

CDM/JI Project Study

Summary

CDM Project based on Promotion of Palm Oil Bio-diesel for Transport in Thailand

(1) Basic Elements Related to Project Implementation

General Outline of the Proposed Project and Background for the Project Planning

The Project envisages producing palm methyl ester (PME) which can alternate the diesel fuel or so called palm oil bio-diesel Fuel (PME-BDF) using a crude palm oil (CPO) as its raw material through chemical reaction called esterification process using methanol. The oil palm has been grown traditionally and widely in Thailand. The use of BDF produced from palm oil as for an alternative fuel of diesel fuel for transport means to reduce the consumption of diesel fuel at equivalent volume of its use. Therefore, the volume of carbon dioxide emission can be reduced because of using BDF as an alternative fuel, at the same volume of carbon dioxide which is emitted by the diesel fuel of same volume. PME-BDF is of carbon neutral character. As the Project is designed to produce BDF at 300 tons per day, when all products produced is used as an alternative fuel of diesel fuel, the reduction of carbon dioxide emission per year can be estimated at 217,000 t-CO₂.

According to the national bio-diesel development plan of the Government of Thailand or the host country of the Project, the target volume of alteration of diesel fuel consumption with BDF is set at 10% of annual diesel consumption by year 2012. This means that 8.5 million liter of BDF is needed per day or 27 units of BDF plant of which production capacity is 300 tons per day as designed for the Project is needed to be put into operation. The estimated maximum annual carbon dioxide emission volume reduced, if this national BDF program is realized as planned, is estimated at 5.86 million t-CO₂. Thus, the total volume of carbon dioxide emission in 10 years would reach to 58.6 million tons. If the Project is realized, it would be the first BDF project on commercial scale in Thailand.

General Profiles of the Host Country

Thailand is situated in a center part of the Indochina Peninsula and surrounded by Myanmar at north, by Lao PDR at north-east, by Cambodia at east and by Malaysia at south. The total land area is 514,000 km² and largely occupied by flat field. Most of the land falls under tropical monsoon climate. May – September is the season of south-west monsoon and the temperature is hot with high precipitation. November – March is the season of north monsoon and the temperature is a bit cool but dry. Average annual temperature is 28 ° C but there is not much difference of temperature throughout the year and it is hot throughout the year.

The total population is 65.4 million as of 2005 and annual growth rate is 0.85% which is low. The population of Bangkok is around 6.0 million and accounts for around 9% of the total population. The number of labor force is estimated at around 3.64 million. The share of labor force by sector is 50% by agriculture, 14% by industry and 37% by service. Unemployment rate is around 1.5% which is comparatively low. Since the agriculture sector absorbs labor force even the number of unemployment increase by season or economic situation as a whole, it does not cause an acute increase of unemployment. Absolute poor accounts only around 10% of total population.

Outlook of Agriculture: Thailand has been developed based on agriculture as its foundation of economy. Although the share of agriculture in GDP and export has been declining since the later half of 1980 when the industrialization progressed rapidly, the agriculture sector has been still an important economic sector which support national economy because almost half of the labor force relates to agriculture, almost 40% of national land is occupied by agriculture land, around 30% of export earning is derived from agriculture and fishery products and this sector's export value exceed its import value. Under such situation, the importance of agriculture still is considered as high. These days, the agriculture export has been shifting from primary products to more value added processed products and the agro-industry has been growing as an important industry.

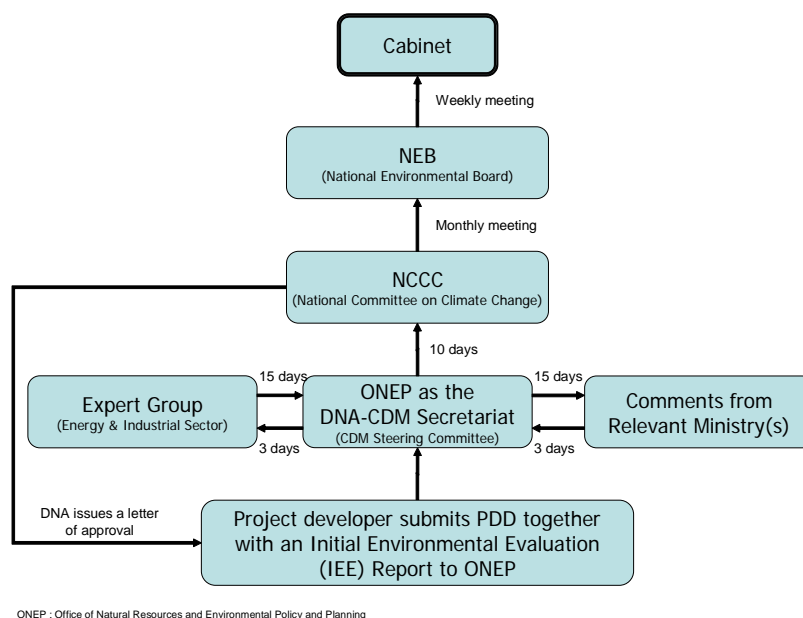
Cash Crop Production: Thailand is the leading agriculture products export country in the world. The export volume of rice in 2003 reached to 8.4 million tons (around 30% of world total trade volume) and was ranked as the top export country of the world, which is followed by Vietnam (3.81 million tons, 14%), USA (3.80 million tons, 14%) and India (3.4 million tons, 12%). The promotion of shift from rice production to cash crops such as natural rubber, oil palm, pineapples, etc. has been encouraged so as to transform the monoculture structure to more diversified structure. Thailand is the leading export country of rubber as well. The rubber production of Thailand reached to 2,400 ton (34%). The annual production of oil palm, which is planned to be used as the raw material for the proposed project, in Thailand is 620,000 tons (2.2%) and ranked fourth in the world. In the case of oil palm, Malaysia is the leading producing country which produced 13.3 million tons (48%) and followed by Indonesia 10.0 million tons (35%), and Nigeria 910,000 tons (3%).

Outlook of Energy: After the economic crisis experienced in 1997, the energy consumption of Thailand has been continuously increasing at a considerable rate as shown before the economic crisis. The stable increase of industrial production since 2002 has been pushing up GDP growth. The energy consumption structure in 2004 is as follows: petroleum product accounts 47.3%, natural gas 35.7%, coal 14.7% and hydraulic power 2.3%. The imported

energy's share in the total energy consumption accounts 64%. This share of imported energy has been expanding constantly at an average 3.4% per year in the past 5 years. Almost 60% of petroleum products are used as for the transport related fuel and its annual growth of consumption has been increasing at around 4.5% per year, it can be foreseen that most of the energy for transport will depend on imported energy. The diesel for transport accounts 45.6% of the total petroleum products consumption, which is almost double of gasoline as it accounts only 21.3%. As such, the diesel consumption in Thailand occupies an important position and it suggests strongly that it would increase to the future and almost all diesels are consumed by transport sector.

Policy and current state relating CDM/JI, including the host country's criteria to accept CDM/JI and current state of DNA installation

The Government of Thailand ratified United Nation Framework Convention for Climatic Change in 1994 and Kyoto Protocol in March 2002. In February 2004, it registered Ministry of Natural Resources and Environment (MONRE) as DNA. The working organization to receive and evaluate application for CDM as well as its evaluation criteria have been under preparation. The Government of Thailand formed the organization for evaluation and approval on CDM as illustrated below but it has not been completely fixed yet as of January 2006.



The table below shows “CDM Sustainable Development Criteria in Thailand” adapted by the Ministry of Natural Resources and Environment of the Government of Thailand. The Project complies with all of these criteria.

Aspect	Objective	Indicator
Environment	<ul style="list-style-type: none"> - Promoting Environmental Quality and GHG reduction project. - Promoting reduction of natural resource utilization such as underground water and finite energy sources - Full life cycle plan of the project including plan after CERs contract ended 	<ul style="list-style-type: none"> - Improve environmental quality - GHG emission reduction - Air pollution SO₂, NO_x, PM10 - Water pollution - Solid Waste - Land contamination - Include plan to sustain biodiversity - Include underground water conservation plan - Reduce utilization from finite energy source - Promote sustainable use of other natural resource (Reduce, Recycle and Reuse) - Include plan to mitigate environmental impact - Include decommissioning plan or long term maintenance plan after the end of CERs purchase agreement
Social	Public participation is a major part of SD, and in order to avoid community conflict, the project developer must seek permission from both local and national authority.	<ul style="list-style-type: none"> - In agreement with law and regulations as well as EIA rules - Information Dissemination to the public - Equity in Benefit sharing in the community - Health - Child Education - Improve workers skill - other benefit
Economic	To promote local economy in the project area that would reflect national economy	Employment (in years)

*2005/3/15 International Seminar on Study to Promote Clean Development Mechanism in Transportation sector to Resolve Global Warming Problem: "Utilization of Biodiesel as Alternative Fuel"

The view of the project participants of the contribution of the project activity to sustainable development.

The proposed project will contribute to the sustainable development of the host country especially on the following points:

Reduce the dependency on imported energy:

As the PME-BDF produced through the proposed project is an indigenous energy produced and distributed in Thailand, it would reduce the dependency of Thai economy on imported energy by developing indigenous energy and would effect to stabilize the energy supply.

Ensure steady or increase income of farmers in rural area in Thailand:

Oil palm is a major cash crop and important commodity for the rural people especially in the southern part of Thailand where the raw material for the production of PME bio-diesel is produced. Constant purchase of CPO from palm oil millers by the project activity will

stabilize the domestic oil palm market and it will contribute to palm oil millers or farmers in the area to ensure steady income and/or creation of new income source. And the project activity will not only enhance the increase of oil palm production in the area, but also it will contribute to increase the income of farmers. The constant revenue for palm oil millers and farmers will form a financial ground to expand or upgrading of palm oil industry in general but particularly in rural area where such value added activity is an earnest desire.

Improve the air quality in Bangkok Metropolitan Area:

A rapid increase of number of vehicles and acute traffic congestion make Bangkok' air polluted and residents suffer from respiratory problems due to the degradation of air quality. In Bangkok, the level of PM is higher than the international standards of this scale of cities. The urgent and cost effective measures to curve the PM level are most important issues to be addressed by Bangkok City. It is known that the use of bio-diesel ensures a decrease of PM level. It is thought that the PM, HC, and CO can be effectively reduced if the public bus system will use BDF because the public bus is a major diesel gas emission source.

Trans-esterification Technologies:

The technologies which produce methyl-ester by removing glycerin from vegetable oil using methyl-alcohol and other catalysts: and adjusts and stabilize such product to an alternative fuel of diesel fuel has not been common in Thailand yet. The transfer of this technology will not only applicable to produce BDF but also to produce highly valued alcohol based on fatty acid thus it would form the foundation for highly valued industrial development in the future.

Study Implementation Structure

This feasibility study on the proposed project was carried out in cooperation among Almec Corporation, Japan Transport Cooperation Association (JTCA) and Japan Weather Association (JWA).

(2) Project Design

Project Description

Location of BDF Production:

The proposed project envisages production of bio-diesel using crude palm oil (CPO) which has been grown traditionally in Thailand, through esterification process with methanol at a rate of 300 tons per day. The planned location for the construction of the bio-diesel production plant is Bangpakong situated east-south suburb of Bangkok City and close to the unloading port of CPO.

Area of Raw Material Production:

CPO used as raw material for the production of bio-diesel through the proposed project is collected in Suratthani and Kurabi Provinces in the southern part of Thailand the major production area of oil palm. CPO is planned to be loaded at the CPO loading port in Suratthani and transported by liquid carrier of 1,600 – 2,000 DWT to Bangpakong.

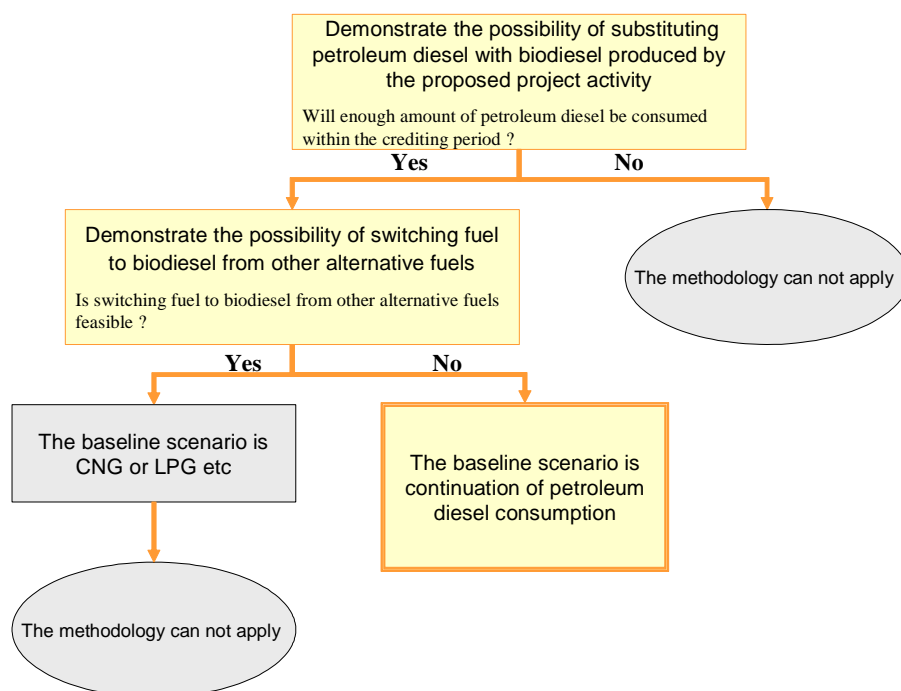
BDF Distribution:

The bio-diesel produced through the proposed project is planned to be distributed by PTT, the largest petroleum refining and distribution company in Thailand, after it is blended with diesel fuel at predetermined blending ratio.

Project Boundary, Baseline and Additionality

Determine the Baseline Scenario:

The baseline scenario was determined by applying baseline methodologies which has been submitted to UNFCCC by the project designer for its approval and is referred as NM0142 “Baseline Methodology for Palm Methyl Ester or Coconut Methyl Ester Biodiesel Fuel Production for Transportation Using Life Cycle Assessment Approach”.



The amount of PME-BDF to be supplied by the project will be 85ktoe and the necessary amount of petroleum diesel will be 765 ktoe for a 10% biodiesel blending. Based on these figures, it can be concluded that there will be enough amount consumed within the crediting period.

It can be expected that a sufficient volume of diesel which will possibly altered by PME-BDF will be consumed in the period of project implementation and no possibility to switch other alternative fuel such as CNG, LPG, power, etc. to bio-diesel are confirmed, the baseline or baseline fuel is determined to be diesel fuel.

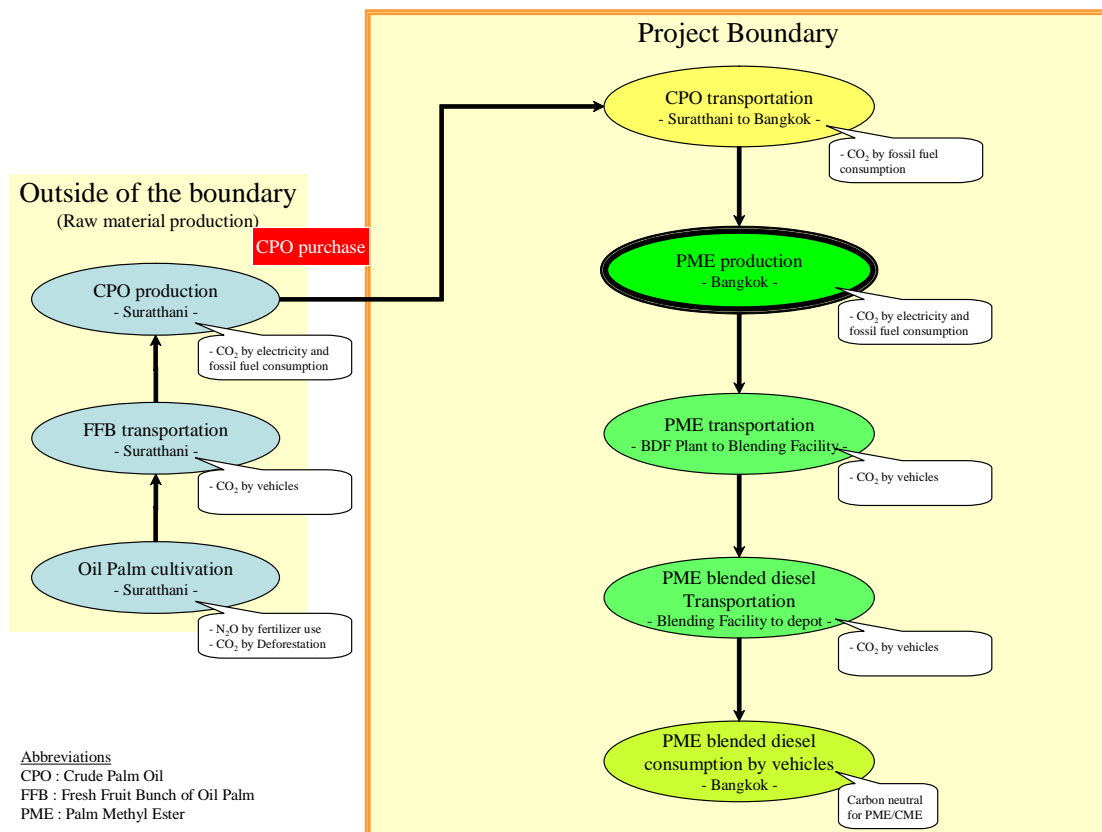
Verification of Additionality:

The additionality of the proposed project was justified by applying both investment analysis and barrier analysis in accordance with the tool approved by CDM Board namely “Tool for the demonstration and additionality (Annex 1, EB16).

According to the result of investment analysis the FIRR of the project was 9.4% when the project is without additional revenue due to CER and 13.4% with CER. And the barrier analysis shows that the production of bio-diesel fuel by methyl-esterification process has been under still laboratory level or examination level; and no experience on the operation of large-scale BDF production. Therefore, it depends still on the technologies imported from abroad. The additionality of the proposed project is justified based on these reasons.

Project Boundary:

The boundary of the proposed project is determined in accordance with the methodologies applied and as illustrated below.



Abbreviations
 CPO : Crude Palm Oil
 FFB : Fresh Fruit Bunch of Oil Palm
 PME : Palm Methyl Ester

GHG reduction and leakage due to project implementation

Baseline Emission Volume:

Respective GHG emission volumes in the following process were totaled to obtain the baseline emission volume in accordance with the methodologies applied.

- Crude oil production, transport/storage, diesel refining/transportation (EB_{wtt})
- Consumption of petroleum diesel fuel by vehicles (EB_v)

$$EB = EB_{wtt} + EB_v = 295,643 \text{ tCO}_2\text{e/yr}$$

Project Emission Volume:

Respective GHG emission volumes in the following process were totaled to obtain the project emission volume in accordance with the methodologies applied.

- CPO-BDF transportation (EP_{tCPO})
- PME-BDF production (EP_{pPME})
- PME-BDF transport (EP_{tPME})
- PME-BDF blended diesel transportation (EP_{tBF})
- PME-BDF consumption by vehicle (0 carbon neutral)

$$EP = EP_{tCPO} + EP_{pPME} + EP_{tPME} + EP_{tBF} = 37,973 \text{ tCO}_2\text{e/yr}$$

Leakage Emission Volume:

Respective GHG emission volumes in the following process were totaled to obtain the leakage emission volume in accordance with the methodologies applied.

- Oil palm cultivation (EL_{pf})
- FFB transportation (EL_{tFFB})
- CPO production (EL_{pCPO})

$$EL = EL_{pf} + EL_{tFFB} + EL_{pCPO} = 39,915 \text{ tCO}_2\text{e/yr}$$

GHG emission volume reduced due to the project implementation:

The GHG emission due to the project is calculated as follow.

$$EP_{total} = EP + EL = 77,888 \text{ tCO}_2\text{e/yr}$$

The GHG emission reduction volume is calculated as follow.

$$ERs = EB - EP_{total} = 295,643 - 77,888 = 217,755 \text{ tCO}_2\text{e/yr}$$

The total GHG emission reduction volume in 10 years credit period is as shown in table

below.

Years	Estimate of project activity emissions (tons of CO ₂ e)	Estimate of baseline emissions (tons of CO ₂ e)	Estimate of leakage (tons of CO ₂ e)	Estimate of emission reductions (tons of CO ₂ e)
Year 1	39,915	295,643	37,973	217,755
Year 2	39,915	295,643	37,973	217,755
Year 3	39,915	295,643	37,973	217,755
Year 4	39,915	295,643	37,973	217,755
Year 5	39,915	295,643	37,973	217,755
Year 6	39,915	295,643	37,973	217,755
Year 7	39,915	295,643	37,973	217,755
Year 8	39,915	295,643	37,973	217,755
Year 9	39,915	295,643	37,973	217,755
Year 10	39,915	295,643	37,973	217,755
Total (tons of CO ₂ e)	399,150	2,956,430	379,730	2,177,550

Monitoring plan

It is necessary to monitor the following items needed for the calculation of GHG emission volume of the project, baseline and leakage, respectively, in accordance with the monitoring methodology applied which is referred to NM0142 "Monitoring Methodology for Palm Methyl Ester or Coconut Methyl Ester Bio-diesel Fuel Production for Transportation using Life Cycle Assessment approach.

In order to make sure of data collected, the project operator shall prepare the monitoring plan on PME-BDF CDM project. This monitoring plan shall contain the items to be monitored, monitoring method applied, procedure of QA/QC, etc. The supervision on monitoring shall be carried out monthly or yearly as needed based on this plan. The data format shall be defined in this plan report. The related personnel shall hold meeting as needed so as to make sure of data's quality level.

	Serial No.	Variable	Source	Unit	Frequency
Project	1	Diesel fuel consumption volume for transport CPO by liquid carrier	Transport Company	liter/yr	month
	2	Calorific value of diesel fuel	National Statistics	MJ/liter	year
	3	Coefficient of Carbon Emission of Diesel Fuel	National Statistics	MJ/liter	year
	4	Total running distance of truck used for CPO transport	Transport Company	km/yr	month
	5	CO2 emission coefficient of truck	Research report, etc.	gCO ₂ /km	year
	6	CO2 emission coefficient of grid power	Power generating company	gCO ₂ /kWh	year
	7	Power consumption from grid to produce PME-BDF	BDF production plant	kWh/yr	month
	8	Fuel consumption to produce PME-BDF	BDF production plant	liter/yr	month
	9	Total running distance by truck transporting PME-BDF from PME-BDF production plant to fuel blending point.	Transport company	km/yr	month
	10	Total running distance by truck transporting PME-BDF from fuel blending point to service station or bus/truck depot	Oil distribution company	km/yr	month
	11	PME-BDF production volume	BDF production plant	liter	day
	12	PME-BDF sale volume	BDF production plant	liter	day
	13	PME-BDF export volume	BDF production company or oil company	liter	month
	14	CPO purchase (Location and supply source)	BDF production plant	-	month
Baseline	15	Total sale volume of PME-BDF at each service station and depot	Oil company	liter	month
	16	PME-BDF calorific value	National statistics or scientific literature or data obtained by project operator	MJ/liter	year
	17	GHG emission coefficient during crude oil exploitation/transport, diesel refining / transportation	Academic report/paper	gCO ₂ /MJ	year
	18	C emission coefficient of diesel fuel	IPCC data	tC/TJ	year
Leakage	19	CPO supply volume at PME-BDF production plant	BDF production plant	ton	day
	20	1Volume of fertilizer per 1ha	Local data or academic report	ton/ha/yr	year
	21	Average yield of CPO per ha.	Local data or academic report	ton/ha	Year
	22	Composition of Nitrogen in fertilizer	Local data or academic report	ratio	year
	23	CO ₂ emission coefficient of truck	Academic report	gCO ₂ /km/ton	year
	26	Running distance per FFB 1ton	Local data	Km/ton/yr	year
	27	Average yield of CPO per FFB 1ton	Local data	ratio	year
	28	Grid power consumption for production of CPO 1ton	Local data or academic report	kWh/ton	year
	29	Fossil fuel consumption volume to produce CPO 1ton	Local data or academic report	liter/ton	year
	30	CO ₂ emission coefficient of grid power	Power generating company	gCO ₂ /kWh	year
	31	Area of forest replaced with oil palm cultivation area	Palm farmers	ha/yr	year

Environmental Impacts/other Indirect Impacts (including risk study for reforestation)

Environmental Impact Concerned to Raw Material Cultivation Area Development: The raw material planned to be used for the production of BDF by the proposed project is oil palm. At the initial stage of the project operation, all raw material planned to be used is the crude palm oil (CPO) processed in oil palm mills from oil palm collected from existing oil palm cultivation areas. It is estimated that around 450,000 hectares of land is to be newly developed as oil palm cultivation area to produce BDF in accordance with the national biodiesel development program. At present, the total cultivated area of oil palm in Thailand is around 3 million hectare. However, new cultivation area requirement is planned to be met by transferring the kind of plant cultivated at present such as durian or rambutan, etc., those fruit trees losing commercial value substantially, to oil palm. In such a way, a necessary land for expansion to cultivate oil palm does not need to be prepared on newly opened land by deforestation or a like, so as not to give any adverse effect to the natural environment.

Environment Impacts from Industrial Wastewater: If the content of industrial wastewater effluent from proposed BDF plant would exceed the limits regulated by the government or the total volume of wastewater exceeds 3,000 tons per day, then, it will require an agreement with the agency concerned to the environment protection separately. However, the volume of wastewater generated from the proposed BDF plant is estimated to be only around 100 ton and the volume of waste water which contains a solid substance per 10 tons is only 600 liter. And as such solid substance is a kind of soap, it is quite easy to process and will not require any special equipment for treatment of wastewater. Thus, no adverse environmental effect is expected by provision of proper and common industrial wastewater treatment plant.

Comments from Project Stakeholders

Ministry of Natural Resources and Environment (MONRE), Climatic Change Coordination Unit (CCCU): The CCCU is the DNA appointed by the Government of Thailand. The CCCU has been expressing its willingness to consider the proposed project positively for CDM project when the PDD will be submitted to them by the project operator with a support document from a relevant ministry based on the approved methodology, because it is thought that the proposed project will reduce the carbon dioxide emission effectively and a social benefit can be expected through increased income of the farmers and workers who relates to the oil palm industry.

Ministry of Agriculture: Around 450,000 hectares of cultivation area for oil palm is planned to be added on top of existing cultivated area for oil palm in coming 7 years aiming to support the national bio-diesel development program. This additional cultivation area for oil palm will

be realized by means of transferring the cultivated area for durian, ranbutan, etc., those fruit trees losing their commercial value, to oil palm.

Ministry of Energy (MOE), Department of Alternative Energy Development and Efficiency

(DEDE): DEDE expects that the proposed project will be realized soon because the project is designed in line with the new renewable energy strategy promoted mainly by MOE aiming at decrease the dependency on imported energy.

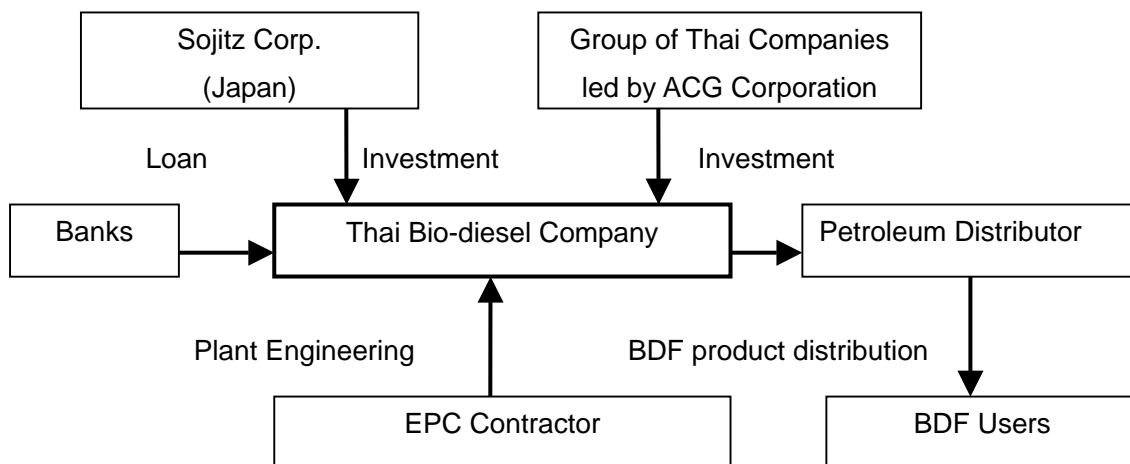
Palm Oil Millers: The raw material for BDF production is palm oil. Palm oil millers suggest that it would be difficult to supply the raw material constantly at constant price without an establishment of appropriate raw material purchase or supply contract system between BDF producer and them as a new business model for the palm oil millers.

Prominent Investors for BDF Production: BDF production and distribution project is a quite interesting project because this business is supposedly supported and promoted by the government. However, it is not easy to make sure of stable supply of raw material since its price fluctuates according to the market movement. Jatropha can be thought as one of the stable sources of raw material as it does not relate to any market of edible oil, however, it is not too easy to employ this as a raw material for BDF production because there neither example or experiment to use this as a raw material for BDF production on commercial basis in the world in the past.

(3) Commercialization

Project Implementation Structure (Japan, host country and others)

The construction of BDF production facility; production and sale of products; and management of operation of the proposed project is planned to be undertaken by the company established newly in Thailand, which is composed by following private entities illustrated in figure below. The prominent investors for this project operation company are Sojitz Corporation of Japan, and a group of Thai companies led by ACG Corporation. The ratio of equity share and other companies being involved is planned to be determined in details under an agreement after the proposed project is approved as a CDM project.



Financial Plan for Project Implementation

The initial capital investment cost of the proposed project is estimated at around US\$35 million. Of this amount, 25% is planned to be covered as equity and 75% is planned to be borrowed from the banks. The role and function among shareholders as well as an introduction of credit from Japanese financial institutions will be determined in details through the preparation of project implementation program in details in the future.

Cost Benefit Evaluation

The estimated total volume of carbon dioxide emission reduced in 10 years as credit term due to the implementation of the project is 2,177,550 t-CO₂. The cost benefit effect per 1 CO₂ reduced can be calculated as follow:

$$4,000,000,000 \text{ Yen} / 2,177,550 \text{ t-CO}_2\text{eq} = \text{Yen}1, 836 / \text{t-CO}_2\text{eq}$$

Prospect for Project Implementation and Major Issues

Establishment of System for Stable Supply of Raw Material: The most significant and important element of bio-diesel production and distribution business to succeed is how the raw material can be purchased in stable manner at constant price by the BDF producer. A slight change of raw material price affects the financial viability of the project substantially. Because the total cost flow of raw material is comparatively large when it is compared with the initial capital investment cost and operation cost. One of the solutions to avoid this problem is to introduce a long-term raw material purchase/sale contract between raw material supplier and BDF producer. The raw material or CPO volume required to operate the proposed project is estimated at around 375 tons per day. As no single oil mill can supply this volume of CPO per day, the number of CPO suppliers to one BDF producer should be plural in number. Oil mill may willingly to commit a part of his production volume to

BDF producer to supply its CPO on a long-term basis (i.e. 5 years) at fixed price aiming at to stabilize the flow of revenue or hedge his risk when the CPO price goes down below a certain level due to a seasonal fluctuation of CPO price in the market. If such long-term purchase/sale contract of raw material will be realized between plural number of oil mills and BDF producer, the expansion of oil palm cultivation land will become easier because of stable and continuous revenue flow into oil mill will appear. Such a stable and constant cash flow among the participants of BDF business will create a positive cycle of its business.

Quality Assurance of Final Product: Bio-diesel is commonly used in mixture with the petroleum diesel. Therefore, the establishment of standardization and quality guarantee is needed so as the consumers will be able to purchase BDF as an automotive fuel without any anxiety. Although the technical standards of bio-diesel has bee already established but no licensing system for BDF producer and quality inspection system have been established yet in Thailand. As the purchase of BDF from the BDF producer and distribution of BDF in the market is planned to be PTT that is the petroleum refining company representing Thailand, such necessary arrangement for distribution of products will be realized shortly, however, the introduction of such rules and regulation are to be scheduled in time.

(4) Validation / determination (if the project is implemented)

Outline of Validation (determination) or desk review

- Out of scope

Progress of Discussion with OE

- Out of scope