Role of Carbon Credit in Driving Energy Transitions in ASEAN

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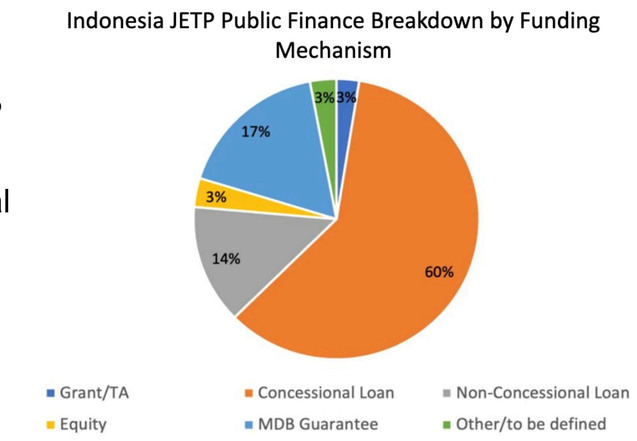
Project Introduction & Objective

Energy transition plays a critical role in Indonesia's pathway toward achieving net-zero emissions by 2060. As coal-fired power plants remain the largest source of emissions in the power sector, accelerating their retirement has become a key policy priority. This project explores a blended finance structure that incorporates carbon credits as part of the financing strategy. It evaluates the financial feasibility of retiring the Cirebon-1 coal-fired power plant by 2035—seven years ahead of its planned end-of-life—and replacing its capacity with solar energy.

I. Indonesia JETP Framework

- Indonesia's Just Energy Transition Partnership was launched at the G20 Summit in 2022, with a total commitment of USD 20 billion—50% from public sources and 50% from private investments. The initiative supports the early retirement of coal-fired power plants and accelerates the development of renewable energy across the country.
- As shown in the chart, the USD 10 billion public finance portion of JETP is structured through a blended mix of funding instruments. Concessional Loans account for the largest share (60%), followed by MDB guarantees (17%), with the remainder made up of grants, equity, and other mechanisms.



Source: JETP Indonesia Comprehensive Investment and Policy Plan 2023

II. Methodology

(1) Applied a Discounted Cash Flow model to assess project viability over two phases:

- Phase 1 (2026–2035) covers coal retirement and solar ramp-up.
- Phase 2 (2036–2053) focuses on solar operations.

(2) Optimized the capital structure using a Python-based model to minimize the Weighted Average Cost of Capital (WACC), solving the circular relationship between discount rate and financing mix.

(3) Scenario analysis evaluated NPV, carbon credit pricing, and the role of blended finance mechanism in transition project feasibility.

Blended Finance Sources
- Commercial Loan
- Concessional Loan
- Private Equity
- Carbon credit renenue

Capital Structure Optimizationl
Used Python to minimize WACC and determine the optimal weights for each financing source.

Carbon Credits' role in the project
Scenario results show how carbon credits can improve project bankability under different market conditions.

III. Model Assumptions

FCF Model Assumptions

- This illustration summarizes the logic and assumptions behind our DCF model, which calculates project free cash flow over time. The cash flow in Phase 1 and Phase 2 adoptes the same assumptions for operations.

Project Free Cash Flow	
Figures in US$ millions	2026
	Year 1
Revenue	**272**
1 Coal Power Plant	248
1 Solar Panel	24
% Growth	*0%*
2 (-) Opex	(166)
EBITDA	**106**
% EBITDA margin	*39%*
3 (-) D&A	(54)
EBIT	**51**
% EBIT margin	*19%*
3 (-) Income Tax	(13)
NOPAT	**38**
(+) D&A	54
4 (-) Change in NWC	(3)
4 (-) CapEx	(273)
FCFF	**(183)**

1. Annual Energy Generated from CFPP = 4,329,056 MWh - Annual Electricity Generated from Solar
   - ***Coal Fire Power Plant Revenue*** = *Total Electricity generated * Electricity Price*
   - CFPP PPA Price = 64 ($US / MWh)
   - Annual Energy Generated from SPP = 4,329,056 MWh/10 years = 432,906 MWh
   - ***Solar Power Plant Revenue*** = *Total Electricity generated * Electricity Price*
   - SPP PPA Price = 56 ($US / MWh)
2. (Opex Unit Cost + Average Fuel Cost) x Electricity Generation = (7.3 $US/MWh + 33.9 $US/MWh) x 432,906 MWh
   - PLTU Cirebon-1 Carbon Intensity < Carbon Intensity Cap => Financial Cost of Carbon x Carbon Intensity Above Cap=0
   - ***CFPP Opex*** = *O&M Cost + Carbon Financial Cost + One-time Decommision Cost*
   - One-time Decommision Cost = 38.4 $US mm
   - ***SPP Opex*** = *SPV Opex Unit Cost x SPV Capacity*
   - SPP Opex Unit Cost = 11,320 $US/MW
   - Launching additional 309 MW/yr in 10 yrs
3. **CFPP S-L Dep** = Net PP&E / Remaining Useful Life — Remaining Useful Life = 10 yrs
   SPP S-L Dep = CapEx/ Remaining Useful Life — Solar Panel Useful Life = 20 yrs
   Income Tax for CFPP = Tax rate for CFPP x (CFPP Revenue – CFPP Opex) — Tax Rate for CFPP = 15%
   Income Tax for SPP = Tax rate for SPP x (SPP Revenue – SPP Opex) — Tax Rate for SPP = 0%
4. **Chage in NWC** = Change in NWC as % of Revenue x Revenue — Comparable Comps Change in NWC % =1%
   - ***Solar Power Plant CapEx per yr (win 10 yrs)*** = *Solar PV Initial Unit Cost x SPP Project Capacity*
   - Solar PV Unit Cost= 870,000 $US/MW
   - 309 MW/yr

Financial Sources Assumptions

- Carbon Credit (CC) Revenue = (CC Unit Price x Electricity Generated from Solar Panels x Carbon Intensity of Solar) – (Costs from Selling CC)
  - Revenue: Base case CC price = Singapore (SG) Carbon Tax in recent 10 years, which is from US$ 35 ~ 39/tCO2 --- SG's carbon price is chosen as benchmark price by considering the maturity and stability of SG CC market
  - Cost: Total Verification Fee from Verra = 88,879 $US + Unit Transaction Fee 0.23 $US/tCO2

Financing Sources	Cost of Capital %	Notes
Commercial Loan	9%	Indonesian Lending Interest in 2024
Concessional Loan	3%	World Bank blended fixed rate
Sponsor Equity	15%	Indonesia renewable energy projects average cost of equity
Carbon Credit Revenue	0%	Treat as a grant

IV. Scenarios & Key Results

Scenario 1& 2: Test CCR Needed For Funding Gap

- Scenario 1–2 (Base vs Break-even): To achieve break-even NPV, the financing structure must shift significantly—commercial loan share drops from 16% to 1.6%, while Carbon Credit Revenue (CCR) share must rise from 4% to 18.4%. This sharply lowers WACC from 6.86% to 6.05% .

Scenarios	Commercial Loan	Concessional Loan	Private Equity	CCR	Carbon Credit Price	WACC	NPV (USD $, mn)	LCOE
Base	16%	50%	30%	4%	$35-39	6.86%	-108	59
Break-even	1.6%	50%	30%	18.4%	$161.74	6.05%	0	57

Scenario 3: Examine Effect to NPV by Increasing CCR%

- Scenario 3 (CCR Sensitivity under Fixed Structure): We tested CCR shares at 5%, 10%, 15%, and 20%, keeping concessional loan at 50% and equity at 30%. While CCR helps reduce WACC and increase NPV, the gains are marginal—NPV only turns positive at 20% CCR, underling that carbon credit alone cannot solve the bankability gap without deeper concessional support.

Commercial Loan	Concessional Loan	Private Equity	CCR	Carbon Credit Price	WACC	NPV (USD $, mn)	LCOE
15%	50%	30%	5%	$41.19	7.23%	-150	60
10%	50%	30%	10%	$84.34	6.79%	-100	59
5%	50%	30%	15%	$129.64	6.35%	-44	57
0%	50%	30%	20%	$177.19	5.91%	18	56

Scenario 4: Find Optimized Financing Structure

- Scenario 4 (Optimized Structure for Max NPV): When we relax the assumptions—reducing equity to 15% and raising concessional loans to 70% to reach coal-only NPV = 222M. At CCR prices between USD 94.87 and USD 146.20, project NPV rises to 216–306M, with lower LCOE and WACC. This shows that blended finance and carbon markets can work together to deliver financially superior outcomes over coal.

Commercial Loan	Concessional Loan	Private Equity	CCR	Carbon Credit Price	WACC	NPV (USD $, mn)	LCOE
10%	70%	15%	5%	$46.23	5.19%	135	54
5%	70%	15%	10%	$94.87	4.75%	216	53
0%	70%	15%	15%	$146.2	4.31%	306	52

Commercial Loan	Concessional Loan	Private Equity	CCR	Carbon Credit Price	WACC	NPV (USD $, mn)	LCOE
4.66%	70%	15%	10.34%	$98.29	4.72%	222	53

V. Risk Mitigations and Recommandations

Firstly, the financing gap will be addressed through blended finance combining concessional loans, MDB guarantees, equity, and carbon credit revenues with long-term PPAs and carbon price floors. Additionally, deployment delays and grid stability concerns will be mitigated by phased solar rollout. To manage policy and carbon market uncertainties, the project aligns with PLN's transition roadmap and engages with verified credit frameworks such as Verra and Singapore's compliance markets under Article 6. Meanwhile, social and workforce transition risks will be addressed through comprehensive Just Transition programs, including worker compensation, retraining, and community reinvestment, drawing on international best practices. Finally, exposure to interest rate and market volatility will be reduced by targeting 50–70% concessional capital, applying hedging instruments, and attracting ESG-driven private investors through policy incentives.