Strategy of PT PLN (Persero) to Achieve a Renewable Energy Mix through the Co-Firing Program

Review of Integrative Business & Economics Research

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ABSTRACT

CFPPs are the most dominant power plants in Indonesia. Based on data from the General National Energy Plan (RUEN), the use of coal fuel is 34.09% in Q1 2020. Coal is dominant because the price is low with high calories compared to others. On the other hand, CFPPs emissions are ranked first, 28% compared to emissions in other energy sectors. Following Law No. 16 of 2016 concerning the Ratification of the Paris Agreement, the Government is committed to reducing greenhouse gas (GHG) emissions by 29% by 2030. It has set an energy mix target of at least 23% of New Renewable Energy (NRE) by 2025. Through PT PLN, one of the fastest and most economical solutions to achieve this target is through co-firing. In this study, a cost-benefit analysis of co-firing at XYZ CFPP was conducted using two types of biomass, namely 95% coal - 5% sawdust and 95% coal - 5% wood pellet. The results of the B/C ratio and NPV of a mixture of coal fuel with biomass are superior to 100% coal fuel. It is hoped, that PT PLN (Persero) can reduce GHG emissions with the co-firing program.

Keywords: CFPP, co-firing, Biomass.

1. INTRODUCTION

As the sector that contributes the most to CO_2 emissions in Indonesia, PT PLN (Persero), as a SOE entrusted by the government in managing the electricity sector, seeks to shift power plants from environmentally unfriendly fuels to power plants sourced from new and renewable energy. It is known that the energy production sector contributed 43.83% of GHG emissions in Indonesia in 2019 (ESDM, 2020).

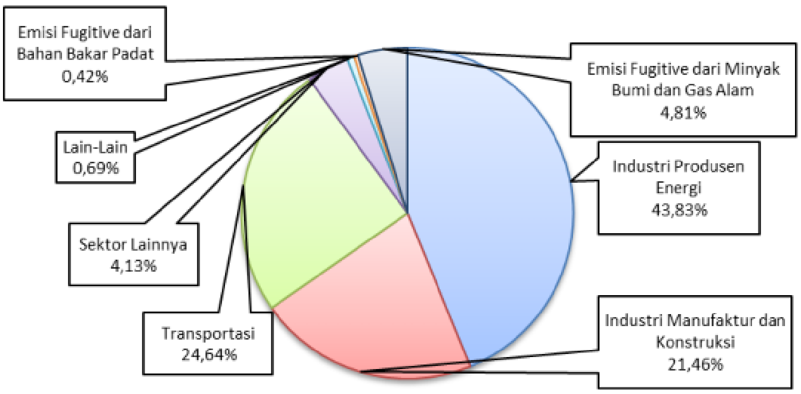

Figure 1 Contribution of Each Category in 2019 GHG Emissions

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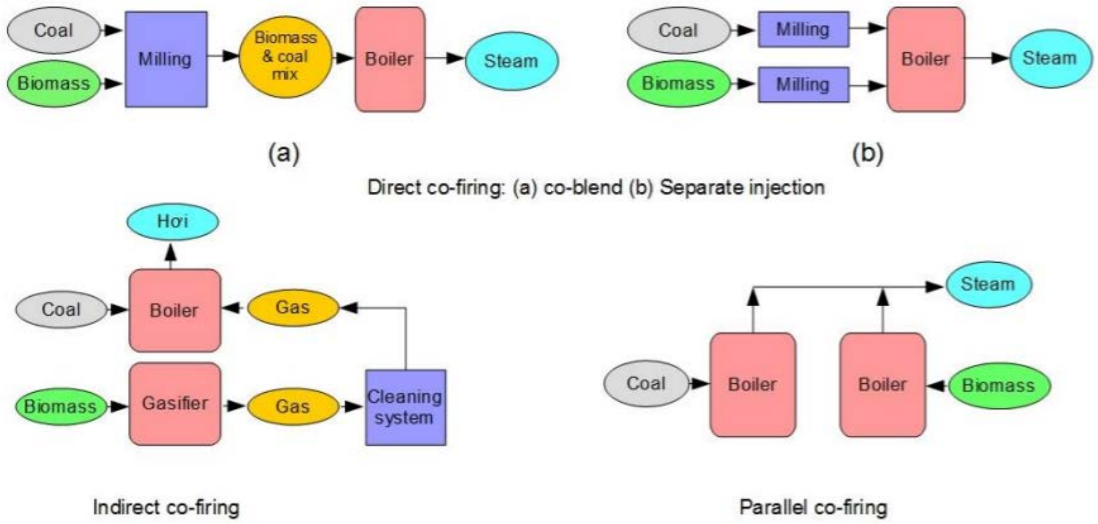

Figure 2 Simple Diagram of Co-firing (an Ha Truong, 2016)

From an environmental perspective, Indonesia was the fourth-largest emitter of greenhouse gases in the world in 2015. Indonesia's economy is the 16th largest in the world and the largest in Southeast Asia. The highest source of emissions comes from deforestation and peat forest fires, followed by emissions from burning fossil fuels for energy (Aziz & Faturohman, 2021). However, shifting the power plant requires a large investment cost. A breakthrough has been taken by PT PLN (Persero) and has been determined through the RUPTL- 2021-2030 document, to combine CFPP fuel with biomass. The breakthrough uses the co-firing method. Co-firing biomass with coal started in Europe and North America in the late 1990s. It is proven to offer a relatively quick and cost-effective way to partially decarbonize coal-based electricity generation in the short to medium term. The co-firing system currently consists of 3, namely direct co-firing, indirect co-firing, and parallel co-firing. For co-firing that has been implemented in Indonesia is direct co-firing. Direct co-firing is applied because it is the most economical and simple. The following is a simple diagram related to the co-firing system.

Tests were carried out on CFPPs spread across Indonesia, one of the XYZ CFPPs with a power of 3x350MW. The biomass used is divided into two scenarios. The first scenario uses coal composition: sawdust, and the second scenario is coal: wood pellets. Based on the IEEFA report, there are several biomasses used in Indonesia, as shown below:

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Figure 3 Comparison of Predominant Biomass Fuels

Fuel type		Typical Calorific Value kcal/kg NCV	Typical Price Range *Not Normalized for CV*	Remarks
Wood Pellet		3,940 - 4,400	**IDR 1,040 to 2,000/kg at NCV > 3,940 kcal/kg** Vietnam FOB price index (Jul 2017-Sep 2019) **IDR 1,300+ /kg at NCV > 4,100 kcal/kg** Domestic market prices estimates	• Existing production is largely destined for export market with premium price • High production cost, majority of potential supplies are located outside of Java-Madura-Bali region (Jamali) • Properties could vary depending on the feedstock
Palm Kernel Shell		3,500 – 4,200	**IDR 825 to 960/kg at NCV > 3,500 kcal/kg** Indonesia FOB price index (Jul 2017-Sep 2019) excluding export tax package	• Existing production is largely destined for export market with premium price. PKS is a key biomass export with 1.72 mTonne exported in 2019 • Pulverized coal boiler which constitutes 85% of PLN CFPP capacity is largely unsuitable for PKS
Refuse Derived Fuel (RDF)	 	2,600 – 3,400	No clear price reference, below based on *reported* price from PLN and producers **IDR 300–550/kg at est NCV < 3,200 kcal/kg** Community-scale development with CSR funded capital. Note NCV varies with composition and pre-treatment **IDR 300/kg at 3,000-3,200 kcal/kg NCV** Industrial scale development with support funding from external grants	• No viable *commercial* model has been developed, existing community scale development are producing at very low capacity < 1 tonne/day • With limited potential of other biomasses in Jamali, cofiring in the region (with 76% of PLN CFPP capacity) will likely be constrained more toward RDF • Greater technical challenges, varying composition with potential contamination, higher ash content
Sawdust		±2,450	No clear price reference, below based on *reported* price from PLN **IDR 350/kg at NCV ±2,450 kcal/kg**	• Lower cost but largely unsuitable for long haul transport due to low energy density and bulk density, and more prone to weather exposure • ±140 kg/m³ Bulk density compared to coal (900), Wood pellet (780), PKS (590) (PJB Cofiring Study 2020) • Availability will competed with other existing uses, including as raw material for wood pellet production • Homogeneity of source material also need to be examined to ensure consistency
Coal		3,500 – 4,900	**IDR 766-782 /kg Average** PLN Avg coal price 2016-19 2020 PLN RKAP budget forecast of IDR 815/kg. PLN coal consumption is dominated by 4,400-5,200 kcal/kg GAR (47%) and 3,800-4,400 kcal/kg GAR (36%)	

2. PURPOSE

The purpose of this calculation is to provide a picture of the co-firing program from a financial perspective. Whether co-firing can provide more benefits and be a breakthrough that needs further development.

3. METHODOLOGY

The methodology used is Cost-Benefit Analysis, by setting the parameters to be calculated, then comparing the costs incurred with the benefits obtained. This method uses Present Value and Discounted Cash Flow techniques. Present value is the current value of a future amount—the amount of money that would have to be invested today at a given interest rate over a specified period to equal the future amount (Gitman & Zutter, 2015).
Discounting cash flows is finding present values, the inverse of compounding interest.

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Attached below is the relationship between Present Value (PV) and Discounting Cash Flow (DCF)
The formula of PV is as follows:

$$PV = \frac{FV_n}{(1+r)^n}$$

PV = Present Value
FV = Future Value
n = Number of periods

Cost-Benefit Analysis Formula :

NPV = ∑PV of Future Benefit - ∑PV of Future Costs

Benefit-Cost Ratio = ∑PV of Future Benefit / ∑PV of Future Costs

4. ANALYSIS

The biomass specifications used in this study were Sawdust and Wood Pellet.

Table 1 Specification of Biomass

No.	Item	Sawdust	Wood pellet
1	Price	± IDR 350/kg	± IDR 1.300/kg
2	Net Caloric Value (NCV) kcal/kg	± 2.450	± 4.100
3	Moisture Content	41,74%	4,5%
4			

The two types of biomass selected are adapted to the type of CFPP boiler. Wood is the basic material of biomass with different moisture content to see the differences in the financial analysis. The cost taken into account in this Cost-Benefit analysis is the cost of fuel for each kWh of fuel consumption produced to generate electrical energy following the capabilities of the CFPP. The benefit obtained is a reduction in the price of fuel, which previously used full coal. The following are the results of the calculations carried out:

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Tables 2 and 3

Project Name :	**Cofiring CFPP**	
Installed Capacity (Gross Output)	**1.050,00**	MW
CF	**79,77**	%
Data & Assumption		
Inflation	3,00%	/year
Electricity Tariff as revenue	924,67	IDR/kWh
Escalation of Power Tariff	0,00%	/year
Other income	-	IDR/kWh
Escalation of other income	0,00%	/year
	8760	Hour
Service Life (Year)	22	Year
Income tax	20%	
Growth of electrical load	5,30%	

	Full Coal 100%	
NPV	15.426.627.313	x 1000 IDR
B/C Ratio	1,27	
	Coal 95%, Biomass 5% - Sawdust	
NPV	19.457.371.203	x 1000 IDR
B/C Ratio	1,37	
	Coal 95%, Biomass 5% - Wood Pellet	
NPV	19.373.512.144	x 1000 IDR
B/C Ratio	1,37	

Wood pellet Biomass is three times more expensive than sawdust in price. However, it turns out that based on cost and benefit analysis between sawdust biomass and wood pellets, they both have a benefit-cost ratio of 1.37. This is because sawdust has more water content than wood pellets. But in general, the use of co-firing has a more positive financial value than the use of 100% Coal CFPP fuel.

A sensitivity test was also conducted, based on the results of the cost-benefit analysis of biomass with the following results:

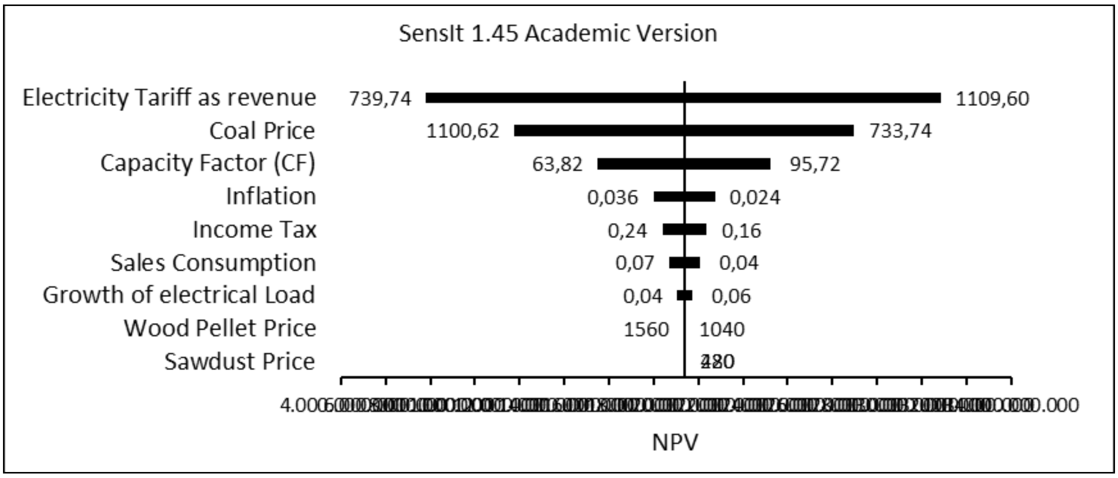

Figure 4 Sensitivity Test of Co-firing

The first sensitivity is occupied by the tariff factor as a source of revenue or benefit in the calculation. Next is the price of coal fuel. This is following the percentage of fuel which is dominated by coal. Then there are CF, inflation, tax, sales consumption, growth of electrical price, and ending with the biomass price.

5. CONCLUSION

The cost-benefit analysis result on CFPP XYZ, found that biomass as a fuel substitute has a higher benefit value than the use of 100% coal as fuel. More comprehensive studies are still needed, especially technical ones, to support the sustainability of the co-firing program in the future.

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