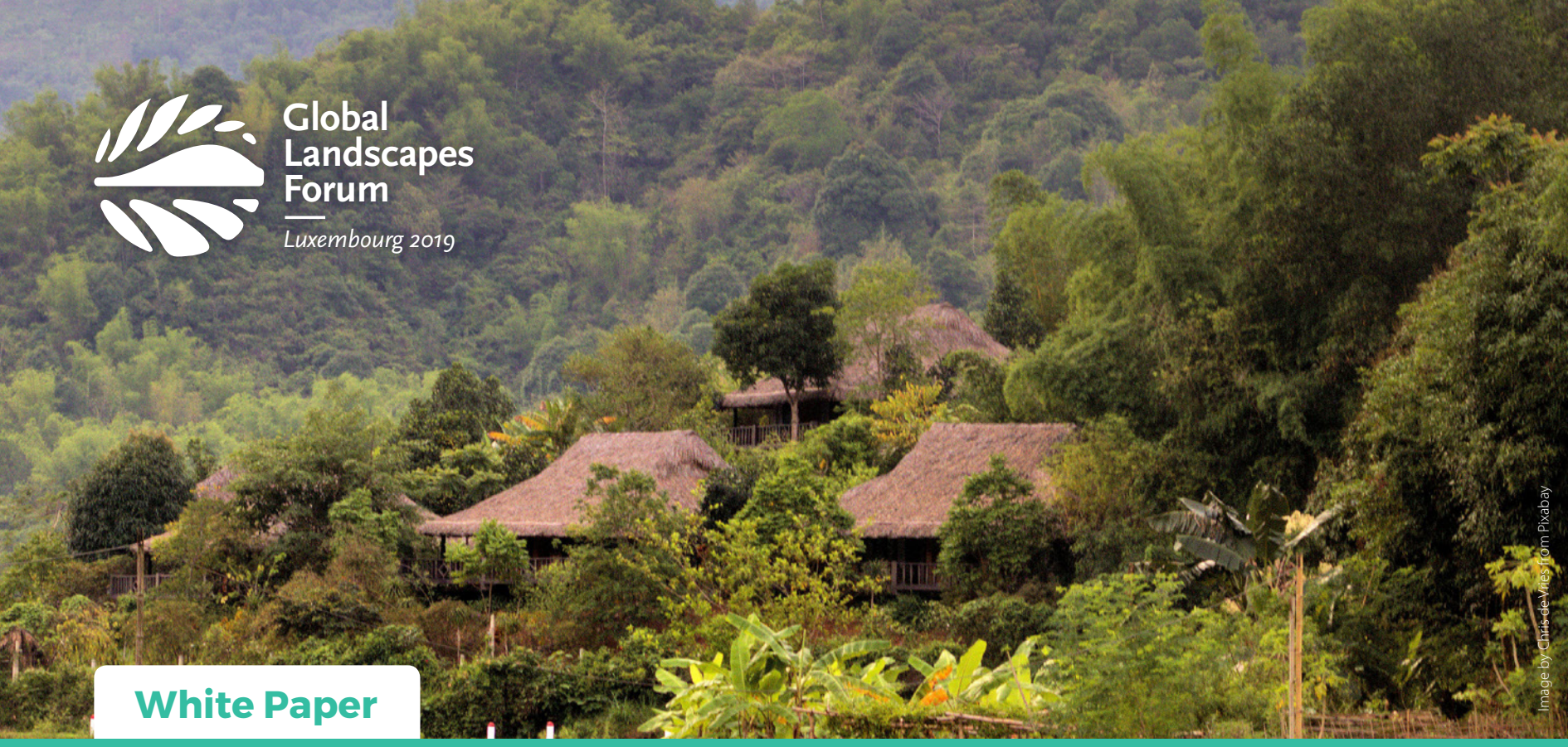

White Paper

Breakthroughs in
Sustainable Finance

Powering the Indonesian Archipelago

Through Community-based Forest Landscape Restoration and Biomass Energy

This White Paper was produced by **Clean Power Indonesia** and **Center for International Forestry Research** (CIFOR). The content of this GLF white paper is the sole responsibility of the authors

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Photo by Aris Sanjaya/CIFOR

Background and policy context

Primary energy demand in Indonesia is growing rapidly due to urbanisation, economic growth and population increase. Through the National Energy Policy (*Kebijakan Energi Nasional*), the Government of Indonesia (GoI) is committed to supplying energy to its entire population. Policies highlight the importance of diversification of energy supply, environmental sustainability and enhanced deployment of domestic energy resources. The contribution of New and Renewable Energy (NRE) to the national energy mix is mandated to reach 23% by 2025. Indonesia's Nationally Determined Contributions (NDC) stresses five sectors in which greenhouse gas (GHG) emissions are to be reduced with forestry and energy being of highest priority. The country's NDC implementation strategy clearly identifies restoration of degraded land for renewable energy as key activity, that allows engaging a wide range of stakeholders including government agencies, private sector and local communities. Vast areas of degraded and underutilised land are available for restoration and biomass energy in the country, providing an opportunity to engage local communities in restoring degraded land and improving rural livelihoods, while supporting the achievement of climate and development goals, including the Sustainable Development Goals (SDG).

Current challenges

Indonesia is a large country with a population of over 260 million people; the fourth most populous country on earth. As the biggest archipelago in the world, consisting of more than 17,500 islands, Indonesia has a serious challenge to distribute electricity to the whole population. Currently, only big cities have adequate power distribution, whereas in rural areas the electricity ratio is still very low. In Indonesia, around 40,000 villages on 4,000 islands remain without permanent electricity supply. This amounts to more than 50 million people in rural communities without access to reliable power. People in rural areas are still using kerosene lamps or expensive diesel-generators for simple lighting, making energy bills 10-20 times higher than what people are paying in Jakarta or other big cities in Indonesia. This imbalance adds to the 'poverty-energy trap', where the poorest members of society are least likely to have access to power, and without access to power they are more likely to remain in poverty.

Currently, Indonesia is very dependent on (often imported) fossil fuels for energy, including crude oil, coal and natural gas.

However, if these resources continue to be exploited at current rates to meet demand, reserves will be depleted and finally run out. If this trend continues, Indonesia will surely experience an energy crisis in the future.

One way to prevent such crisis is to begin using locally accessible renewable energy resources, such as hydro, wind, solar, geothermal and biomass. These, however, are not always possible to be developed in every region of Indonesia. For example, hydro and geothermal resources are limited to specific locations and electricity from these resources can only be distributed locally. Wind power has not proven to be easily generated, since Indonesia has unstable and weak wind patterns due to its proximity to the equator. Moreover, many locations in Indonesia are frequently cloudy, resulting in low potential for solar energy.

Geographically, Indonesia is in a region of high rainfall and high temperatures throughout the year, and with conducive soil conditions for various types of perennial plants. These conditions are ideal to supply energy from plant biomass locally and sustainably.

Suitable renewable energy for Indonesia

Community-based plant and forest biomass offers a suitable, effective, and sustainable source of renewable energy for remote villages and islands in Indonesia. With over 24 million of hectares of degraded lands and lands that are being used to plant crops, there is a great potential to combine land restoration with biomass production. Bamboo is among the plants that are native to most islands in Indonesia and suitable for producing local biomass in all sorts of conditions..

While a variety of biomass energy crops exist in Indonesia, this paper discusses mainly bamboo. Bamboo is not only an excellent source of bioenergy, but also can be utilized for a wide range of biomaterials and ecosystem services (see Paudyal et al 2019). While bamboo has yet to achieve the attention it deserves as the next green fuel (bioenergy) material to be utilized in Indonesia, it is a biomass for the future. Bamboo is a native and environmentally friendly plant that can regenerate quickly and easily (it can grow up to 2 meters in 1 week). There are about 150 bamboo species widely available and socially accepted across the archipelago. The benefits of bamboo are well known among rural communities; it serves as material for products that are sold or used at home. It is a versatile plant, combining food, medicine, textile and construction uses. It is planted along riverbanks to prevent floods, along steep slopes to prevent erosion, along roads to provide shade, and in critical land to restore degraded land. Though its benefits are plentiful, it requires little water, fertilizer and maintenance. Moreover, bamboo can be a tool for large-scale carbon storage, with well-managed bamboo forests able to sequester carbon at a higher rate than many tree species.

When using bamboo as an energy source in Indonesia benefits are threefold: first, an increase in the use of renewable energy, limiting Indonesia's dependency on imported fossil fuel and contributing to climate change mitigation. Second, the production and sale provide income and livelihood opportunities in remote places of Indonesia, contributing to alleviating income disparities across the country. Finally, bamboo helps restoring large areas of degraded and underutilized lands found around most rural communities.

First bamboo-based biomass power plant in Asia-Pacific

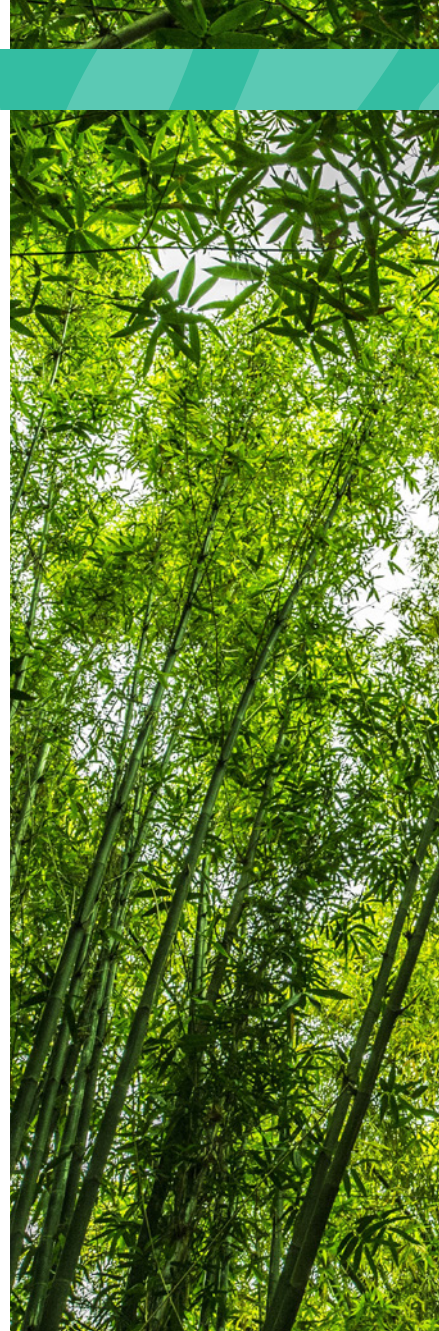
In 2018, the firm Clean Power Indonesia (CPI) developed an operational model that can be replicated around the Indonesian archipelago. Three remote villages, namely Saliguma, Madobag and Matotonan in Siberut Island of the Mentawai Islands in West Sumatra, Indonesia, were selected to develop biomass energy projects.

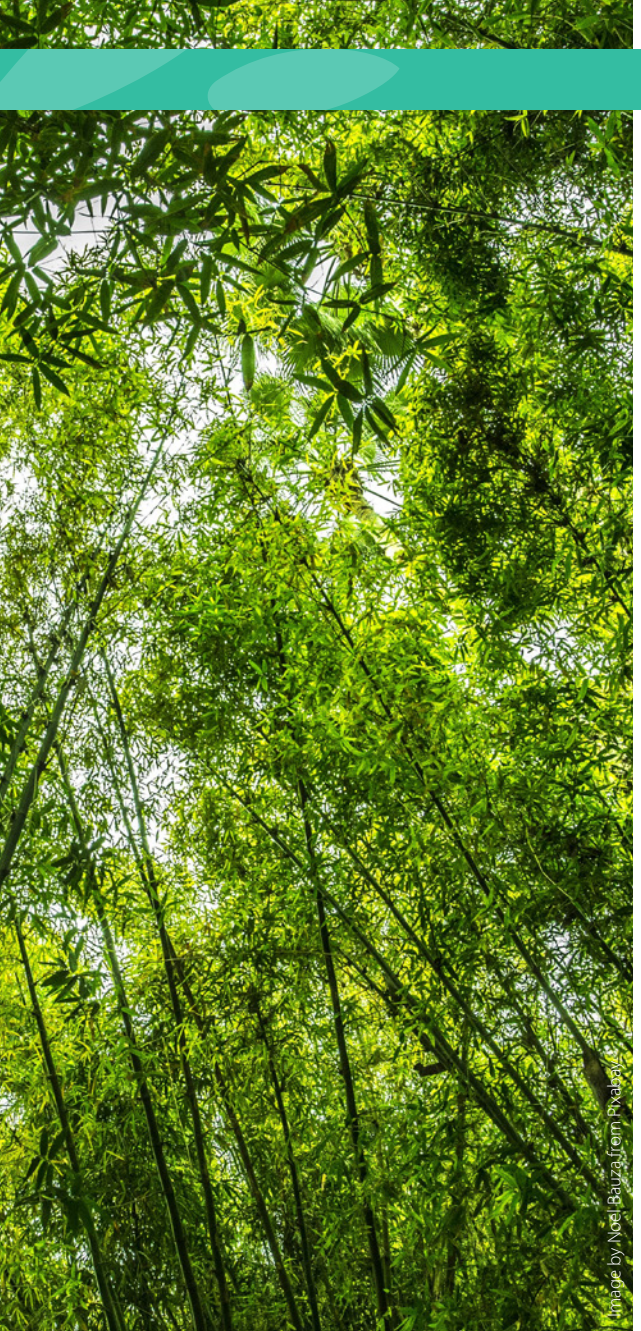
Around 6,000 people live in the 3 villages selected for mini-grid installation. A pre-project survey revealed a total electricity demand for 1,200 households at around 700 kW. , Applying technology due diligence, the "Down Draft Gasification" technology from India was selected. Gasification converts solid fuels such as wood, wood-waste, bamboo, or agricultural residues and wastes into a combustible gas.

Seeking an extension of the electricity supply for commercial and productive uses, the village of Saliguma, located in a bay area, plans to construct a new cold storage and seaweed processing facility. The village of Madobag intends to scale-up their sago processing facility and expand into other agroforestry products. The village of Matotonan, located near the national park of Siberut, will use the newly built electricity for domestic and tourism uses. The three villages have become a reference for the other 40,000 villages across the Indonesian archipelago on how to build self-sustaining renewable energy mini-grids to power homes and enterprises.

The Mentawai energy project in the 3 villages is based on a partnership between the communities, the state-owned utility company (PLN) and CPI. In this turnkey electricity generation and distribution project, PLN purchases all electricity generated by the project under a 20-year Power Purchase Agreement (PPA) for a regulated price of USD 0.15 per kWh. PLN then sells the electricity purchased from the project to the community at its National Electricity Rate (TDL) of 415 IDR/ kWh (~USD 0.031). In turn, a 20-year Feedstock Supply Agreement allows purchasing all bamboo feedstock produced by the villages for a set price at 25% of PLN's electricity tariff paid to the project. This heavily subsidized tariff allows the local community to realize excess income from supplying bamboo feedstock to the project after paying for the electricity from PLN.

The Mentawai project was funded by a grant from the USA-based Millennium Challenge Corporation (96%), and in-kind contributions by CPI and its local government partner. The cost of the mini-grid project included eight units of distributed power generation, electricity grid and electrical installation in more than 1,300 homes, plus about 300 hectares of newly established bamboo forest as well as commissioning and training for local operators. The total capital cost was USD 12.5 million.





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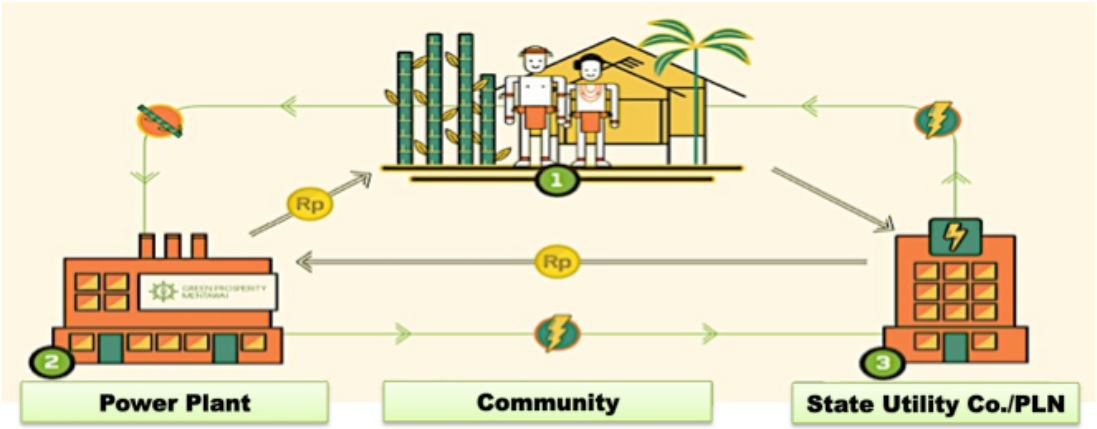
Sustainable project financing scheme

For the local expansion of the project to be commercially feasible, three separate investments need to be in place: i) developers that only focus on the power plant development, ii) PLN to provide the network distribution and off-taker guarantee, and iii) the regional government or ministries responsible for bamboo farming activities, including funding and training for communities.

Funding for land restoration and livelihood improvement for rural communities can be used to complement the power plant investment from the private sector. PLN acts as guaranteed off-taker all over Indonesia and therefore projects can be funded under project finance schemes. Aside from being the off-taker, PLN can also offer state subsidies to consumers in remote areas. This role guarantees affordability regardless of location. The diagram below shows the relationships between communities as biomass producer, private sector as power plant investor, and PLN (or state owned utility company) as off-taker.



Mentawai project outcomes and expectation for future projects

With the aggregated power of 700 kW generated by the project, the 1,300 households in 3 remote villages are directly benefiting. The economic situation of the villages has stabilised, and growth is expected with future installations of cold storage units, improvements in agroforestry, and increased electricity access for commercial and productive uses.

Around 450 direct jobs were created in the villages – 150 jobs in each. The sustainability of the mini-grids is high: Each village is realizing about 3,000 tonnes CO2e/year from emission avoidance and carbon sequestration due to new bamboo planting. These indicate the highest impact on job creation and carbon sequestration found across renewable energy projects in South and Southeast Asia (see Table 1).

Table 1. Overview of mini-grid case studies and their impact in rural South and South-East Asia

Private Developer(s)	Location	Commissioning year	Size & technology	Households electrified	Jobs Created	Annual GHG emissions avoided (tonnes CO_2)
Rahimafrooz Renewable Energy	Ghorjan Island, Bangladesh	2018	80 kWp solar PV hybrid	310	60	25
Okra and Pteah Baitong	Kbal Damrei, Cambodia	2018	8 kWp solar DC hybrid	64	5	1
Mlinda Foundation	Sahitoli, India	2016	22.4 kWp solar PV hybrid	124	18	29
Tara Urja	Derni, India	2018	31.2 kWp solar PV hybrid	141	43	44
Clean Power Indonesia	Mentawai, Indonesia	2018	700 kWp biomass gasifier	1,250	450	3,000
Mandalay Yoma	Dee Doke South, Myanmar	2018	55 kWp solar PV hybrid	126	23	5
Yoma Micro Power	Thit Seint Gyi Village, Myanmar	2017	31.2 kWp solar PV hybrid	270	20	23
Gham Power	Khotang, Nepal	2015	52 kWp solar PV hybrid	650	200	36
Subas and Sujan Electric Service Center	Simli Khola, Nepal	2016 (original project start 2009)	29 kWp hydro	495	140	9
PowerSource Philippines	Rio Tuba, Philippines	2016 (original project start 2005)	893 kWp biomass gasifier	1,885	16	n/a
Blue Solar and Symbior Solar	Koh Jik Island, Thailand	2018 (original project start 2004)	60 kWp solar PV hybrid	400	13	85

Source: Alliance for Rural Electrification, (2019)
https://www.ruralelec.org/sites/default/files/Final.pdf

Scaling up biomass energy and land restoration goals

As part of the future expansion of mini-grids, the project is going to spread to other villages in Mentawai (about 43) and the neighbouring island of Nias.

Drawing from the lessons in community-based distributed power generation in Mentawai, CPI is scaling up biomass energy and developing further projects in other parts of Indonesia, focusing first on Lampung Province, Indonesia. The Lampung landscape restoration project, for instance, intends to convert an existing 14 MW power plant operated by PT PP Energi in Central Lampung District from coal to biomass, extended to 60 MW using additional biomass feedstock in a second phase.

These new projects are at an early conceptual stage and have engaged the Indonesia Ministry of National Development Planning (BAPPENAS), PT. PP Energy Indonesia, Global Green Growth Institute (GGGI), and Center for International Forestry Research (CIFOR). International financing and investment in the projects are being pursued. The total capacity anticipated to be developed in the next five years is about 500 MW, all using locally sourced biomass.

Biomass power generation systems combined with landscape restoration not only support rural livelihoods, but also contribute to several international commitments and agreements such as the Bonn Challenge, a global effort to restore 350 million hectares of degraded land by 2030, the Paris Climate Agreement and the Sustainable Development Goals.

Reference

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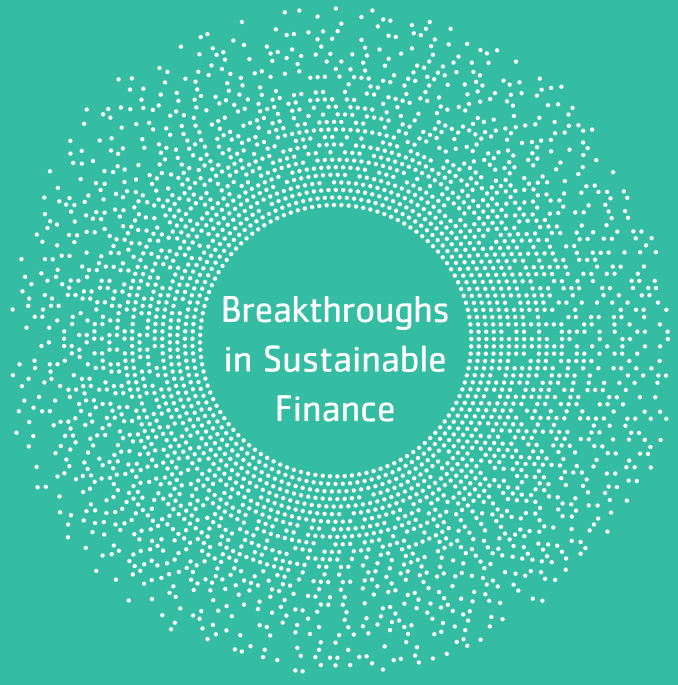
Image by Jamie Nakamura from Pixabay



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