

ODA-UNESCO project

Promotion of Energy Science Education for Sustainable
development in Lao PDR

Theme 7:

Good practice of Renewable Energy projects in Lao PDR

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Good Practice in Lao PDR (2 classes @ 90 min/class)

Case	Person In charge	Number of slides
Renewable energy based Rural Electrification in Lao PDR	Khamphone	60
Family size Biogas Digester	Boualy	30
Improved Cook stove	Boualy	30

Contents of RE based rural electrification in Laos

- Background of RE-based Rural electrification projects in Lao PDR
- Some good practice of RE-based Rural electrification:
 - Solar Home System program
 - Small scale hydropower Development
 - RE-based Hybrid Power System
 - New Pilot projects with Hybrid system

Rural Electrification policy

- Electrification is a key component in rural development programs
- National target: 90% electrified HH by 2020, where
 - 85%-on grid coverage; 5%- off-grid coverage or equivalent to 150,000 HH

RE-Based Rural Electrification

Rural Electrification options

- Grid extension (dominant)
- Off-grid connection:
 - Solar Battery Charging station (SBCS): community
 - Micro-mini Hydropower (with or without mini grid), community(s) use
 - Solar Home system (SHS): individual household's
 - Solar PV with mini grid: public places (health center, school, village hall)
 - In the future: biomass, wind or hybrid system

Why off-grid Rural Electrification?

Problems of off-grid areas:

- Low power demand (low population density and scattered inhabitation)
- Mountainous area
- Undeveloped infrastructures
- Lack of income generating activities

Grid extension is economically not viable

→ to promote off-grid options instead

Possible Options for off-grid electrification:

- SBCS
- SHS
- Small scale hydro
- Biomass based power generation
- Wind power
- Hybrid system

Rural Electrification: Achievement

Rural Electrification status

- **Ratio 2008: household base-63% (60%-EDL grid; 3%-off-grid),**
- **2010- 71%**
- **2012- 84% (target by 2015: 85%)**

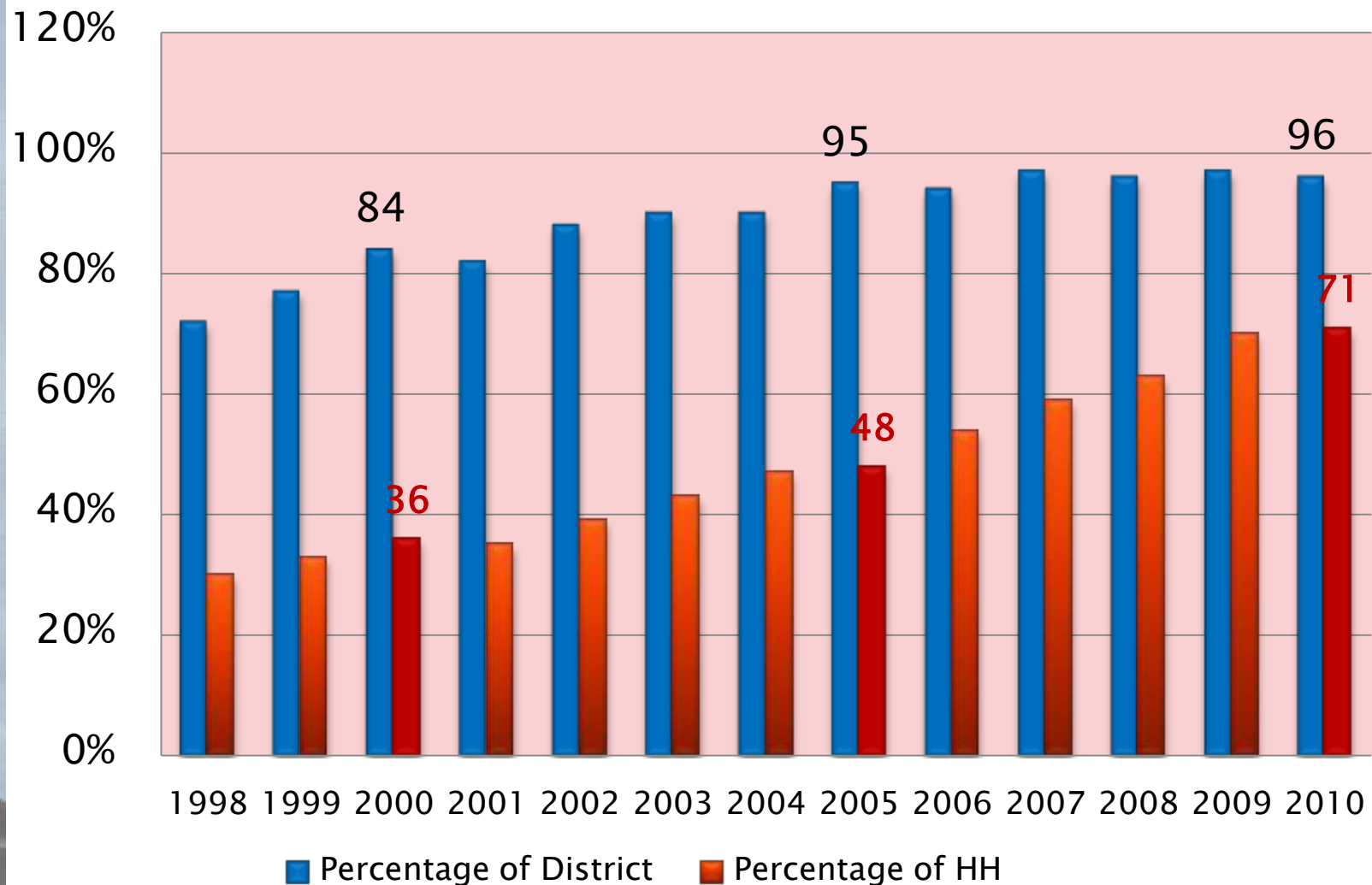


RE in Rural Electrification

- **Micro hydropower (<100 kW): since early 90s**
 - 50,000-60,000 Individual PICO (300-1000W) are in use in all parts of Laos
- **Solar PV: since late 90s (Solar BCS, SHS, solar lantern)**
 - Up to 2012: around 19,000 SHS Installed



Rural Electrification Status



MEM's latest data: 84% HH base by 2012 (planned 85% by 2015)

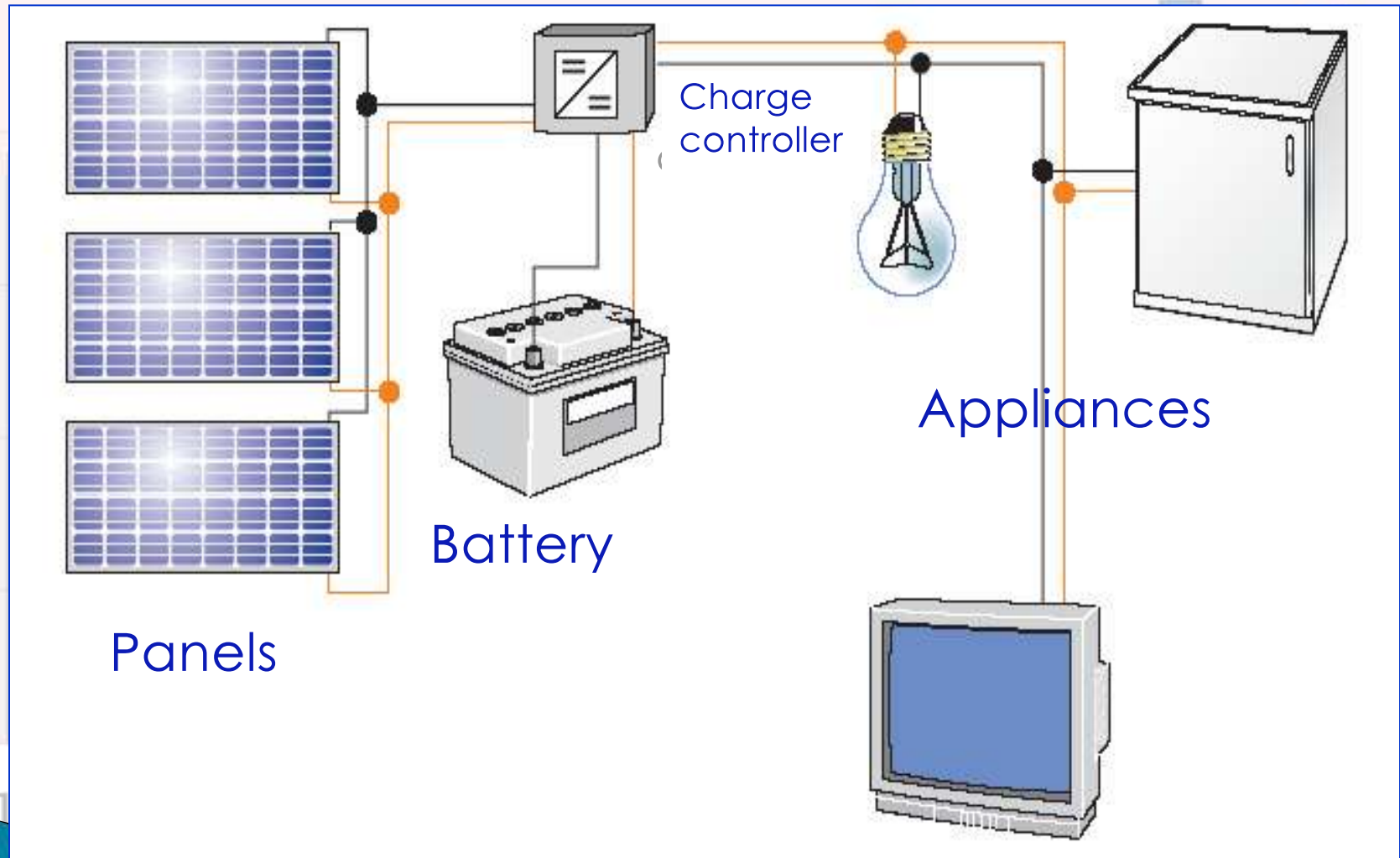
Some Good practices

Selected Case studies:

1. Sunlabob Solar Lantern Rental system (SLRS)
2. Hire purchase SHS (HP SHS)
3. Shared PICO hydropower
4. Hybrid system

Stand alone PV system

95



200

Percentage of HH

Stand alone PV system: Typical components

Panel



Appliance: saving lamp

CFL



LED



Charge controller

Battery



Battery box

Stand alone PV system: Lessons learned

- Improper System installation:
 - ✓ Place selection (shaded, vegetation growth)
 - ✓ Wiring (wire size, type)
 - ✓ panel orientation (incorrect Southern faced)



Good practice 1:33 PM

Stand alone PV system: Lessons learned

- Controller

- ✓Insect, dirt, bad ventilation, ...
- ✓Use instruction violation: repair or modification be users selves; overtime use



Stand alone PV system: Lessons learned

- System maintenance

- ✓ Battery maintenance
- ✓ Panels maintenance (dirt, shades, pole, ...)
- ✓ Spare parts replacement (size, type, market availability)
- ✓ Battery disposal



1. SUNLABOB Solar Lantern Rental System (SLRS)

Source: courtesy by Sunlabob Co.

Background

Rental Solar Home System (RSHS), 2004

- Sunlabob provided SHS for lease on monthly base payment
- System installation by Sunlabob technicians
- Users pay for installation fee (initially) and monthly used energy (depending on system size);
- O&M by village technician, under supervision of local Sunlabob's franchisee (Local ESCO)

1. SUNLABOB Solar Lantern Rental System (SLRS)

Rental Solar Home System (RSHS), 2004

- Advantages and disadvantages:
 - Hardware remained Sunlabob property
 - Users pay for installation fee and monthly used energy (depending on system size);
 - System installation by Sunlabob technicians
 - O&M by village technician, under supervision of local Sunlabob's franchisee
 - Less initial investment for user

1. SUNLABOB Solar Lantern Rental System (SLRS)

Rental Solar Home System (cont.)

Advantages and disadvantages:

- **Long term System reliability and sustainability**
(Users' awareness and behavior, improper O&M)
- **High rental** (pure private initiative)
- **O&M problems** (service in remote and difficultly accessible areas)
 - ✓ *Slow expansion rate*

- Good quality hardware
- Centralized service
- No subsidy

→ **High rental:** affordable
for 10 % of villagers only

1. SUNLABOB Solar Rental Lantern System (SRLS)

The First version of SRLS (2006)

- Delivery Approach:
 - This is community system
 - Assembled in Laos, used Local materials (as much as possible)
 - More flexible in providing service and payment due to Programmable possibility
 - Convenient in use (as torch, ceiling lighting)
 - Less cost for consumers and service provider



1. SUNLABOB Solar Rental Lantern System (SRLS)

The First version of SRLS (2006)

- Management scheme:
 - System installation by Sunlabob technicians
 - O&M by local Sunlabob Franchisee (Village electricity manager , VEM)
 - Fee collection & transfer VEM→ESCO→Sunlabob
 - Village electricity committee (VEC) oversees VEM works



1. SUNLABOB Solar Rental Lantern System (SRLS)

The First version of SRLS (2006)

- Incentives:

- Users: better lighting; affordable and manageable payment \leftrightarrow system works \leftrightarrow payment
- VEM gets margin \leftrightarrow good service \leftrightarrow system works
- VEC: villagers satisfaction and service margin \leftrightarrow system works \leftrightarrow supports to VEM
- Sunlabob's Franchisee (local ESCO) margin \leftrightarrow systems work \leftrightarrow consistent supports to VEM
- Sunlabob (private sector): investment revenue \leftrightarrow systems works \leftrightarrow supports to Local ESCOs, VEC and VEM
- **GoL: electrification targets \leftrightarrow provide necessary supports (!)**

1. SUNLABOB Solar Rental Lantern System (SRLS)

Project Background

The First version of SRLS (2006):
problems

- Assembling quality (Locally made)
- Product quality and reliability, especially light bulb without protecting cover
- Incentive measures



1. SUNLABOB Rental Solar Lantern System (RSLS)

**New solar Lantern (2009): specially made
(by Phocos, Germany)**



More Flexibility in use



1. SUNLABOB Rental Solar Lantern System (RSLS)

New solar Lantern (2009): specially made by Phocos (Germany)

Delivery Approach: some changes

- ▶ Donor provides fund;
- ▶ Sunlabob provides service: (hardware procurement and installation, local managers and end users training)
- ▶ VEC and VEM: formulation-training by Sunlabob
- ▶ PDEM (Provincial Department of Energy and Mines) supervises VEM-VEC
- ▶ Collected fees are used for system O&M, for scheme expansion to other targets

1. SUNLABOB Solar Lantern Rental System (SLRS)

New solar Lantern (2009): Advantages

- **High quality product**
- **Robust (not easy breakable, water resistance)**
- **Highly Flexibility in use, payment and recharging**
- **Easy and low cost O&M → can be done by local company/technicians**
- **Easily removable (e.g., if grid come)**

1. SUNLABOB Rental Solar Lantern System (RSLS)

New solar Lantern (2009): specially made by Phocos (Germany)

Flexibility

Ceiling/wall lighting



Torch

Table lighting



Easy



User training



1. SUNLABOB Rental Solar Lantern System (RSLS)

New solar Lantern (2009): specially made (cont.)

Ceiling lighting at rural school dormitory



User training



1. SUNLABOB Solar Lantern Rental System (SLRS)

New solar Lantern (2009)

Lessons learned:

- Robust equipment → long term sustainability and easy O&M ensured;
- Imported hardware → expensive → financial support (tax measures, funding support,...)
- Inflexibility in spare parts supply (equipment import)

2. Hire–Purchase SHS (HP–SHS)

Source: courtesy by Rural Electrification Division (IREP/MEM)

Background

Delivery Approach:

- ▶ Rural People hire the SHS from MEM-WB programs by Making the upfront payment for SHS installation fees and BOS (Battery, appliances and in house wiring)
- ▶ The Program is managed by VOPS (Village Off-grid Promotion and Support)- functioning under DOE (Department of Electricity) unit

2. Hire–Purchase SHS (HP–SHS)

Approach (cont.):

- ▶ SHS installation by Local Provincial ESCO together with Village technician(s)
- ▶ Then Users make regular monthly repayment (depending on hired system size)

2. Hire–Purchase SHS (HP–SHS)

Approach(cont.):

- ▶ Users will own the SHS when the payment complete (5 or 10 years)
- ▶ **SHS maintenance by village technicians**

2. Hire–Purchase SHS (HP–SHS)

Incentives

► User's Incentive: prospective ownership of the SHS

↔ to keep system in good operating conditions ↔ systems work well

2. Hire–Purchase SHS (HP–SHS)

Incentives (cont.)

- ▶ Service Providers (PESCO, VAC, VEM): They will get own operation rebates \leftrightarrow if villagers made payment \leftrightarrow to keep systems work well \leftrightarrow better service

PESCO-provincial Energy service company; VEAC-Village Electricity Advisory committee; VEM-Village electricity manager

2. Hire–Purchase SHS (HP–SHS)

Incentives (cont.)

▶ VOPS/Government:

- ✓ MEM-WB SHS Program benefits
- ✓ Achieve target of 90% electrification ratio by 2020
- ✓ Leave LDC status

2. Hire–Purchase SHS (HP–SHS)

**The First phase of the project (2001-2004):
to achieve low repayment rate:**

- Learning phase
- Low quality hardware (battery, charge controller)
- Improper O&M (spare parts, system use, ...)
- Improper installation
- Not attractive incentives (low incentive payments)



Improper Panels installation



Unreliable wiring

2. Hire-Purchase SHS (HP-SHS)

Improved Hire-Purchase SHS (2004-09)

- Improved operational structure:
central level (VOPS)-Provincial level (PESCO)-Village level (VEAC, VEM)
- Improved capacity of all levels
- Improved support measures
 - ✓ Increased incentives
 - ✓ Higher rebate payment (nearly 100% increased)
 - ✓ Soft loans availability for ESCOs



2. Hire-Purchase SHS (HP-SHS)

Improved Hire-Purchase SHS (2004-09)

- **Better hardware**
 - **lead acid battery → Dry cell**
 - **Wooden battery box → metallic**
- **More comprehensive training for VOPS staffs, VEAC, VEM**



2. Hire-Purchase SHS (HP-SHS)

- **Better installation**
- **Wooden battery box → metallic**



3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Project Background

Individual PICO hydro

- Application since middle 1980s, firstly in Northern then spread to all parts of Laos
- **Easy market availability: products of China and Vietnam**
- There are two types of runner: propeller and Turgo turbine,
- Capacity between 300-1000 W



3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Individual PICO hydro

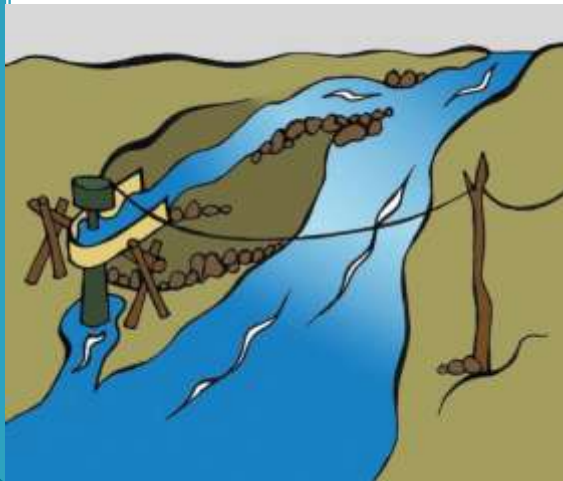
- **Cheap PICO turbine-generators, without any controller (100-300\$ depending on output capacity)**
- **Easy installation: users got brief instruction by the shop owner and then installed them selves**

3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Individual PICO hydro

- **Two basic installations found:**
 - Water fall installation, with intake channel and draft tube (better power output)



3. Shared PICO hydropower

Individual PICO hydro

- **Free standing installation:** prolonged runner shaft, connected to boat propeller (as runner); without draft tube
- Modified installation, lower power output



3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Individual PICO hydro: Problems

- **Hardware**
 - Low quality,
 - Short lifetime,
- **Installation**
 - Installation by Users selves, or by village technicians, who often have no fundamental electro – technical-civil knowledge
 - Draft tube are used, but incorrectly (purpose, size, installation)
 - Improper Wiring (size, type, connection, safety concerns)

3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Individual PICO hydro: Problems

- **Power supply**
 - Unstable power supply
 - No protection facility → often damage of electric appliances
 - Safety concerns: unsafe distribution network and indoor wiring;

3. Shared PICO hydropower

Source: courtesy by Loa Institute for Renewable Energy (LIRE)

Individual PICO hydro: Problems

- **O&M**
 - Improper O&M,
 - Usually Users maintain PICO themselves, without any instruction/guideline, just learned from neighbor
- **Water use**
 - Not enough suitable places for all;
 - Water for power production <> other water consumption
 - Environmental impacts

3. Shared PICO hydropower

Problems of Individual PICO hydro



3. Shared PICO hydro generator

Problems of Individual PICO hydro

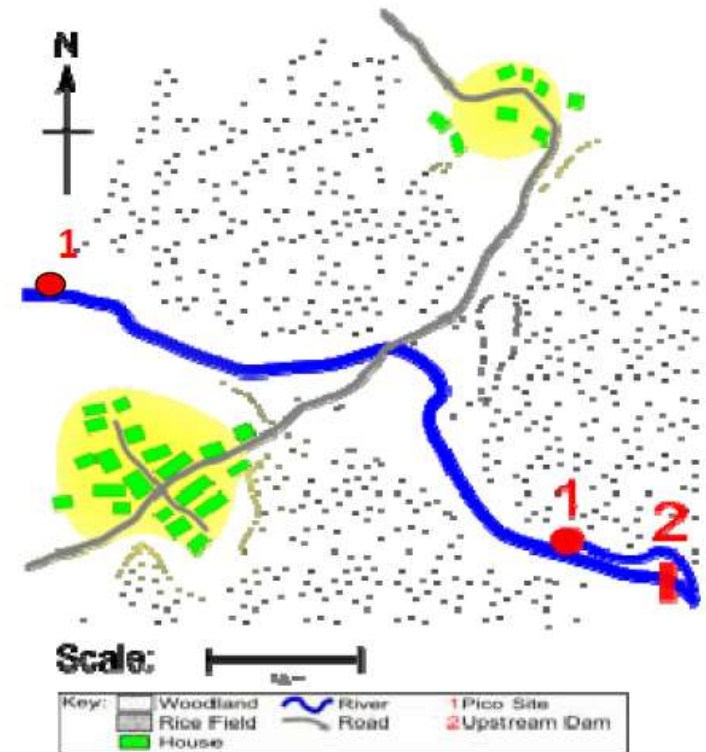
safety concerns



3. Shared PICO hydro generator

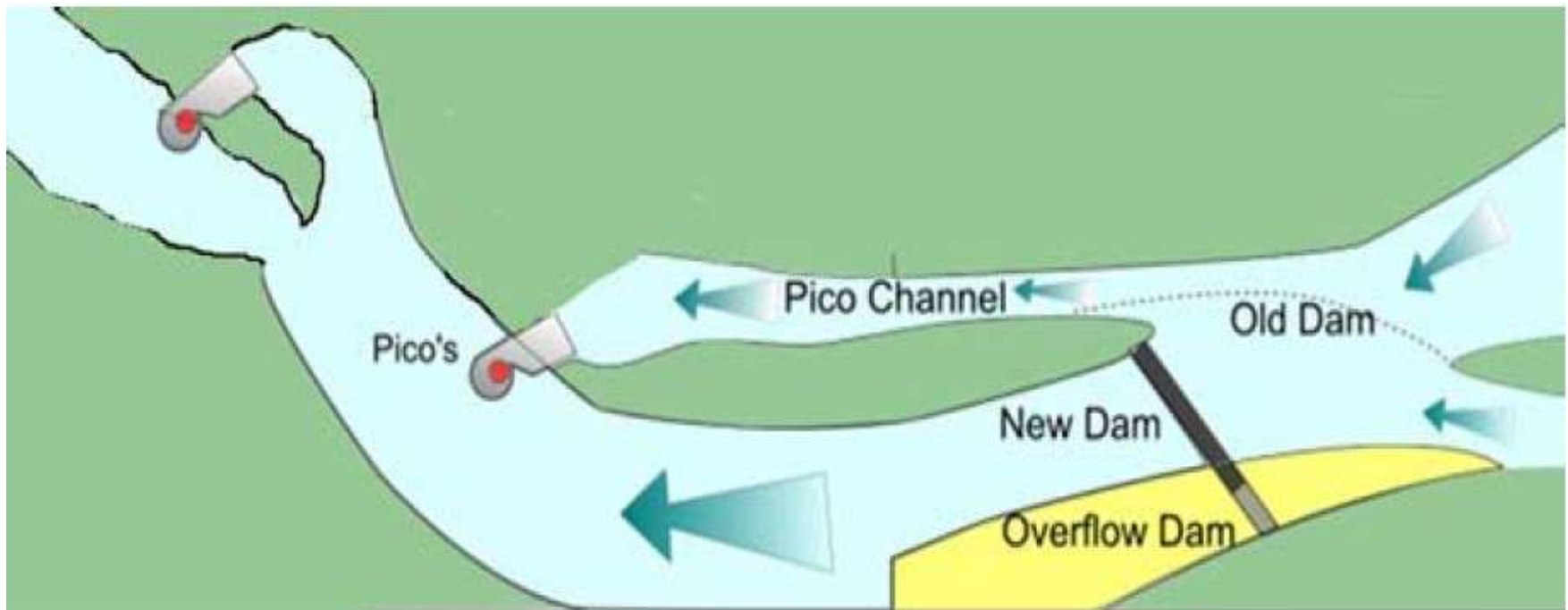
Collective shared PICO

- ▶ To replace existing numerous individual PICO by installing two collective PICO (1000W each)
- ▶ Demonstration system
 - 24 households → two clusters, each served by one PICO, independently
 - Users divided into lower tariff (30W, lighting only) and higher tariff (100W, light + small TV/stereo)



3. Shared PICO hydro generator

Proper planning and civil works



3. Shared PICO hydro generator

Collective shared PICO

- Better turbine, equipped with Electronic Load controller (ELC)
- Properly designed intake channel and draft tube



3. Shared PICO hydro generator

- ▶ Constructed Standard distribution network and in door wiring: almost ready for grid connection in case of grid comes
- ▶ Proper technicians training



3. Shared PICO hydro generator

- Local People contribution
 - Shared Investment
 - Contribution in kind (labor, local construction materials, supports to Project's technical team)



3. Shared PICO hydro generator

Advantages

- **AC 220 voltage: more common appliances can be found in the local market**
- **Sharing ability in power use**
- **Shared Investment and other contribution**
- **Proper O & M by well trained technicians**
- **Setup Proper management scheme**

3. Shared PICO hydro generator

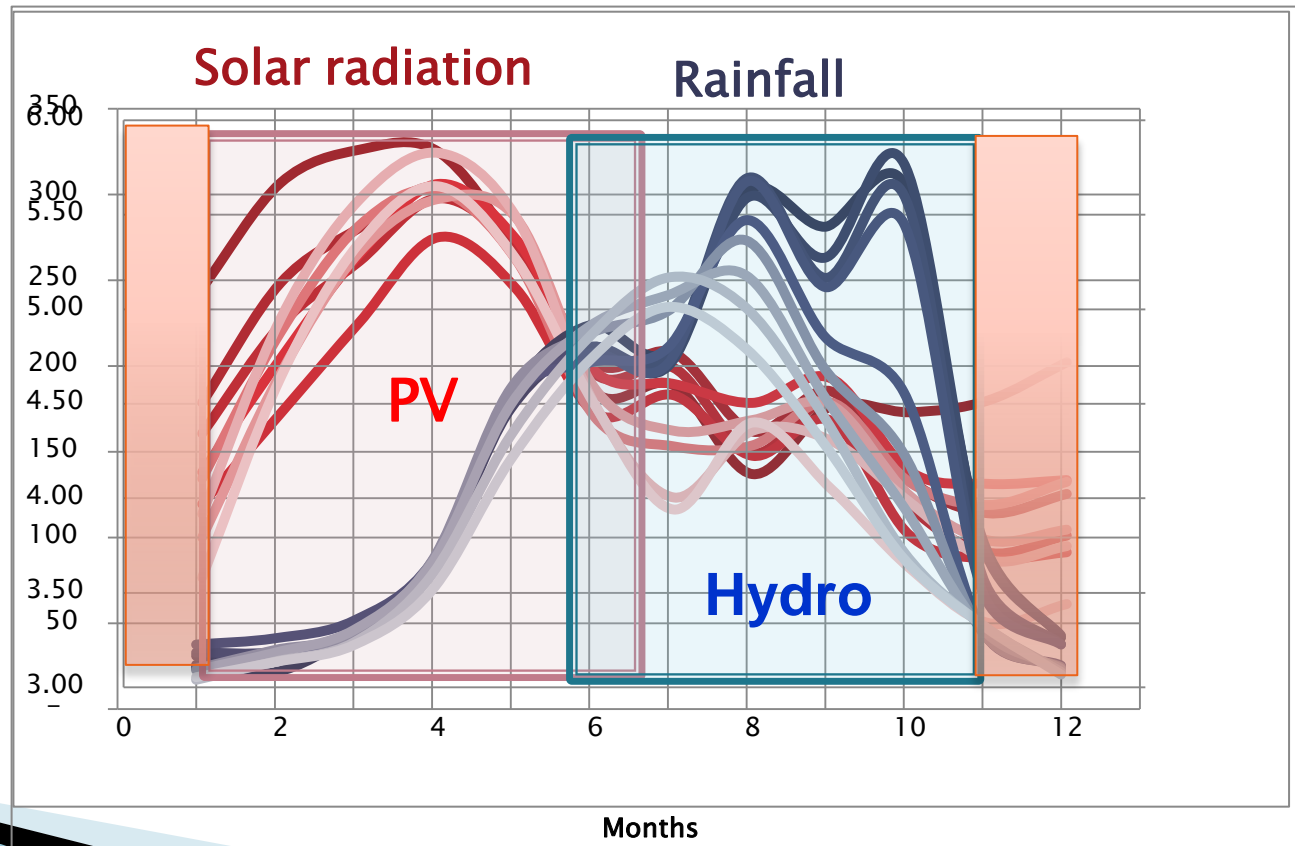
Disadvantages

- Higher investment (better equipment and standardized network)→financial support might be needed
- Proper management scheme should be in place to avoid future conflicting situation in power use, system maintenance, consumers charges, spare parts replacement, etc.

4. RE-based Hybrid system

Why?

- ▶ Resource availability is not constant for different period
- ▶ Solar energy: Jan–May, November–December
- ▶ Hydropower: June–October



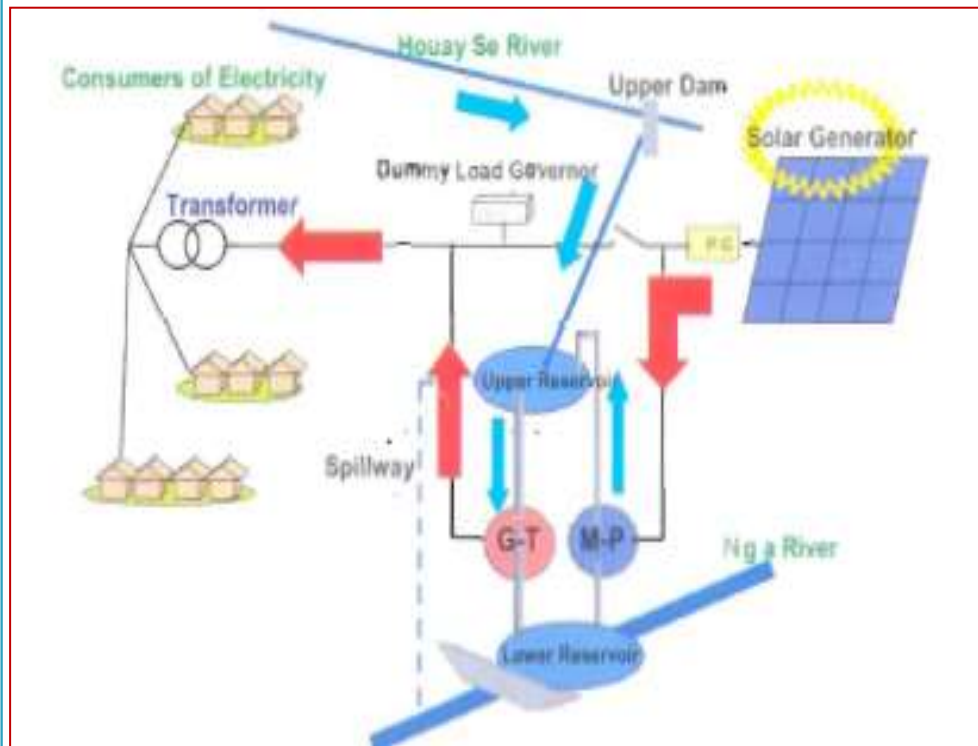
4. Hybrid System: Pilot Projects by NEDO and MEM

Micro hydro-PV hybrid system (2005-2007)

- Pumping-storage type Power system
- 80kW micro hydropower + 100kWp PV system
- During the day times PV is used for powering water pump, pumping water from the tailrace channel back to enlarged reservoir
- Distribution by mini grid (at district center, 4 hours daily)
- Cooperation project between MEM-NEDO
- Funding: NEDO

4. Hybrid System: Pilot Projects by NEDO and MEM

Micro hydro-PV hybrid system (2005-2007)



Solar PV Panel 100 KW



4. New Pilot Projects by NEDO and MEM

- ▶ **SMP + PV + Storage with Mini grid**
- ▶ **Location: Meuang Mai district, Phongsaly province (Northern Laos)**
- ▶ **Supply Power to several close by villages**
- ▶ **Cooperation: MEM-NEDO**
- ▶ **Funding: NEDO**

4. New Pilot Projects by NEDO and MEM



4. Hybrid systems: Advantages and disadvantages

- ▶ **More reliable power supply**
- ▶ **But high investment**
 - Funding supports needed
- ▶ **More complex management, O&M**
 - Requires more qualification technicians
 - inflexible spare parts supply in case of failures: import

THANK YOU