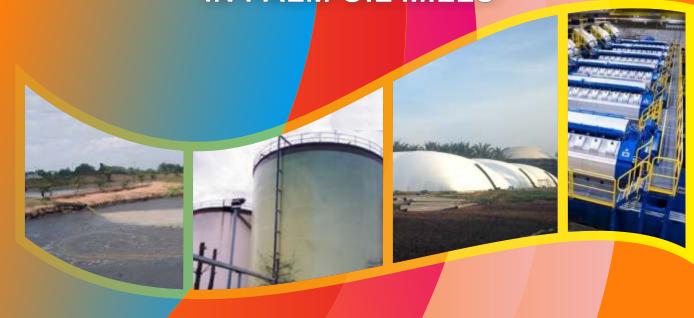
POLICY AND FINANCIAL ANALYSIS FOR DEVELOPMENT OF BIOGAS POWER PLANT IN PALM OIL MILLS





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"Toward Low Carbon Development in Oil Palm Sector"

Towards Low Carbon Development in Oil Palm Sector

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Preface



Oil palm plantations, as one of the most important export commodities has grown rapidly in the last 2 decades. It has become one of the most strategic commodities in supporting economic development in Indonesia. In 2015, oil palm plantation area has reached 11 million hectares with palm oil production of 37 million ton consist of CPO and CPKO). Currently, palm oil has become the country's largest foreign exchange earner, exceeding that of oil and gas, with export value amounted to US \$ 16 95 billion or equivalent to Rp. 228.8 trillion in 2015. Indonesia has become the country's largest palm oil producer in the world with a contribution of 53% of the total world consumption of palm oil. The rapid development of palm oil industry in Indonesia has also changed the business portfolio of palm oil, from previously limited to fulfill the need of

products that are fundamentally needed by people in large numbers, namely: bio-plastics and bio-energy either in the form of liquid (bio-diesel and bio-ethanol), solid (palm kernel shells) or gas (metahne).

However, rapid development of oil plantation has caused anxiety and concerns of many parties, particularly related to the negative environmental impacts that may result. Worry and anxiety are unnecessary as the government at the end of September 2015 had agreed on the agenda of Sustainable Development Goals, and in late December 2015 has renewed its commitment at COP 21 for the reduction of greenhouse gas (GHG) emissions up to 29%. Lately, the Coordinating Ministry of Economic Affairs has actively encouraged the strengthening of Indonesian Sustainable Palm Oil (ISPO) which must be implemented by all businesses in the Indonesian palm oil industry.

However, rapid development the plantation has caused anxiety and concerns of many parties, particularly related to the negative environmental impacts that may result. Worry and anxiety are unnecessary as the government at the end of September 2015 had agreed on the agenda of Sustainable Development Goals, and in late December 2015 has renewed its commitment at COP 21 for the reduction of greenhouse gas (GHG) emissions up to 29% by 2030 with own effort and 41% with foreign help. In addition to that, in order to achieve sustainable oil palm cultivation as part of achieving the sustainable development goals (SDGs), the Coordinating Ministry for Economic Affairs has been current active in the coordination of the strengthening of Indonesian Sustainable Palm Oil (ISPO), development of institutional organization and standard operating procedures to prevent forest and land fires, as well as postponement and evaluation of licensing of new oil palm plantations on peatlands.

One of the most prominent issues in palm oil industry is the emission of greenhouse gases (GHG) from palm oil mill efflent (POME). The high GHG emissions from POME can be obviously seen and is undeniable. One way to cope this is by implementing methane capture techniques. For that reason, the Coordinating Ministry for Economic Affairs in cooperation with the Japan International Cooperation Agency (JICA) through the Project on Capacity Development Assistance For Low Carbon Development in the Republic of Indonesia has conducted a review in the form of Economic Feasibility and Policy Study for the Development of Bio-gas Power Plant at palm oil mill.

Study results are briefly presented in this Booklet, in which some obstacles have been able to disclose and require follow-up action by all related parties so that our commitments, particularly in GHG emission reduction can be achieved accordingly.

Finally, we hope the study results will provide an important contribution for the development of oil palm plantations in Indonesia due to the development of a sustainable palm oil industry is a key element of economic growth and environmental conservatio in Indonesia.

Jakarta, 30 May 2016 Deputy Minister for Food and AgricutureCoordinating Ministry for Economic Affairs

Musdhalifah Machmud

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Economic and Social Impact

Indonesia is the largest palm oil (CPO = Crude Palm Oil) producer in the world, by the year of 2014 the CPO production was of 29.33 million ton from about 10.92 million hectares of plantation. The export value increases from US\$ 13.8 billion in 2008 to US\$ 21.1 billion in 2014. CPO export value in 2015 dropped to US\$ 19 billion, but this value is apparently higher than the export value of oil and gas which was US\$ 12 billion.

National consumption of CPO is between 20 -25%. Oil palm industry absorbs 8.4 million job in 2015, and becomes the source of income of at least 2.1 million farmer family. Rural developments are triggred by oil palm industry developments.

Environmental Concern

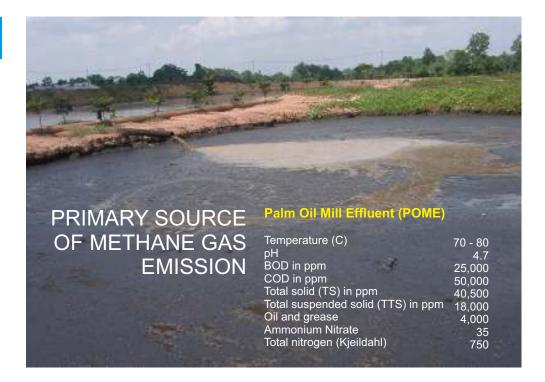
Fast development of oil palm industry in Indonesia has caused a big concern of various elements of society, regardsless the reasons behind it. One of the main important environmental concerns is emission of greenhouse gases (GHG) from palm oil mill effluent (POME) open ponds. The release of methane and other gases from ponds near palm oil mill factories is obvious and can be easily measured.

Three main greenhouse gases and their global warming potential (GWP) compred to CO₂:

Carbon dioxide1 x

Methane21 x (IPCC = 25 x)

Nitrous oxide
 298 x



High biological oxygen demand (BOD), chemical oxygen demand (COD), total solid and total suspended solid, and the presence of metahonogenic bacteria in POME promote high rate production of methane, carbon dioxide and hydrogen sulfide gas in a proportion of 62.5%, 37%, and 0.5% respectively. One cubic meter of POME could potentially produced 26 cubic meter biogas.

In 2014
740 palm oil mills
produces
89.4 million tons POME
potentially emit
894,000 tons of
methane

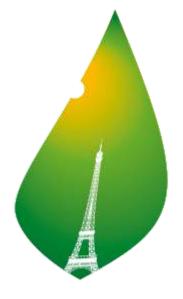
Government commitment

Government of Indonesia has a commitment to participate along with other countries in world agendas related to sustainability actions. The two big world agendas become important reference or guidance for the country development.

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in COP 21

At the G20 Meeting in Pittsburg, Indonesia had committed to voluntarily reduce the emission GHG in the level of 26% based on the projection of business as usual (BAU) until year of 2020. Recently – year end of 2015 in COP 21-at Paris, the President of Indonesia has set a commitment to cut emissions by 29% based on the projection of BAU until the year of 2030.

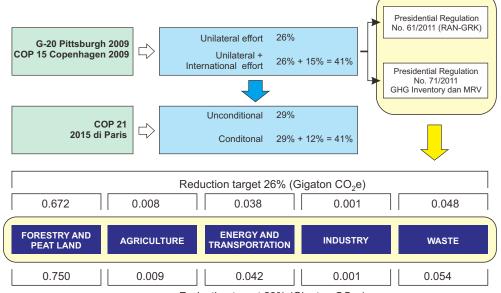


PARIS 2015





PRESIDENT COMMITMENT



Reduction target 29% (Gigaton CO₂e)

"cut emissions by 29% based on the BAU projection at 2020-2030"

In September 2015, the Sustainable Development Goals (SDGs) has been endorsed by the United Nations in New York. The Government has a 1 to 2 years to prepare supporting policies. Palm oil mills could contribute 4 out of 17 SDGs, i.e. Renewable Energy (SDG 7), Sustainable (SDG 11), and Climate Actions (SDG 13), and Life on Land (SDG 15).



In 2011 Indonesia established its Indonesian Sustainable Palm Oil (ISPO) which aims to enhance the global competitiveness of Indonesian palm oil and brings it under stricter environmental legislation. ISPO principles and criteria consist of existing laws and regulations. ISPO is mandatory and applies to all Indonesian palm oil producers to receive ISPO certification, based on Ministry of Agriculture Regulation (MAR) No. 11 Year 2015, a revision of MAR No. 19 of 2011

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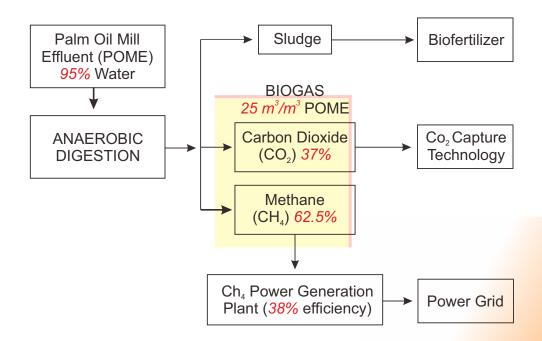
in Other Commitment

Oil Palm Industries support the government moves and commitments in international agendas, including COP 21 and SDGs. In a communication with US-Environmental Protection Agency (US-EPA), Indonesian Palm Oil Board (IPOB) pledged to establish methane capture facilities in 60% of available palm oil mills nationwide, within 10 years period.

Progress of POME utilization

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There are various ways of utilizing POME biogas in palm oil mills. With the proper technical configuration and system, biogas generated from the POME can be converted into useful energy either for heat, electricity or both. The setting up of biogas plants in palm oil mills would be useful to mills that require additional power for other plants such as the empty fruit bunches (EFB) fiber plant, kernel crushing plant, as well as for grid-connection.



"High purity of methane and carbon dioxide might also be compressed and bottled in gas tubes for easy transport and wider application"

Converting biogas from POME into electricity has a two-fold benefits, reduction of GHG emission and provision of electricity in many remote areas. In May 2015, Ministry of Energy and Mineral Resources (MEMR) launched the 35,000 MW Power Plant Program. This 35,000 MW Program is a leading program to achieve one of President Jokowi's 9 Priority Agenda items ("nawacita"). POME Biogas Power Plants would contribute a very significant role in achieving that target in the near future.

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35.000 MW Power Plant Program

Currently 740 palm oil mills have been established in Indonesia, mostly in remote areas. The production capacity is generally expressed as the amount of fresh fruit bunches (FFB) being processed daily, either 30, 45, 60, 90, 120 tons FFB/day. From a mill of 45 tons capacity, 175.500 cubic meters of POME could be produced annually that could generate 2.194 tons of purified methane gas. From that mill capacity, 1,48 MW power plant could be developed and generate 12.187.500 kWh electricity per year.

LOW ACHIEVEMENT



From a total 740 mills, theoritically 1.100 MW ellectricity could be

"Unfortunately, after 5 years of commitment, only 39 mills have implemented methane capture activities"

(Source: Asosiasi Biogas Indonesia, 03 May 2016)

Policy and Financial Studies

The Coordinating Ministry for Economic Affairs in collaboration with Japan International Cooperation Agency (JICA) - Indonesia, have conducted policy and financial studies on the implementation of POME Biogas Power Plant development in Indonesia, under the frame work of "Assessment on Key Sector - Palm Oil Sector for Low Carbon Growth" in 2015/2016.



Objective

The aim of this study is to determine if the obstacle is due to technical reason, financial reason or due to the existence of unsupportive regulations.



Methodology

Desk study, discussion with experts and top level managers or directors of oil palm plantation companies, and field visit have been conducted for technical, financial and policy analysis.





Technical Aspects

Greenhouse gases (GHG) are naturally produced in open ponds of POME. However, those gases are released freely into the air. Capturing the gases, the pond could be covered with an airtight sheet material. The production of gases could be improved by giving a proper condition for the optimum growth of bacteria involved in the system of biogas generation. One of the most important actions is by continuously stiring the POME.





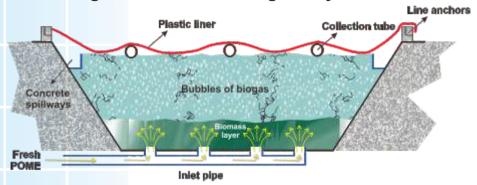
FROM OPEN TO CLOSED SYSTEM





Conversion through an anaerobic digester system is one of the best alternatives in the treatment of wastewater of Palm Oil Mills, because the COD and BOD values will fall dramatically producing renewable energy in the form of methane gas and sludge.

Diagramatic representation High Rate Anaerobic Lagoon System







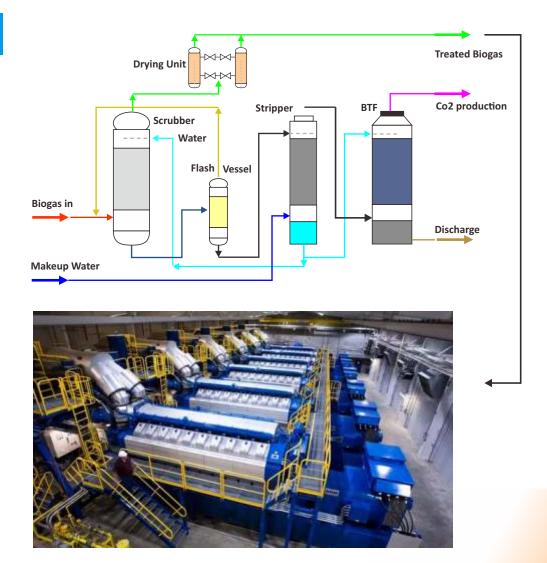


In addition to covered lagoon system, there are at least four other biodigester systems: (a). Up-Flow Anaerobic Sludge Blanket (UASB) system, (b) Completely Stirred Tank Reactor (CSTR), (c) Anaerobic Fixed Film (AFF), (d) Anaerobic Baffle Reactor (ABR). Two commonly used system in Indonesia are Covered Lagoon and CSTR which are subjected to financial analysis in this study. The main component for the construction of Covered Lagoon system is High Density Polyethylene (HDPE), while for CSTR is non-corrosive steel.





Methane generated from POME can be upgraded through scrubbing of H₂S and CO₂ to be subsequently used in gas engine for power generation. H₂S and CO₂ have to be removed as they can potentially corrode and damage the engine parts of power generation plant through the formation of carbonic acid when CO₂ reacts with water and sulfuric acid. Diagrammatic representative of methane purification is shown below.



"It could be concluded that technology of methane capture from POME for the generation of electricity is readily available"



Financial and economic analysis is based on palm oil mill capacity of 45 tons FFB/hour producing liquid waste of POME generating electrical energy for about 1.5 MW. Covered lagoon system and CSTR system are compared with the following assumption.

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	Description	Unit	Covered Lagoon	CSTR Tank
ı	Investment ranges Investment cost including IDC IDR Exchange Rate License + Installation Total Investment	Mio US\$/MW Mio US\$/1.5 MW IDR (IDR 1000) (IDR 1000)	2.0 - 2.5 3.375 13,500 45,562,500 3,500,000 49,062,500	3.05 4.500 13,500 60,750,000 3,500,000 64,250,000
II	Operational Cost Total Operational Cost (7% Invt)	IDR/kWh IDR 1000/y	318.00 3,434,375	416.44 4,497,500
III	Selling Price (MEMRR) No. 27 Year 2014 Factor F (ex Sumatera) Selling Price	IDR/kWh	1,050 1.15 1,207.50	1,050 1.15 1,207.50
IV	Capacity Hour Production Max Production Selling	kWh hour/year Mwh 50%-90%	1,500 8,000 12,000 6,000 - 10,800 MW	1,500 8,000 12,000 6,000 - 10,800 MW

Highly Sensitive to:

- Selling Price of electricity
- Mill processing capacity
- Availability of subsidy
- Reduction of Taxes on Good's Import

In this financial studies, the transmission line of 20 Kv from power plant to PLN grid is assumed to be within 2 Km at IDR 500 million/ Km. Taxes are not included in the calculation of operating costs. IDC stands for interest during construction. Total Operational cost is assumed to be 7% from investment cost.

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Financial analysis results for PLTBg 1.5 MW from POME with covered lagoon or tank CSTR

Criteria	Covered Lagoon	CSTR Tank
Total Investment (IDR 1000)	49,062,500	64,250,000
Operational cost (IDR 1000/ y)	3,434,375	4,497,500
NPV (df-12%) in IDR 1,000	5,479,838	(12,449,904)
IRR	14,18 %	7.80%
B/C	1.0946	0.8359
Payback Periods	Year 7	Year 10
Net income (IDR 1000) for 15	79,559,535	50,137,972

Impact of mill capacity and selling price on IRR (Source: Chadys, 2016)

Criteria	Covered 1 MW	d Lagoon 2 MW	CSTF 1 MW	R Tank 2 MW
Total Investment (US\$ million)	3.18	4.95	4.04	5.93
IRR, selling price Rp. 1.050	7.9%	15.2%	2.9%	11.6%
IRR, selling price 11.75 Cents (US)	17.9%	26.0%	12.8%	21.2%



Development of POME Biogas Power Plant is economically demanding



Rigorous Feasibility
Study needs to be
conducted for each
plan of POME Biogas
Power Plant
construction.

However, it should be noted that intangible benefits are not taken into account in financial analysis. Reduction of greenhouse gases (GHG) emissions that support government programs (COP21) to reduce 29% of CO2-e by 2030 and assisting the government in providing electricity to rural areas are the two most important contributions.

"POME Biogas
Power Plant
development
should become
a national priority"

FORESTRY AND PEAT LAND AGRICULTURE ENERGY AND TRANSPORTATION INDUSTRY WASTE

0.750 0.009 0.042 0.001 0.054

Reduction target 29% (Gigaton CO₂e)

From POME alone, it is sufficient to fullfil national target of emission reduction in Agriculture sector

Estimated biogas production from POME, Power plant capacity, and CO2-e avoided based on the CPO production of Indonesia in 2014

PARAMETER	UNIT	VALUE
CPO production	Tonnes	29,340,000
POME generated	m^3	89,400,000
COD level in POME	mg/L	50,000
COD converted	Tonnes	3,576,000
CH ₄ produced	Tonnes	894,000
Energy rate	MJ	44,700,000,000
	MWh	12,416,666.67
Diesel equivalent	L	1,262,319,618
Electricity generated	MWh	4,966,667
Power plant capacity (gas engine)	MW	620.833
CO ₂ -e avoided	Tonnes	9,834,000
Number of household receiving electricity (450 watt/KK)	Family	1,379,630

more than enough



Type of Regulations	Relevant Regulations	Summary of Regulations	Status Implementation of Regulation
1. Sustainable oil palm plantations	Ministry of Agriculture Regulation (MAR) No. 11 Year 2015	Implementation of Indonesian Sustainable Palm oil (ISPO) is expected to increase the sustainability of palm oil industry and strengthen the competitiveness of Indonesian oil palm plantations.	There is no penalty for those palm oil millers who do not capture their greenhouse gas. Nevertheless, there are at least 34 companies which having palm oil mills as well as associated with their oil palm plantations already received ISPO certificates
2. Guidelines for waste water of POME quality	State Minister for The Environment Regulation (MER), No. 5, Year 2014	Standardizes the waste water quality of 27 types of industries including the use of palm oil feedstock using a wet process or dry process and liquid waste of POME from palm oil mills.	The parameters standards of the water quality from palm oil industry especially related to wastewater for disposal into water bodies. While parameter for air pollution associated with the emission of methane gas and CO ₂ at all is not included as an important parameter.



	Type of	Relevant	Cummom, of Dogulations	Status Implementation of
	Regulations	Regulations	Summary of Regulations	Regulation
	3. National	Presidential	Indonesian Government's	The Government through the
	Action Plan for	Regulation (PR) No.	commitment to reducing greenhouse	National Development
	Reducing	61 Year 2011	gas emissions by 26% by its own	Planning Agency has set a
	Greenhouse Gas		efforts and 41% with international	target to reduce emissions
	Emission and	Presidential	support in 2020; includes activities in	by 26%, with a total of 0.767
	Implementation	Regulation (PR) No.	the fields of agriculture, forestry and	Gton CO2-e, in some sectors.
	of Greenhouse	71 In 2011	peat land, energy and transport,	The socialization is needed
	Gas Inventory		industry, waste management and	to encourage more
			other supporting activities.	aggressive action to reduce
				emissions through the
				construction of a biogas
ļ				power plant.
	4. National	Presidential (PR) N	NEP prepared as guidance to provide	In 2025 the role of the New
	Energy Policy	Regulation (PR) No.	direction in order to achieve national	Energy and Renewable
Ī	(NEP)	79 Year 2014	energy independence and energy	Energy at least 23% and in
			security to support national	2050 at least 31% over its
			sustainable development, which are implemented for the period 2014 to	economic fulfilled
			2050.	
			2030.	



	Type of Regulations	Relevant Regulations	Summary of Regulations	Status Implementation of Regulation
	5. Purchasing of Biogas electricity (PLTBg) by PLN	Ministry of Energy and Mineral Resources Regulation (MEMRR), No. 27 Year 2014	These regulations set the feed-intariff for the purchase of renewable energy from biomass (PLTBm) and biogas (PLTBg) by PLN's power plants <10 MW.	Feed-in-tariffs for new renewable energy from biogas is IDR1,050 / kWh to IDR 1.400 / kWh and multiplied by a factor (F) = 1.0 to 1.6. However, in article 7 is stipulated that electricity price set at the beginning of a purchase agreement with PLN is for a period of 20 years (not considering the increase in operational costs and inflation).
	6. Income tax reduction for renewable energy investments	Presidential Regulation (PR) No.18 Year 2015	This policy, providing incentives to investors in the form of a reduction in income tax (VAT). This regulation was published to further enhance the direct investment activities in order to encourage economic growth, and for equitable development and acceleration of development for specific business sectors or in certain areas.	The business sectors that received Income Tax Facility for Investment related to POME are: (1) Business area no. 77: Waste management and (2) Scope of products being covered include biogas which is produced from organic waste such as sludge and POME generated in palm oil mills.



Type of Regulations	Relevant Regulations	Summary of Regulations	Status Implementation of Regulation
7. Facilities on the	Ministry of Finance	A policy which provides	This regulation is still
income tax reduction	Regulation (MFR) No.	Income Tax Exemption for	unfavorable for investors of
	159/PMK.010/2015	industry pioneer, which can be	Biogas Electric Power Plant
		granted for a maximum period	(PLTBg) to obtain the tax
		of 10 fiscal years and a	holiday because it is still
		minimum tax of 5 fiscal years.	constrained by the
			requirement of a minimum
			investment plan amounting to
			IDR 500 billion
8. Exemption of	Ministry of Finance	This regulation provides	The capital goods are
import duty on the	Regulation (MFR) No.	exemption from import duty	machinery, equipment, and
import of capital	154 / PM K.011 /2012	on capital goods for the	manufacturing equipment in
goods for new		Construction and	both the attached and
renewable energy		Development of Electricity	detached, but does not include
		Power Plant Industry	the spare parts used for
			maintenance.

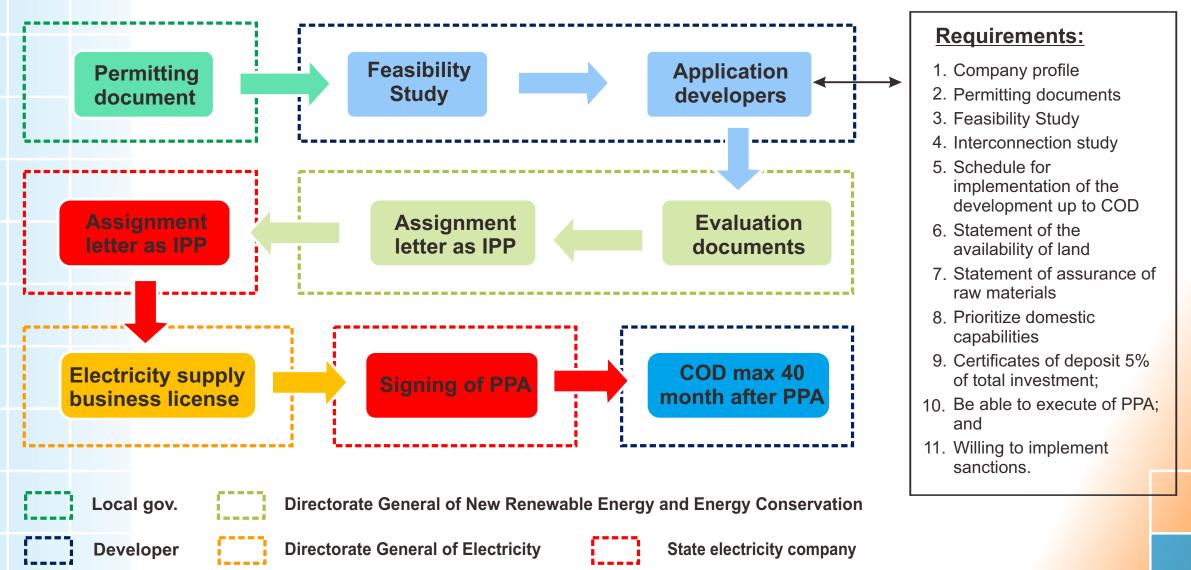


MEMR has simplify and significantly reduced the time to obtain permit "but in field, developers still encounter dificulties'

PERMIT SCHEME ON UTILIZATION OF BIOMASS/BIOGAS FOR ELECTRICITY

27

Source: MEMR



Conclusion

- Indonesia has a huge potential to develop POME-PLTBg from around 740 units scattered throughout Indonesia, particularly in Sumatra, Kalimantan, Sulawesi, and Papua. Each palm oil mill could generate electricity around 1 MW. At least 740 MW electricity can be generated from POME only.
- PLTBg development of 1.5 MW with a covered lagoon technique is feasible, the payback period of the investment around 7 years with net income of IDR 4.97 billion/year. However, if the construction of the PLTBg be made with CSTR tanks higher investment the payback period will be about 10 years. PLTBg with CSTR tank is more reliable and higher safety.
- Development of PLTBg in Indonesia has been significantly slow mainly due to the long and slow process of licensing, high cost of investment and the high maintenance costs of machinery and equipment as the majority of machinery and equipment are imported.
- FIT for biogas has been introduced yet the fixed selling price of electricity to PLN seems too low and it is not attractive to investors. (though we need to review newly revised regulation on FIT)
- Cost of connections to grid is high and huge burden to investors. Distance between methane capture facilities and PLN grids are not close in many cases.

- Licensing process for installing PLTBg in various regions varies and is very long. At least there are 7 stages needed to get the licenses. There are too many documents for license to be completed. In the past it takes at least 8 months, while in practice it can take more than 2 years.
- The cost of the investment and maintenance is significantly high, since most machineries and equipment are imported without tax incentives.
- Several incentive and financing schemes exists such as JCM and domestic incentive policies. Yet for example, methane capture investment would not be eligible for tax holiday as a huge investment is required for the incentive.



Recommendation

It is recommended to consider the following options for enhancing policies and regulations as to promote methane capture. Before considering concrete policy options, it is also crucial to clarify and recognize oil palm sector's contribution in climate change target in Indonesia.

- It is suggested to consider more stringent regulations to manage methane emissions from each POME, i.e. the reduction of GHG emissions in oil palm industry is an obligation/mandatory.
- The regulation of the Ministry of Energy and Mineral Resources No. 27 Year 2014 on "The purchase electricity generated by Biomass Power Plant (PLTBm) and Biogas Power Plant (PLTBg)" needs to be reviewed and revised.

 1). the cost of line connection to PLN's electricity grid be accounted as PLN contribution cost and 2). pricing power purchase imposed for 20 years without any adjustments and level of tariff suggested be on yearly bases adjustment.
- Third, to suggest for obtaining tax holiday for reduction of GHG emission, the level of investment be appropriate to at amounting of IDR 50 billions up.
- Fourth, enhanching palm oil millers to utilize current system of climate finance such as GCF (Green Climate Funds), JCM and others.
- Relevant regulations related to licencing and permits should be streamlined and clarified, it should be issued by a government body.

Appendix

Regulation of new FIT has been recently produced by the government. With this new tariff, the CSTR become a better choice for PLTBG developers.

Comparison on Feed in Tariff on electricity from Ministry of Energy and Mineral Resources Regulation (MEMRR), No. 27 Year 2014 with MEMRR No. 21, Year 2016

		MEMRR, No. 2	7 (2014)	MEMRR, No. 2	1 (2016)
Region	Factor of Multiplica-	Feed-in-tariff (IDR/kWh) up to 20 MW		Feed-in-tariff (sen USD/kWh) up to 20 MW	
	tion (F)	Low Voltage	Medium Voltage	Low Voltage	Medium Voltage
Java	1,00	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Sumatera	1,15	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Sulawesi	1,25	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Kalimantan	1,30	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Bali, Bangka Belitung, Lombok	1,50	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Riau Islands, Papua and other Islands	1,60	1.400 x F	1.050 x F	13,14 x F	10,64 x F
Maluku & Papua Islands	1,70			13,14 x F	10,64 x F

Financial analyses results for PLTBg 1.5 MW from POME with covered lagoon or CSTR tank*)

No	Criteria	Covered lagoon 1.5 MW	CSTR tank 1.5 MW
1	Total Investment (IDR 1000)	49,062,500	64,250,000
2	Operational cost (IDR 1000/ y)	3,434,375	4,497,500
3	NPV (df-12%) in IDR 1,000	28,811,413	10,881,671
4	IRR	22.27%	15.26%
5	B/C	1.4974	1.1435
6	Payback Periods	Year-6	Year-7
7	Net income (IDR 1000) for 15 years	143,813,991	114,392,428
8	Net income annually (IDR 1000)	8,988,374	7,149,527

