5 Republic of Indonesia

5.1 PESTLE or Macro Analysis

Introduction

In Indonesia, there is a total of 1,779 palm oil companies (Statistics Indonesia, 2017, p. ix) that deals with either planting or processing. 608 of those are designated Palm Oil Mills (POMs); 38 of which are equipped with methane-capture facilities (Winrock International, 2015b), and the remaining 569 are still operating a series of open lagoon. 10 of these POMs have Palm Oil Mill Effluent (POME)-to-electricity projects (Moriarty et. al., 2013, p. xiii) and only one is connected to the national power grid (MCA-Indonesia, 2014, p.2).

POME-based biogas industry faces political, economic, social, technological, and environmental challenges. The related issues are broad, cross-sectoral, and involving a wide array of actors. Given the particularities of Indonesian renewable policies and strategies, identifying stakeholders is required to correctly mitigate risks (Yudha & Tjahjono, 2019).

5.1.1 Political aspects

1. National targets and strategies

The development of biogas technology in Indonesia is inextricably tied to the nation's aspirations towards energy security. The revised National Energy Policy (*Kebijakan Energi Nasional* – "KEN"), signed through Government Regulation 79/2014, is a policy revolving energy mix diversification, independence, and a push towards renewable energy (RE) sources including biogas.

Another policy also exists as renewable energy target in Indonesia. The General Electric Generation Plan (*Rencana Umum Pembangkitan Tenaga Listrik*/RUPTL), promulgated in 2019, is essentially a business plan of the State Electricity Company (*Perusahaan Listrik Negara*/PLN). However, since they are the sole distributor of power in Indonesia, this plan can also serve as indicator of governmental interest in the sector in a moderate-to-long term. RUPTL also indicates the extent of guaranteed support PLN will give to RE development, as it shows their allotted budget and capacity to RE generation as shown in Figure 24.

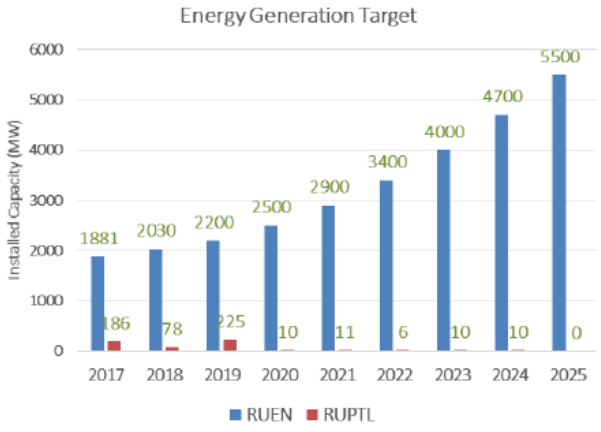


Figure 24: Energy generation target from 2017-2025, as written in the latest RUPTL (2019).

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

2. Fossil Fuel Dominance

Indonesia's purported enthusiasm for the broader promotion of renewables in its recent energy policies falls flat through its lack of a clear strategy and implementation. The Indonesian government continues to contradict its clean energy goals with heavy investments towards new coal-fired power plants development. The attraction to coal usage within Indonesia lies in its reliability, low price, as well as its central role in the country's revenue stream to counterbalance oil and gas deficits (Arinaldo and Adiatma, 2019). Fossil fuels have historically been, and continue to be, a major player in Indonesia's energy sector.

3. Lack of Prioritization on Biogas and POME

Within the renewable sector, the Indonesian government has largely prioritized biofuel over biogas in its broader bioenergy strategy. Although Indonesia has achieved its 2018 bioenergy investment targets, this has little implication for the biogas industry and for POME-based biogas, as a significant portion of this figure is for biodiesel development (DITJEN EBTKE, 2019: p. 38). The long-term trends for general bioenergy are also concerning. Despite ramping up investments in general renewables, the 2018 bioenergy investment target is a drastic drop from 2017's $0.749 to $0.073 (in billion USD) (DITJEN EBTKE, 2019). Based on previous bioenergy trends, it would be safe to assume this would manifest as a decreased focus in biogas in lieu of biofuel development.

In terms of energy production and supply capacity, biogas makes up an alarmingly small amount of the potential domestic energy supply source (DITJEN EBTKE, 2019, p.39). Of this small figure, there have been further difficulties in increasing biogas energy supplies, as indicated by the DITJEN EBTKE 2018 Performance Report. There are also concerns regarding a sudden absence of POME-based biogas information, compared to previous reports between 2013-2017. This is concerning for two reasons. First, it reflects a larger trend of irregularity in government data and reports. It also signals a false shift of interest – private actors who read these reports will likely assume POME usage is no longer relevant for national government policies, incentivizing transition to cheaper non-biogas bioenergy. Proper planning and execution of risk management is important to RE development, since the sector is still relatively young. Financiers are wary of the monetary risks, Engineering-Procurement-Construction firms (EPCs) are still dependent on policy stability, and benefits for site owners are largely passive.

4. Governance

The project risks arising from the intersection of political, economic, institutional, and social characteristics should be taken into account when considering new biogas projects. Research by Aipassa, Kristiningrum and Tarukan (2018) on the potential of POME-to-energy programs in East Kalimantan demonstrates the need for intricate, multi-stakeholder cooperation in mitigating risks for new projects.

These projects span multiple levels of government, ranging from regency, provincial government, and district governments. This complex decentralization is further complicated by the additional need to coordinate with the private sector, such as the palm oil mills supplying feedstock, as well as other financing bodies supporting the program. The lack of administrative body for biogas development in Indonesia poses an issue for both Indonesia's aspirations towards energy security and disparity reduction. The Indonesian government lacks proactiveness in establishing, implementing, or promoting biogas projects in a tangible form. The current

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

form of leadership provided by the government is hindered by overlapping priorities and jurisdictions, which slows the decision-making process.

Large-scale palm oil plantations have been incentivized to introduce POME-to-energy projects out of corporate social responsibility, ethical or public relations purposes instead of through government initiation (Winrock International 2015; Budiman 2019). However, this is not feasible for smallholder plantations, who may be more restricted in terms of capital and are deterred by higher risk factors and could benefit more from stricter biogas governance. Problems of governance are inextricably tied to previous issues of coal dominance and lack of focus on biogas, further made complicated by the lack of regulatory and administrative support by those who have the most influence (IISD 2018). Government decentralization also seeps into the problem of regulatory uncertainty, where the private sector is demoralized due to a lack of transparency on government support (Taylor et al, 2019).

5.1.2 Economic Aspects

1. Feed-in Tariffs

Feed-in tariffs (FITs) is the major policy support scheme for biogas development in Indonesia. They guarantee a fixed purchase price of renewable generation from power producers and aims to cover the costs of RE development, while providing reasonable rates of return to investors and reduce investor risks from RE projects financing (Bohringer et al 2012). The application of the feed-in-tariff scheme is commonplace for governments seeking to implement RE. In Southeast Asia alone, a majority of the developing countries already have applied FITs, as seen in Table 28. Indonesia is a bit late in joining in, only having FITs implemented after the creation of the General Energy Plan (RUEN) in 2017. The rates in which FITs are implemented in Indonesia are also biased towards the government's rates for fossil electricity generation – unlike other countries who provide greater FITs to encourage RE transition. To some extent this is also evident in Vietnam, but their recent achievements in RE generation prove that lower FITs do not always translate to underdevelopment.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Table 28: (Solar) FIT implementation in major South East Asian countries (IRENA, 2018).[82]

FiT (USD cents/kWh)							
	Thailand[a]		Philippines[b]	Malaysia**[c]		Indonesia***[d]	Viet Nam
2012			23.11/kWh with 0.6% degression yearly after the first year	4–72 kW	39–40		
				72 kW–1 MW	37.6		
				1–10 MW	31		
				10–30 MW	28		
2013	Rooftop 0–10 kW	21.5	No change	4–72 kW	30–36		
	Rooftop 10–250 kW	20.2		72 kW–1 MW	32		
	Rooftop 250 kW–1 MW	19		1–10 MW	24.3		
	Solar farm > 1 MW	21*		10–30 MW	21.8		
2014	No change		19.58/kWh with 0.6% degression yearly after the first year	4–72 kW	22.9–31.5		
				72 kW–1 MW	22.1		
				1–10 MW	18.4		
				10–30 MW	16.5		
2015	Rooftop 0–10 kW	19	19.08/kWh	<4 kW	25.67		
	Rooftop 10–250 kW	17.78		4–72 kW	21.42–25.04		
	Rooftop 250 kW–1 MW	16.69					
	Solar farm > 1 MW	15.73					
2016				<4 kW	19.92	14.5–25	
				4–72 kW	14.83–19.44		
2017				<4 kW	17.22		9.35 (solar rooftop)
				4–72 kW	12.1–16.8		

There are two key actors associated with the current FIT program. The Indonesian government, through the state-owned enterprise State Electricity Company (PLN), is the major player in determining investments by independent power producers (IPPs). PLN regulates all current tariff regimes. Each tariff is benchmarked against PLN's average electricity generation. If local Levelized Cost of Energy (LCOE) is higher than national rates, PLN will only pay a certain percentage of it (never 100% FIT). If local LCOE is lower than national rates, the developer has rights to negotiate with PLN (>100% FIT is possible but very unlikely). This showcases a preferential treatment to existing generation systems.

Tariffs and pricing are sensitive issues within the Indonesian renewables and biogas regulatory framework. Although it purports greater flexibility and higher incentives for the development of Indonesia's outer provinces, the governmental level regulation (No 50/2017) has been heavily criticized for its non-investor friendly design and selective prioritisation of governmental pro-

[82] Full document can be accessed in: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_Market_Southeast_Asia_2018.pdf

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

jects. Through this regulation, PLN has power over tariff negotiations through their direct selection mechanism, providing an incentive to sign PPAs suitable with PLN's mandates, while excluding those that have failed to do so.

Once selected, IPP projects are obligated to complete construction of the power plants in accordance with the PPA, where sanctions and penalties are imposed on those that fail to finish projects (PWC 2018a). Investors have criticized these low power purchase prices, claiming high risk implications and a "roadblock" that keeps developers from recovering investment and generating reasonable profit from projects (IISD, 2018).

2. Investment Types

Investments for biogas development can be sourced from both public and private sector. Public funding are commonly grants derived from the national budget. Private funding is provided from a wide range of non-government; we will mainly focus on commercial bank loans.

That aside, a lot of investment is needed to achieve the government's target of 5.5 GW renewable energy by 2025 (stipulated in RUEN, promulgated in 2017), as shown in Figure 25.[83] Around 13.5 Billion USD to be exact – and this is 2017 rates. That capital is to be distributed across 1.300 projects with a 2MW to 7.5MW generation scale.

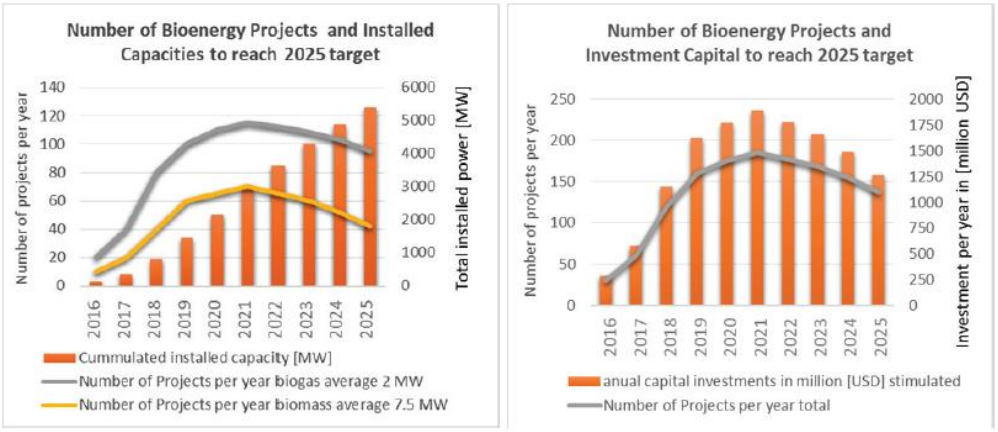


Figure 25: Estimation of investments required to achieve 2025 targets.

In addition to the Indonesia's FIT mechanism, biogas development is also, to a smaller extent, supported by other government-mandated mechanisms and incentives. This support scheme varies from a national, regional, and local level. However, implementation and execution are concentrated in the regional and local levels. These come in the form of disparity reduction programs (national targets on achieving 100% electrification to reduce energy supply disparity) and are supported by direct government subsidies. Non-governmental organisations, however, have panned the fully subsidized approach to biogas development by the Indonesian government as it contradicts the market-based sector development approach utilized by various international donor agencies (Greenpeace, 2019; IESR, 2018)

A. Commercial Banks

[83] The General Plan of National Energy can be accessed in: https://www.esdm.go.id/assets/media/content/content-rencana-umum-energi-nasional-ruen.pdf. (In Bahasa).

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

The significance of banks within the Indonesian financial system should not be understated. Although Indonesia's financial market is small, with its financial sector assets representing 72% of the country's GDP, banks hold approximately three quarters of all financial sector assets (IMF 2017; ADB 2018). However, the financial sector's lack of experience with renewable energy led to risk averseness that impacts financing costs, capital availability and project viability (CPI 2018). There is also the issue of equity and debt balance. Biogas projects are costly in the earlier stages. Neither project owners nor EPCs are able (or willing) to set aside a large amount of asset as equity, but investors cannot be expected to just cover it all with debt.

Table 29: Commercial finances that are available in Indonesia. 2nd and 3rd are most common (GIZ LCORE-INDO and MEMR, 2017).

Investor	Project Phase	Duration	Return Expectation	Investment Size (Million USD)
Private Equity Fund [5]	Development Construction Operation	Short – medium	More than 20%	Minimum 100
Infrastructure Fund	Operation	Long	10 – 20%	50-100
Industrial Investors	Construction Operation	Short - long	15 – 20%	1 - 100

The novelty of biogas, let alone POME-to-energy project, further complicates financing schemes as lenders lack information from past projects, affecting their confidence in assessing future ones, leading to a conservative stance. This unfamiliarity with RE has resulted in the rarity of project finance implementation by local banks (CPI, 2018). Biogas programs ended up having to deal with equity or corporate financing (essentially 2nd option in Table 29 above).

As briefly summarised in Table 29, infrastructure funding done via corporate structure does not have favorable terms and rates for renewable energy development. It is created to finance well-established infrastructures (like roads) which already have a set development pattern and minimal, spread risks. RE development, in contrary, needs a lot of support even in earlier stages and significantly larger capital upfront. The latter is currently unsolvable, since the central financial authority has yet to legalize loan structures that allow large upfront investments. Blending financial sources is essentially required.

As an alternative, biogas programs have relied on international philanthropic donor-funded programs (Winrock International, 2015; IESR, 2019; APEC, 2017). This alternative is not without caveats. Donor program funding period are often limited to the length specified in a proposal, rendering post-project operations unpaid for. Combined for the philanthropic nature of donors, business viability is rarely in the equation in such funding schemes.

5.1.3 Technological Aspects

Anaerobic digesters (AD) are now being used as primary treatment for POME at Indonesia Palm Oil Mills (POMs) because aeration processes don´t need to be accommodated here, hence reducing cost and technical complexity effectively. Biogas from anaerobic processes, irrespective of the involved technology, can be utilized for other purposes such as producing

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

electricity. This process will also produce sludge that can be reprocessed as fertilizer for agricultural applications (Abdurahman, et. al., 2013).

A. Covered Lagoon

Covered Lagoon is mostly used by Palm Oil Mill to treat POME in Indonesia (Eastern Research Group, Inc. and Winrock International, 2015). Covered lagoon is an improved version from the open lagoon method, covering a waste reservoir with floating plastic membranes. The operational simplicity and low investment cost of covered lagoons support and enable more installations of the covered lagoon compared to other AD technologies in POME treatment in Indonesia (Rajani A., et. al., 2019). However, the covered lagoon infrastructure requires large physical space and will still leave a sizable carbon footprint.

B. Continuous Stirred Tank Reactor (CSTR)

According to Eastern Research Group, Inc. and Winrock International (2015), there are only three POMs using the tank system to treat POME in Indonesia. A continuous stirred tank reactor (CSTR) is similar to a cylindrical closed tank reactor but it uses an agitator to increase contact between biomass and waste. Due to the agitation, CSTR can produce more biogas than closed tank. This reactor should be operated at steady state with continuous feed flow. There are several assumptions used in CSTR such as uniform composition throughout the reactor and uniform composition between exit stream and in the reactor.

5.1.4 Environmental Aspects

The Government of Indonesia has implemented the Program for Pollution Control, Evaluation, and Rating (PROPER) to promote “clean technology” back in 1995. PROPER is a national-level public environmental initiative created under the umbrella of the Environmental Impact Control Council (*Badan Pengendalian Dampak Lingkungan* - BAPEDAL). PROPER was created due to the BAPEDAL’s limited capacity to monitor the pollution caused by business expansions in the agricultural sector.

This mechanism helps enforce the industry to adopt “clean technology” practices by rating each company’s performance based on the regulatory standard. The rating of PROPER ranges from gold as the highest category to black as the lowest. Actual implementation, however, is rather lacking at this stage.

Sanctions exist for those who violate regulations related to PROPER; varying from administrative sanctions (written reprimand, revocation of operational permit, etc.) to punishment in jail as short as a year up to 15 years, as covered in Indonesian Law (UU) *Perlindungan dan Pengelolaan Lingkungan Hidup*, 2009. Perpetrators would also be fined 500 million IDR up to 15 billion IDR, depending on the severity of the case.

5.2 Market Characterization and Definition

Biogas project development in Indonesia will is best focused on turning palm oil effluent (POME) into electricity. This is the case due to several reasons: the palm industry is the only sector with the ability to produce constant feedstock, with regional localization that ease logistics, and with a clear track record of waste-to-energy practices. All these factors contribute to a decent potential for the palm oil sector to become a dependable power supplier.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Commercial power purchase in Indonesia is only done at the national level, as mandated by law. Therefore, market assessment in this report will be conducted on the nationwide 'electricity market'.

5.2.1 Electricity Market Form

The Indonesian electricity market, like many developing nations, is state-controlled. The state-owned utility solely controls the national power distribution and is enabled by several laws to also control the generation side through the Build, Own, Operate, Transfer (BOOT) scheme. The State Electricity Company (PLN) operations are divided into regional branches – each with their own territorial reach but still compliant to the Central PLN. Non-governmental entities can also enter the power generation business, but on-grid supply will ultimately be done through the PLN infrastructure.

This topology divides the larger Indonesian market into multiple regional segments. The Java-Bali region of PLN is the largest power producer and consumer across the national grid, region also highly concentrated with power stations (several reaching Gigawatt-level capacity) and industrial facilities (especially in East Java).

The existence of PLN creates a balance between power producers and the general power consumers by supporting national-level management. However, this condition has resulted to difficult non-governmental development of renewable energy, especially in the upstream market. PLN, a state-owned enterprise benefits from governmental leverage through national regulations and bureaucratic structure enables and supports PLN operations (subsidies, project development process, electricity sale rates, etc.).

Indonesia's industrial scale of biogas generation market is very concentrated and developed due to stable supply of feedstock. For POME-based biogas, this means close proximity of biogas installation locations to palm plantations. By far, POME-based biogas installations are very prevalent in Sumatera and Kalimantan well-known regional hubs of Palm Oil Cultivation and Processing. Essentially, every province in these islands hosts large-scale biogas facilities. However, it is also important to note that majority of these facilities operate solely to support internal primary needs without having to sell excess power to PLN's national grid. Biogas technology owners end up using the electricity to fill gaps in their power deficit.

The financial and administrative labour intensive process deters biogas owners in exploring opportunities to sell excess power to PLN's national grid. In addition, Indonesian Palm Oil Association claims that palm mills only use 0.5 to 0.7 MW from biogas and therefore there is really no incentive to invest in biogas tech larger than 1MW. At least, until PLN decides to adjust the requirement for power purchase agreements.

5.2.2 Electricity Market Size

PLN is guided by governmental policy targets in planning the infrastructural and capacity development/expansions. This approach is useful in maintaining market equilibrium, maintaining energy demand forecasts and preventing excessive energy supply—this can be seen in how Indonesia's energy reserve is higher than average load, but not to the point of development being wasteful.

As we can see in the illustration in Figure 26, net capacity is consistently higher than peak load across all the regions shown below:

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

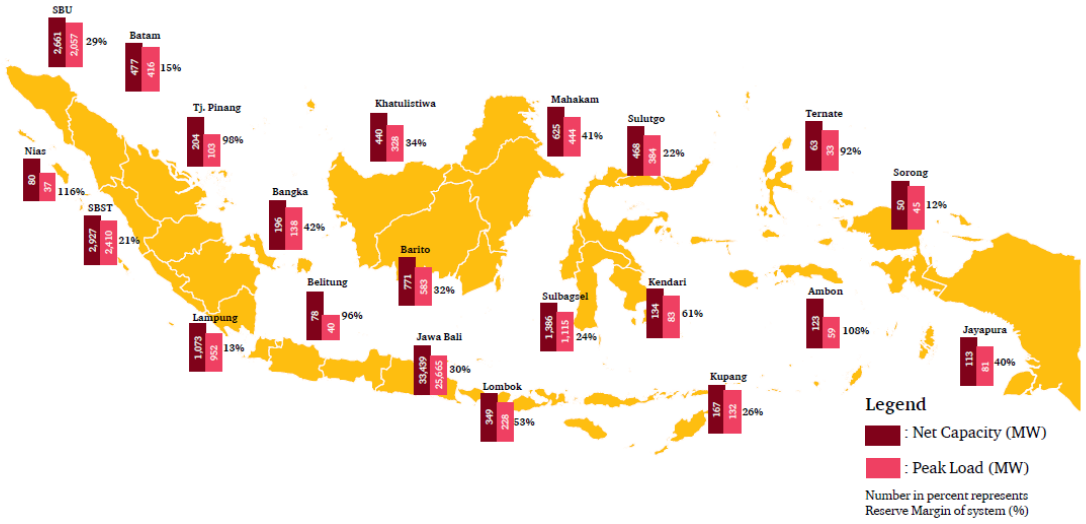


Figure 26: Governmental Targets for Electricity Expansion (Pricewaterhouse Cooper, 2018)

All regions within Indonesia have no shortage of power—if calculated by demand. Although not every regional demand is representative of its populace. If we attempt to compare regions purely on the basis of demand and observe the 25 GW demand of Java-Bali, other regions become relatively insignificant in terms of energy demand. In reality, many regions outside Java-Bali still need additional power. Unfortunately, the national grid (and by extension, PLN operations) cannot reach regions. Therefore, the lack of access to the national grid has birth off-grid power producers' market.

Biogas is rarely considered as a feasible power source in Indonesia and no demand can be directly traced to it. This negatively affects the size of biogas as a 'commodity'. The Ministry of Energy can only trace household usage of biogas, which is around 167 Barrels of Oil Equivalent (BOE) in the entirety of 2018 (MEMR, 2017). This is somewhat inconsistent with the PLN 2018 General Electricity Plan that listed around 39.4 MW worth of active biogas plants across Sumatra and Kalimantan excluding t biogas plants that are currently under construction.

In a more detailed rendition of the General Electricity Supply Plan (RUEN), PLN declared that Indonesia has an overall biogas potential of 94.2 MW (out of the total renewable energy goal of 2.1GW). This data was quite unclear, as the 2.1 GW goal was written as a 'national' projection which includes both industrial and household implementation. Therefore, this amount might not be representative for the actual growth.

We assume this means biogas demand is very exclusive, i.e. only considered by stakeholders that are related to the feedstock. Even then, the way Indonesian government perceives bioenergy favors biomass and biofuel implementation more than biogas.

Biogas is barely utilized for electricity generation in Indonesia. The government prefers other renewable sources such as hydro and geothermal. Biogas utilization ended up being focused to gaseous forms of energy, such as combustible for households or methane upgrading for industries. Even for bioenergy in general, POME and biogas usage as a source is rarely considered as the government prefers using solid palm hulls or straight up Municipal Solid Waste (MSW) via Biomass processes. Recent policy even shifts palm waste usage (both POME and the solid hulls) to Biofuel synthesizing for the national B30 initiative—a policy that intends to gradually replace conventional diesel fuel to biodiesel, with the national oil & gas company

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

(Pertamina) serving as guaranteed buyer. Such measures further reduce the benefits of attempting a Biogas development project.

The private sector, especially owners of palm plantations, perceive the value of Biogas technology differently. Most of them utilize Anaerobic Digestion technology to provide electricity for internal use. By doing this, they can save operational costs while improving waste management (which further grants them certain environmental certifications) practice at the same time.

5.2.3 Electricity Market Growth

Stabilisation of demand can already be felt in several regions, especially those with higher count of electrification/had access to power early on. Java-Bali, Sumatera, and Kalimantan demands are stabilising. PLN acknowledged that the largest sum of electricity demand comes from annual household connections (PLN, 2018). Demand growth gets slower every year since electrification is indeed getting better, despite questions around '99% electrification rate' declared by the government.

Note that the Indonesian market is just stabilizing, i.e. it will no longer benefit from the large influx of new customers. Both PLN and private sectors believe that the uptrend will persist due to the developing nature of domestic economy. Energy demand increases with the growing industrial and financial sector.

If we follow PLN's methodology and take 2018's national economic growth rate and assume the same condition will persist for the following years, we can see (see Figure 27) that power demand will still rise despite the aforementioned stagnating household demand. Existing capacity will not be able to accommodate the growth rate.

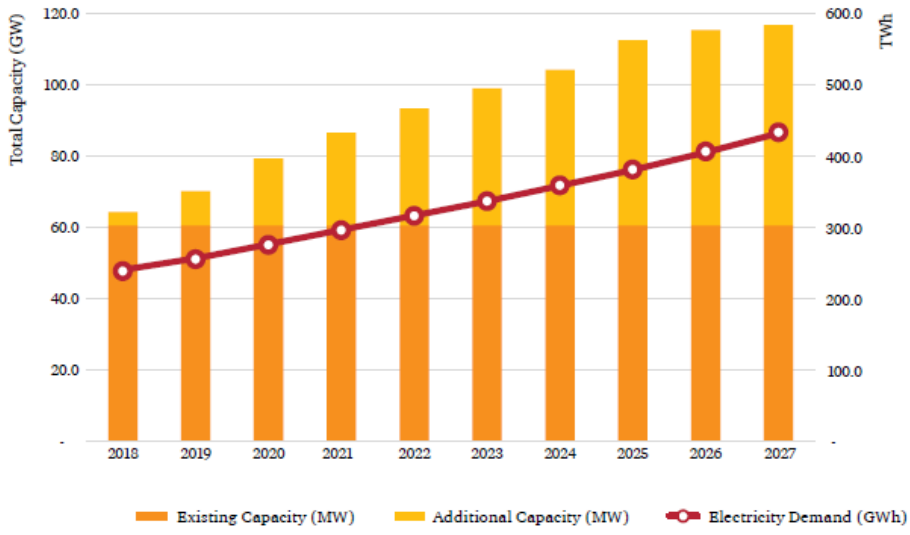


Figure 27: Electricity Demand (2018-2027) (Pricewaterhouse Cooper, 2018)

Demand will only surpass current generation capacity at around 2021-2022. Table 30 shows the development targets of the generation capacity of power plants.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Table 30: Generation Capacity of Power Plants (PLT) (PLN, 2018)

No	Pembangkit - EBT	Kapasitas	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Jumlah
1	PLTP	MW	190	151	147	455	245	415	2,759	45	145	55	4,607
2	PLTA	MW	154	326	755	-	182	1,484	3,047	129	466	1,467	8,009
3	PLTM	MW	140	238	479	200	168	232	27	20	20	10	1,534
4	PLT Surya	MWp	63	78	219	129	160	4	250	-	2	2	908
5	PLT Bayu	MW	-	-	30	360	260	50	150	-	-	5	855
6	PLT Biomass/ Sampah	MW	12	139	60	357	50	103	19	5	15	35	794
7	PLT Kelautan	MW	-	-	7	-	-	-	-	-	-	-	7
8	PLT Bio-Fuel	Ribu Kilo Liter	520	487	291	167	151	146	154	159	166	175	2,415
Jumlah		**MW**	**560**	**933**	**1,697**	**1,501**	**1,065**	**2,287**	**6,251**	**199**	**648**	**1,574**	**16,714**

We can see that PLN is considering these estimates and is planning a massive expansion in 2021, to secure a total of 1,607MW additional supply in preparation of the projected demand increase. In addition, it must be highlighted that biogas is not explicitly mentioned in the table – but the biofuel target may serve as an entry point.

5.2.4 Electricity Market Share

In 2018, electricity became quite a large energy use in Indonesia. Indonesia consumed 156.95 Million BOE of its energy supply as electricity (industry, commerce, and household combined), making up 18.07% of the total energy consumption (National Energy Council of Indonesia, 2018).[84] This number is only surpassed by fuel use, which made up 38.79%.

The commonly discussed renewable energy target is 23%. The current administration hopes for renewable energy to contribute that amount to the national energy mix by 2025 – which would be around 560MW. This represents renewable energy's expected share in a larger energy market. Which is unrealistic when we consider the very minimal amount of renewable energy contribution was 4-5% in 2017. In the document (RUPTL 2018-2027)[85] itself biogas is only expected to contribute 5MW energy output (MEMR, 2018). That can also be understood as less than 1% of total renewable energy generation by 2025, likely because the government only expected heat energy out of Biogas.

[84] Full report by the National Energy Council of Indonesia: "2018 Energy Outlook for Indonesia" can be accessed in: https://www.esdm.go.id/assets/media/content/content-outlook-energi-indonesia-2018-bahasa-indonesia.pdf (In Bahasa)

[85] The full RUPTL document can be accessed in: https://web.pln.co.id/statics/uploads/2018/04/RUPTL-PLN-2018-2027.pdf (in Bahasa)

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Jenis Pembangkit	Kapasitas
PLTA	154
PLTBg	5
PLTBm	5
PLTM	140
PLTP	190
PLTS	58
PLTS/H	6
PLTSa	2
Total	560

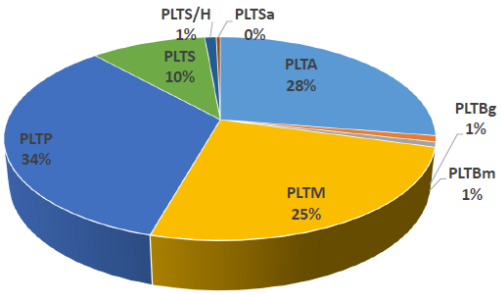


Figure 28: Detailed breakdown of Indonesia's 2025 renewable targets. (PLN, 2018).

National supply wise, the majority of electricity is generated by PLN (~74%) while the rest is generated by IPPs (~22%) and off-grid producers.

The BOOT scheme might contribute further to increasing PLN's numbers. IPP developers in contract with PLN were once obliged to hand over all assets after around 10 years of operations. IPP numbers were essentially transitional. This is changed in the latest iteration of the energy law (Energy and Mineral Resources Ministerial Law 4/2020 Article 27B), where IPPs are no longer required to hand over all infrastructure assets. But changes were so recent that no projects are made under these favorable terms yet.

Currently, the government is mainly focused on short term objectives such as improving electricity supply to the productive sector (i.e. industrial and financial sector), transitioning to renewable energy sources and solving waste issues. Therefore, we can infer that technological advancement and sustainability of business would not immediately be considered.

For example, this can be seen in one of the larger renewable energy initiatives of the current administration, where MSW-based bioenergy is to be developed in 12 major cities in Indonesia. The technology promoted is thermal biomass, which means burning via incinerator. The initiative also has a significant energy potential, but the primary goal is waste management. If this trend is to persist, bioenergy (and biogas alongside it) would stay a minimal contributor to the overall energy share.

5.3 Customers and Clients

There are 2 types of stakeholders that can be understood as customers. The definition will be based on our previous stakeholder mapping categorization which includes the technical role, clientele, input/process/output, and external issues;

Palm oil companies (both plantation and mills due to interdependency between them)

- Their technical role in a larger supply chain is the periodic cultivation and initial processing of palm into oils of varying quality;
- Clients of Palm Oil Companies operating in other industrial sectors; either domestic or international;
- Input: land use granted by the government, capital sourced via financing is required to reform land to palm standard and manage climate risk and operational cost via income, seeds are not in constant supply, because a tree can be productive for around a decade.
  There is a notable side impact to a developing market economy via employment (but on the other side an analogue process will limit productivity).

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

- Process in a mill starts by sterilization – which applies for all mills, and the point where POME is created. Fruit bunches can also be taken from this point for biomass energy. Another POME-creating stage is the extraction.
- Outputs are crude palm oil (CPO) or Palm Kernel Oil (PKO) plus derivatives; these markets are generally in uptrend due to a sustained demand of consumer goods – several of which using palm oil to manufacture. Another recent trend is biofuel, also for domestic and foreign market consumption (but is subject to different sustainability certifications). Palm outputs are essentially products sold in large amount i.e. a commodity; (price very elastic to demand, closely related to policy making). There's an ongoing issue about productivity due to the slow replanting cycle. Indonesia's weaker currency value also makes international trading difficult and somewhat seasonal.
- General issues of palm mill/plantation include: a high dependency on the international market for sales, a product / commodity value that is very susceptible to market fluctuations, and important components for expanding value chain are almost never available in domestic markets.

Engineering, Procurement, and Construction (EPC) firms that work in biogas projects:

- EPC technical role is the installation of various biogas infrastructure, ranging from digesters, gas engines and methane upgrading; They have a limited role in sourcing these technologies pre-project, and maintaining it after the construction project has finished.
- Clients of EPC firms are companies with a stable access to feedstock – either through own processes (palm companies) or waste collection (municipal landfill). Most Indonesian EPCs prefer engaging with one larger institution rather than several smaller ones, presumably to reduce operational and development risk;
- Input is mostly capital used for purchasing technology which can be sourced in several ways – own capital and repaid later, client's capital, or corporate financed by banks. This is dependent on the project structure and partners involved;
- Project development in Indonesia requires extensive coordination with related line ministries and the PLN. A project design relies heavily on ministries' and PLN approval, before proceeding to financing. There is also rigid tendering process for national projects. There is a limited number of projects approved within a period and contractors need to be pre-approved by the government. Thereafter, project developers are required to secure capital funding within a short period of time, before applying for construction approval;
- Output is generally turnkey projects, where the EPC source technology and installs it for the project owner to own (completely or partially) after completion/agreed date (the BOOT scheme practiced by PLN). Latest reviews of the law have removed this clause; Technically, AD processing yields gases that can be further used to provide CHP or upgraded to excrete methane component, while gasification (a derived process of bioenergy) is a way to produce syngas which has high industrial value and has a clear demand in Indonesia;
- General Issues for EPCs revolve around the difficulty in accessing the commercial money market, reactive governance (in policy and structure alike), difficulty in sourcing reliable inputs, unclear demand for biogas, and how RE implementation is rarely prioritized by the government and potential clients.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

As an attempt to mitigate the innate risks of palm companies and EPC profiles, we decided to set targets on state-owned enterprises. They represent a good balance between privatized business operations and governmental leverage. State enterprises are exempt from many bureaucratic processes a regular company would have to deal with. A three-year long development cycle can be reduced to one and a half by this status. They also have the benefit of subsidization, which theoretically allows them to take more business risks. State enterprises also synergize well with other state enterprises, which can benefit cross-sectoral biogas projects.

5.4 Competitive Analysis through the Porter's 5 Forces

In Indonesia, EPCs usually have an external supplier for technology while also being capable of planning a development project. The difference is that EPCs offer a wider range of services which usually include construction maintenance etc.

- Relevant because these EPCs indirectly provide all of the components – usually sourced from the US, Germany, or China. Service-wise these EPCs (ones picked as benchmark) compete on a national level – most have extensive project portfolio.
- Indonesian EPCs are required by law to piece together projects (indirect government role)

The competitive analysis included in this report will therefore be conducted from the perspective of POME-based Biogas EPCs. Implementation scale will be industrial due to project requirements, as household implementation will significantly limit target achievement and evaluation. Market scope will be national since many of the sample EPCs are based in Jakarta but targeting Sumatra and Kalimantan palm industries that normally focus on export.

Each force indicator will be analyzed, and later scored with these following specifications:

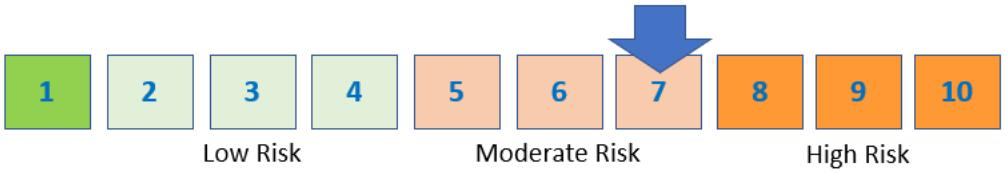
1. is absolute zero risk
2. is low risk with straightforward operational solution
3. is low risk which require strategic adjustment
4. is persisting low risk attributed to business model
5. is moderate risk with straightforward operational solution
6. is moderate risk which require strategic adjustment
7. is persisting moderate risk attributed to market responses
8. is high risk with straightforward operational solution
9. is high risk which require strategic adjustment
10. is high risk that is not solvable with available capital

5.4.1 Rivalry among Existing Competitors

- **Sectoral Growth** is not significant. It is negatively affected by 7-or-more years before actual returns. Profit margins from a project are not very different from other EPC jobs. One-time project owners rarely want to commit additional development.

  Scored 7. Even if not stagnating or negative, the long return period slows activity in the market.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Capital Costs** are high. During a bioenergy event conducted on 25 February 2020, one project owner stated that the total project cost can reach around 1 million in USD which is a lot for Indonesia. In a joint report with the Indonesian Financial Services Authority (2016), USAID also found that 30 to 40 % of that cost is incurred by Biogas technology such as digester, engines, auxiliary components. And that is only the fixed costs. Risks associated with developing biogas incur due to a lot of variable costs. Switching costs are a bit tricky, since customers are free to pick contractors before the project starts (essentially for free).

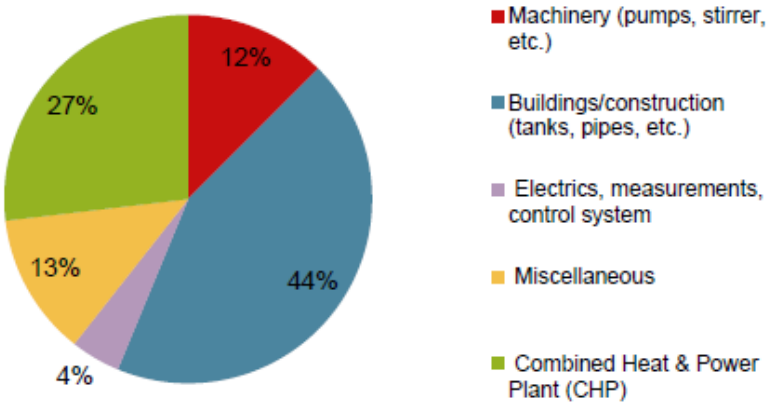
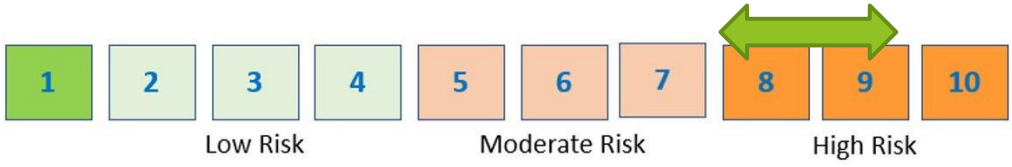


Figure 29: Detailed composition of investment in a biogas project.

Scored 8-9 depending on project. Starting a project costs a lot, and most of that cost cannot be adjusted because it is incurred by the technology. Unclear switching costs in between projects force competitors to be more active in engaging the market.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

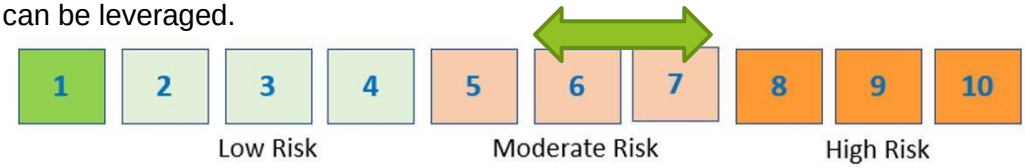
5.4.2 Customers (Bargaining power of Buyers)

- **Effect on Industrial Processes** is limited for the time being. A vast majority of customers only utilize biogas for electricity generation – be it internal or to be bought by PLN. Benefits of biogas implementation tends to be a 'saving' than creating additional income, which is a lost opportunity for companies. But there is a side benefit for plantations who utilize biogas in the form of certifications, since a biogas process intersects on a lot of points with several environmental certifications e.g. Indonesian Sustainable

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Palm Oil Certification System (ISPO) or Roundtable of Sustainable Palm Oil (RSPO). Owning these sustainability certificates opens additional markets for plantations – especially international.

Scored 6-7 depending on the buyer. The benefit of installing biogas into existing business is still limited. However, the role of biogas in achieving sustainable certifications can be leveraged.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Buyer Costs** are numerous. In the project stage costs will be incurred by many things aside from the technology price – installation, logistics (customs included, almost every piece of critical technology is imported), land clearing, feasibility studies, etc. After everything is done the customer will still have to set aside some funds for maintenance and repair operations.

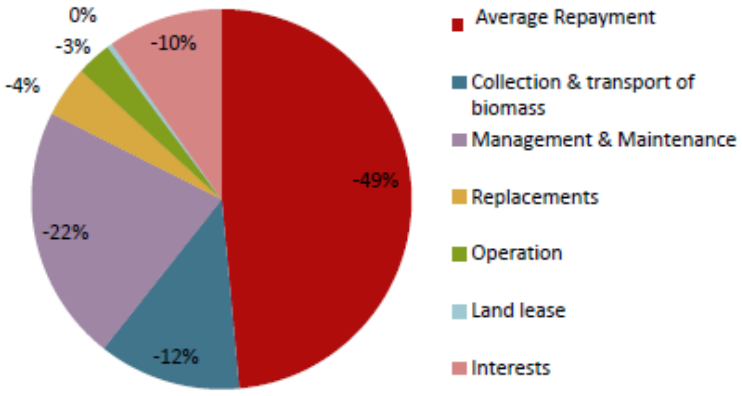
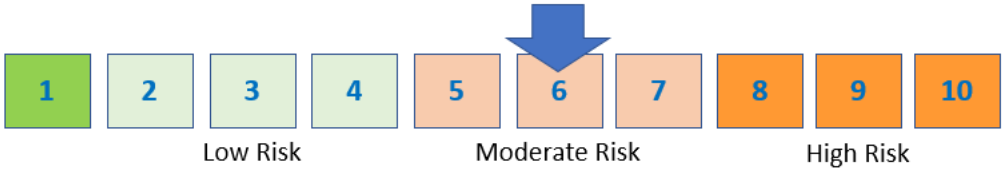


Figure 30: Costs incurred by operations. (USAID and OJK, 2016)

Scored 6. In a plantation context, a lot of additional costs will be involved in biogas development. Workaround is difficult since the law forbids POME to be moved out of the premises of a mill, and these palm mills are typically quite far from urban areas. Paying and arranging these additional services will be a hassle, but the effect to cost structure is actually not significant.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

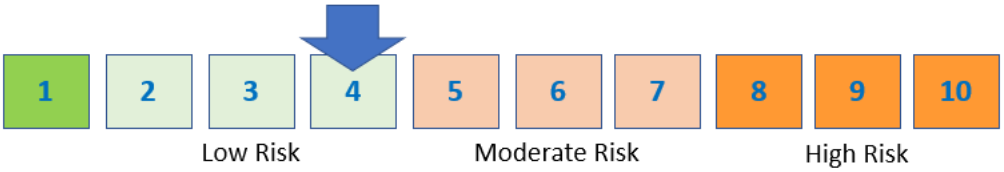
This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

5.4.3 Suppliers (Bargaining Power of Suppliers)

To facilitate a comprehensive analysis, auxiliary component manufacturer or general exporting logistics will also be accounted as 'service provider'/supplier equivalent.

- **Substitutes** are only valid before a project starts. Once a project is initiated technology can rarely be replaced. But before projects substitute biogas technologies are provided by other EPCs (bundled with their own services) or by pure tech supplier/reseller.

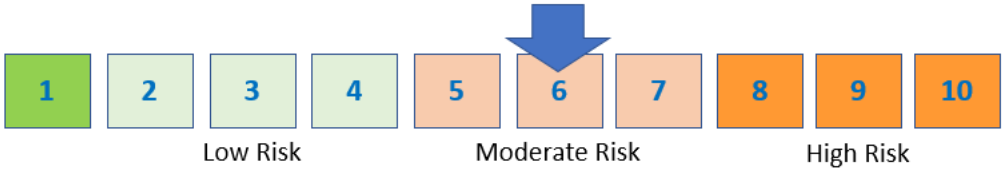
  Scored 4. There are a number of EPCs in Indonesia that can supply a project with technology, so pre-project decisions can be made with a degree of flexibility. But it's kind of a choice illusion when we remember that the technology available in Indonesian EPCs are imported from foreign tech manufacturer anyways.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Supplier Concentration:** Concentrations of major international manufacturer (whose products are used in Indonesia) are all foreign – US, Europe, China. This will inevitably cause additional cost and time.

  Scored 6. Biogas technology is almost exclusively imported. This adds inevitable cost and time for EPCs or suppliers to stock up (or start a project). Trade routes are also prone to disputes, taxation, and exchange loss from dealing with a foreign currency. Fortunately, it appears that technology exporters also found value in the Indonesian market as no EPCs or suppliers have experienced a debilitating shortage of technology.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

5.4.4 Threat of New Entrants

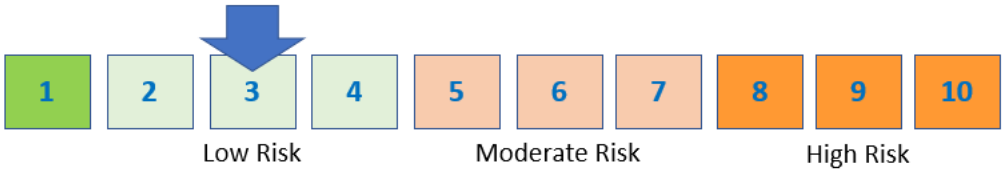
Threat value becomes high when the market structure allows for easier participation from would-be competitors.

- **Scalability** is theoretically achievable for industrial-scale implementation. Biogas infrastructure of this level starts as small as 1MW generating power per 30 ton of waste. Increasing feedstock input (in this case, POME) yields greater power with an increase of 0.3MW per 15 ton of waste. Same thing with cost scalability. Larger biogas projects

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

benefit from relatively stable design and construction cost (i.e. at least physical dimension not radically changing per MW upscale).

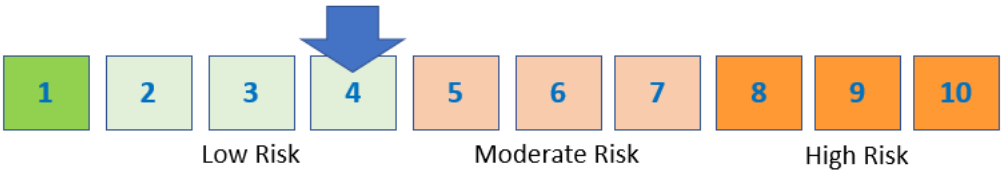
Scored 3. Economics of scale applies in implementing POME biogas in plantations. This is especially the case for industrial-scale implementation, which gives old players with established revenue stream and anyone who has additional capital an advantage over newcomers. Will be a bit problematic for smaller-scale attempts.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Capital Requirements** are high as mentioned before. New entrants who do not have previous industrial/engineering/chemical industry background (and assets) will have a hard time trying to participate in the market. Implied necessity of a Special Purpose Vehicle (SPV) establishment doubles this notion. On the flipside – larger companies from adjacent sectors (especially fossil energy) who transition into biogas development will be able to retain their network, assets, and reusable capacities effectively.

  Scored 4. Big initial capital is required to develop biogas projects. While theoretically this can become a barrier for newcomers similar to the 'Scalability' aspect, existence of financial institutions can bypass this.

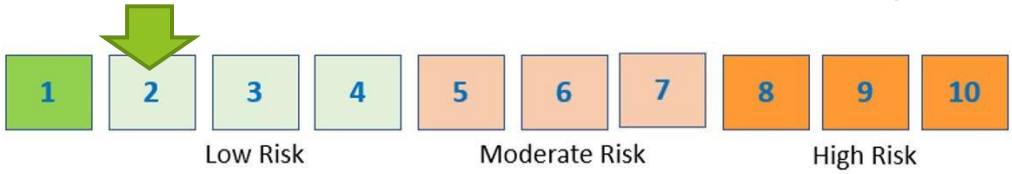


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Government Policies** can act as barrier. Although no policy explicitly denies entry to the biogas market, there are policies who disincentives the intent. For example; low FIT prices when selling biogas electricity to PLN grid, mandatory transfer of assets after PPA term expires, minimum local content requirement (where development needs imported technology – happened in other industries as well). The whitelist previously mentioned also limits new entries.

  Scored 2. This is more or less the main determinant for someone to transition into renewable energy in the Indonesian market. While the government subsidizes energy, the same is not true for renewables. At the moment they only regulate, and the regulations are not exactly business friendly – even for the old players. This is clearly not encouraging.

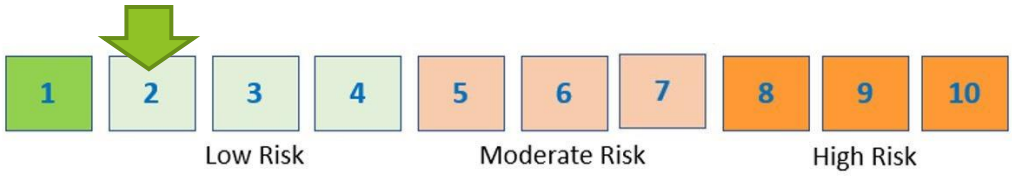
This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Incumbency** is somewhat perpetuated in the culture (thanks to the market as well). Project owners, either government or private, strongly prefer working with known EPCs. Project development portfolio is also a point of consideration. This gives old players a massive advantage. Biogas stakeholders also know one another, and this network of connections enables Business-to-business (B2B) marketing, a clear Human Resource (HR) pipeline, project opportunities, and several other benefits.

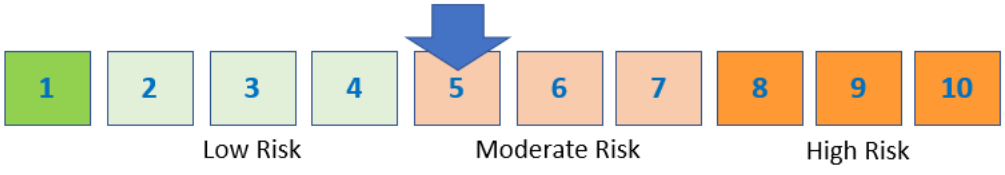
  Scored 2. The poor quality of information management in Indonesia does not give benefit from late movement. Not to mention the limited amount of biogas development projects available to tender in each given period. EPCs who move fast will get the project, and EPCs who get said project will be known across the market – easing future projects and collaborations.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Project Stream** is also limited for government and private alike. The government approaches contractors via the whitelist, because state fund allocation for renewables is getting cut every year – and biogas is not prioritized in the list. Private sector is hesitant to participate because they are not yet sure about the financial feasibility and value of implementing biogas into their existing business processes.

  Scored 5. While government and private sector projects are communicated to the market most of the time, actually accessing the tender process is difficult. The government has its limitations, and actors from the private sector rarely do so. Not to mention direct contracts which depends on the extent of someone's network.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

5.4.5 Substitute Sector

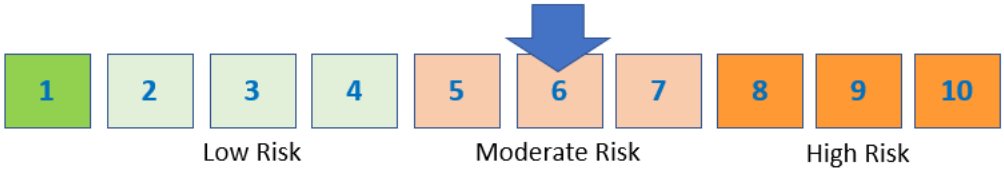
- **Price Gap** exists between biogas and biomass development, but the yield-to-cost ratio is actually in favor to biogas. In Indonesia biogas is 1:1, biomass incinerators 1:2, and

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

MSW landfill gas 1:4. The ratio mentioned is also based on Covered Lagoon technology, which is generally subpar in everything but price. CSTR biogas exists in Indonesia, but information on its development and associated costs are very limited.

The price gap is indirect for biofuel development. Unlike biomass technology (where the implementation excludes the use of biogas because a site rarely has both), biofuel enters a palm mill process from a different point. They purchase mill CPOs directly, not engaging with waste. In this sense, a buyer will not need to invest on tech infrastructures but still participating to renewable energy production BUT they will not be able to internally control savings or income rates.

Scored 6. Biogas is stuck in an unusual condition where the commonly used technology is actually cheaper, but it is neither endorsed explicitly by the government nor does it have clear offtake for yields. EPCs ended up preferring the more expensive substitute for the clarity of benefits. Biofuel, while supported by governmental uptake, is beyond private stakeholders' control.

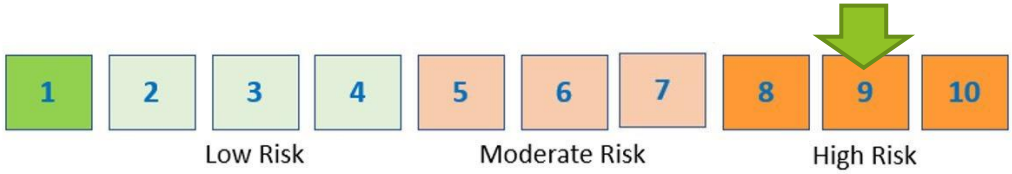


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **<u>Buyer Sensitivity</u>** is very apparent in the biogas market. Clients are wary of a market that is still non-commercial, since there aren't many other cases that can be used as a benchmark. The plantation sector (as primary client segment) is also dealing with a naturally fluctuating business. Investing in a technology that currently has limited use *and* is risky to develop is not a good decision.

  In this manner biofuel is more threatening. The current governmental purchasing scheme addresses buyer sensitivity to price flux directly by buying their products at a fixed rate. While the scheme does not necessarily buy all of a mill's output, the fact that they will be able to sell a guaranteed amount per period sets a price floor and ceiling for their core business (CPO).

  Scored 9. Buyers are considering every financial component of renewable energy projects due to the massive time and money investment required. Development costs cannot be modified in a meaningful way since it consists of fixed costs, and financial benefit is still limited and uncertain.

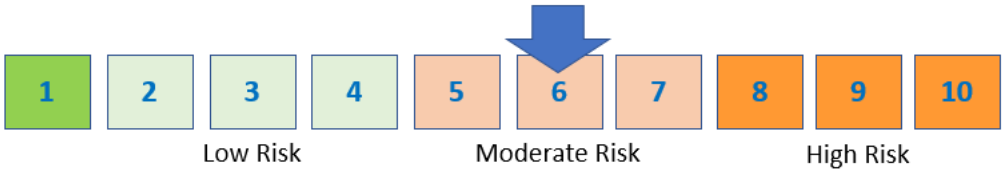


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

- **Product Performance** – within the context of palm plantations as clients, biomass plants will be using fruit bunches. Biomass plants have two clear uses for its yields: electricity from heat-based generators and ash that can be sold as fertilizers. Biogas, on the other hand, requires additional processing and technology to utilize maximized yield (since biogas is effectively manufacturing material as well). Both will require a long time before return of investment occurs. Relative simplicity can also ease local development.
  Biofuel performance does not matter, since the current scheme is limited to raw purchase of CPO.

  Scored 6. The rates in which these technologies produce power is similar. The difference lies in the process. Biomass seemingly offers higher performance because the process is more straightforward than biogas (and the full potential of biogas is not yet realized in the market).

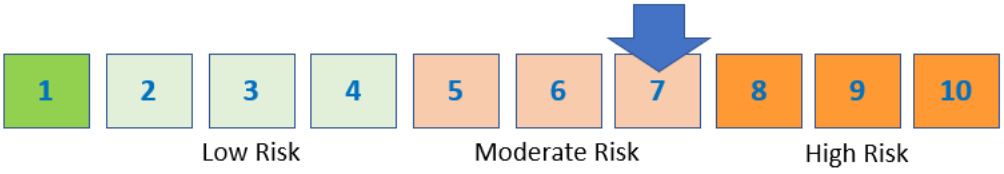


1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

- **Sub-Sector Trends** are positive in large part thanks to the government. Earlier, we mentioned how renewables development in Indonesia is largely dependent on governmental policy and decisions. And the government is quite supportive of biomass recently. For example, Presidential Order No.35/2018 mandated the development of biomass in 12 Indonesian major cities to solve municipal waste problems. Even if the target is not power generation, orders like these are still beneficial for the substitute sector. Biomass development became a government target, with quite a clear guideline as well.

  The same applies to biofuel, to a greater extent. A Presidential Mandate regarding national biofuel use is in effect, with clear milestones and asset mobilization. Having governmental support increases confidence in the biofuel segment, and it seems that the trend will persist at least until the cabinet changes in the next period.

  Scored 7. Biomass sectoral performance is not affected by the current trend, as technology research and development are generally progressing slowly in Indonesia. However, increased adoption that is enforced by the government continually improves financial access and EPCs efficiency in implementing – essentially reducing the risk of additional costs.



1 absolute zero risk 2 low risk 3 straightforward operational solution 4 require strategic adjustment 5 moderate risk 6 straightforward operational solution 7 require strategic adjustment 8 high risk 9 straightforward operational solution 10 require strategic adjustment

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

5.4.6 Competition

Competition for new biogas project developers will come from those who provide access to biogas technologies to the market. The role is primarily fulfilled by EPCs who are either in standing agreement with certain suppliers, or by a tech manufacturer's subsidiary organization. When the industrial scale of >1MW of biogas power plant is taken into context, identification parameters are:

- Operational Region is important because it is related to palm variety, soil characteristics, related stakeholders, and governmental idiosyncrasy.
- Primary Digester Technology (and yield) will show us the most relevant type and size of technology that typically leads into a successful project.
- Organizational Status ranges from local EPCs that are made from scratch to palm mills that are starting to transition into renewable energy development.

Accounting for tech suppliers is also important, but it is rarely mentioned by the companies or the news pertaining their activities. Any notable responses to approach will also be detailed – whether these stakeholders are taking a competitive or cooperative stance. Names listed below are taken due to their close relation to GIZ Indonesia's current efforts at improving Bioenergy commercial viability, i.e. they are well-known as veteran players, or have achieved a milestone, or have a tendency to actively participate in market-building events.

1. GREE New Energy became notable for its development of a large cassava-based covered lagoon in Lampung with 3MW yield, which was successfully connected to the national grid. It is also notable how they are explicitly setting a GHG reduction target of 65KT per year. GREE is an independent EPC which also offers operational services (post-construction, taking a role similar to SPVs) and project feasibility checking.

2. Ecody Agro Energy is one of the most prolific EPCs in Indonesia, with 11 Biogas plants spread across Sumatra and Kalimantan. They usually deal with covered lagoon technology ranging from 500KW to 3MW in size. Ecody also offers a wide range of services, essentially becoming a one-stop shop for Biogas development. This extensive capacity, coupled with a constant stream of governmental and private contracts, left them in an advantageous market position. We perceive them as market leader in commercial Biogas development.

3. Pasadena Engineering Indonesia is one of the early players in Indonesian renewables development. Initiated in 2006 as an EPC and continually adapting to the market, Pasadena is adept at capitalizing off market trends. Their covered lagoons are located across Sumatera and Kalimantan, yielding 1-2MW in average. They are currently chasing the prospect of Biofuels, shown by the establishment of Pasadena Biofuels Mandiri, a subsidiary that exclusively deals in Biofuel processing. Both of these companies were cooperative and are willing to provide information and resources in later stages of the project.

4. Austindo Aufwind New Energy (AANE) is a special purpose vehicle (SPV), created via joint venture between Austindo Nusantara Jaya plantation and Germany-based Aufwind Schmack Asia Holding (GmbH). Austindo originally deals with operating plantations that yield consumable crops, one of which being oil palm. Wastes of internal

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

processes are then handled by AANE to generate energy. Their covered lagoon in Belitung currently generates 1.8MW, with technology directly supplied by their German counterpart.

5. Taat Inti Energy is a relatively new participant in the Indonesian Biogas community but has the privilege of association with Pasadena. This allows them access to a number of ongoing Biogas tenders, which unfortunately cannot be disclosed in detail. Taat Inti's earlier ventures as EPC are based in Sumatera, implementing covered lagoons around the 1-2MW range. They are also testing the waters on gasification and CNG upgrading in Kalimantan.

6. Asian Agri is one of the larger palm plantations in Sumatera (and Indonesia, and even Asia), boasting around 100.000 Hectares of cultivated land in cooperation with plasma and smallholder farmers. Their venture to Biogas was very recent. In 2018, they developed 5 CSTR plants (yielding around 2MW each, imported from Japan) in some of their sites with the assistance of BPPT (the National Agency of Technology Implementation). The usage of CSTR is still rare in Indonesia, as most companies prefer to use the cheaper lagoon method.

5.5 Market Policies and Incentives

The scope of incentives in Indonesia is largely limited to governmental legislations. The current cabinet has directed line ministries, along with their regional branches and other national-level agencies, to take measures in developing an environment that is beneficial for the entire biogas development process. This is evident in the policy incentives available in Indonesia.

Several ministries have begun legislating laws that may serve as incentives or assistance to stakeholders in the Indonesian biogas sector. In addition, several governmental agencies also serve an important role for biogas development, such as the Financial Services Authority. The current cabinet may also be involved directly in governing the biogas sector.

In the following section, analysis on incentives will be structured in accordance to the regulated process of biogas development, divided into phases of project development: **initiation**, **feasibility study**, **power purchase agreement**, **financial closure**, **construction**, **commercial operation date**, **operations and maintenance**.

Structure of writing in the following sections will follow these basic guidelines:

a) General principles of law will be used in determining relevant legislations – specific laws over general laws, newer laws over older ones.
b) Explicit differentiation will be made between incentives and directives. The former hastens growth, while the latter stabilize the scene in order to sustain it.

Initiation phase revolves around project conceptualization and planning. *For Indonesia, this phase explicitly requires a clear policy directive, which can significantly affect project Segment Target Position (STP).* Policies help project owners by specifying market segments and giving quantifiable targets. The following regulations are relevant with project initiation phase:

Presidential Directive No.61/2011 on Greenhouse Gas Emission Reduction

➔ Highlights the governmental commitment in reducing national greenhouse gas emission by 26% (independently, 41% if accounting foreign assistance) by 2020. Sectoral

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

focus put on farming, forestry, energy, transportation, industrial manufacturing, and waste management sectors (including other related sectors).

➔ Gives private developers a quantifiable target and points at specific sectors to target (allowing developers to correctly focus their resources).

Legislative Act No.30/2007 on Energy

➔ Prioritizes local energy sources for renewable energy generation, and mandates local governments to allocate funds into electrical development of rural areas—which are typically stuck with low income, lagging in development, and geographically remote.

➔ Essentially incentivizes regional governments to invest on renewable power, legally obliging them to be a potential client for private developers.

Legislative Act No.30/2009 on Electricity

➔ Reinforcing the prioritization of 30/2007 regarding local renewables, and explicitly allowing the private sector to operate their own renewable infrastructures and sell energy to the PLN.

➔ Allows the implementation of a more profitable long-term business model. By operating and selling rather than hired for construction, the private sector is able to create a new income source and actually have asset investments. The democratization of power generation also helped stabilize power pricing.

Ministry of Energy Regulation No.35/2013 on Power Provider License Requirements

➔ Defines and provides procedural guidance for power generation businesses – for public purposes, for company internal use, or for support businesses.

➔ Helps private developers to further define the most profitable positioning in the market and ensures administrative compliance for a project.

Feasibility Studies cover benchmarking of project design to situations in the field OR existing technology. *This phase needs clear methodology from the EPCs/developers/contractors and data consistency from the project owner.* Benefits of standardization incentivize project owners to start (and standardization details provide a foundational framework of assessment), while utilization directives ensure that renewable yields will have a degree of guaranteed offtake. The following regulations are relevant in the Feasibility Study phase:

Ministry of Environment Decree No.28/2003 on Technical Guidelines regarding Wastewater Utilization in the Palm Oil Industry

➔ The government will grant utilization of wastewater based on the results of certain assessments;
a. Analysis on Environmental Impact (AMDAL);
b. Environmental Management Intent (UKL) and Environmental Control Intent (UPL) standards;
c. Studies on Environmental Impact Evaluation (SEMDAL);
d. Environmental Control Strategy (DPL).

➔ Despite clarifying administrative needs of waste utilization, the multiple layers of required documentation add complexity in checking a project's feasibility.

Ministry of Farms and Plantations Regulation No. 19/2011 on the Indonesian Sustainable Palm Oil Certification

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

- ➔ Subjects all palm mills and plantations to Indonesian Sustainable Palm Oil Certification System (ISPO) assessment per December 31st of 2013.
- ➔ Indirectly benefits palm oil producers that practice sustainability standards since ISPO-certified products will have an easier time being distributed into the market. Incentivizes mills and plantations to (at least) comply with ISPO sustainability standards for the sake of strategic advantage.
- ➔ Waste-to-biogas may become an alternative for mill owners to comply towards sustainability standards while generating insubstantial profits.

Ministry of Farms and Plantations Regulation No.11/OT 140/2015 on ISPO Certification Targets

- ➔ Article 2 (1) declares that the implementation of the Indonesian Sustainable Palm Oil Certification System (ISPO) will be conducted both mandatorily and voluntarily.
  1. Mandatory ISPO will be applied for:
     a. Plantations that conduct land cultivation along with industrial processing;
     b. Plantations that focus on conducting land cultivation; Plantations that focus on industrial processing.
  2. Voluntary ISPO will be available for:
     a. Plasma plantations (which land is granted by the government, owned by plantations, are community fields, or privately owned) that are associated to a plantation in developing their land;
     b. Smallholders that develops/owns land entirely on their own capital;
     c. Standard-compliant plantations that are producing palm oil with the specific intent of generating renewable energy.
  3. Can be utilized as a selling point for companies to better market their products. Newer standard-compliant plantations with limited interest in maintaining sustainability can be persuaded to instead develop Biogas to exempt them from mandatory ISPO audits.

Power Purchase Agreement (PPA) is somewhat exclusive to Indonesia since we have PLN as the sole monopolistic distributor. *A deal needs to be made with PLN for pricing and ownership of renewable-based power generating infrastructure. This is particularly important if the Biogas plant is going to generate electricity, since it determines pricing and stakeholder coordination.* At the bare minimum, PPA regulations set a uniform procedure for all renewable energy projects. The following regulations are relevant with the PPA Phase:

Ministry of Energy and Mineral Resources Regulation No.31/2009 on PLN Renewable Power Purchasing

- ➔ Mandates PLN to purchase surplus renewable energies in a fixed price, from producers that yield less than 10MW. Priced at 656 Rupiah per KWh (medium voltage) and 1.004 Rupiah per KWh (high voltage), not accounting regional variabilities.

Ministry of Energy and Mineral Resources Regulation No.4/2012 Revising No.31/2009

- ➔ Changing the mandate in No.31/2009, increasing the fixed price. It became around 975 to 1.725 Rupiah per KWh, dependent on technology and voltage, not accounting regional variabilities.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Ministry of Mineral and Energy Resources Regulation No.27/2014 on PLN Power Purchase from Biomass and Biogas Power Plants

- ➔ Further changing the mandate in No.4/2012, increasing the fixed price again. It became around 1.050 to 2.400 Rupiah per KWh, dependent on technology and voltage, not accounting regional variabilities (now expressed in a 1.0 to 1.6 price multiplier). This iteration also implemented a load follower scheme for Bioenergy plants.
- ➔ Allowing Bioenergy plants to become load follower rather than full-fledged producer makes investing to Biogas more feasible for stakeholders with limited capital. Load following plants only need to produce at peak demand – removing the need to use large generating infrastructures.

Ministry of Energy and Mineral Resources Regulation No.21/2016 on PLN Power Purchase from Biogas Power Plants

- ➔ Directs PLN to specifically purchase electricity from Biomass or Biogas power plants run by certified private producers.
- ➔ Even if the government *de facto* prefers solar, wind, and hydro renewables, the existence of this legislation can be invoked in a PPA deal.

Ministry of Energy and Mineral Resources Regulation No.10/2017 on Power Purchase Agreement (PPA) Principals

- ➔ This law details all non-price elements of PPA such as risk management in the face of force majeure, supply chain structuring, and a sort of minimum service requirement. A most notable result of this law would be the application of a mandatory ownership transfer in all PPA (after 10-20 years).
- ➔ To some degree, this law helps project owners or developers to determine project direction and business strategy in the future by creating quantifiable standards for all aspects in a PPA. Unfortunately, parts of it are either risk-inducing or restricting for private stakeholders.

Ministry of Energy and Mineral Resources Regulation No.50/2017 on Renewable Power Generation

- ➔ Reiterates the Indonesian Feed-in-Tariff rates. Percentage of local cost of energy is used to determine purchase prices if renewable cost is higher than existing cost (which is most likely the case). Biomass and Biogas FIT is capped at 85%, while MSW-based Bioenergy is negotiable.
- ➔ Actually, this is more of a disincentive for project owners and developers alike. The law overwrites older iterations of FIT which are able to support commercial operations. The current percentage-based FIT makes commercial operations very difficult on financial balance.

Ministry of Energy and Mineral Resources Regulation No.4/2020

- ➔ Declaring the removal of mandatory asset transfer to government agencies post-PPA.

Financial Closure marks the point where the project's finances gets covered by corporate financing of commercial banks, grant from donor organizations, internal funds – or a mix of all. *One important factor is the accessibility of these funds to renewable energy development.*

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Even if a country's money market is alive, they rarely focus on renewables. Investment legislations created by the Ministry of Finance and any related stakeholders do not affect developers directly, but it will push commercial banks or other financial institutions to invest in renewables. The following regulations are relevant in the project's financial closure phase:

Financial Service Authority Regulation No.18/POJK 03/2016 on Risk Management for Commercial Banks

- ➔ Mandates the implementation of risk management strategies for commercial banking operations. This includes credit risk assessment, market analysis, asset liquidity, operational management, legal compliance, and some more.

Financial Service Authority Regulation No.51/POJK 03/2017 on Sustainable Financing by Financial Institutions

- ➔ Mandates the implementation of sustainable financing principles for financial service providers and companies who underwent public offering via stocks or bonds. Aspects that have to be implemented as baseline are:
  a. Development and launch of sustainable credits, green investments, or similar projects;
  b. Internal development of sustainable finance divisions;
  c. Organizational strategy adjustment to facilitate sustainable finance practice.

  Implementation of these measures will be rewarded by the government.
- ➔ This law is beneficial for the Biogas sector, by pushing financial institutions to start funneling capital into sustainability – and by extension, renewables. Unfortunately, this law is still general in coverage with weak incentives for financial institutions.

Ministry of Energy and Mineral Resources Regulation No.21/2016 on PLN Power Purchase from Biogas Power Plants

- ➔ Article 10 (2) set a deadline of 12-month gap between PPA agreement and financial close. If developers were unable to source adequate amount of funds within this timeframe, their awarded Biomass or Biogas development rights may be rescinded.
- ➔ Article 12 (1) states that proof of successful financing will have to be presented to the government, specifically the Ministry of Energy and Mineral Resources, via Renewables and Energy Conservation Division.
- ➔ Article 13 (1) mandates that developers who have achieved financial close for their development projects must immediately apply for the Electricity Generation Business License.
- ➔ This regulation is more of a directive than incentive. This stage of a project shows that achieving complete financial close is important for continuation. However, from stakeholder experience, 12 months can sometimes be difficult since renewable energy developments are still assessed as corporate projects.

Construction is where EPCs/developers/contractors are given green light to begin the physical building of the Biogas plant. Logistics and administration occur at this phase as well. Usually this is accompanied by some form of monitoring to ensure design and regulatory compliance. *Regulations or policies that can circumvent additional processes can be utilized to cut time and costs from this phase.* Construction standards reduce project owners' risk by enforcing EPC conduct and (sometimes even further by) providing quantifiable, technical baseline.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Tax and administrative waivers for particular sectors direct stakeholders to focus on a particular segment.

Ministry of Finance Regulation No.176/PMK.011/2009 on Import Tax Waiver of Industrial Machineries and Components Necessary for Industrial Development

➔ Machinery importing taxes that are usually imposed on companies can be waived if:
   a. Machineries are not yet manufactured domestically;
   b. Already manufactured domestically but not up to par with necessary specifications;
   c. Already manufactured domestically but not able to fulfil demand.

Ministry of Finance Regulation No.66/PMK.010/2015 on Import Tax Waiver of Electricity Generation Infrastructures

➔ Is basically a specified extension of the preceding law. All companies with an Electricity Generation Business License can apply to the National Agency of Investment Coordination and Ministry of Finance for this waiver.

Standards also play a part in directing construction. There may be more standards that are available and practiced internationally, but the Indonesian market has a tendency to apply lenient domestic standards instead, or just straight up ignoring standardization.

- Indonesian Standard (SNI) 7826:2012 on Biogas Manufacturing Units with Fixed Dome Digesters
- Indonesian Standard (SNI) 7926:2013 on the Workings of a Biomass Boiler
- Indonesian Standard (SNI) 7929:2013 on the Grid Requirements for a Biogas Unit

Commercial Operation Date (COD) is when the Biogas plant actually starts supplying power. Depending on the project participants, this may come as soon as the operation starts, or set to a later date to make room for testing (the latter being more common). The following regulations are relevant with the commercial opening date of the project:

Ministry of Energy and Mineral Resources Regulation No.21/2016 on PLN Power Purchase from Biogas Power Plants

➔ Article 5 of the regulation states that a PPA will last for up to 20 years after COD and it can be prolonged.

➔ Article 11 mandates for developers to report upon their construction, per 6 months, up to COD. This report is to be delivered to both Ministry of Energy and Mineral Resources and PLN.

➔ Article 14 (1) Limits COD start of Biomass and Biogas projects to 36 months after PPA signing.
   (2) Failure to achieve COD within 36 months will subject developers to reduced power purchase prices, differentiated according to how late it is finally completed:
   a. 3 months or less will be subject to 3% reduction
   b. 3-6 months will be subject to 5% reduction
   c. 6-12 months will be subject to 8% reduction

Operations and Maintenance will occur indefinitely. Can either be conducted by the EPCs/developers/contractors themselves or handled by the project owner on their own/via SPVs.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

5.6 Resources

5.6.1 Natural Resources

Indonesia is the world's largest palm oil producer, with 29,344,500 tonnes worth of annual production. Indonesia contributes 50% share of global production (OECD, 2017) with its main exports are directed towards China, Singapore, Malaysia, India, Pakistan, Bangladesh, Sri Lanka, Egypt, Netherlands, and Germany. Thus, it was not surprising when the palm oil sector became one of Indonesia's strategic focuses. Despite the country current focus on hydro and geothermal power, the government has also shown keen interest in the by-products of palm oil as it presents an opportunity for renewable energy. Considering the waste management needs of the palm oil sector, biogas can actually be a good investment for palm producing regions, such as South Sumatra.

South Sumatra is considered relevant to biogas project development for four reasons:

- The province's palm industry is quite large and concentrated in certain regions, which allows for a reliable feedstock supply.
- Development in the province is growing at a quick pace, improving accessibility to important infrastructures that may aid construction.
- Governance and bureaucracy in medium-scale cities (Palembang) in developing provinces (South Sumatra) are usually less complex.
- Existence of other industries and energy distribution channels are able to support biogas offtake in the future.

As a country with a strong agricultural background, Indonesia is also producing several other commodities that are also relevant for biogas generation as listed in table 31.

Table 31: Commodities Relevant for Biogas Generation (MEMR, 2016)

Commodity	Waste forms	Potential electricity generation (MWe)
Palm oil	Fibre, shell, empty fruit bunch, fronds, POME	12,654
Sugar cane	Bagasse, leaves and shoots	1,295
Cassava	Effluent	271
Plywood	Sawdust, offcuts, bark	380
Rice	Husks and straw	9,808
Total		24,408

Past biogas developments projects have also explored these potentials – especially rice and cassava. Rice husks are often used in community-level, while cassava feedstock for industrial-level generation is a relatively recent breakthrough that is currently being explored.

5.6.2 Human Resources

Out of all 8.4 million inhabitants of South Sumatera, approximately 4 million is actively employed, with 1.8 million specifically by the agricultural sector. Labor concentrations exist in the

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

Palembang Municipality, plus Ogan Komering and Banyuasin Regencies. The latter is expected, as these regencies house most (if not all) of South Sumatera's palm plantations. No less than 150.000 agricultural workers reside in each of these regencies.

A large amount of the agricultural labor force has not completed basic education (1.1 million of them) while only 25.336 *across the entire province* are known to complete college. This is rather problematic as a bulk of the labor demand requires General High School-level expertise, followed by University-level expertise (BPS, 2019).

Palm oil plantations require intensive labor, which implies availability of human capital in regions that depend on palm as a main income. This is also true for South Sumatra. Agricultural sector's growth and production keeps increasing and small and plasma holders of palm exist alongside larger plantations. This emphasizes the availability of human resources. A lot of these human resources are blue-collar. Most of the employment created by the palm sector is for tending the plants and collecting fruit bunches, characterized by purely physical labor.

Plantations and mills usually require 3 types of workforce: planters, factory workers, and administrative staff.

- Planters tend and cultivate palm tree in the field (including harvesting and transportation) and require more practical experience than education. Planter demand covers the bulk of workforce absorption by the sector. Small or plasma holders associated with a company can be put into this category.
- Factory workers in the palm sector used to be mid-tier workers, i.e. one's education will be expected, but specific knowledge was not mandatory. This was when the industrial process of palm was strictly mechanical. Nowadays, the bioenergy trend introduced biochemical processes into a mill. This calls for workers with such specific knowledge.
- Administrative staff are necessary for proper operations and management of a plantation or a mill. These types of workforce usually require a degree of education – varied according to role and rank. A purely operational desk worker can pass with high school credentials when managerial roles will demand higher education or more experience.

Labor's importance in the business can be estimated through costs that represent 60% of total operational expense. Paying wages is the highest cost share for plantations. The numbers, however, might not be representative for the entirety of the labor force. Fruit haulers and mill operators are both plantation labor – but their wage rates are surely different.

Minimum wages for plantation workers are calculated per hour or per fresh fruit bunches harvested. National minimum agricultural wage in plantation regencies is also very low – a mere 1.7 million IDR (provincial average) which is around half or third of the Capital's 4.7 million minimum wage. Premium wages are usually applied when individual harvest exceed 600 kg of fresh fruit bunches/worker/day.

The income of small or plasma holders who are not directly employed by a company still comes from selling fresh fruit bunches as revenue or payment from companies. Depending on whom (state companies, multinational companies, group of individuals, or other smallholders) one deals with, profits will vary with price as low as 700-950 IDR/kg when the normal commodity price is 1,300 IDR/kg (November 2015).

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.

5.6.3 Infrastructure and support industry

Palm oil is a commodity that significantly contributes to the economy of South Sumatra and Indonesia in general. Support industries exist throughout the product stream to improve value.

The increasing growth of the agricultural sector is not accompanied by adequate infrastructure development in many important areas. While Sumatera is subject to rapid modernization in its urban areas, palm plantations are far from population centers. Limited infrastructures make access difficult for vehicles and power grid alike.

According to a study conducted by the Indonesian Palm Oil Association (IPOA) in 2016, major supporting sectors of the Indonesian palm oil sector include:

- National and International Traders as primary customers of the palm oil sector. Larger mills usually sell their products themselves, with some of the smaller mills also selling to them. Alternatively, smaller mills can sell their products locally instead.
- Banking and Insurance provides capital input and risk management facilities. Many commercial banks involve themselves with the palm sector, but via regular corporate financing. While this allows investment into the palm sector, it is not very suitable for renewable development.
- Transportation, Logistics, and Seaports allow distribution. Larger mills usually have their own logistic infrastructure set up – a fleet of trucks or tanker vessels. Smaller mills with limited capital can instead 'rent' these infrastructures to extend distribution chain.
- Research and Development can improve efficiency and increase value in the long run.
- All palm companies conduct R&D (according to their available resources) in order to achieve more value. This can be done by improving efficiency, creating a new palm strain, or implementing proprietary technology. Governmental agencies e.g. the Oil Palm Plantation Fund Management Agency (BPDP-KS) for palm-specific tech, or BPPT for renewables in general) can also assist.
- Technical Education is important to have workers with adequate skills. This is especially evident for the technical workforce demand, which requires graduate or vocational education. Several universities across Indonesia have noticed this trend and have started to integrate palm sector skills into their curriculum. There is even a new polytechnic institution (Citra Widya Palm, in Bekasi) recently created for this purpose.
- Fiscal and Monetary Legislators create laws that affect price, cost, and budgeting. This role is fulfilled by the Ministry of Finance (fiscal regulations on the national level) and the Financial Services Authority (regulating bank operations).
- Land Use Legislators create laws that affect long-term strategies. The Ministry of Farms and Plantations is responsible for the legislation, implementation, and assessment of these laws.
- Commodity Associations promote and facilitate product uptake in the market. The prime example would be the Indonesia Palm Oil Association (IPOA). IPOA advocates for palm oil trading and use, while also conducting some degree of research and networking events.

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement N° 857804. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the EU.