ACCELERATING FINANCIALLY VIALBE HYDRO MINI GRIDS

A CLOSER LOOK AT SMALL-SCALE HYDROPOWER IN S/SE ASIA

4th International Off-grid Renewable Energy Conference and Exhibit (IOREC)
Session Moderator

Dr. Binu Parthan, Sustainable Energy Associates

Presentors

Mr. Bir Bahadur Ghale, Hydro Energy Concern Pvt. Ltd.
Ms. Dipti Vaghela, Hydro Empowerment Network

Panelists

Mr. Bikash Pandey, Winrock International
Mr. Kapila Subasinghe, DFCC Bank Sri Lanka
Ms. Trimumpuni, IBEKA
Senator Adrian Banie Lasimbang, Tonibung
Ms. Rana Ghoneim, UNIDO
Mr. Gerhard Fischer, ASEAN Hydropower Competence Centre (HYCOM)
Case Profile

Nepal’s Barpak Micro Hydro Project

Bir Bahadur Ghale, Project Developer/Owner

- 1986: Dynamo water mill
- 1991: 50 kW hydro plant
- 2004: 130 kW hydro plant
- 2015: Earthquake
- 2018: Upgrade to 500kW
<table>
<thead>
<tr>
<th></th>
<th>1991 - 2004</th>
<th>2004 - present</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation Capacity</strong></td>
<td>50 kW</td>
<td>130 kW</td>
</tr>
<tr>
<td><strong>Design Flow &amp; Head</strong></td>
<td>100 l/s Flow, 96 m Head</td>
<td>90 l/s Flow, 193 m Head</td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>564 households, plus enterprises</td>
<td>1186 households, plus enterprises</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>6.4 km LT line, 1.8 km MT line</td>
<td>12 km LT line, 2.8 km MT line (11kV)</td>
</tr>
<tr>
<td><strong>Project Cost</strong></td>
<td><strong>USD 58,022</strong></td>
<td><strong>USD 158,000</strong></td>
</tr>
<tr>
<td><strong>Government Subsidy</strong></td>
<td>20% (USD 11,600)</td>
<td>48% (USD 74,000)</td>
</tr>
<tr>
<td><strong>Loan</strong></td>
<td>60% (USD 34,810 USD) from Agricultural Development Bank</td>
<td>40% from relatives</td>
</tr>
<tr>
<td><strong>Equity</strong></td>
<td>20% (USD 11,600)</td>
<td>12%</td>
</tr>
</tbody>
</table>
### Barpak Micro Hydro Project

#### Productive End Use

<table>
<thead>
<tr>
<th>Type of End Uses</th>
<th>Max. Load (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agro processing mills x5</td>
<td>20 kW</td>
</tr>
<tr>
<td>Oil Expeller mills x2</td>
<td>12 kW</td>
</tr>
<tr>
<td>High vision hall x1</td>
<td>1.2 kW</td>
</tr>
<tr>
<td>Cyber cafe x1</td>
<td>0.8 kW</td>
</tr>
<tr>
<td>Photo studio x1</td>
<td>0.8 kW</td>
</tr>
<tr>
<td>Metal workshop x2</td>
<td>12 kW</td>
</tr>
<tr>
<td>Stone Cutting Mill x3</td>
<td>12 kW</td>
</tr>
<tr>
<td>Bakery (Off hours) x1</td>
<td>12 kW</td>
</tr>
<tr>
<td>Mobile Tower x3</td>
<td>12-20 kW</td>
</tr>
<tr>
<td>Feed Mill x1</td>
<td>4.5 kW</td>
</tr>
<tr>
<td>Furniture Mil x2</td>
<td>13 kW</td>
</tr>
<tr>
<td>Cable TV x1</td>
<td>1.2 kW</td>
</tr>
<tr>
<td>Electronic Repairing Center x3</td>
<td>1.2 kW</td>
</tr>
</tbody>
</table>

**Total Load = 105.7kW**
Barpak Micro Hydro Project

Financial Viability

Factors for Success

- Ownership structure: private - with clear incentive to promote productive end-uses and maximize energy sales.
- Technically competent owner/ operator
- Awareness raising and financing to increase productive end use; MHP is used much more than for lighting.
- Fair and transparent tariff setting, using a time-of-use structure.
- Capacity meets the demand

Tariff Structure

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Service</th>
<th>Flat Rate for Min. 25 Units</th>
<th>Per Unit Rate Above Minimum</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1 phase, up to 5A</td>
<td>USD 1.50</td>
<td>USD 0.07</td>
<td>24 hours</td>
</tr>
<tr>
<td>Dedicated 24 Hours Lines</td>
<td>3 phase, up to 25 kVA</td>
<td>USD 0.10 - 0.12</td>
<td></td>
<td>24 hours</td>
</tr>
<tr>
<td>Day time cottage industries</td>
<td>3 phase, up to 10 kW</td>
<td>USD 30</td>
<td>USD 0.08 - 0.10</td>
<td>7AM - 6AM</td>
</tr>
<tr>
<td>Off hours cottage industries</td>
<td>3 phase, up to 20 kW</td>
<td>USD 10</td>
<td>USD 0.03</td>
<td>11 PM - 5AM</td>
</tr>
<tr>
<td><strong>Case Profile</strong></td>
<td>Myanmar’s Mae Muk Waterfall Micro Hydro Project</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dipti Vaghela on behalf of U Sai Htun Hla, Project Co-developer/ Co-owner</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Plant Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>30kW hydro plant</td>
</tr>
<tr>
<td>2015</td>
<td>80 kW hydro plant</td>
</tr>
<tr>
<td>2018</td>
<td>Upgrade to 300kW</td>
</tr>
</tbody>
</table>

### Generation capacity
- 80kW to be upgraded to 300kW

### Design Flow and Head
- 100 l/s dry season, 200 l/s wet season; 183 meters

### Connections
- 600 households, plus enterprises and social services

### Transmission
- 32 km MT line (11kV), plus 32 km LT line, covering 11 villages

### Project Cost
- USD 380,000 (as per current exchange rate)

<table>
<thead>
<tr>
<th><strong>Government Subsidy</strong></th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loan</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Equity</strong></td>
<td>60% from shareholders, 40% from connection fees</td>
</tr>
</tbody>
</table>
Mae Muk Waterfall Micro Hydro Project

Productive End Use

External Enterprises
- Coffee plantations, 2
- Fuel pump, 1
- Poultry farm, 1
- Rice mill, 1
- Telecom tower, 2

Villager Enterprises
- Brick making
- Cash crop farming
- Daily goods shops
- Damson fruit processing
- Fabrication shop
- Lime baking
- Scaled lettuce crop
- Silkworm breeding
- Tailoring
- Truck rental
- Vehicle repair shop
- Wood working

Social Services
- Health clinics, 2
- Monasteries, 10
- Public centres
- Schools, 8
- Streetlights

Household Use
- Carpentry tool, 1
- Corn thrasher, 1
- Electric rice cookers, ~250
- Electric frying pans, ~200
- Fans, many
- Grinders, several
- Mobile phone charging, many
- Rice mills, several
- Refrigerators, several
- Televisions, many
- Water heaters, several
- Washing machines, several
- Water pumps, many
Mae Muk Waterfall Micro Hydro Project

Financial Viability

Tariff Structure (as per current exchange rates)

<table>
<thead>
<tr>
<th>Services (24 hours)</th>
<th>Residential</th>
<th>Village Enterprises</th>
<th>Shareholders (Cooperative Members)</th>
<th>Dedicated Lines (External Enterprises)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Phase</td>
<td>USD 0.16</td>
<td>USD 0.16</td>
<td>USD 0.08</td>
<td>USD 0.16</td>
</tr>
<tr>
<td>3-Phase</td>
<td>USD 0.25</td>
<td>USD 0.25</td>
<td>USD 0.13</td>
<td>USD 0.16</td>
</tr>
</tbody>
</table>
**Viable Renewable Energy Mini-Grids**

**Factors for Efficiency, Equity, and Scalability**

- **Ownership Models**
  - Community Owned
  - Cooperative Owned
  - Developer Owned
  - Cooperative + Developer

- **Financing Modes**
  - Full Grants
  - Subsidies
  - Loans/Shares
  - Re-invested Revenue

- **Management Structures**
  - User Group Based (VECs)
  - Traditional Cooperatives
  - Myanmar Cooperatives
  - Private Limited Companies

- **Techno-Economic Options**
  - Biomass Gasifiers
  - Micro Hydro
  - Solar PV

**Economic Viability of Small-Scale Hydropower in Nepal and Myanmar**

- **Input Factors**
  - Efficiency
  - Equity
  - Scalability

**Output Metrics**

Lin Yang Chi Micro Hydro Cooperative-Owned Utility in Myanmar

Photo Credit: D. Vaghela
Louis, master machinist at the Centre for Renewable Energy Appropriate Technology (CREATE), Malaysia

Photo Credit: D.Vaghela
HPNET S/SE Asia Regional *Training of Trainers for Electronic Load Controllers*, supported by Wisions SEPS, at ASEAN Hydropower Competence Centre (HYCOM)

Photo Credit: D. Vaghela
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