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The Status of Biomass Energy Industry Development in Taiwan

(I) Supply & Demand

The success of an emerging industry or application requires government support. Official policy plays a crucial role within an emerging industry, and countries that are more mature in their promotional efforts for biomass energy industry development provides government support in the way of tax-related compensation and incentive schemes. Taiwan's biomass energy industry is built on government policy for energy self-sufficiency, the significance of which has become very apparent in the wake of a green energy trend and rising petroleum prices. The Taiwanese government has mapped out sound policies to back the development of biomass energy by local industries. Vital to the momentum of that development are the government's "Recycled Energy Development Statute" and "Greenhouse Gas Mminimizationtion Approach."

To set up a comprehensive environment for the development of renewable energy, the Executive Yuan (the Cabinet) officially passed the "Renewable Energy Development Act" in June 2005. The Act assigns designated prices for the purchase of electricity produced by renewable energy schemes and the duration of guaranteed purchase. The guarenteed price for wind-energy is NT\$2.9 per KW, and other forms of renewable energy is purchased at NT\$2.2 per KW; the duration of guaranteed purchase is 20 years. The Act also declares that the total power generated by renewable energy measures will account for 12% of overall output; where high costs are required for renewable energy power generation, the government will provide financial support. With regards to biomass categories, the Act proposes to produce 100,000 kl of through biodiesel per year to diversify applications.

Officially passed by the Executive Yuan in 2006, the draft “Greenhouse Gas Minimization Approach” was then submitted to the Legislative Yuan (Congress), where it successfully passed its first reading in May 2007. The Act provides clear criteria for governing greenhouse gas emissions in the hope that by 2030, greenhouse gas emissions in Taiwan will be restored to its 2005 emissions levels of approximately 250 million tons per year. The successful accomplishment of these goals calls for the promotion and wide-use of renewable energy. Studies reveal that transportation is a major origin of emissions. Replacing petroleum with biodiesel or bioethanol as a means to minimize greenhouse gas emissions is an important global development trend.

Biomass Energy Promotions Goals in Taiwan

1. Biodiesel Promotion Goals in Taiwan:

Description/Year	2006	2007~2008	2009	2011
Promotion Volume	650 kl	6,500 kl	45,000 kl	100,000 kl
Promotion Model	Trial run of environmentally-friendly vehicles and green vehicles for government agencies	Green Country	B1 nationwide	B2 nationwide
Method of Energy Supply	Mandatory purchase from domestic sources		Open to free market	
Planting Goals for Source Materials	2,000 hectares	8,000 hectares	20,000 hectares	80,000 hectares

2. Bioethanol Promotion Goals in Taiwan

Description/Year	2006	2007~2008	2009	2011
Promotion Volume	---	770 kl	12,000 kl	100,000 kl
Promotion Model	---	Green vehicles for government agencies	E3 for urban areas	E3 nationwide
Method of Energy Supply	Preferential purchase from domestic sources, import if inadequate		Open to free market	

Planting Goals for Source Materials	Trial planting (30 hectares)	30 hectares	3,000 hectares	20,000 hectares
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Source: Bureau of Energy, Ministry of Economic Affairs; compiled for the present study; 2007/12

In addition to strong policy support, the biomass energy industry is working hard to establish relevant industry alliances. Through the establishment of such alliances, it is hoped that industry, academia, and government can join forces to create the niches vital to biomass energy industry development. At the moment, the Ministry of Economic Affairs (MOEA) plans to team up with the Council of Agriculture (COA) and Environmental Protection Administration (EPA) to set up an inter-agency “Biodiesel Green Procurement Chain” and to implement the Green Country Program. Their joint efforts should create a sound industrial climate in accord with market mechanisms. On the other hand, as Taiwan imports almost all of its energy, the ideas of energy self-sufficiency and environmental protection demands the development of a local biomass energy industry. With the support of the aforementioned government projects, Taiwan should be able to implement the use of substitute energy and decrease energy importation.

In the area of implementation, the Taiwanese government expects to implement the nationwide use of biodiesel (B2) and ethanol gasoline (E3) by 2011. The annual demand for biodiesel (B2) is 100,000kl, or approximately 9.4 tons. The annual demand for ethanol gasoline (E3) is also 100,000kl, or approximately 8.33 tons. There are currently five local companies engaged in the production of biodiesel (B2), including Taiwan NJC, RESI, Gibson, Chen Tech, and Great Green, with a total output approximately 160,000 tons. With regards to ethanol gasoline (E3), companies including Weichuan, the Taiwan Sugar Corp. (Taisugar), Taiwan Fertilizer Co., and China Petroleum (CPC) are showing interest, and plan to bring total output up to 460,000 tons per year. According to the Bureau of Energy, this number will not meet domestic demand. Therefore, the biomass energy industry in Taiwan needs to enhance

international promotions, using domestic demand as a means to attract foreign capital or technological investments.

Taiwan's currently has about 2 % energy self-sufficiency and relies on imports for the rest. Meanwhile, the island's agricultural industry seems to be entering a long-term decline. Biomass energy development could reduce reliance on energy imports, promote energy diversification, reinforce energy safety, and reduce CO₂ emissions. Farmers would also profit more from growing crops with high added-value. Concerned about energy safety, agricultural development, and environmental protection, Taiwan has designated biomass energy as an important green industry for development. However, Taiwan still faces obstacles in the steady supply of source materials, high costs, raising public acceptance, and the lack of relevant regulations. Among these factors, the stability of energy crop supply and planting costs will be the premier issues for biofuel development in Taiwan.

As Taiwan has little available land for cultivation, the island has not had any experience with the large-scale cultivation of energy crops. The adaptability of energy crops to the island's soil, waters, and climate will greatly affect the decision of farmers to get involved. The COA has already chosen sunflowers, soybeans, and oil beans as trial crops for biodiesel development. The government began providing farmers with guidance for growing these energy crops back in 2006, establishing a production and evaluation system. Converting waste edible oil into biodiesel now costs NT\$30 per litre, but using local crops will cause production costs to reach NT\$45-64 per litre (pre-tax), which is far higher than the NT\$27.5 price of normal diesel, making biodiesel not at all competitive. An international comparison on the production costs of biodiesel shows, that production using waste edible oil, sunflower, soybean, and rape in Taiwan incur higher

costs than it does abroad. The authorities note that we need to pay more attention to finding those crops suitable to the local climate to enhance the efficiency of crop and oil production. Taiwan should look to sugar cane and the sweet potato as viable local crops for biomass energy production. In the long run, we should work on making use of domestic agricultural waste as a means of bypassing the disadvantages of limited land.

Unit Price & Cost Biodiesel in Taiwan

Unit: NTD/Litre of biodiesel

Cost Category/Source	Waste Edible Oil	Domestic Sunflower	Domestic Soybean	Domestic Rape
Seed Purchasing Costs	18	63	80	37
Pressing Costs	0	6	12	6
Trans-fat Processing Costs	6	6	6	6
Biodiesel Production Costs	24	75	98	49
By-product Related Income	0	-17	-51	-10
Total Production Costs	24	58	47	39
Expenses/Profit	6	6	6	6
Price	30	64	53	45

Source: Environmental Protection Association, Executive Yuan (2006)

Note: By-product income includes only dregs & leaves-related income.

Total Biodiesel Production Costs

Unit: USD/Litre

Country	Source	Costs
China	Waste edible oil	0.20~0.42
Brazil	Sunflower, palm oil residue	0.57
U.S.A	Soybean oil	0.53~0.66
Canada	Low erucic-acid rapeseed oil	0.46
EU	Rape seed oil	0.61
German	Rape seed oil	0.66
Poland	Rape seed oil	0.73

Source: Jian-ming Li (2006)

Taiwan and Foreign Biodiesel Production Cost Comparison

Unit: USD/Litre

Area/Source	Waste Edible Oil	Sunflower	Soybean	Rape
Taiwan	0.77	1.87	1.52	1.26
Abroad	0.20~0.42	0.57	0.53~0.66	0.46~0.73

Source: TRI

Note: US\$1 = NT\$31

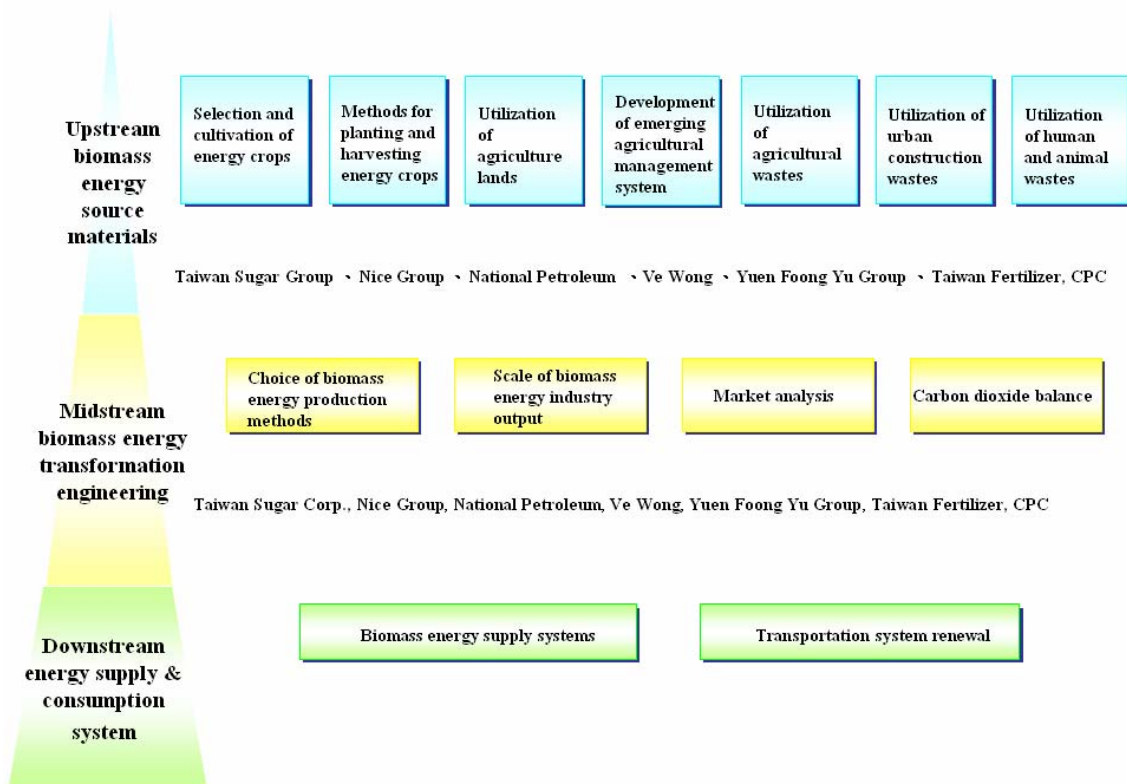
The MOEA Bureau of Energy indicated during the Taiwan Global Technology and Industry Summit Forum that the renewable energy industry in Taiwan would focus on the promotion of photovoltaic, wind power, and biomass industry development, and the government will work hard to stabilize source material supply and implementing the development of key and promising technologies to reduce cost. It will also work on establishing an industry structure for a complete supply chain. The biomass energy industry output value is estimated to reach NT\$6 billion by 2010, NT\$20 billion by 2015, and NT\$76.8 billion by 2025. The industry is possessed of the synergy of energy diversification, agricultural development, and environmental

protection, widely recognized by both the government and the public. To broaden biomass energy applications at the present juncture, the industry is expected to grow rapidly, benefiting from collaboration among industry, academia, and government.

(II) Analysis of Gaps in the Industry Supply Chain, Investment Niches, and Prospective Foreign Investors

The biomass energy industry in Taiwan is a newly emerged industry that has received little hands-on investment. Nevertheless, no one can deny that it will have a bright future. In terms of the biomass energy industry chain, Taiwan has established quite a sound foundation of associated industries and production know-how, such as production and management capabilities for agriculture, warehousing & transportation management, dispatch and distribution, as well as a robust chemical engineering and fermentation industry. By means of cross-industry cooperation, industrial development alliances and other such measures, Taiwan will surely have great returns on its efforts.

The Biomass Energy Industry Chain in Taiwan



Source: Compiled for the present Study; 2007/12

An analysis of Taiwan’s biomass industry chain reveals its weakest points to be midstream production and downstream supply systems, where it is most in need of foreign technological assistance. Biomass energy production equipment and technology remains in foreign hands. Foreign firms including Conrad, POET Energy, and VeraSun Energy are the major bioethanol production equipment and technology suppliers. In addition to equipment, supply system infrastructure is a great place for foreign investment, especially as demand for supply facilities will rise along with the domestic biomass energy consumption ratio. Just as the petroleum-product supply equipment/facility industry is the domain of foreign firms, so will the biomass energy supply equipment/facility industry be.

(III) Major Suppliers in Taiwan

In recent years, most investors in Taiwan’s biomass energy industry have been large conglomerates. Through resource integration within these conglomerates, investors could not only reduce their learning curve upon entering the biomass energy industry, but also establish a patent plan that would grant it a robust competitive edge. Investors in Taiwan’s biomass energy industry have consisted primarily of national corporations and food giants. In fact, early phases of the paper manufacturing process in Taiwan already share much similarity to the bioethanol production process. This means a significantly lower entry barrier which many firms will find particularly attractive; many firms have been conducting market assessments, in particular the Yuen Foong Yu Paper Manufacturing Co. Local biomass energy source material producers include Taisugar, Nice Group, National Petroleum, Ve Wong Corp., Yuen Foong Yu Group, Taiwan Fertilizer, and CPC. Local biomass energy transformation firms include Taisugar, Nice, National Petroleum, Ve Won, Yuen Foong Yu, Taiwan Fertilizer, and CPC.

Source Materials, Technologies, and Products Employed by Taiwan’s Biomass Energy Industry

Description/ Conglomerate	Taiwan Sugar Corp.	Nice Group	National Petroleum	Ve Wong Corp.	Yuen Foong Yu Group	Taiwan Fertilizer Co. & CPC
Source Materials	Sugarcane, sweet sorghum	Waste oil, plant oil	Plant oil	Tapioca powder (Thailand)	Cellulose	Sweet potato, sugarcane
Technology	Fermentation	Chemical engineering	Chemical engineering	Fermentation	Hydrolysis, fermentation	Fermentation
Products Currently Planned	Bioethanol	Biodiesel	Biodiesel	Bioethanol	Bioethanol	Joint-Producti on of Bioethanol

Source: Compiled for the present study, 2007/12