"Micro hydro Power Development Nepal"

-Madhusudhan Adhikari
- National Advisor
Community Electrification
AEPC/NRREP
INTRODUCTION

Per capita income US$ 562 and

85% population live in rural areas (total 26.6 million) and agriculture main occupation

Per capita energy consumption is 14 GJ

60% population have access to electricity including 14% from RETs
Share of Energy Consumption by fuel types
Share of Energy Consumption by the Fuel Types

- FUEL WOOD (77.7%)
- PETROLEUM (8.2%)
- COAL (1.9%)
- ELECTRICITY (2%)
- BIO GAS (0.6%)
- MICRO HYDRO (0%)  
- SOLAR (0%)
- AGRICULTURAL RESIDUE (3.7%)
- ANIMAL DUNG (5.7%)
### Current sources of Electricity in GWh

- **NEA Hydro, 2104.52**
  - NEA Thermal, 13.12
  - Purchase (Total), 1571.63

- **Purchase from India, 612.58**
  - NEA Hydro
  - Nepal (IPP), 959.05

- **Import, 612.58**
- **Domestic Generation, 3076.69**
- **Load Shedding, 677.86**

### Energy Resources Potential Current Development Status

<table>
<thead>
<tr>
<th>Energy Resources</th>
<th>Potential</th>
<th>Current Development</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro Power Potential</td>
<td>83000 MW</td>
<td>~700 MW</td>
<td></td>
</tr>
<tr>
<td>Solar Potential</td>
<td>2100 MW</td>
<td>20 MW</td>
<td></td>
</tr>
<tr>
<td>Biogas Potential</td>
<td>1.1 million</td>
<td>250,000 (no. of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>plants</td>
<td>plants)</td>
<td></td>
</tr>
<tr>
<td>Wind Potential</td>
<td>3000 MW</td>
<td>~0.5 MW</td>
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</tbody>
</table>
INTRODUCTION

![Rivers of Nepal Map]

- **Rivers No.:** 6000
- **Hydro Potential:** 84000 MW
- **Generation:** 705 MW
INTRODUCTION

Rivers No. : 6000
Hydro Potential : 84000 MW
Generation : 705 MW
HYDRO RESOURCES IN NEAPL
POWER (GRID) DISTRIBUTION IN NEPAL
Alternative Energy Promotion Centre

- Established on November 3, 1996.
- Currently under the Ministry of Science, Technology and Environment.
- Semi autonomous status; Board represented by public sector, private sector & financial sector.
- Working as a national focal agency for alternative/ renewable energy in Nepal.
- Mandate: policy and plan formulation, resource mobilization, technical support, M&E, standardization, quality assurance & coordination.
Mission and Vision

• The mission of AEPC is to make renewable energy mainstream resource through increased access, knowledge and adaptability contributing for the improved living conditions of people in Nepal.

• The Vision of AEPC is to make it "An institution recognized as a regional/international example of promoting large-scale use of renewable energy sustainably and a national focal point for resource mobilization"
**Achievement of AEPC**

- Private Sector Development
  - more than 350 enterprises in RE sector and increased other business at village level from end-use application.
- Around 30,000 job creations at local level.
- Positive outcomes on education of children
- Improved access to information and communication
- Reduce drudgery for women and girl and increased their involvement in household decision making
- Reduce indoor air pollution and improved health
- Positive impact on environment by replaces fossil fuels and reducing firewood consumption
National Rural and Renewable Energy

✓ National Rural & Renewable Energy Programme (NRREP)

✓ Single Program Modality
✓ Starting Date: 16 July 2012
✓ Duration: 5 years
✓ Budget: USD 184 Million
  (Around Rs. 15.64 Billion)
## NRREP Targets

<table>
<thead>
<tr>
<th></th>
<th>Target Description</th>
<th>Target Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mini and Micro Hydro Power</td>
<td>25,000 kW (150,000 HHs)</td>
</tr>
<tr>
<td>2.</td>
<td>Solar Home Systems</td>
<td>600,000</td>
</tr>
<tr>
<td>3.</td>
<td>Improve Cookstoves</td>
<td>475,000</td>
</tr>
<tr>
<td>4.</td>
<td>Household biogas systems</td>
<td>130,000</td>
</tr>
<tr>
<td>5.</td>
<td>New MSMEs establishment</td>
<td>1300</td>
</tr>
<tr>
<td>6.</td>
<td>Employment Increased by MSMEs</td>
<td>19000</td>
</tr>
</tbody>
</table>
Outputs of Community Electrification

- Project management capacity is in place and performing, and number of completed projects increases at a faster rate.
- Community electrification projects better designed with regard to available potential, and operate at a higher load factor.
- Community electrification technology is scaled-up and is of a higher standard.
- Improved Water Mills promotion is scaled-up and the technology is of a higher standard.
**Microhydro Development Process**

**NOW:**
- **HHs:** beside lighting, means to charge mobile phone and watch TV
- **Politicians:** effective development packages
- **Decision makers:** Viable option for increasing access to electricity in remote areas
- **Donors:** attractive development agenda
- **Regional countries:** knowledge centre
- **Private Sector:** Business

**BEFORE:**
- Mostly used for mechanical energy
- Electricity was added on for lighting purpose
- Privately owned
Micro hydro power plant Layout

- Canal
- Intake
- Forebay
- Penstock
- Powerhouse
- T&D
- End-User
MICRO HYDRO PROGRESS IN NEPAL

Potential > 100 MW
Progress ~ 22 MW
Micro Hydro Project Approval Cycle...

1. **Demand, Planning Process & Pre-feasibility (6 months)**
2. **Detailed Feasibility Study, TRC / Final Approval (9 months)**
3. **Civil Construction & E / M Equip. Installation (12 months)**
4. **One Year Guarantee (12 months)**
5. **T & C / POV (1 month)**

AEPC
MAJOR STAKEHOLDERS

- Socio-cultural Actors (Civil society, media, opinion leaders)
- Economic Actors (Banks, MFIs)
- GO/NGOs/INGOs/Private Organisations Working in RE Sector
- Political/Regulatory Actors (government, lobbyists, parties, regulatory bodies, international institutions)
- AEPC NRREP
- Central Renewable Energy Fund (CREF)
- Technological Actors (Universities, research institutes, standardization bodies)
- RRESCs
- DDC/DEEs/DEEsUs
- Community Users Groups
IMPLEMENTATION MODALITY

Demand side
- Public sector
  - Capacity building
  - Technical & financial assistance
  - Coordination
  - Quality assurance

Public Private Partnership

Supply side
- Private sector
  - Manufacturing
    - Supply & installation
  - After sales services
  - Internal quality control

Procedures/ Guidelines Subsidy

Users/ Beneficiary
DEMAND COLLECTION PROCESS

Formation of Users Committee

Submission of Application

- DDC/DEES
- RRESC
- AEPC

Verification (district planning/GIS)

Sanction for DFS
PROJECT IDENTIFICATION PROCESS - GIS

Diagram showing the project identification process with key elements including:
- Head work
- Penstock
- Power house
- Canal
- Forebay
- Transmission Line
Project Stage & Support Activities

1. Project Preparation stage - UC, RSC, Consultants
2. Project Approval Stage – RSC, AEPC
3. Project Implementation – UC, RSC, Company
4. Project operational stage - UC, DDC
**PROJECT DEVELOPMENT**

- **Selection of Consultant By Developer**
  - From the list of pre-qualified consulting firms

- **Desk Study, Field survey**
  - Desk Study (for projects >50 kW only)
  - by pre-qualified Engineers/Technicians

- **Design, Cost Analysis and Report Preparation**
  - Based on AEPC Design Guidelines
  - Dry Season flow measurement, 90% exceedance, overall efficiency >50%

- **Submission of DFS report to DDC/REES, RRESCs, AEPC**
PROJECT APPROVAL PROCESS

DDC, RRES C

Consulting Firm

AEPC Technical Team

Technical Review Committee

Recommend for Subsidy
PROJECT IMPLEMENTATION

Mobilization of Funds
- Subsidy ~ 50%
- Cash/Kind contribution ~ 20%
- DDC/VDC and others ~ 20%

Selection of Manufacturing/Installation company
- Subsidy ~ 50%
- Cash/Kind contribution ~ 20%
- DDC/VDC and others ~ 20%

Agreement
Between the Project Developer and the Company

Civil Works
Manufacturing of Electro-Mechanical Parts

Installation of Electro-Mechanical Equipments
QUALITY CONTROL MECHANISM

Monitoring and Inspection of Under Construction Project
RRESC/ MHQI/ DEES/U Regular process

Testing and Commissioning
RRESC/ MHQI/ DEES/U After completion of the project, approval from all: users; AEPC; company

Power Output Verification
POVI/ RRESC/DEES/U and submit to TRC From Nov to May every year

One year guarantee (10% of project cost)
RRESC/ MHQI/ MGSP One year from the date of approved date of T & C
PROJECT  OPERATION AND MANAGEMENT

- Responsibility of the user committee
- Tariff is fixed by the users committee
  - Based on installed capacity (Rs/Bulb, Rs/Watt.month)
- Plant operator and manager are trained by AEPC
- Major Maintainance is supported by Rural Energy Service Centers (in 40 districts)
TOOLS/GUIDELINES/FORMATS AT AEPC

- GIS system
- Carpet Field verification Format
- Carpet Field Verification Guidelines
- Feasibility study guidelines
- Feasibility Study Format
- Design Spread Sheet
- Model Bidding Document

- Monitoring Format
- T & C format
- T & C equipments
- POV format
- POV equipment
- OYGC formats
  ETC.
## Mini/Micro Hydro Schemes in pipe line

<table>
<thead>
<tr>
<th>Particulars `</th>
<th>Under Construction</th>
<th>Conditionally Approved</th>
<th>Detail Feasibility Study</th>
<th>Demand Collection (No)</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Identified Demand nos. of MHP</td>
<td>167</td>
<td>263</td>
<td>219</td>
<td>185</td>
<td>834</td>
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<tr>
<td>Total (kW)</td>
<td>5,418</td>
<td>8,071</td>
<td>5,839</td>
<td>6,401</td>
<td>27,397</td>
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### Possible Local Grid Sites in Nepal

<table>
<thead>
<tr>
<th>S.N.</th>
<th>District</th>
<th>No. of Schemes to be Connected</th>
<th>Total Power Output of the Schemes (kW)</th>
<th>Approx. Surplus Power Available in Peak Hour (kW)</th>
<th>Approx. Transmission Line Length (km)</th>
<th>Distance between MHP and Nearest Market (km)</th>
<th>Distance between MHP and Nearest Grid (km)</th>
<th>Estimated Soonest Availability of Grid in the MHP Area (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achham</td>
<td>12</td>
<td>798.2</td>
<td></td>
<td></td>
<td>100</td>
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<td>4</td>
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<tr>
<td>2</td>
<td>Baglung</td>
<td>5</td>
<td>238</td>
<td>52</td>
<td>6.4</td>
<td>0.3</td>
<td>1.5</td>
<td>5</td>
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<tr>
<td>3</td>
<td>Bajhang</td>
<td>13</td>
<td>276</td>
<td>N/A</td>
<td>16</td>
<td>2</td>
<td>85</td>
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<tr>
<td>4</td>
<td>Bajura</td>
<td>7</td>
<td>332</td>
<td>45</td>
<td>24.7</td>
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<td>154</td>
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<td>Doti</td>
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<td>Panchthar (I)</td>
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<td>2</td>
<td>1</td>
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<tr>
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<td>Panchthar (II)</td>
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<td>11</td>
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<td>96</td>
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<td>2</td>
<td>5</td>
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<tr>
<td></td>
<td>Taplejung</td>
<td>10</td>
<td>535</td>
<td>100</td>
<td>36.8</td>
<td>5</td>
<td>70</td>
<td>5 33</td>
</tr>
</tbody>
</table>
7 Micro Hydro Plants connected Minigrid in Baglung
Issues in MHP implementation

• Technical Issues
  
  • Quality of project study
    
    ➢ Quality of DFS – poor quality which can not rely on.
    
    ➢ Time – taking time for finalization 1-2 years.
  
  • Project Construction
    
    ➢ Quality – Electro/Mechanical component
    
    ➢ Supervision – Companies role in construction supervision.
    
    ➢ Quality of civil construction-responsibility.
    
    ➢ Time – Taking long time 2/3 years.
Impact of MH electrification

- has a positive impact on income from livestock and small business but has no evidence of impact on farm income.

- has both direct and indirect health benefits.

- has a positive impact on the educational outcomes

- has played a vital role in improving access to information.

- has a positive impact on women’s’ involvement in household decision making process.
Impact of MH electrification

- End use applications established has increased business activity, created employment opportunities and improved livelihood in general.

- Mini grid electrification has a positive impact on the environment.

- Mini grid has met household’s expectation.

- Reduce people’s aggression with government.
Issues in MHP implementation

- **Financial issues**
  - Very high cost of E/M equipment
    - Difficult to justify with solar PV and others.

- Bidding process
  - Procurement by community low bargaining power and end of poor quality high cost.

- Funds to be arranged by community
  - Fund outside subsidy is very high to be arranged by community.

- No consideration for inflation
  - interest and time over run
**Issues in MHP implementation**

- **Social issues**
  - Very poor and remote communities left.
  - Difficult to raise awareness and motivation.
  - Difficult to find even unskilled labors in the villages gone for remittance.
  - Waiting for others to come work for them.
  - Various conflicts in community.
  - The leaders of the user group made MHP enterprises for income.
  - Those who are financially better are adopting PV
Challenges of micro hydro technology

- Up scaling and upgrading – scaling up the implementation, upgrading quality of technology and construction.

- Inter connection and grid connection of existing schemes.

- Capacity addition in old projects due more demand

- Financial viability in business model

- Operation and management of plant in local level

- Fate of the micro hydro plant after grid expansion

- Rehabilitation and protection from natural calamities
Way forward

- Improvement quality and in DFS
  - Mandatory survey by certified technician.
  - Consequence wrong information and errors/mistakes.
  - Supervision during construction.

- More defined technical specifications and BOQs and strictly monitor and if not followed consequences.

- Training to design engineers both civil and E/M

- Bidding Procurement
  - Detail procurement guideline formally agreed and approved, Strictly implementing it.
  - May be bid opening in center together with UC/RSC.

  - The installer companies should be closely monitored for quality of civil and E&M construction.
Way forward

- Final approval should strictly assures the remaining money collected - is objective evidence.

- More stricter Project Management - Final approval also approve the final time bound construction schedule – need to be met by both company and community otherwise will have consequence.

- BG extension should substantiated by objective evidence of project process and it should be for one time only.

- Capacity building of companies in design/fabrication up to 500kW (if not 1MW)
  - Turbine, governors, Generators
  - Turbine testing and certification

- Design and implementation of mini hydro and mini grid.

- Involvement of DDC for follow and monitoring during and after construction of MHP.
Thank you