilogram of catfish fat could produce 1 liter of biodiesel. Viet Nam produced about 60,000 tones of “Basa” fish oil in 2005. The production in the past was primarily for exports to the United States and Europe (Mail & Guardian 2006).

Technology for producing biodiesel from used cooking oil has been successfully developed by HCM City’s Research Centre for Petrochemical and Refinery Technology. About 73,800 tones of used cooking oil were produced in 2005, which would translate to approximately 33,000 tones of biodiesel. A trial project producing 2 tones/day biodiesel is underway by Saigon Petro (Tran Dinh Man 2007). Biodiesel production from rubber seed oil and other oil-bearing crops (Jatropha) is being researched by the Institute of Applied Materials & Science and Institute of Tropical Biology in Ho Chi Minh City (HCMC). The Department of Agriculture & Rural Development has a Jatropha trial plantation of 5,000 ha. Eco-Carbone has identified four regions in Viet Nam for Jatropha development, and will enter into partnership with local farmers and communities for a minimum of 30,000 ha. Within the framework of the R&D program carried out by Eco-Carbone, a series of agronomic tests for yield comparison are being implemented to select the most productive Jatropha species for cultivation in Viet Nam. Biodiesel production is expected to start in 2010 and Eco-Carbone’s objective is to reach 60,000 tons of biodiesel production per year at full capacity (Eco-Carbon 2008).

Sources

Asia Cleantech, Asia Clean Energy & Asia Clean Technology News, November 2007
Biopact, August 2007
Eco-Carbon, March 2008 , Mail & Guardian, July 2006
**Thailand** has set up serious efforts to reduce oil imports and carbon emissions by replacing at least 20% of its vehicle fuel consumption with renewable energy sources such as ethanol and biodiesel within the next five years. Biofuels are also seen by the government as an opportunity for rural development and trade.

**Production**
Ethanol production in Thailand was 192.8 million liters in 2007. There are nine operating plants with a total capacity of 435 million liters per year, and nine plants are under construction (440 ML per year). Biodiesel production in Thailand was 58 million liters in 2007. Currently, there are nine biodiesel plants with a total production capacity of 655 million liters annually.

**Feedstock**
Almost 90% of ethanol produced in Thailand is from cane molasses. The remaining 10% is from cassava. The proportion is expected to shift over time in favor of cassava. Molasses supplies are expected to increase to 3 million tones, half of which will be used in food industries (mostly for liquor production), and the balance will be for exports and fuel ethanol production (USDA 2007). Cassava production was 22.5 million tones in 2006, and it is expected to grow as the planned cassava-based ethanol production plants start operating.

The main raw material for biodiesel in Thailand is palm oil. The economy ranks third in the world after Indonesia and Malaysia. Total crude palm oil output is 1.3 million tones a year, with about 800,000 tones going to the food sector. Of the 500,000 tones used in non-food businesses, 420,000 tones are now needed to make B2 (2% biodiesel with 98% petroleum diesel). At least 600,000 tones would be required to make B5 (5% biodiesel with 95% petroleum diesel). The government plans to expand palm oil cultivation area by 2.5 million Rai (1 hectare = 6.25 Rai) during the next five years. Few biodiesel plants are using cooking oil as feedstock. Jatropha is seen as an alternative feedstock for biodiesel production in Thailand, and one plant intends to use this feedstock.

**Economics**
Ethanol US$/liter
From cassava0.54
From cane molasses0.46

Source: DEDE, 2007; 34.5 Baht/US $

Biodiesel US$/liter
From palm oil0.86
From used cooking oil0.68

Source: DEDE 2007; 34.5 Baht/US $

**Biofuels in Use**
Thailand currently sells gasohol (E10), which accounts for about 20% of total petroleum sales, through its service stations. The state-owned companies PTT and Bangchak started supplying E20 in January 2008. Bangchak plans to introduce E85 at its stations in the near future. B2 is available nationwide; PTT and Bangchak started selling B5 in 2007.

**Infrastructure and Vehicles**
There were 3,822 gasohol service stations in Thailand as of December 2007. Currently, 40 stations in Greater Bangkok sell E20 (February 2008). B2 is available at all stations throughout Thailand; 976 stations offer B5 in Greater Bangkok.

E20 compatible vehicles are available in Thailand from Ford, Toyota, Honda, and Nissan.

**Trade**
Most ethanol producers plan to supply ethanol domestically (particularly those who do not have sugar

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mill businesses), due to concerns regarding sourcing of raw materials (USDA 2007). However, fuel ethanol export is expected to grow as the production increases in Thailand. About 14.4 million liters of fuel ethanol was exported in 2007 to Singapore, the Philippines, Chinese Taipei, Australia, and Europe.

Policy
Policymakers in Thailand have taken measures to increase investments in the production and use of ethanol, including a Board of Investment (BOI) privilege for a fuel ethanol plant, a waiver on the excise tax for the ethanol blended in gasohol, a low rate of oil fund levy, and expansion of cassava production. Also, the government set gasohol prices around 2.0 - 2.50 baht/liters cheaper than regular and premium gasoline. The government requires all its fleets to be fueled with gasohol. Thailand's Cabinet approved an excise tax reduction for cars using gasoline containing at least 20% of fuel ethanol, proposed by the Excise Department and effective January 1, 2008. The excise tax cut is expected to lower the price of cars by at least THB10, 000 ($1=THB0.03204). A car with a cylinder capacity of no more than 2,000 cm³ and an engine performance of no more than 220 hp will be taxed at 25%, down from a previous 30%. Cars with a cylinder capacity of no more than 2,500 cm³ and no more than 220 hp will be charged at 30%, down from 35%. Finally, cars with a cylinder capacity between 2,500 and 3,000 cm³ and no more than 220 hp will be taxed at 35%, down from a previous 40%. The rates apply to passenger cars and vans with fewer than 10 seats. The Excise Department estimates that about 30,000 new vehicles powered by E20 or higher will be in the market in 2008 (DEDE 2008).

The Thai government announced the Strategic Plan on Biodiesel Promotion and Development in January 2005. The plan targets replacing 10% of diesel consumption in 2012 by increasing palm oil cultivation, and promoting community-based and commercial biodiesel production. The Thai government introduced a B2 mandate in February 2008, which would require the production of approximately 420,000 tones of biodiesel per year. The government is making available 3 billion Baht in soft loans to farmers growing palm crops. It also supports R&D of other crops such as Jatropha. A B5 mandate is planned to be introduced in 2011, and B10 in 2012.

Sources
Department of Alternative Energy Development and Efficiency (DEDE)
Bangkok Post (Thailand), March 8, 2008

The Philippines embraced the development of Biofuels a few years ago with hopes of achieving future energy security, augmenting farmers’ income, and generating rural employment. The member economy also hopes to position itself as a leading Biofuels producer in the region. The main challenge facing the industry is the availability of feedstock and the processing facilities to meet the demand of the government’s National Biofuels Program.

Production
Biofuels production in the Philippines is currently limited to just biodiesel. The member economy had seven biodiesel production plants as of August 2007, with a total output of 257 million liters a year. This production capacity exceeds the requirement of the mandatory volumes set by the Biofuels Act, thus the biodiesel producers see it as an excellent export opportunity. Production of fuel ethanol will commence in late 2008, in time for its mandated use in 2009. Several ethanol plants are under construction, but their scheduled completion, inclusive of their corresponding feedstock supply-base, is uncertain (USDA 2007).

Feedstock
Primary feedstock for biodiesel production in the Philippines is coconut oil. The Philippines is one of the largest producers of coconut oil in the world - approximately 1,400 million liters per year. Nearly 20% (400 million liters) of this production is used for domestic consumption, and the balance of 80% is exported. Mindanao accounts for almost 60% of the economy’s total coconut oil production (Embassy of the Republic of the Philippines 2007). Potential biodiesel feedstocks in the Philippines are Jatropha and
palm oil. The government has announced its plan to launch massive propagation and cultivation of Jatropha seeds covering around 2 million hectares (ha) of unproductive and idle public and private lands nationwide. This effort will produce about 5,600 million liters of Biofuel in the next 10 to 12 years (Bulatlat 2007). There are few pilot plantations growing oil palm. In the Philippines, sugarcane is considered a primary source for ethanol production. The government sees it as the most reliable feedstock due to its well-established farming technologies and the highest yield per hectare compared to other feedstock (corn, cassava, and sweet sorghum). Sugarcane production in the Philippines is expected to increase to meet the requirements of the Biofuels Act. At present, the sugar industry can only supply 79% of the needs of the 5% ethanol blend, which is between 200 and 400 million liters per year. The Philippines, therefore, needs to expand its current 167,300 sugarcane farms covering a total area of 344,700 hectares to meet the ethanol demand. The Sugar Regulatory Administration (SRA) already identified 237,748 hectares of new sugar fields, mostly in Mindanao, that can be tapped to produce fuel ethanol (Bulatlat 2007). Additional ethanol feedstocks considered by the government are sweet sorghum and cassava.

**Biofuels in Use**

B1 (1% biodiesel and 99% petroleum diesel) and E10 (10% ethanol and 90% gasoline) are available nationwide.

**Infrastructure and Vehicles**

B1 is available through all service stations in the Philippines, and it has been successfully used by thousands of vehicles in the Philippines since 2002. E10 is currently offered by all Sea oil stations nationwide. It is expected that in 2008 more gas stations will be offering E10 (Biofuels Philippines 2007).

In 2007, Ford Philippines opened a plant that manufactures flexible fuel engines in Santa Rosa, Laguna. These engines are designed to run on a mix of up to 20% ethanol. Production output of the Ford facility reportedly is estimated at 105,000 FFV engines in the next five years, with some units intended for export to South Africa and other Association of Southeast Asian Nations (ASEAN) countries. The Ford plant's opening is expected to enhance and accelerate the adoption of Biofuels in the economy (USDA 2007).

**Trade**

Chemrez Inc. has 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.

**Policy**

The Philippine Biofuels Act, implemented in January 2007, establishes the following requirements for ethanol and biodiesel:

Within two years from the affectivity of this Act, at least five percent (5%) Bioethanol shall comprise the annual total volume of gasoline fuel actually sold and distributed by each and every oil company in the member economy, subject to the requirement that all Bioethanol blended gasoline shall contain a minimum of five percent (5%) Bioethanol fuel by volume.

Within four years from the effective of this Act, the National Biofuels Board (NBB) created under this Act is empowered to determine the feasibility and thereafter recommend to the Department of Energy (DOE) to mandate a minimum of ten percent (10%) blend of Bioethanol by volume into all gasoline fuel distributed and sold by each and every oil company in the member economy. In the event of supply shortage of locally-produced Bioethanol during the four-year period, oil companies shall be allowed to import Bioethanol but only to the extent of the shortage as may be determined by the NBB.

Within three months from the effective of this Act, a minimum of one percent (1%) biodiesel by volume shall be blended into all diesel engine fuels sold in the member economy; provided that the
biodiesel blend conforms to the Philippine National Standards (PNS) for biodiesel. Within two years from the affectivity of this Act, the NBB created under this Act is empowered to determine the feasibility and thereafter recommend to DOE to mandate a minimum of two percent (2%) blend of biodiesel by volume which may be increased taking into account considerations including but not limited to domestic supply and availability of locally-sourced biodiesel component (Republic Act No. 9367).

Among the incentives designed to encourage the production and use of Biofuels are an exemption of the ethanol/biodiesel portions of fuel blends and an exemption from value-added taxes for raw materials (coconut, sugarcane, Jatropha, cassava, etc.). There are also favorable loan policies available from banks for Biofuel investors and producers.

Sources
Biofuels Philippines, January 2007
Embassy of the Republic of the Philippines, Berlin, Germany, January 2007
Bulatlat, the Philippines alternative weekly magazine, Vol. VII, No. 3, February 2007
Republic Act No. 9367, the Biofuels Act of 2006.

Biofuels in Malaysia has been identified as a new source of growth for the plantation commodities industry. The concentration is on biodiesel from palm oil, because of the large domestic production of this feedstock. An opportunity for cellulosic ethanol production exists from the oil palm biomass (part of it left unutilized), but this technology is yet to be commercialized. Meanwhile, the economy is focused on creating a successful industry with what exists, which is palm biodiesel. The main concern for expanding biodiesel production in Malaysia is land availability and associated sustainability and biodiversity issues.

Production
Biodiesel production in Malaysia was 120,000 tones in 2006. There were five operating plants as of December 2006 with a total capacity of 258,000 tones per year. The government has approved licenses for the establishment of 84 biodiesel plants with a potential annual capacity of 9.26 million tones. However, the pace of commercialization is expected to slow down, due to the rapid increase in the cost of palm oil.

Feedstock
The primary feedstock for biodiesel production in the member economy is palm oil. Until recently, Malaysia was the world's largest palm oil producer; however, Indonesia surpassed Malaysia in 2007. Together, these economies produce about 90% of the world's palm oil. In Malaysia, nearly 11% of the total land area (about 62% of the economy's agricultural land) is devoted to oil palm. The production more than doubled during the past 10-11 years, from 7.81 million tones in 1995 to 16.5 million tones in 2006. Malaysian government policy currently allows only 6.0 million tones of palm oil to be converted into biodiesel.

Economics
A study by Tatsuji Koizumi and Keiji Ohga indicates that the cost of producing biodiesel from crude palm oil (CPO) was roughly U.S. $0.54 per liter in 2006. The raw material is about 80% of the total cost. Due to the increased price of palm oil in 2007, the production cost of biodiesel from palm oil in Malaysia today is probably double that in 2006.

Biofuels in Use
Malaysia introduced a type of biodiesel known as Envo Diesel, which is a mixture of 95% petroleum diesel and 5% processed palm oil (RBD palm olein). Envo Diesel is different from the biodiesel blend B5 used in Europe (it uses straight palm oil, not a methyl ester), and it is intended for local use. For
export markets — and local use, only if necessary — the industry produces biodiesel (methyl ester) from palm oil and methanol.

Infrastructure and Vehicles
A small number of government-owned vehicles currently use biodiesel, comprising mainly palm oil, but commercial sales have yet to start.

Trade
According to the Malaysian Timber Industry Board (MTIB), from August 2006 until February 2007, 52,654 tonnes of biodiesel had been exported to the United States, European Union, and Japan, generating RM132 million in revenue. Malaysia may export biodiesel to European markets at the range of 300-350 thousand tons by 2010.

Policy
The National Biofuel Policy was implemented in March 2006 to encourage the production of Biofuels, particularly biodiesel from palm oil, for local use and for export. The ministry formulated the Malaysian Biofuel Industry Act, which will introduce a B-5 mandate, equivalent to a biodiesel demand of 500,000 tonnes, from 2008. However, the implementation of the act has been delayed due to soaring palm oil prices. The government will wait until prices for RBD (refined, bleached, and deodorized) palm oil fall to MYR2,000 ($1=MYR3.49511) per tone, or below, before it decides on the exact date of the introduction of the biodiesel mandate.

Sources
Malaysia Palm Oil Board (MPOB)
Ministry of Plantation Industries and Commodities (MPIC)
Department of Agriculture, “GAIN Report 2007”.

Korea is interested in adding Biofuels to its energy matrix, driven primarily by the desire to reduce air pollution and oil dependency. Biodiesel is the primary choice given the fact that Korea consumes large amounts of diesel (twice the amount of gasoline) and it has the option of producing feedstock domestically.

Production
Biodiesel production in Korea was 50 million liters in 2006. There are 15 operating biodiesel plants with a total capacity of 625 million liters/year.
There is no fuel ethanol production in Korea. Only a small amount of ethanol is produced by Changhae Ethanol Co. Ltd as a test.

Feedstock
Nearly 70%-80% of biodiesel in Korea is produced from imported soybean oil and 20%-30% from used cooking oil. Several biodiesel plants have the capability of using palm oil (USDA 2007). Due to rising soybean and palm oil prices, biodiesel producers are considering alternative feedstock such as jatropha oil, produced in the Southeast Asia region, the Philippines and Thailand for example.

Options for producing biodiesel feedstock domestically are currently explored in Korea. It is estimated that 300,000-500,000 ha of coastal land could be available for winter canola with potential output of 450,000-750,000 tones of canola oil per year. Three demonstration sites in the Southern part of Korea have been selected for cultivation (KIER, 2007).

Economics
Biodiesel US$/liter
From used cooking oil0.90
From rapeseed0.53 (with subsidy) - 1.37
From soybeans1.06

Source: KEEI, November 2007
**Biofuels in Use**

B5 (5% biodiesel and 95% petroleum diesel) and B20 (20% biodiesel and 80% petroleum diesel) are available nationwide.

**Infrastructure and Vehicles**

Korea has supplied B5 through all of its gas stations since July 2006. There are about 200 stations offering B20 operating for fleets only. Korea also is testing E3 (3% ethanol and 97% gasoline) and E5 (5% ethanol and 95% gasoline) stations.

**Trade**

Korea imports soybean oil mainly from Argentina (86%) and the United States (14%). The domestic soybean oil industry estimated that of the 260,000 tons of soy oil imported in 2006, less than 25% was used for biodiesel production. Korea may import 1 million tons of soybeans by September 2008, the U.S. Department of Agriculture forecasted recently.

**Policy**

The government of Korea supports the development of Biofuels and it aims to develop energy policy that considers both economic growth and environmental protection.

The Ministry of the Environment (MOE) began testing biodiesel and biodiesel fuel blends in early 2002. As a result of these emission tests, MOE recommended biodiesel as a renewable fuel to the Ministry of Commerce, Industry and Energy (MOCIE). MOCIE is responsible for setting standards for petroleum and petroleum substitutes, and MOE is responsible for regulating air pollution. In late 2002, 73 gas stations in the Seoul metropolitan area and Chonbuk Province were designated as demonstration stations and began carrying B20. By January 2006, the number of stations testing B20 reached 200. In 2003, Korea began preparing official biodiesel standards, and the biodiesel demonstration was extended to June 2006. The final standards, drafted in September 2004 by MOCIE, were adopted in January 2006 and are very similar to EN14214, the European biodiesel standards (USDA 2007).

Korea plans to mandate nationwide B3 by 2012 and will extend the current tax incentives on production of biodiesel to 2010.

**Sources**

Korea Energy Economics Institute (KEEI)

Bioenergy Research Center, Korea Institute of Energy Research (KIER), 2007


**Japanese fuel ethanol production** is in an experimental stage, and the current production level is 30,000 liters (April 2006). Figure 1 depicts the location of the existing biorefinery. Sugarcane molasses in Okinawa, wheat and corn unsuitable for food in Hokkaido, sorghum in Yamagata, and wood residues in Okayama and Osaka are the raw materials used for ethanol production. To further promote domestic ethanol production, the government hopes to use abandoned arable land (Koizumi and Ohga 2007). It also will rely on technological breakthroughs in lignocellulosic ethanol in the near future, which would allow the use of waste material such as crop and wood residues.

Current Biorefineries in Japan (Koizumi and Ohga 2007)

Biodiesel doesn't receive as much attention as ethanol in Japan. Current annual production from used cooking oil is estimated at nearly 3 million liters. In 2006, Nippon Oil Corporation and Toyota Motor Corporation announced development of a palm oil-based biodiesel that performs comparably to petroleum diesel. They claim to have removed the oxygen from the palm oil, which would normally cause the fuel to degrade. Nippon Oil aims to develop a commercially viable biodiesel by 2010 (USDA 2006).

**Economics**

**Ethanol US$/liter**

From sugarcane molasses: 1.20

From wheat: 1.26
Biodiesel US$/liter
From rapeseed 2.9

**Source:** Koizumi and Ohga 2007
Biofuels in Use
Japan began testing E3 (3% ethanol and 97% gasoline) and ETBE (ethyl tertiary butyl ether) in 2007.

**Infrastructure and Vehicles**
Japan started to offer E3 at two gasoline stations, one in Sakai City and the other in Daito City, in October 2007. E3 is also offered in Osaka but is limited to about 100 cars registered in advance with the local government. Japan is gradually increasing the number of E3-supplying gas stations to sell the product to the general public in 2008. There are about 50 stations in the Tokyo metropolitan area offering ETBE blended gasoline. Their number is expected to reach 100 during 2008, increasing to 1,000 nationwide in 2009 (Asia Times 2007).

**Trade**
Japan imports ethanol (mostly from Brazil and China) to supply its beverage, chemical, and pharmaceutical industries. Brazil has the world's largest ethanol export potential, and it is seen by Japan as its major source of the alternative fuel. Last year, the governments of Japan and Brazil set up a study group on trading in the fuel. It is expected that large amounts of fuel ethanol will be imported from Brazil in the coming years (Ohmy News International 2007).

**Policy**
In 2002, the Biomass Nippon Strategy was published, which recognized the need to halt global warming, encourage recycling in Japanese society, and foster alternative energy industries. As a signer to the Kyoto Protocol, Japan has pledged to reduce CO2 emissions by 60% from 1990 levels by the year 2010. To reach that goal, the Japanese government plans to replace fossil fuels with 500,000 kiloliters of ethanol for the transportation sector by 2010. In addition, the new National Energy Strategy, compiled in 2007 by the Ministry of Economy, Trade, and Industry (METI), set a goal of reducing the nation's reliance on oil for transport to 80% from the current 100% by 2030.

A preferential tax system for gasoline blended with ethanol is expected to be introduced in 2008, when tariffs may also be lifted on imports of ETBE. Under the planned tax system, Biofuels mixed with gasoline will be exempted from the gasoline tax — currently 53.8 yen (US$0.48) per liter — in proportion to the amount of Biofuels included. For example, E3 will be taxed 1.61 yen less per liter than pure gasoline. There is no tax break for gasoline mixed with Biofuels, regardless of the ratios involved. The government is also expected to make imports of ETBE tariff-free, removing the current 3.1% import tax (Asia Times 2007).

**Sources**
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Asia Times, “Japan steps up its Biofuel drive,” December 2007
Ohmy News International, “The goal of saving 500,000 kiloliters of crude oil by 2010 is not easy to reach,” May 2007

**Indonesia** sees Biofuels as one of the key instruments to accelerating economic growth, alleviating poverty, and creating employment opportunities while also, under the Kyoto Protocol, mitigating greenhouse gas emissions. The government had set up goals of reaching 2% Biofuels in the energy mix by 2010 (5.29 million kiloliters), growing to 3% by 2015 (9.84 million kiloliters) and 5% by 2025 (22.26 million kiloliters). A major challenge to achieving these goals is financing, and the government has provided a set of incentives to attract domestic and foreign investors. The government prohibits rainforest deforestation for Biofuels purposes.
Production
Ethanol production in Indonesia was about 140 million liters in 2007, and the economy plans to reach 3,770 million liters in 2010 (Figure 1). Biodiesel production in 2007 was about 1,550 million liters and it is estimated to reach 5,570 million liters in 2010 (Figure 2).

Feedstock
The main biodiesel feedstock in Indonesia is crude palm oil (CPO) due to the well-established CPO industry and potential for the increase in production. Indonesia surpassed Malaysia in palm oil production in 2007 and is now the world leader. Together, Malaysia and Indonesia provide 87% of the world's palm oil. Indonesia's CPO output is estimated to be 17.4 million tones in 2007, up from 15.9 million tones in 2006. There are 6 million hectare of oil-palm plantations. The government established laws and regulations guiding their expansions to prevent deforestation.

Other potential biodiesel feedstocks in Indonesia include coconut oil and Jatropha. In 2006, Indonesia's coconut oil production was about 880,000 tones, with between 450,000 and 550,000 tones used for export purposes. Jatropha is still in the early stage of development and there are concerns that it is not feasible for large-scale production. At least two companies are making serious preparations to use Jatropha as a feedstock. Though using Jatropha would remove the conflict between food and fuel, Jatropha is more labor-intensive and produces less oil than oil palm. At this time, Indonesian government efforts appear to be focused on using Jatropha in villages where electricity is not cost-effective (USDA).

Currently, fuel ethanol in Indonesia is produced from sugarcane molasses. Indonesia has about 5.5 million acres dedicated to sugarcane production, and several companies want to expand their plantations. Indonesia is among the top 10 sugarcane producers in the world with about 30 million tones per year. Indonesia is also looking at cassava as feedstock for ethanol. There were 52,195 ha planted with cassava in 2007 and it is expected to increase to 782,000 ha. In Indonesia, 1 ton of molasses yields about 250 liters, and 1 ton of cassava yields about 155 liters of anhydrous ethanol (USDA).

Due to abundant biomass resources, such as palm fruit shells, rice husk, sugarcane Bagasse, and other crop and forest residues, Indonesia is interested in cellulosic ethanol production and actively supports R&D in the area.

Economics
Biodiesel US$/liter
From palm oil0.41
From jatropha0.48

Source: APEC Biofuels Task Force, 2007

Biofuels in use
B5 (Biosolar) and E5 (Biopertamax) are available through the state-owned oil firm Pertamina. In January 2008, Pertamina reduced the percentage of Biofuels in its Biosolar and Biopertamax products from 5% to 2.5% due to rising palm oil prices and lack of incentives.

Infrastructure and Vehicles
B5 is offered at 228 gas stations in Jakarta, Surabaya, and Bali. Since December 2006, E5 is offered at 14 stations in Jakarta, 7 in Surabaya, 4 gas in Malang, and 11 in Bali. Bio-premium (E5 using Premium blend) is offered at 1 station in Malang.

Trade
While Indonesia exports small amounts of biodiesel to China, the European Union (EU), and the United States, CPO remains the main trading commodity. The Indonesian Palm Oil Producers Association estimates that Indonesia's palm oil exports were slowing down in 2007, mainly because of the growth in domestic biodiesel consumption. Exports reached 12.1 million tones in 2006, and it is estimated at 13.1 to 13.2 million tones in 2007. If palm oil production in Indonesia reaches more than 18 million tones in 2008, exports may be about 14 million tones, but it will also depend on the growth of the biodiesel
industry (Pacific Biofuel).
The main export market for Indonesian ethanol is Japan. The future of ethanol export is uncertain, considering the growth of domestic fuel ethanol demand.

**Policy**
Some of the current Biofuels policies in Indonesia include:
- Presidential Instruction No.1/2006 to 13 central and regional government institutions on supply and utilization of Biofuels as alternative energy (January 2006)
- Presidential Regulation No.5/2006 on National Energy Policy, calling for 5% Biofuels in the energy mix by 2025 (January 2006)
- Presidential Decree No.10/2006, established by the National Team for Biofuels Development to coordinate industry expansion (July 2006)

While the Indonesian government had expressed strong interest in Biofuels development, it has been moving slowly and cautiously in implementing supporting policy. The government subsidizes biodiesel, bio-premium, and bio-pertamax at the same level as fossil fuels, leaving Pertamina to cover the difference when biodiesel production costs exceed fossil fuel costs. The government is considering providing various incentives, including value-added tax (VAT) reductions for business players, and excise duty cuts for Biofuels users. In 2007, the government announced an interest rate subsidy of Rp 1 trillion for farmers growing Biofuels crops including Jatropha, oil palm, cassava, and sugar cane.

**Sources**
- Indonesia National Biofuels Team, April 2008.
- Ministry of Energy and Mineral Resources (MEMR), presentation given at the USDA Global Conference on Agricultural Biofuels Research and Economic, Minneapolis, Minnesota, August 2007 (PDF 2.1 MB)
- Pacific Biofuel, August 2007
- U.S. Department of Agriculture, GAIN Report, 2007 (PDF 43 KB)
- APEC Biofuels Task Force (BTF) Report to the Eight Energy Ministers, 2007 (PDF 972 KB)

**Hong Kong** has adopted many programs and measures focused on improving the fuel quality and efficiency, such as liquefied petroleum gas (LPG) taxis and minibus programs, installation of particulate trap and oxidation catalytic converters, and introduction of ultra low-sulfur diesel. To relieve existing pollution, Biofuels and especially biodiesel have also been considered in recent years.

Biodiesel feedstock available in Hong Kong is waste cooking oil and animal fats. About 10,000 liters of used cooking oil are produced every day in Hong Kong, which translates roughly into 3.5 million liters of biodiesel per year. There is one existing biodiesel production plant in Hong Kong, with a small output primarily for domestic consumption (annual capacity of 4.3 million liters). ASB Biodiesel, a joint venture company, is building a second plant near the Tseung Kwan O industrial area of Hong Kong. The plant will have a capacity of 114 million liters per year and it will use waste products including used cooking oil, waste animal fat and grease trap waste (restaurant sewage). The biodiesel produced will be for domestic consumption and export to Europe.

Hong Kong-based companies have invested in ethanol production projects in other parts of the world, such as Noble Group Ltd. in Brazil and Rapid Grow Investments in Fiji.

The government of Hong Kong encourages the use of biodiesel and plans to introduce a duty-free policy on its use. The Environmental Protection Department is developing specifications for biodiesel to ensure fuel quality, boost users' confidence, and help control the impact on environment. The government will further propose a mandatory labeling requirement for biodiesel blends above 5% to ensure their proper use in vehicles and increase awareness of some possible corrosion problems associated with higher blends.

**Sources**
- Electrical and Mechanical Service Department (EMSD), the Government of the Hong Kong Special Administrative Region.
Chinese Taipei is promoting the development and use of Biofuels to reduce carbon dioxide (CO2) emissions and imports of fossil fuels. The government supports many research projects focused on advanced Biofuels production technologies, such as ethanol from cellulosic biomass and biodiesel from used cooking oil, which don't compete with the food industry.

**Production**

Biodiesel production in Chinese Taipei was 3.8 million liters in 2007, a substantial increase from 2.4 million liters in 2006. Currently, there are five operating plants with a total capacity of 42.1 million liters per year. One plant is under construction with an annual capacity of 100 million liters per year. There is no fuel ethanol production in Chinese Taipei, but state-owned Taiwan Sugar Corporation produces about 20-30 million liters of sugarcane-based ethanol every year, mostly for the beverage industry. Two fuel ethanol plants are planned with an annual capacity of 100 million liters each.

**Feedstock**

The primary feedstock for biodiesel production in Chinese Taipei is used cooking oil. Additional domestic feedstock includes soybean and sunflower, and the government encourages growing these crops on fallow rice paddy fields. Chinese Taipei is considering ethanol production from sugarcane, sweet sorghum, molasses, and other biomass from agricultural wastes.

**Economics**

<table>
<thead>
<tr>
<th>Biofuel</th>
<th>US$/liter</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From sugarcane</td>
<td>0.62</td>
<td>ITRI 2007</td>
</tr>
<tr>
<td>Biodiesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From used cooking oil</td>
<td>1.08</td>
<td>ITRI 2007</td>
</tr>
<tr>
<td>From soybeans</td>
<td>1.34</td>
<td>ITRI 2007</td>
</tr>
</tbody>
</table>

**Biofuels in Use**

Sales of E3 (97% gasoline and 3% ethanol) started in 2006, and biodiesel is offered at different blending levels from B1 to B20 (20% biodiesel).

**Infrastructure and Vehicles**

Nearly 300 service stations offer B1, and E3 is supplied by eight stations. Biodiesel is used by city buses in Kaohsiung City and Chiayi County.

**Trade**

The biodiesel produced in Chinese Taipei is for domestic consumption, and no import has been recorded. Biodiesel incentives could force the economy to import more soybeans, if biodiesel demand exceeds the supply of recycled cooking oil, the U.S. Department of Agriculture estimated.

Small volumes of ethanol are imported annually from China, Indonesia, and Thailand for use by the food industry.

**Policy**

The government plans to introduce an E3 mandate in 2011. It also plans to have B1 available at all gas stations nationwide by 2008 and B2 by 2010. Some policies include:

- Exemptions from commodity tax and air pollution control fee
- Incentives to encourage motorists to switch to ethanol gasoline
- Subsidies provided for demonstration programs

**Sources**

- Industrial Technology Research Institute (ITRI)
China’s economic growth in the 1990s resulted in a rapid increase of petroleum consumption and led to serious air pollution problems. To deal with fuel shortage, energy security, and air quality issues, the Chinese government began promoting Biofuels in 2000. However, concerns about feeding the world’s most populous nation could limit the growth of China’s Biofuels industry. China has long been concerned about its food security; thus, the top priority for land use is growing crops for food.

Production

China is the world’s third-largest producer of ethanol, but most of it is consumed by the pharmaceutical and beverage industries. In 2006, there were four operating ethanol biorefinery (Figure 1) running at maximum capacity, about 1.02 million tones. Though Beijing has stopped approving new fuel ethanol projects since December 2006, four more plants in the provinces of Guangxi (110,000 tonnes), Hebei (300,000 tones), Liaoning (300,000 tones), and Hubei (200,000 tones) were scheduled to be completed in 2007.

Source:

Institute for Energy Economics, Chew Chong Siang
China National Cereals, Oils and Foodstuffs Corp. (COFCO) is investing 50 million Yuan (U.S.$6.5 million) to build a cellulosic ethanol pilot plant. The plant in Zhaodong, in the northeastern province of Heilongjiang, will have an annual capacity of 5,000 tones. Another cellulosic ethanol pilot plant with a production capacity of 10,000 tones is being planned in the Yucheng area of Shandong.

Biodiesel is in its early development stage in China. In 2006, biodiesel production was 30,000 tones from a dozen of small-scale production facilities. Principal Biodiesel producers are Fujian Zuoyue New Energy Co.Ltd, Sichuan Gusan Biodiesel Co. Ltd, and Hainan Zhenghe Biodiesel Co.Ltd. Since 2006, biodiesel plants have opened in Shanghai, Fujian, Jiangsu, Anhui, Chongqing, Xinjiang, and Guizhou, among other places. The plants are private, state-owned, and even foreign-owned enterprises. New plants are much larger than the existing ones, some reaching 600,000-750,000 tones/year. Dozens of biodiesel projects are under construction, or in planning stages, with cumulative capacity of more than 3 million tones/year.

Feedstock

Nearly 80% of the fuel ethanol in China is made from corn. Three of the existing facilities (Heilongjiang, Jilin, and Anhui) use the grain as feedstock. The biorefinery in Henan uses wheat. Concerns about food supply and high prices led the industry to look at other, non-grain feedstock, such as cassava, sweet sorghum, and sweet potato, viewed as transitional feedstock in the long term. The crops could be grown on China’s 116 million hectares of marginal land unsuitable for producing grains. Ultimately, China plans to transition to ethanol production from cellulosic biomass, particularly crop residue, which is of sufficient supply. Estimates show that the member economy generates approximately 1,500 million tones/year of agricultural and forest residues, which is sufficient to produce 370 million tones of ethanol. Currently, there are several pilot plants producing ethanol from lignocellulosic biomass via biochemical conversion process.

Feedstock supply is a key factor in limiting biodiesel development in China. Vegetable oils are the main feedstock for plants elsewhere, but it is not economical for China to import them to make biodiesel because it already imports significant amounts for food consumption. The existing feedstock is used cooking oil, acid oil, and animal fat. A lot of waste oil and grease are produced from the food-processing industry due to cooking habits. It is estimated that about 3 million tones of waste oil and grease are produced in China annually. For a long-term development of biodiesel, China is considering nonedible feedstock, such as Barbados nut (Jatropha Curcas), Chinese pistachio (Pistacia Chinensis), Chinese tallow tree (Sapium Sebiferum), etc. Jatropha is abundant in Southwest China (Sichuan, Yunnan, Guizhou, etc.) with the potential for planting in large scale, and providing good economic and social benefits. However, this area also contains ecologically sensitive and biodiverse forest area; thus, careful considerations should be made in policy decisions.

Economics

Ethanol RMB/MT
From corn 5,000
From sweet sorghum 4,000
From cassava/sweet potato 4,500

Source: NDRC 2007
Biodiesel RMB/MT
From used cooking oil 4,000

Source: NDRC 2007

**Biofuels in Use**
E10 is used in five provinces: Heilongjiang, Jilin, Liaoning, Henan, and Anhui; and 27 cities: nine in Hubei, seven in Shandong, six in Hebei, and five in Jiangsu (Figure 1). Gasohol consumption in 2005 accounted for nearly 20% of national gasoline consumption.

According to a U.S. Department of Agriculture (USDA) report, biodiesel currently produced in China is of low quality, and it is not suitable for fuel use. It has been used as a solvent or as an additive to coal in thermal power plants or industrial cooking facilities in rural areas.

**Infrastructure and Vehicles**
There are 75,000-85,000 refueling stations in China, with approximately 20,000 offering E10.

**Trade**
Most exports of ethanol from China are undenatured (potable), particularly in Japan, Korea, and Singapore where it is used for alcohol production. In 2006, China hit a record volume of exports, about 500,000 tones. This was mostly due to higher demand in the United States because of phasing out methyl tertiary-butyl ether (MTBE), which increased the price of alcohol.

Official statistics on biodiesel trade are not available, but estimates show that total exports were approximately 10,000 tones in 2006 (USDA). Some attempts were made to import palm oil from Indonesia and Malaysia, but they have been suspended due to increasing prices of this feedstock.

**Policy**
In 2001, the State Council launched a Fuel Ethanol Program, which led to the establishment of the four ethanol plants and distribution of E10 in nine provinces. Policies — such as free income tax, VAT refunding and fiscal subsidies — were made available to ethanol producers. In 2006, each ton of ethanol received a 1,373 Yuan subsidy. Beijing has committed 1.1 billion Yuan (U.S.$143 million) to help develop vehicles that run on Biofuels. In comparison, policy measures for the biodiesel industry are not developed. Technical standards, distribution channels, production techniques, equipment, environmental evaluations, etc. are yet to be finalized.

Under the revised National Plan, fuel ethanol production is to increase to 3 million tones/year by 2010 and to 10 million tones/year by 2020. Biodiesel is to grow to 300,000 tones/year in 2010 and 2 million tones/year in 2020. According to the plan, E10 sales are to expand in more provinces in 2010, and E20 and E85 possibly will be introduced, as well as B5 or B10 in 2020.

The Chinese government’s overall policy for Biofuels is to move this technology forward in a way that it doesn’t compete with arable land, grain is not used as feedstock, and it doesn’t destroy the environment. No new corn-based ethanol plant is to be approved. It considers giving subsidies and tax breaks to demonstration projects: plants using non-grain feedstock and plantations growing non-food crops.

**Sources**
The National Development and Reform Commission (NDRC)