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The challenges in achieving biodiesel target of renewable energy policy in Thailand

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***Abstract*— The Thai government has promoted the Renewable and Alternative Energy Development Plan for 25 percent in 10 years (AEDP 2012-2021) to develop alternative sources of renewable energy in order to replace fossil fuel and oil import, and to move towards the low carbon society. Palm-oil based biodiesel is one of the attractive renewable fuel in Thailand. The policy production target is set at 5.97 milliliter per day by 2021. Such that 880 thousands hectares of oil palm plantation will be required. In 2013, Thailand had approximately 720 thousands hectares of oil palm plantation with the target gap of 160 thousands hectares. In response to land availability for oil palm expansion, the strong legislation to protect the forest has effectively forced the expansion mainly taking place on pre-existing croplands, causing the risk of local crop lost and the competition for land utilization between energy crop and food crop.**

The average of oil palm fresh fruit bunch (FFB) yields and overall oil extraction rates (OER) in Thailand during 2005-2009 are 16.8 ton per hectares and 16.6%, respectively. Malaysia and Indonesia, the world leaders of oil palm producers, have a much higher rate above 40 ton per hectares of FFB and 25% of OER. The approximate value between this gap is several billion THB. This can be explained by that oil palm plantations in Thailand are mostly owned by local farmers and smallholders. Consequently, planting technologies and lacking capital are the main factors to lower yield and quality. Despite this, the Thai government is optimistically looking at the issues as an opportunity to stimulate economic systems in rural areas and thus providing farmers' income distribution and better quality of life.

To achieve the policy target, the Thai government has currently provided (1) subsidies in various forms to farmers as an incentive to convert their croplands to oil palm plantation, (2) cash grants for technology research and development, (3) research funds for a better practice in farm management and rural development studies, and (4) research funds for possibilities of exportation in the future, concerning with the international protocols such as RSPO. These strategies have been developed in consideration of lessons from the past on dramatic deforestation, massive biodiversity losses and extinction of species that have been occurring in other oil palm producing countries. These promising strategies are therefore the challenges.

Keywords—alternative energy policy; food and energy crop competition; biofuel; oil palm expansion; RSPO

I. INTRODUCTION

Energy consumption in Thailand has continuously increased with the country's economic development and population growth [1]. Industrial and transportation sectors consume a substantial portion of the total end-use energy in the country. A projection of energy demand in 2021 would be about 99,000 ktoe, accounting for a 25% increase in all energy demand at the present. The imported energy is the main source of Thailand. Oil import has the highest proportion at 80% of total domestic oil consumption, with an increasing trend from 297 million barrels in 2010 to 318 million barrels in 2013. The value is over 1,000 billion THB (approximately 31 billion US dollars).

With an ambitious focus on reducing dependency of oil importation, the Thai government has promoted the energy conservation policy to develop alternative sources of renewable energy along with encouraging its wider uses throughout all end-use sectors including industrial, commercial, residential and transportation [2,3]. Table 1 shows a total of final energy consumption from alternative sources from 2009 to 2013. On average, electricity and heat annually increased by 187 Ktoe and 526 Ktoe, respectively. Natural energy resources are solar, wind, small hydro power, biomass, municipal solid waste and biogas. Solar energy is one of the most potential alternative sources with an average of radiation intensity of 18.2 $MJ/m^2/day$. Biofuel consumption has evidently increased by stimulated government policies [4]. The most significance energy-producing crops are sugarcane, cassava, oil palm, and jatropha. Thailand is the agriculture-based economic country. It is not only a variety types of fresh crops can be used as feedstock in producing biodiesel and bioethanol, but also agro residuals can be value added as technical potential of producing alternative energy. An increasing trend of renewable energy consumption in the last five years indicates an effective policy implementation to enhance the security of energy supply of the country.

Thailand is the agriculture-based country, and therefore a variety of crop types can be used as feedstock in producing biodiesel and bioethanol energy. In addition, agro waste after cultivation or residues after processing from food industry can be used as energy from waste. These potential sources of energy offer the promising country energy security.

TABLE I. Total final alternative consumption during 2009 to 2013

Alternative Energy	Consumption (Ktoe)				
	2009	*2010*	*2011*	*2012*	*2013*
1. Electricity[a]	594	807	988	1,138	1,341
2. Heat[b]	3,177	3,763	4,529	4,886	5,279
3. Biofuels	865	875	984	1,270	1,612
- Ethanol	340	334	323	430	707
- Biodiesel	525	541	661	840	905
Total	4,636	5,445	6,501	7,294	8,232

[a.] Including Solar, Wind, Small hydro power, Biomass, Municipal Solid Waste (Msw) and Biogas

[b.] Including Solar, Biomass, MSW and Biogas Source: [4]

II. BIODIESEL POLICY TARGET OF THAILAND

Thai government promoted the first National Alternative Energy Development Plan (AEDP, 2004-2011) to use biofuel as the renewable energy. Many Policies such tax and non-tax incentives, research and development supports, and public awareness promotion was applied to encourage biofuel consumption. In 2004, the government began to use E10 premium gasoline by blended 10% ethanol and 90% gasoline into commercial market and the production of biodiesel in 2005 by blended 5% methyl ester and 95% normal diesel, the commercial name is B5 [5]. Due to the high performance to produce biofuel, Thai government decided to develop the second plan with the main target of increasing the proportion of alternative energy.

The second plan (AEDP, 2008-–2022) was released in 2008. The target of this plan was to develop 20% of renewable and alternative energy by 2022. The plan was divided into 3 stages: Short term (2008-2011): focus on promotion of commercial alternative energy technology from high potential energy sources; Medium term (2012-2016): focus on development of alternative energy technology industry, encourage new alternative energy R&D, and introduce a model for the concept of "Green City" to help communities move toward energy self-sufficiency; Long term (2017-2022): enhance utilization of new available alternative energy technology [2,5].

Due to the fact that the 15-year AEDP plan (2008-–2022) has failed to achieve the short-term targets, the government has developed a new 10-year Alternative Energy Development Plan (2012-2021) to replace the 15-year plan. The target is replacing 25% of total energy consumption with renewable and alternative energy by 2021. Fig. 1 presents the AEDP target categorized by alternative energy type in 2021. The objectives of the new AEDP plan are to a) develop renewable energy as the country's major energy sources in a sustainable manner; b) enhance the security of energy supply; c) promote integrated green energy utilization in communities; d) support alternative energy technology production; and e) research, develop and promote Thailand's alternative energy technology for international competitiveness in bioenergy development [3,5]. The new target is 0.88 million ha of palm-oil plantation and 5.97 ml/day of biodiesel by 2021. From the data in 2013, Thailand had 0.72 million ha of palm-oil plantation with the target gap was approximate 0.16 million ha [6].

The 10-year plan let the active result of biofuel consumption in accordance with the increasing trend of biodiesel in 2011 and 2012 was 22.18% and 27.08%, respectively but only 7.73% was found in 2013 whereas ethanol increased to 33.16% in 2012 and large expand in 2013 with 64.41%.

This can be explained by the almost of biodiesel was obtained from Palm-oil, which is monoculture with long-term residue and consider as the food competing and changes to existing farming practices but the ethanol was obtained from various plant with short-term residue such sugarcane and cassava less impact than biodiesel.

To achieve the biodiesel target, the government has a plan for expanding oil palm growing area. The government has set up a soft loan scheme to support policy and promotes the oil palm expansion in the Southern regions. [5,7,8].

This paper focus on palm oil-based biodiesel source in Thailand. We discussed success and failure in a series of government energy-policy initiatives, possibility of oil palm expansion in order to balance between food and biodiesel consumptions, advantages and disadvantages for current situations of yield production and oil extraction rate, and strategic policy for stimulating rural development, research and technology, and future exportation.

III. FOOD AND BIODIESEL CONSUMPTIONS

Competition for land use is a major concern when considering feedstock production. Southern regions of Thailand having a suitable climate for the growth of oil palm. As a result, oil palm is quickly expansion in these regions, setting up on going competition with other crops grown in the areas [5,7].

Although the continued expansion of growing area and the increasing demand of palm-oil Thailand has been banning the logging of forests since 1989 and the remaining forests are declared as national parks or wildlife sanctuaries. The strong legislation to protect the forest has effectively. The expansion of palm-oil is explicitly targeted at waste land such as abandoned paddy fields, degraded land, abandoned fruit orchards, land with acid soils, and land previously used for rubber cultivation [5,7]. However, the expanding area for growing palm is limited due to competitive rubber plantation, and unpredictable weather patterns have negatively impacted on palm yields [7,9].

In addition, the expansions of biodiesel help to avoid the risk of energy security but that also increase the risk of food security such as the palm-oil expansions in southern of Thailand were caused of the reducing rice plantation and increase in the price of food crops [10].

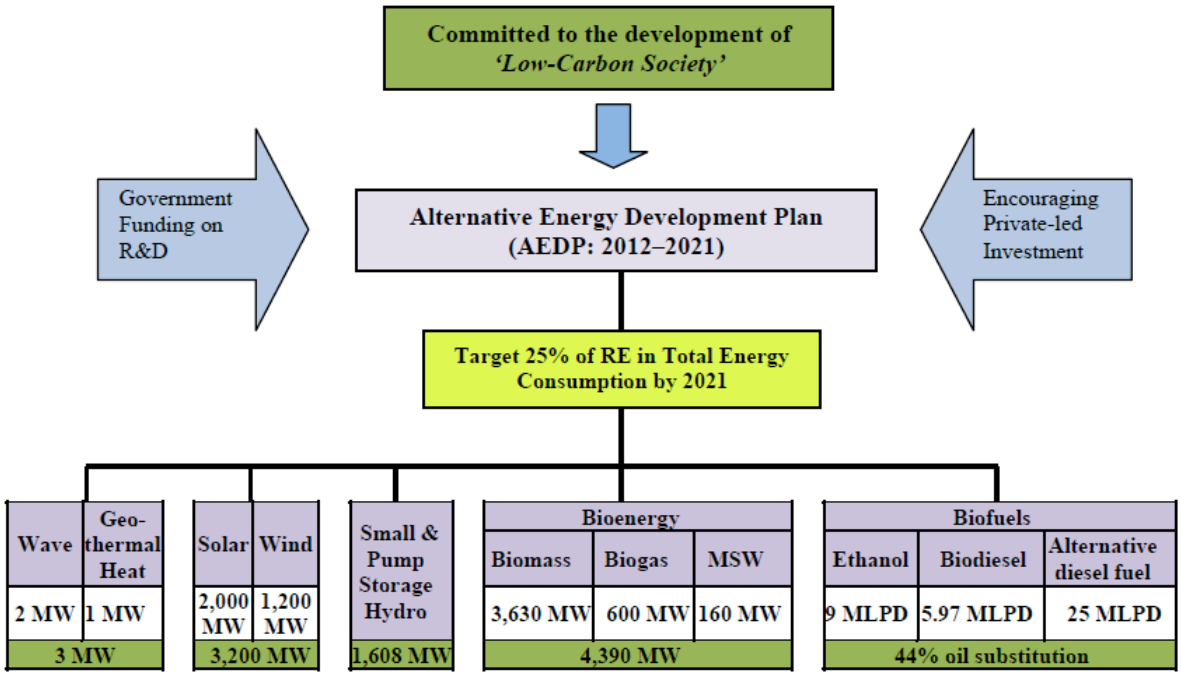

Fig. 1. Alternative Energy Development Plan (AEDP:2012-2021)
Source: [5]

IV. Fresh Fruit Bunch Yields and Oil Extraction Rates of Thailand

Although a trend of fresh fruit bunch (FFB) yield from twenty years between 1990 and 2010 had increased, the annual average FFB yield was 16.8 t/ha during 2005-2009 (Fig. 2). It is much lower than that in Malaysia and Indonesia. FFB yields of Malaysia and Indonesia are above 40 t/ha. Data from calculated shows that if yields increase by 2.5 t/ha, an additional FFB production of 1.276 million tons and CPO production of 217,016 tons would have been produced. The value is 4,972 million THB or 151 million USD [8].

At the same period, a trend of oil extraction rates (OER) in Thailand has been declining. The average OER in the period from 2005 to 2009 was only 16.6%. If the average OER of 18.8% from 1990 to 1994 had been achieved in 2009, an additional 146,923 tons of CPO would have been produced. The value is 3,366 million or 102 million USD. Potential OER rely on good management practices. Malaysia and Indonesia achieve OER of up to 25% under optimum conditions. Various factors such as palms from low quality planting material (seeds), FFB delivery, and the condition on oil mill operation, are the cause of the lower potential OER [8].

Thailand has a higher proportion of small holders than Indonesia and Malaysia. the average size of land holding in Thailand of large scale and smallholder in 2007 was 796 ha and 3.89 ha, respectively [8] (Fig. 3). The main issues facing smallholder farmers relate to low yields from their production systems. The large plantations that are under private or government ownership are able to achieve greater economies of scale such as better planting technologies and more accessible capital. They are able to equal the production rates of large-scale plantation [8,10].

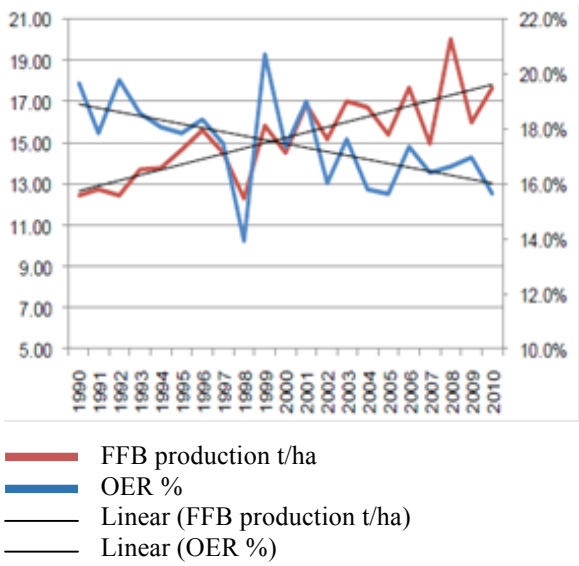

Fig. 2. FFB yields and OER from 1990 to 2010
Source: [8]

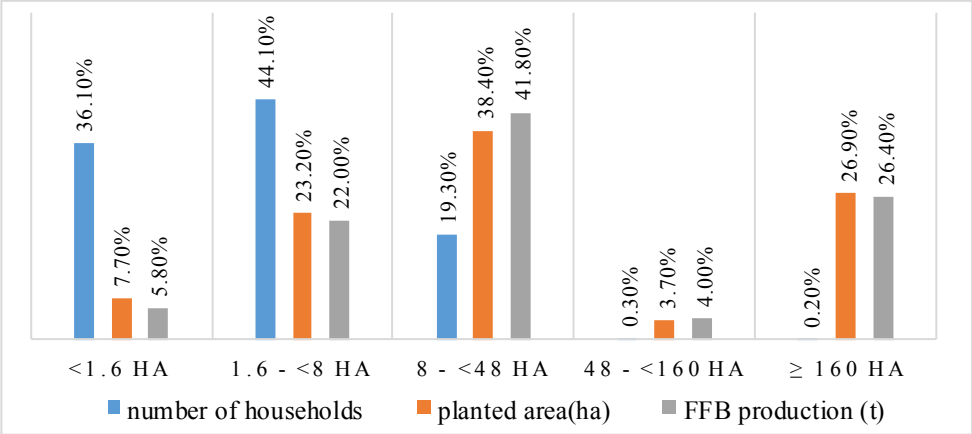

Fig. 3. Estimated share of FFB production, number of households and planted area by land size in oil palm farming
Source: [8]

V. THAI LAND STRATEGIC BIODIESEL POLICY DRIVING FORCE

A. Rural development

The Thai government promotes bioenergy as the opportunities to stimulate rural development. Also, biofuels can create new markets and increase demand for agricultural products. Such an increase in demand for agricultural feedstock will also result in higher commodity prices and hence higher income for farmers and boost the rural economy [5].

In terms of biodiesel, oil palm plantation is great opportunities as well as great risks for small holders. A net income from oil palm plantation is approximately seven times greater than another plantation [11]. On the other hand, the risks that smallholders face are diverse particularly in a scenario involving swings in palm oil prices [5].

To achieve the policy target, the Thai government should effectively develop upstream to downstream process, especially for the smallholders sectors.

B. Oil palm cultivation subsidy

Funding of soft loans such as to encourage farmers convert their croplands to oil palm plantation, and new biodiesel enterprises to reduce the production cost and the payback period. Encourage research and develop of oil palm seedling that suitable for each areas, which can improve the yield and quality of oil palm [12].

C. Research and development

To meet the policy target, substantial funds for supporting research and development technologies for biodiesel production has been granted for (1) the exemption of import duty and incentive for import machinery to produce biodiesel, (2) pushing to create the new biodiesel plant and oil palm extraction plant or improve the efficiency of the old plant to support the oil palm expansion and to meet consumer demand of palm oil and alternative energy [12].

D. Corporate with local community

Promoting research and development to combine experience in the area between academics and community will improve their technology and production process of biodiesel within a reasonable cost economics. Creating self-sufficient economy or production with local resources by the collaboration between local government and community reduces the production cost of biodiesel and improves the quality of biodiesel, allowing competitive pricing with larger private business stakeholders [12].

E. Smallholders RSPO certification

In Thailand, smallholders are the highest ratio of oil palm farmers. Thus, it is difficult to control the standard oil palm production because of the lower technologies and lack of capital, compared with the large plantation. That is the barrier of smallholders to get the certificate. On the other hand, to achieve the principles and criteria form organization such as Roundtable on Sustainable Palm Oil (RSPO), smallholders have to form groups that assist to easily obtain the RSPO certification by the RSPO Standard for Group Certification [8].

RSPO certification can guarantee the standard of national oil palm production and the environmental impact of production. Although, Thailand does not force to get the certificate but Europe countries have the trade barrier. Moreover, the certified oil palm product can receive the better price. For examples, the FFB production can sell certificates for sustainable FFB through the Green Palm certificate trading system. In addition, the RSPO standardized production can improve safety and health conditions of farmers, long-term improvement in soil quality, water management as well as the general physical environment through environmental protection.

VI. CONCLUSION

The challenges in achieving biodiesel target of renewable energy policy in Thailand are (1) oil palm expansion target with less impact to the security of food demand, (2) yield and OER by effectively develop upstream to downstream process, (3) collaborations between smallholders, private business sectors, government to support research and technology development, and (4) the price control mechanism to achieve maximum benefit level at local, regional, national level.

To achieve the policy target will benefit to Thailand in long term as the reducing of energy imported but environmental impact and food security must be considered.

These strategies have been developed in consideration of lessons from the past on dramatic deforestation, massive biodiversity losses and extinction of species that have been occurring in other oil palm producing countries. These promising strategies are therefore the challenges.

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