BIOMASS ENERGY

for Climate Change Mitigation & Adaptation in South Pacific
NABOU BIOMASS POWER PLANT
2. NABOU BIOMASS POWER PLANT

Project Overview

1. **PROJECT TYPE:** BIOMASS POWER PLANT (Renewable Energy)
2. **LOCATION:** NABOU, WESTERN DIVISION, FIJI
3. **CAPACITY:** 12MW (Covering 40,000 households)
4. **FUEL:** WOOD BIOMASS (Wood Chip)
5. **CONSTRUCTION PERIOD:** 28 Months (200 job creation)
6. **OPERATING PERIOD:** 25 Years (Operator 50 jobs, Forest 100 jobs)
7. **OFFICIAL OPENING:** July 27, 2017
2. Nabou Biomass Power Plant

**Project Structure**

**Consulting Group**
- **Finance**: Mirae Asset Daewoo
- **Fuel**: Indufor
- **Tech**: Jacobs (SKM)
- **F/S**: Korea Rating

**Shareholders**

**Off-taker**

**Fuel Supplier**
- Eltech

**Construction**
- gimco

**Plant Operation**
- NABOU GREEN ENERGY
  - O&M
  - Interest
  - Debt

**Finance**
- MIRAE ASSET

**Off-taker**
- fia
2. NABOU BIOMASS POWER PLANT

Fuel Supply – Biomass Energy

- Stable fuel sourcing strategy and fuel handling “know-how” are the key factors to a successful biomass project.

* < Biomass Value Chain >

- **Forest Residue**
  - Initial fuel source
  - Tops & branches that have fallen to the forest floor

- **Logging / Sawmill**
  - Leftovers from sawing and wood products

- **Factory Residue**
  - Energy crop for use as fuel for power plants

- **Short Rotation Tree**

- **Fuel Storage**
  - Fuel chipping / resizing
  - Fuel drying
  - Removal of non-wood components

- **Fuel Handling**

- **Power Plant**
BIOMASS ENERGY PROGRAMME
IN SOUTH PACIFIC
1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

Programme Background

- **Energy** is a cornerstone of national advancement.

- **Greening energy system** contributes to directing national development towards a sustainable pathway.

- South Pacific Islands Countries (SPICs) are actively exploring viable alternative energy sources as their energy needs are met predominantly by diesel generation. Given the region’s **heavy reliance on imported fossil fuels**, we aim to help the SPICs increase the uptake of renewable energy (RE), and ensure **energy security** across the region.

- Hence, we propose a “**Biomass Energy Programme in the South Pacific**” with Korea Development Bank (KDB) and Green Climate Fund (GCF).
1. **HOST COUNTRIES**: Fiji & Papua New Guinea (PNG)

2. **FOCUS CATEGORIES**: Mitigation (Power Generation) / Adaptation (Plantation)

3. **FINANCING SIZE**: U$ 500 mil (approx., funded by GCF, KDB, Mirae Asset Daewoo)

4. **EXECUTIVE ENTITY**: Korean Consortium SPC

5. **BRIEF SUMMARY:**

   - The proposed programme plans to build and distribute **biomass power plants across SPICs**.
   - Starting with a 12 MW power plant in Fiji Sabeto district.
   - Following the completion of the plant in Sabeto, we intend to leverage the biomass deployment model for **scaling-up and replication** to other parts of targeted area.
   - This RE initiative is to help SPICs make a desirable transition to the **RE-based system**, and further realize their full potential.
1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

**Programme Components**

**COMPONENT 1: SIX BIOMASS POWER PLANTS (12MW each)**
- 4 Biomass Power Plants in Fiji / 2 Biomass Power Plants in PNG
- Expected total cost for Comp. 1 is around U$ 300 mil, each costs around $U 50 mil

**COMPONENT 2: WOOD PELLET PLANT**
- Wood Pellet Plant in Fiji for 500,00 ton/yr Production
- Expected total cost for Comp. 2 is around U$ 200 mil

**COMPONENT 3: TECHNICAL ASSISTANCE**
- Provide to create an enabling environment for a successful delivery of the other two components
1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

Sabeto Biomass Power Plant - Location

Sabeto Biomass Power Plant

Nabou Biomass Power Plant
1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

Sabeto Biomass Power Plant – Structure (Tentative)

Consulting Group

- Finance: Mirae Asset Daewoo
- Fuel: Indufor
- Tech: Jacobs (SKM)
- F/S: Korea Rating

Shareholders

- gimco
- GS 파워
- MIRAE ASSET

Off-taker

- fea

Fuel Supplier

- Eltech

Construction

- gimco

Plant Operation

- SPC

O&M

- FSA
- EPC

SABETO IPP

- Interest
- Debt

Finance

- KDB Bank

Equity

- Dividend

Finance Consulting Group

- Finance: Mirae Asset Daewoo
- Fuel: Indufor
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1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

Biomass Fuel

- Securing biomass fuel source (wood) with sustainability is key to successful programme delivery

<table>
<thead>
<tr>
<th>Item</th>
<th>Securing Method</th>
<th>Size</th>
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<tbody>
<tr>
<td>Short Rotation Tree (Energy Wood)</td>
<td>Plantation (Rotational)</td>
<td>5,000 ha / 12MW plant</td>
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<td>African Tulip (Invasive)</td>
<td>Eradication with MF</td>
<td>10 million ton (est.) in Viti Levu</td>
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<tr>
<td>Wood Residues</td>
<td>Sawmill/Logging</td>
<td>50,000 ton/yr in Western Division</td>
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Biomass Fuel – Short Rotation Tree (Energy Wood)

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<td>Short Rotation Tree (Energy Wood)</td>
<td>Plantation (Rotational)</td>
<td>5,000 ha per 12MW plant</td>
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- 5,000 ha is already secured and being planted for Nabou power plant.
- Additional 5,000 ha on abandoned farming area will be utilized for Sabeto plant.
- Gliricidia Sepium and Acacia Mangium are primary species.
### 1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

#### Biomass Fuel – African Tulip (Invasive)

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- African Tulip is the most invasive species tree in South Pacific
- Utilizing it as biomass fuel can bring the invaded land back to farmers
- After eradication, the land also can be used for energy wood plantation
### Biomass Fuel – Wood Residues

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- Sawmill Residue: Sawdust, Shaving, Off-cuts are being dumped or burned
- Harvesting Residue: only 70% of trees (Pine, Mahogany, Raintree) are being taken to sawmill, other branches and small logs are left with accelerated carbon decay
### Biomass Fuel – Wood Residues

<table>
<thead>
<tr>
<th>Species</th>
<th>Residue Generated (ton/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Forest</td>
<td>25,737</td>
</tr>
<tr>
<td>Pine</td>
<td>163,061</td>
</tr>
<tr>
<td>Mahogany</td>
<td>15,858</td>
</tr>
<tr>
<td>Wood Chips</td>
<td>18,900</td>
</tr>
<tr>
<td>Saw Milling</td>
<td>7,240</td>
</tr>
<tr>
<td>Wood Veneer Sheets</td>
<td>4,335</td>
</tr>
<tr>
<td>Plywood</td>
<td>1,200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>236,331</strong></td>
</tr>
</tbody>
</table>

*IRENA, Fiji: Renewable Readiness Assessment*
1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>PROJECT</th>
<th>SIZE</th>
<th>EMISSION REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIJI</td>
<td>NABOU BIOMASS POWER PLANT (2017)</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>SABETO BIOMASS POWER PLANT (2020)</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>3RD BIOMASS POWER PLANT (2022)</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>4TH BIOMASS POWER PLANT (2024)</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>5TH BIOMASS POWER PLANT (2026)</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>WOOD PELLET PLANT (2022)</td>
<td>24 MW</td>
<td>74,848 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td><strong>SUBTOTAL</strong></td>
<td><strong>84 MW</strong></td>
<td><strong>261,968 tCO2eq/yr</strong></td>
</tr>
<tr>
<td>PNG</td>
<td>1ST BIOMASS POWER PLANT</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
</tr>
<tr>
<td></td>
<td>2ND BIOMASS POWER PLANT</td>
<td>12 MW</td>
<td>37,424 tCO2eq/yr</td>
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<td><strong>SUBTOTAL</strong></td>
<td><strong>24 MW</strong></td>
<td><strong>74,848 tCO2eq/yr</strong></td>
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<tr>
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<td><strong>TOTAL</strong></td>
<td><strong>108 MW</strong></td>
<td><strong>336,816 tCO2eq/yr</strong></td>
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</table>

* by 2026, most of fossil fuel power generation in Fiji can be replaced with biomass power plants

* Emission Reduction = Baseline Emission – Project Emission
## 1. BIOMASS ENERGY PROGRAMME IN SOUTH PACIFIC

### Climate Change - Adaptation

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
<th>Increasing Resilience</th>
</tr>
</thead>
</table>
| Agricultural (Farming)    | - Climate Change affecting farming Product (Drier, Cooler, Extreme Events)  
                          | - Idle farming area is rapidly increasing (income loss, job loss)                 | - Energy wood plantation on idle farming area for farmers income & job security        |
| Forest Ecosystem (African Tulip) | - Ecosystem Disturbance                                               | - Utilizing as biomass fuel promotes its eradication  
                          |                                                                                     | - Forest ecosystem stabilization  
                          |                                                                                     | - Replantation with Energy wood |

Gimco
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Conclusion

• With **Biomass Energy**,  
  ✔ SPICs National Renewable Energy Target Implementation  
  ✔ Climate Change Mitigation With Low Emission Development  
  ✔ Increase resilience on climate change with adaptation mechanism  
  ✔ National GDP improvement and other social benefits (Job, Energy Security, Technology)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Current</th>
<th>Targets</th>
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<tr>
<td>Fiji Electricity Generation with Renewable Energy</td>
<td>Around 50%</td>
<td>81%</td>
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