

**ADB**

**NEMC**

Asian Development Bank



CONSULTATION ON  
**HYDRO ENERGY**



# Naypyidaw Energy Consultations

## II. HYDRO ENERGY



Japan  
Fund for  
Poverty  
Reduction



Heinz-W. Boehnke  
U Myo Myint  
U Sein Thet  
NEMC Group

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## Objective

- Assessment, Strategy, and Roadmap (ASR)
- **Renewable Energy Policy**
- RE part of long-term **Energy Master Plan**

## Cooperation NEMC - ADB

- **Planning, Policy and Regulations**
- **Pilot installations** (1 MW PV grid connection)
- **Pilot development** (25 villages Energy4all)
- **Planning Security** needed by public Administration, private Enterprise, Investors, Developers, Donors
- **Develop progressive, simple, liberal support**



## Hydro Energy – a strong driver for rural electrification

- How much do we have ? 108,000 MW estimate WB '95
- How much do we need?
- How much will it cost ?





## Three Generations Renewable Energy

1st Generation - **established**

**Hydropower, Biomass Burning, Geothermal**

2nd Generation - **mature**

**Small Hydro (Mini<30MW, Micro<1MW, Pico<10 kW)**

Solar-Power

Wind-Power

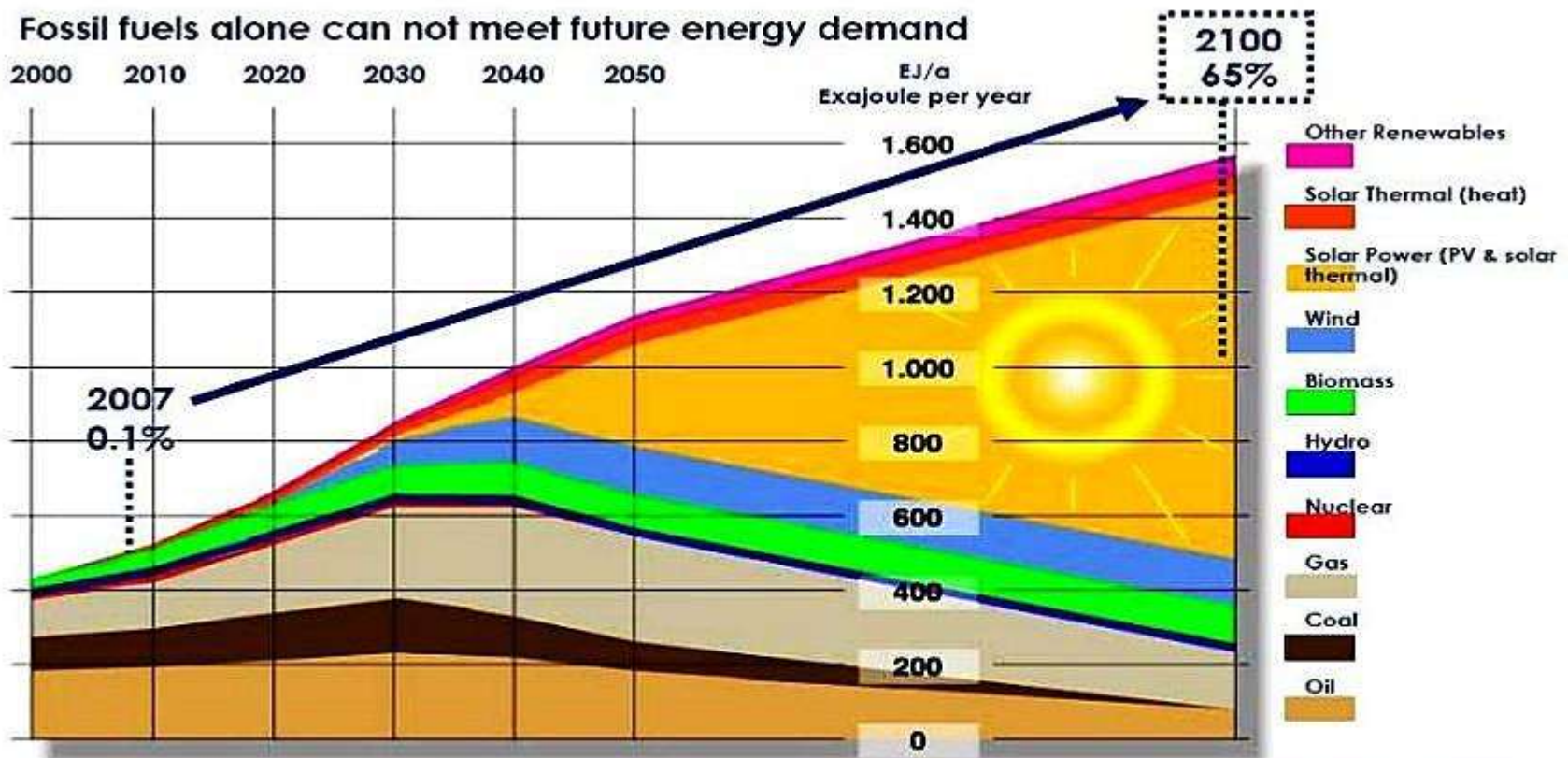
Biogas

3rd Generation - **developing**

Wind-Offgrid, Biomass Gasification, Biorefinery, Marinepower



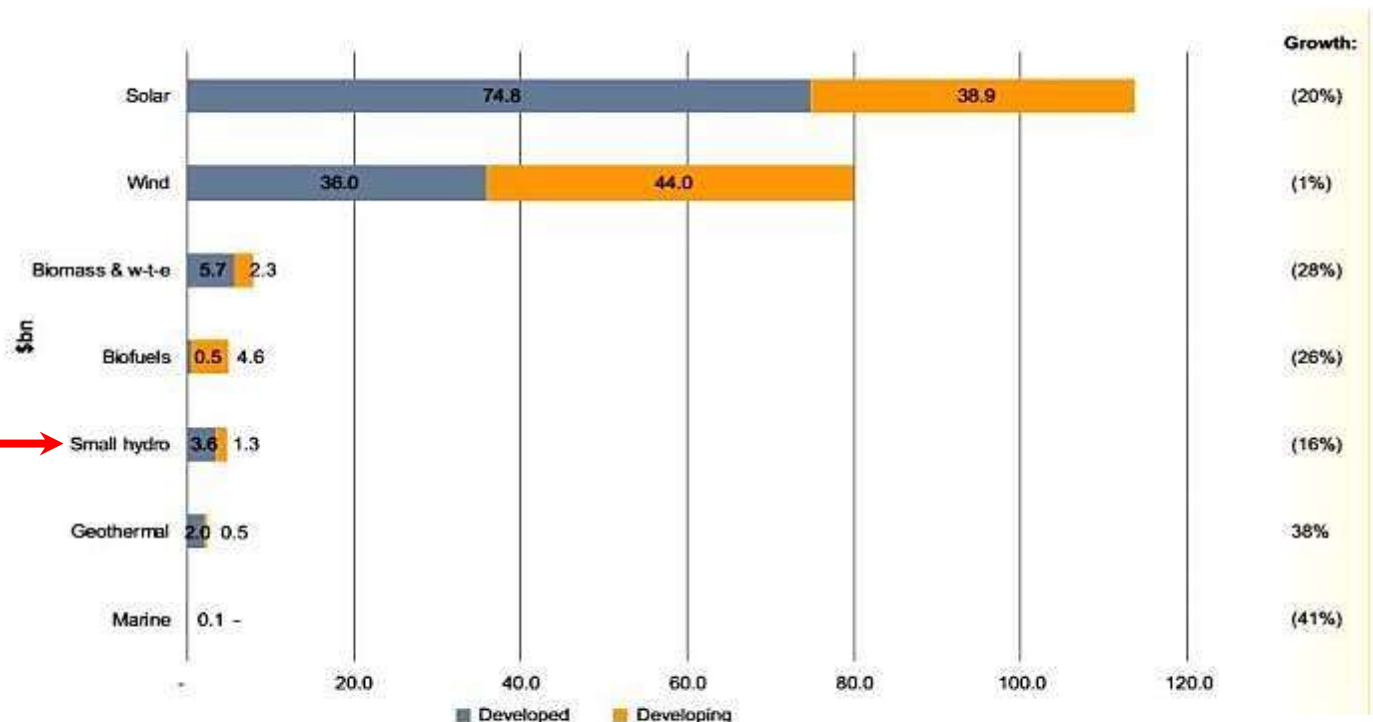
Fossil fuels are **limited** , some Renewables also



**Global primary energy scenario: Renewables 80% of primary energy by 2100**



## Global new investment in renewable energy: Developed vs. developing countries 2013

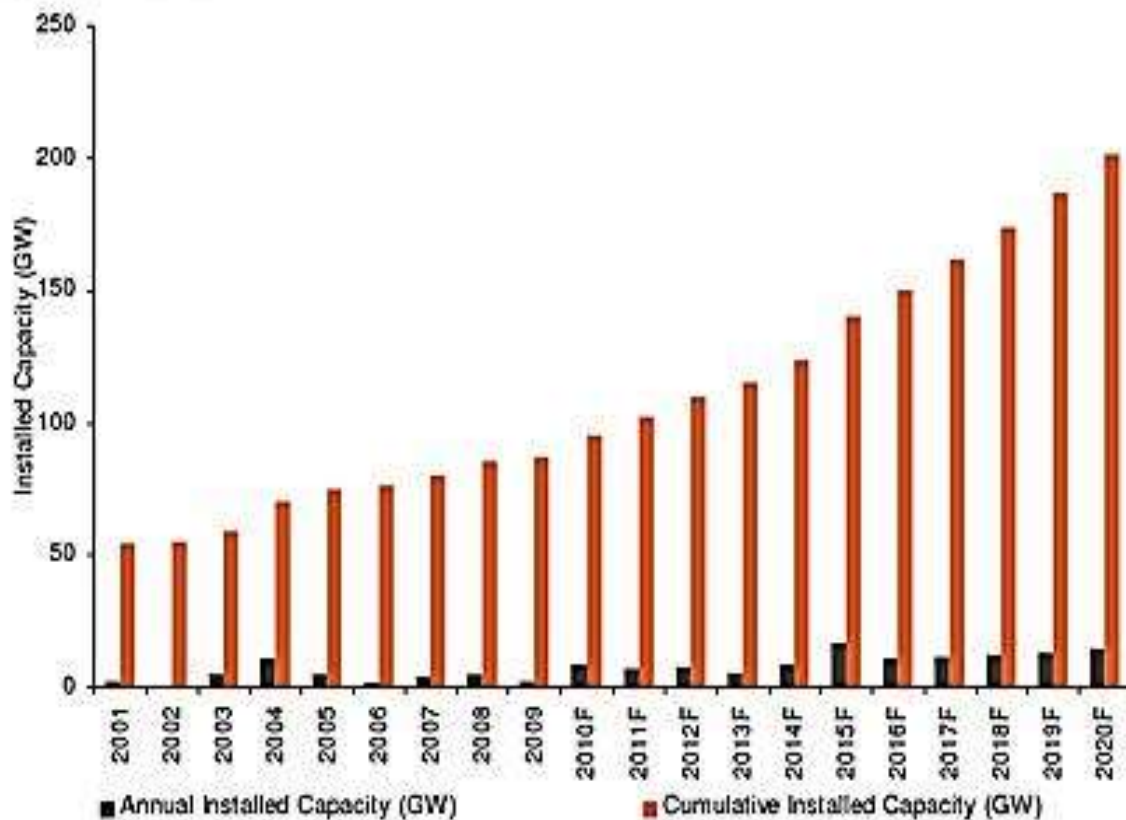


**Note**

Total values include estimates for undisclosed deals. New investment volume adjusts for reinvested equity. Includes estimates for small distributed capacity, corporate and government R&D. Developed volumes are based on OECD countries excluding Mexico, Chile, and Turkey.



**Global Small Hydropower Market, Historical and Forecast Annual and Cumulative Installed Capacity (MW), 2001-2020**

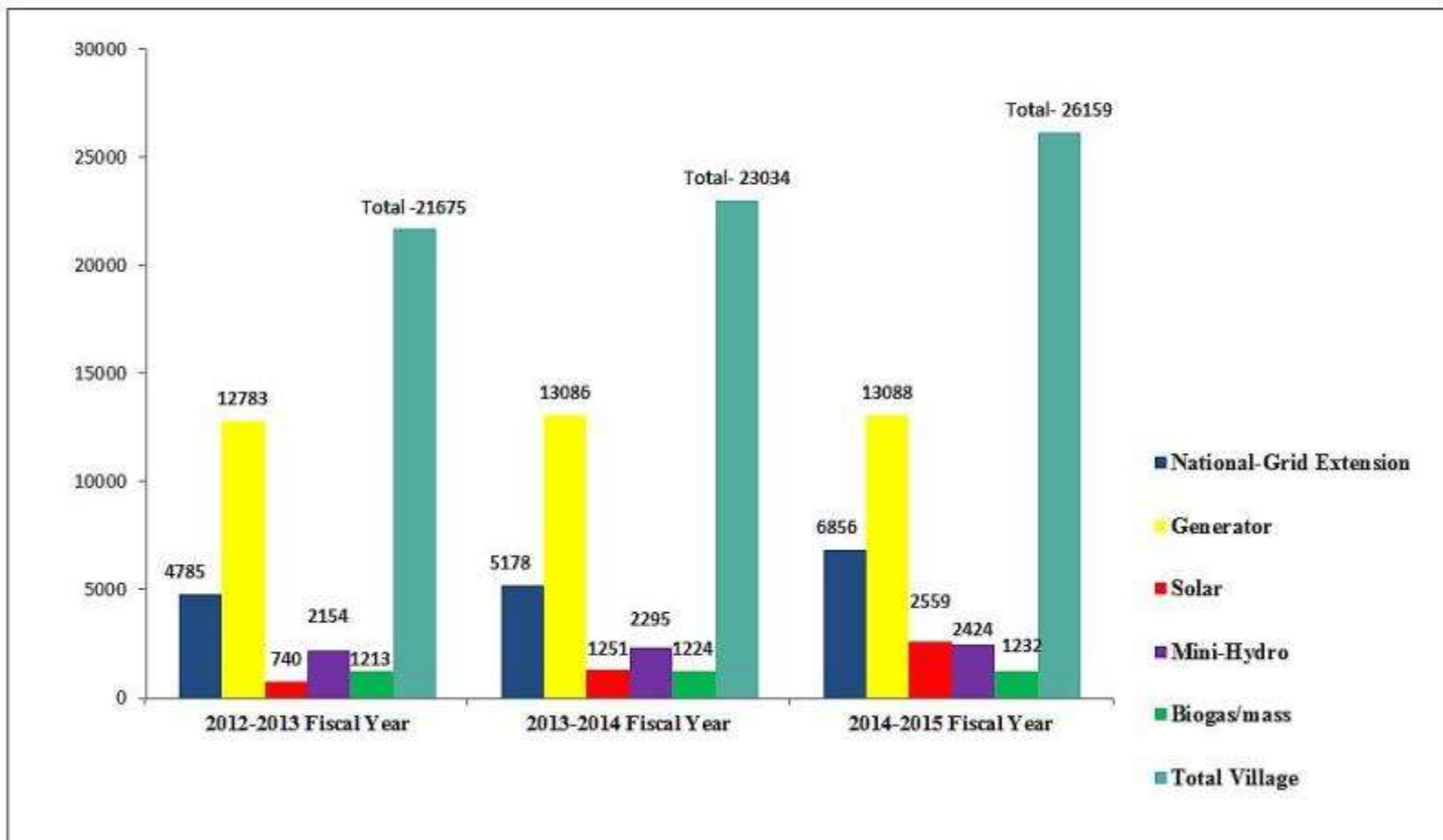


Source: GlobalData



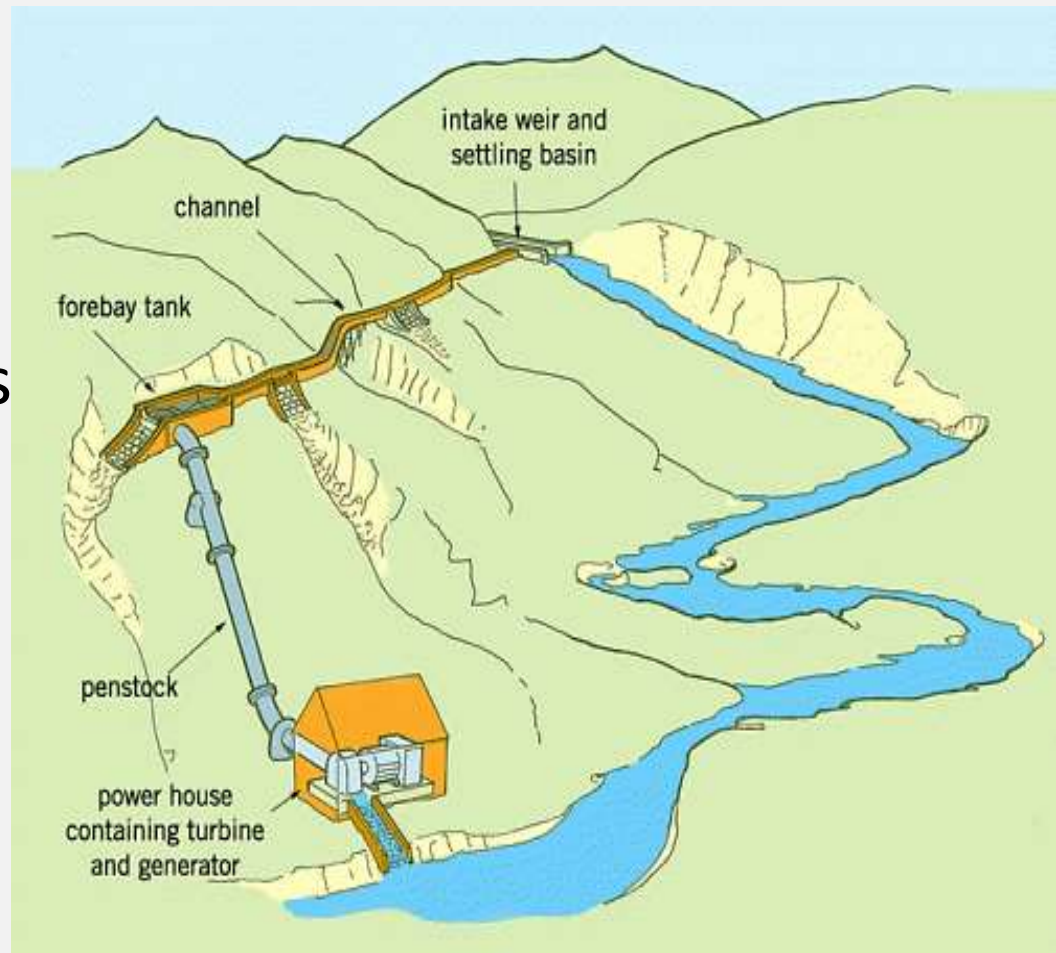
**DRD**

**Annual Progress of Implemented Villages for Rural Electrification**



## Hydro-Schemes

- 1) Run off river
  - simple design
  - no expensive dams
  - village labour
- 2) Run off Dam
  - stable discharge
- 3) Immersed
  - low-cost
  - low maintenance



## Hydro Design

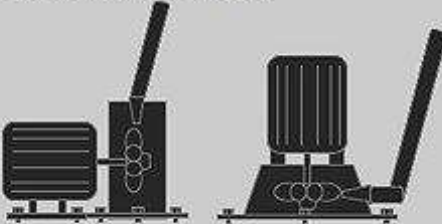


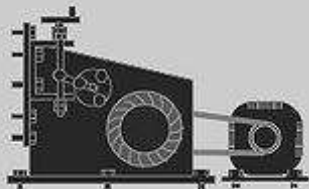







- 1) High Head  
good with low flow  
good efficiency
- 2) Medium Head  
focus on turbine
- 3) Low Head  
needs more flow  
can be low cost

$$P = 7 \times Q \times H \text{ [W]}$$

Where:

Q = Flow Rate (m<sup>3</sup>/sec)

H = net Head (m)

pico turbine types	head	flow
<b>Pelton and Turgo</b> 	high  20 - 60 m	low  5 - 10 l/s
<b>Crossflow</b> 	medium  7 - 25 m	medium  10 - 30 l/s
<b>Open flume (propeller)</b> submersible 	low  3 - 6 m	high  10 - 100 l/s
 ~ 5 m		 ~ 10 l/s

## Hydro Design

Compute Flow  
from catchment  
and rainfall:

$$Q = A \times R / T$$

Where:

Q = Flow Rate (m<sup>3</sup>/sec)

A = Catchment Area (m<sup>2</sup>)

R = Rainfall (m)

T = Time (sec)



## Hydro Design

### Measure Flow

- determine cross-section
- measure water speed

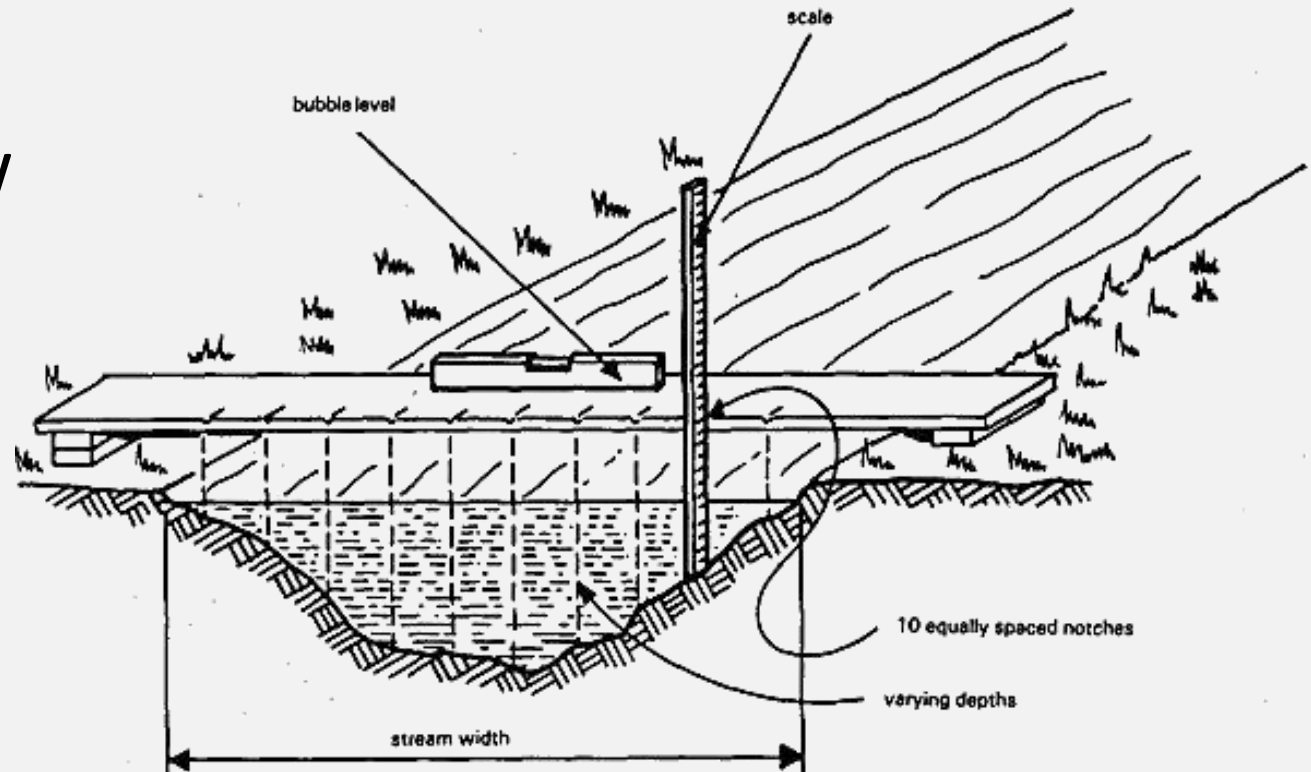
$$Q = A \times T$$

Where:

Q = Flow Rate (m<sup>3</sup>/sec)

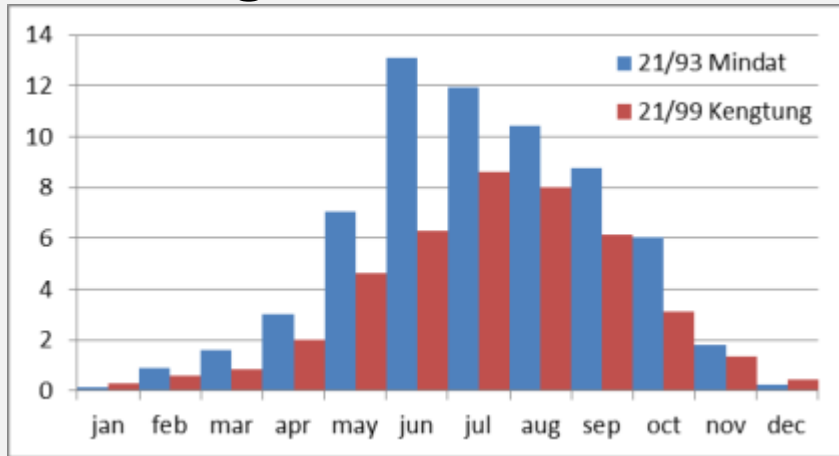
A = Flow Area (m<sup>2</sup>)

T = Speed (m/sec)

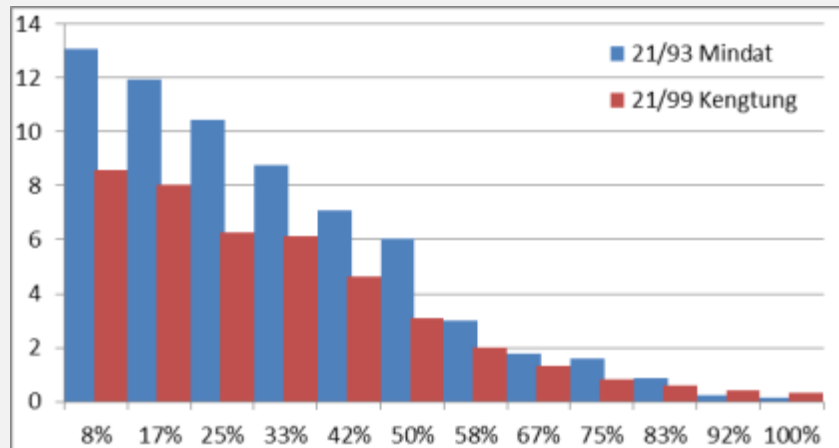




## Discharge



## Flow Duration

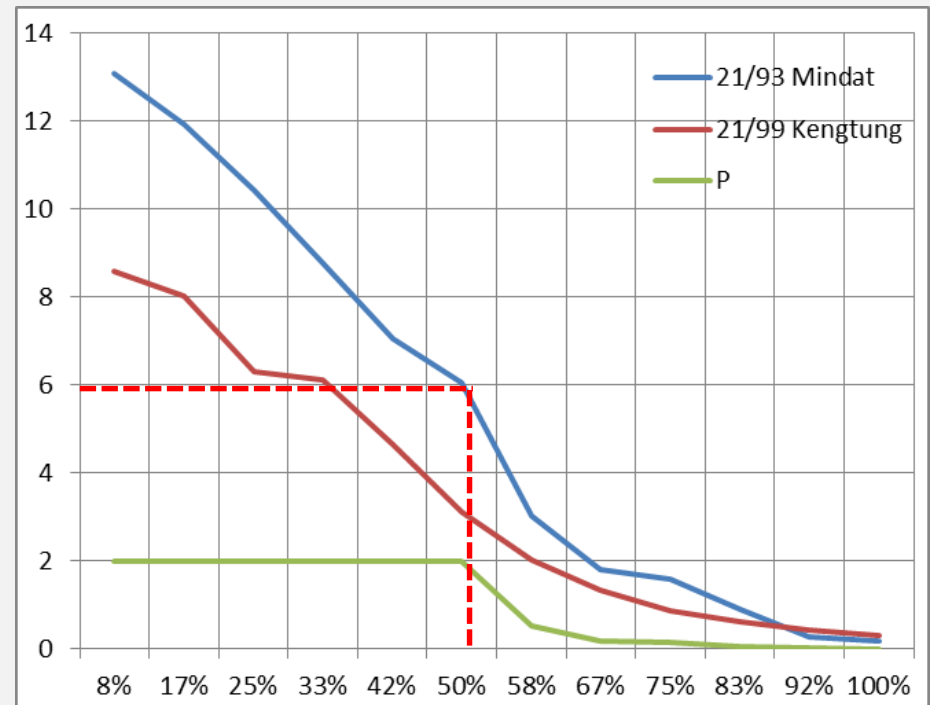


## Hydro Design

Determine design flow

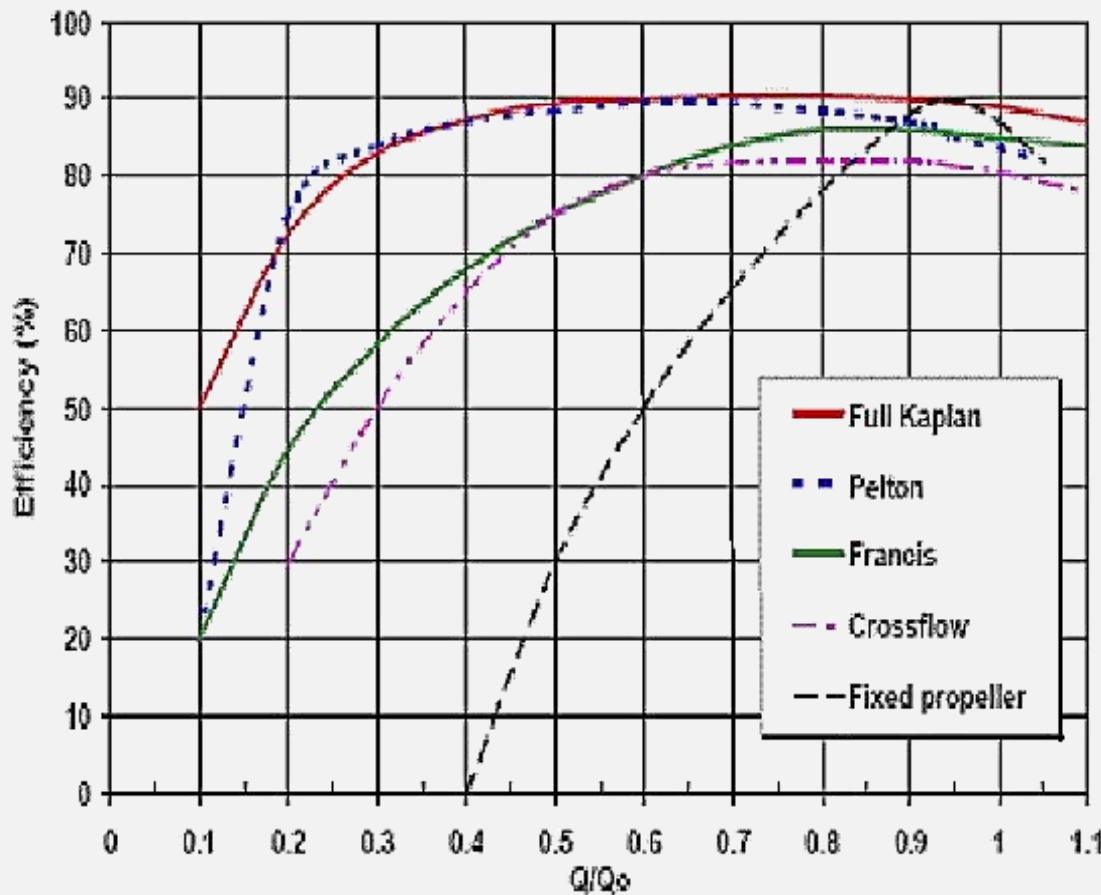
FDC 50%: 6 m³/sec x 50 m x 7

P = 2,100 W



## Efficiency comparison at reduced flow

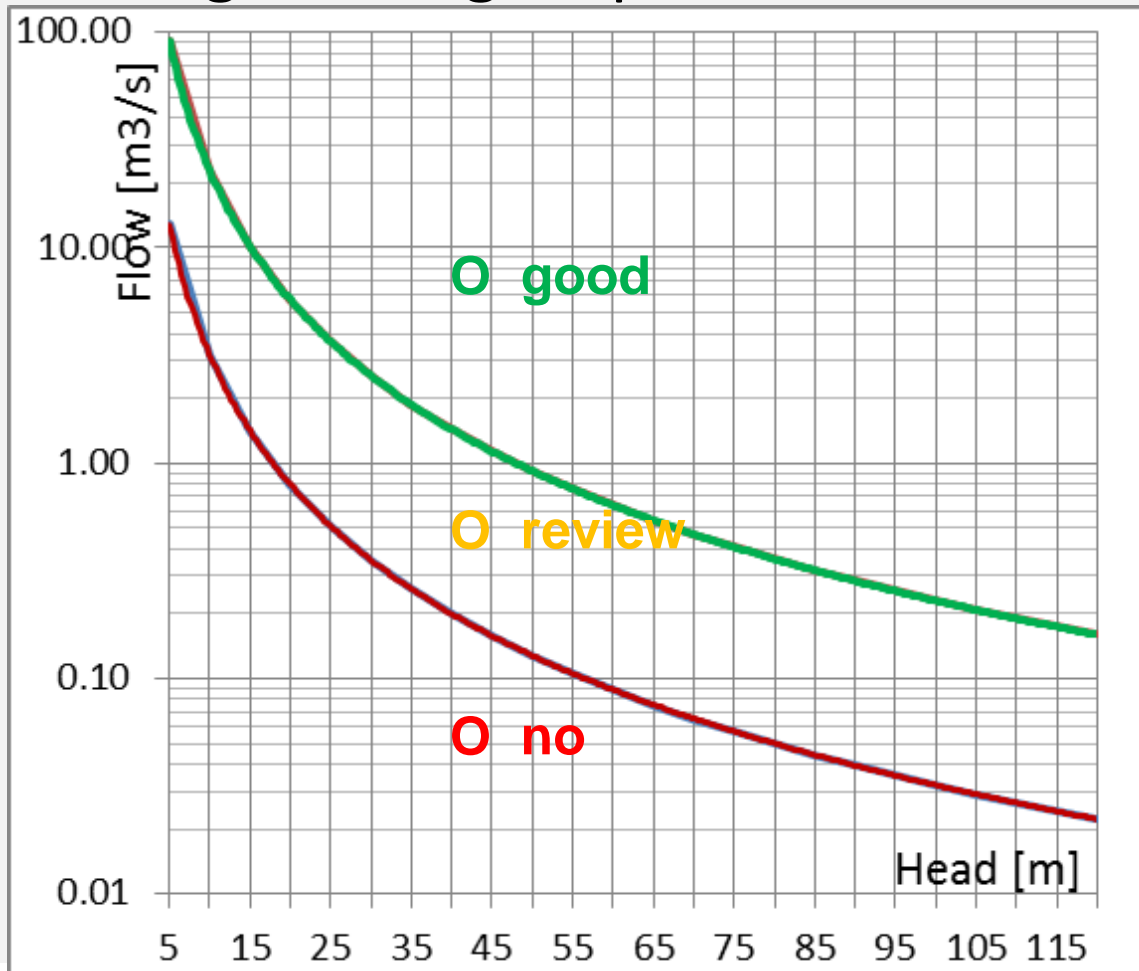
## Hydro Design



Efficiency no more than 90%

Some Turbines lose efficiency rapidly below design flow

## Ranking of Design-Options

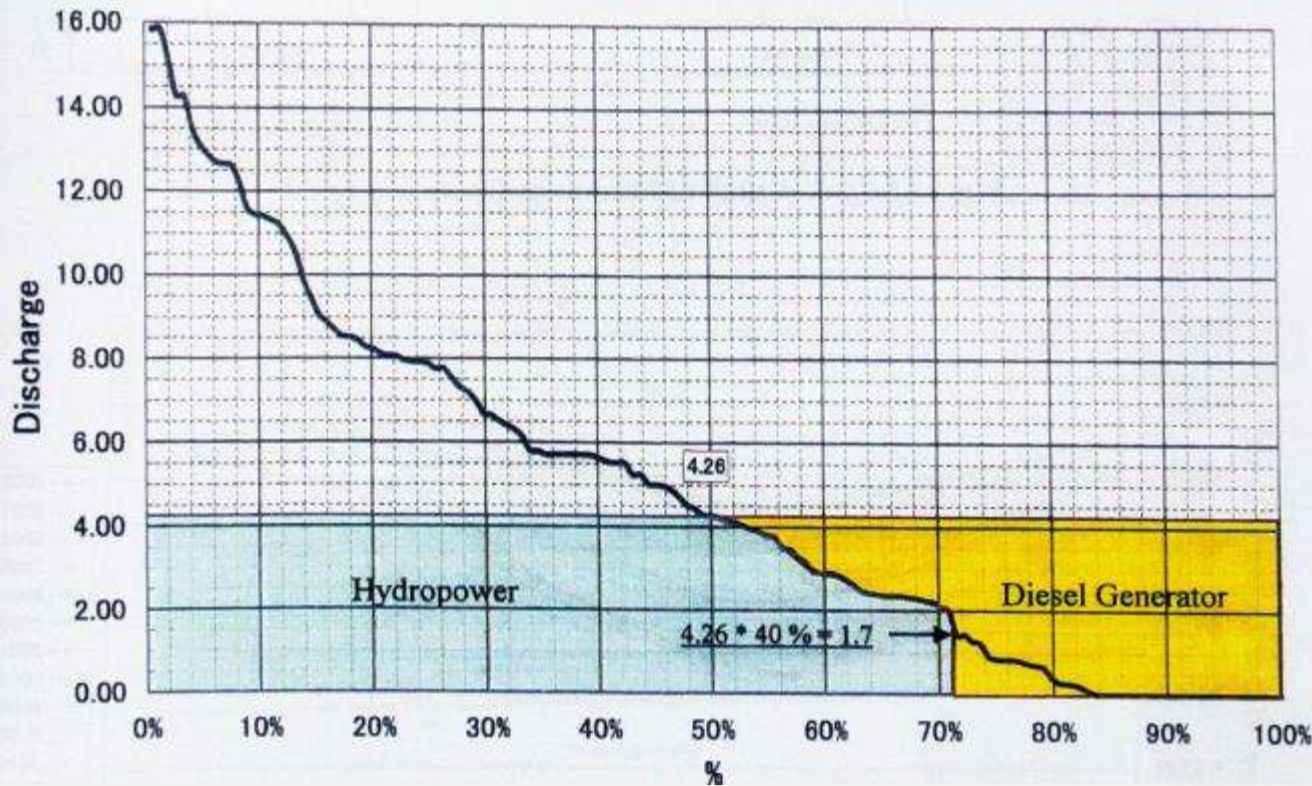


## Hydro Design

Select various desings  
by Flow  $Q_{50}$ , Head

Operation below design discharge:

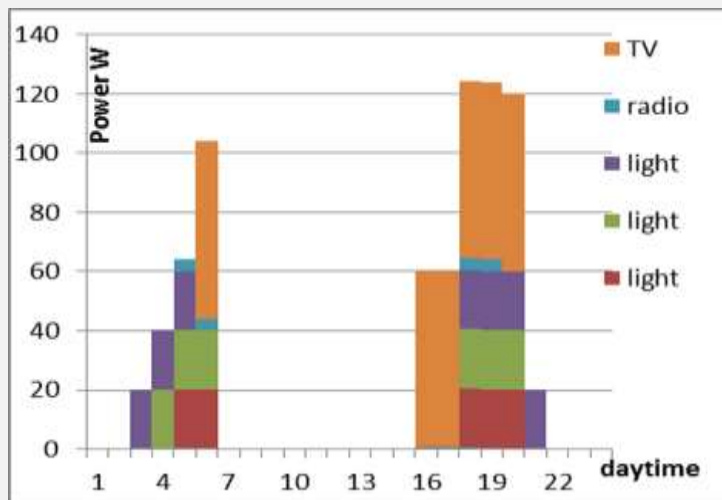
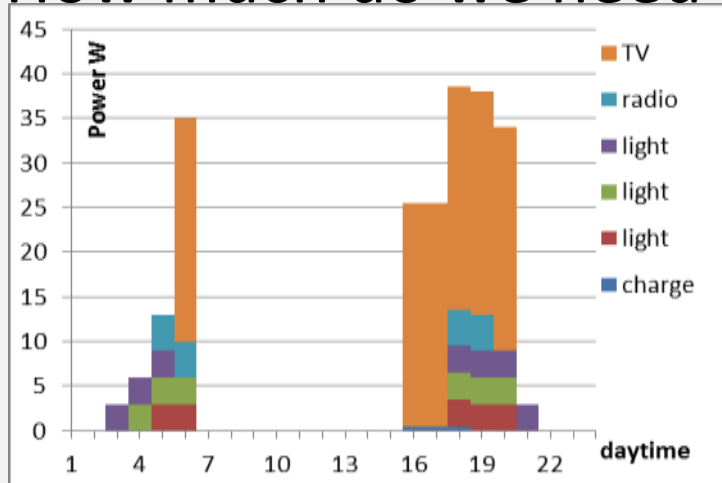
# Hydro Design



Hydro may need  
backup power



## How much do we need



## Hydro Design

### Consumption **Energy Saving Appliances**

255 Wh/d = **93 kWh/a**

- 3 Low-LED lighting morning and evening
- radio or similar, TV/DVD set 25 W
- option for charging

Power rate for 100 homes: **3.8 kW**

### Consumption **Standard Appliances**

876 Wh/d = **320 kWh/a**

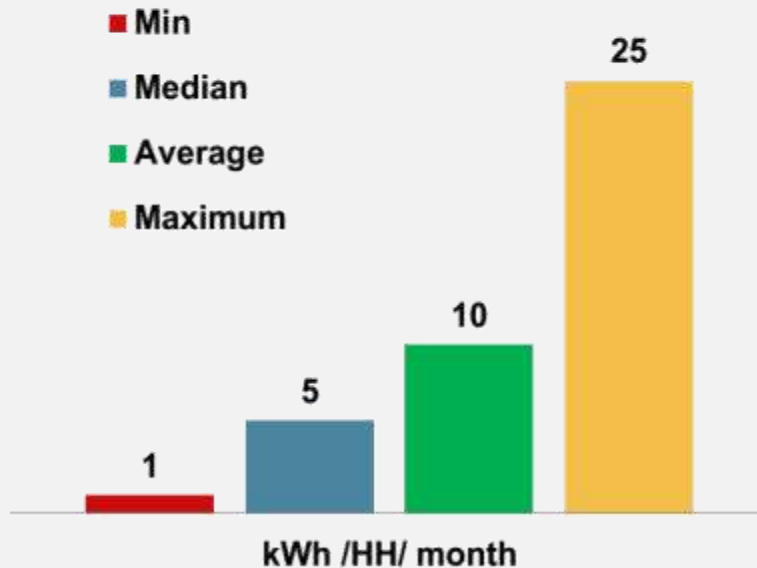
- each home 3x20W FL lighting
- radio or similar, TV/DVD set 60 W

Power rate for 100 homes: **12.5 kW**

## How much do we need

Household consumption differs

Consumed kWh per month per connected HH (n=19) – September 2012

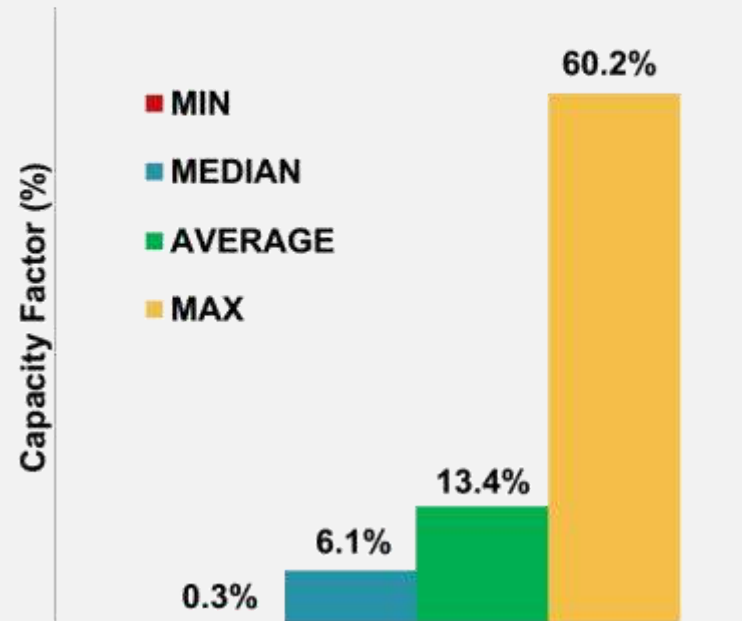


source: GIZ 2013

## Hydro Design

Capacity Factor =  
design power / used power

Capacity Factor (n=19) -  
September 2012



### How much will it cost

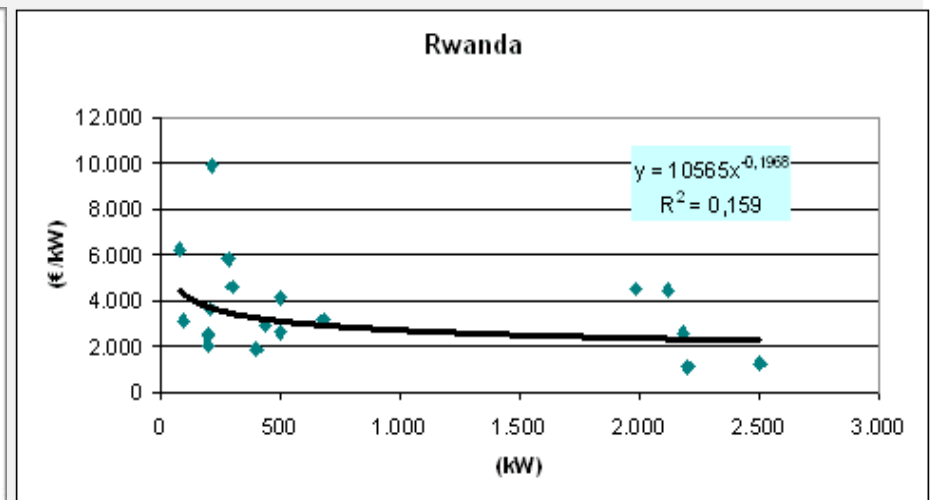
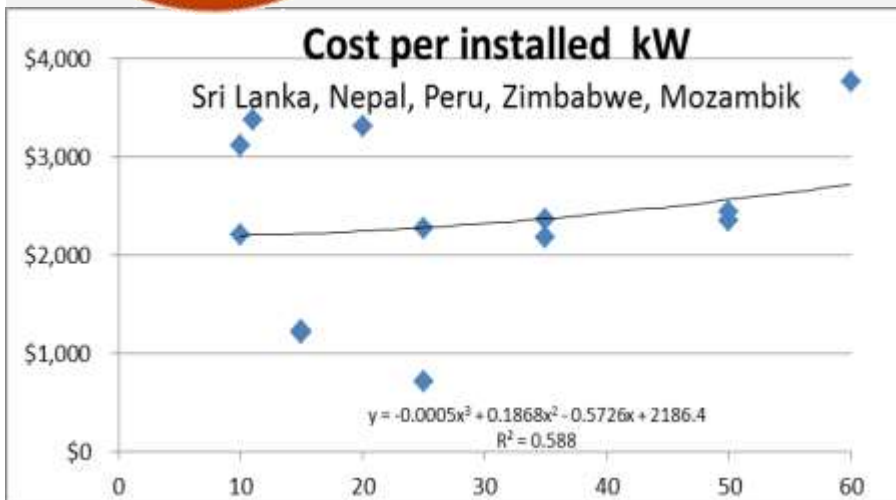
MHP Cost breakdown under GIZ-EnDev- March 2012



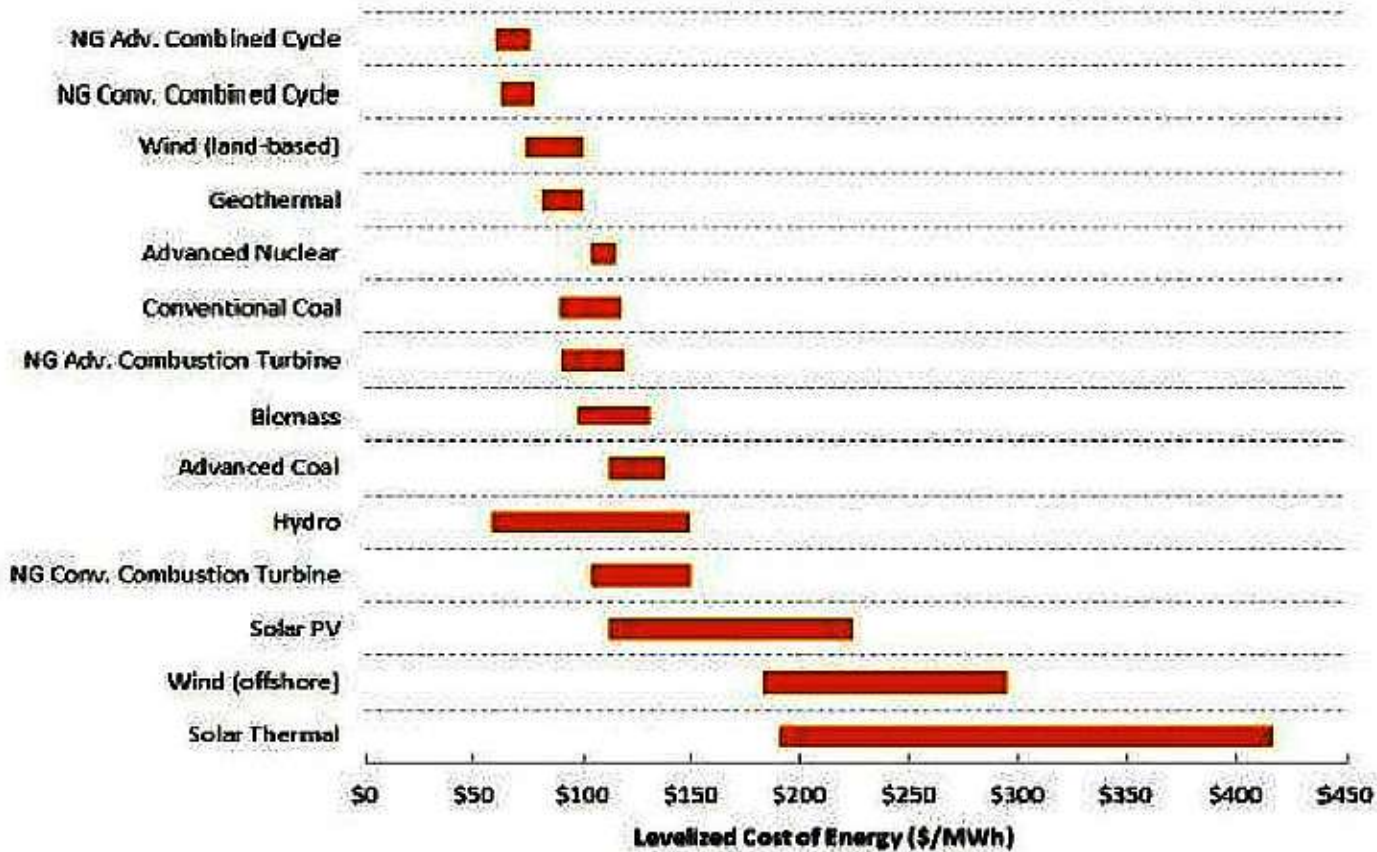
### Hydro Design

Cost Structure:

- Turbine, generator – 700-1500 \$
- Civil Construction, Lines – 500-2000 \$
- Maintenace – 5-10 % of CapEx



## Levelized Cost of New Generation Resources



Data Source: EIA, Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013

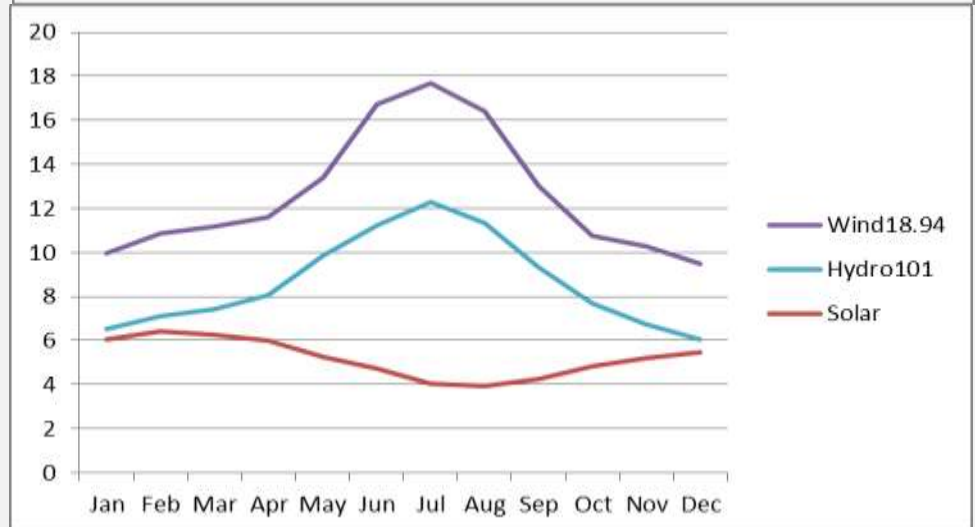
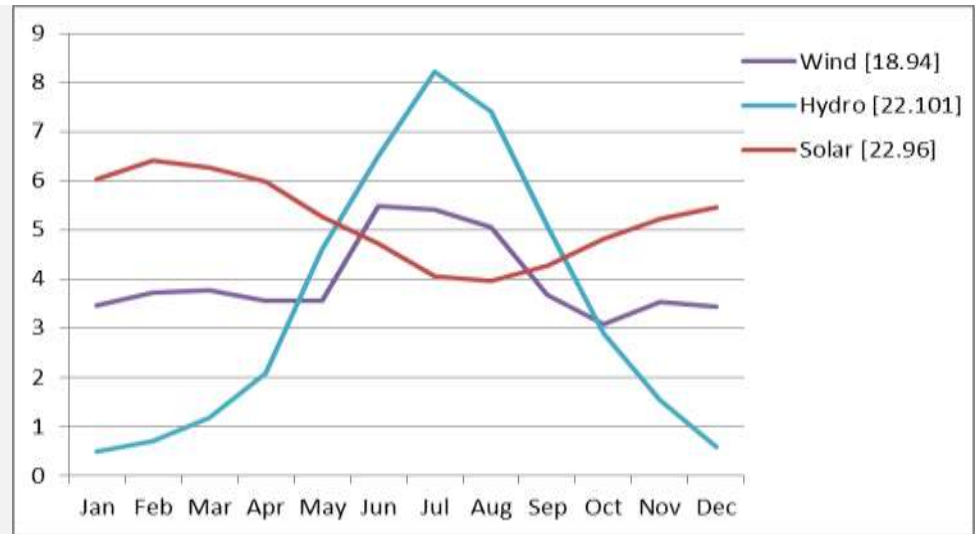
**Hydro Hybrid :**

Power Balancing :

Wind + Solar - ok

Hydro + Solar - ok

Hydro + Wind - no



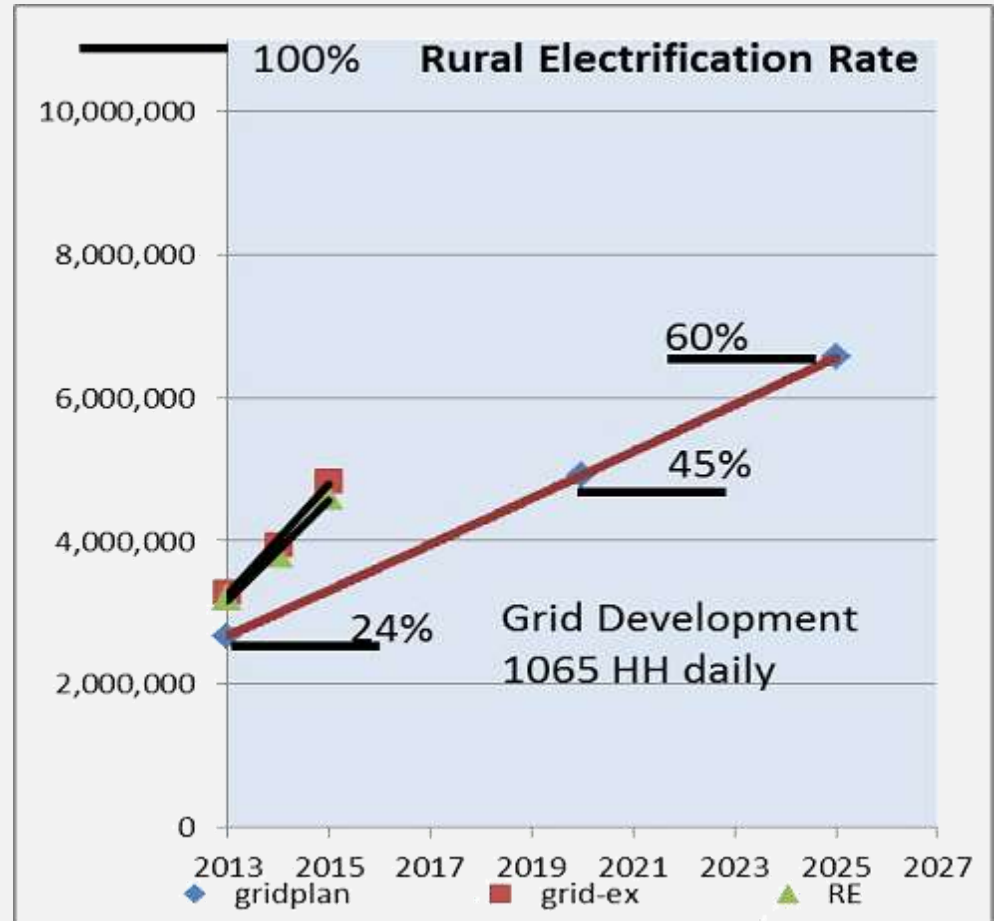


**8,262,324** of 10,937,500  
rural Households  
**unelectrified = 76%**

Grid: electrif. to 40% by 2025  
388,732 new connections/a  
1065 new connections daily

Complement with  
**Micro-Hydro**  
Biomass  
Solar

What can be done ?





## Project development

- Select village (transparent)
- Information drive
- Arrange Downpayment
- Buy, transport material
- Install, commission
- Train users
- Arrange Service
- Collect fees for service, repair
- Provide service, repair, monitoring
- Provide expansion





Action Plan	Renewable Energy Development Myanmar
Assess	Which resources are available How can we use them Do we have the capacity What are training, cost, time needed
Plan	Identify demand Compute supply options
Policy	Define targets, priorities Support, actors and incentives Activities and Responsibilities
Strategy	What is the most efficient way to reach targets How can sufficient capacity, finance be secured
Roadmap	How much can be done over time Define Stages, Milestones, Indicators



## Renewable Energy Agency

- Get **data** (resources, material, regulations)
- **Train** (installers, technician, designer)
- **Plan** development, expansion
- Select, **prioritize** projects
- Secure **Financing**
- **Organize**, supervise installations
- **Standards** and tenders
- **Quality Assurance**
- **Monitor** progress, service
- **Coordinate** different activities





## Issues

Hydropower is a strong driver for village electrification, development

### Village Hydro going down

- less initiatives, projects implemented
- less dedication, confidence of people
- less developers, installers
- knowledge, devotion getting lost
- missing guidance, financing

- Good, long relation to Hydropower
- Existing knowledge and experience
- Willingness to contribute labour, time, payment, care
- Confidence in village organization
- Active social responsibility

**Government**

- Is truly concerned about hydro
- Wants progress, growth,
- Prefers local resources, benefits
- Can create framework :  
regulations, laws, standards, financing

- Needs to move out of implementation
- Cannot follow all single projects
- Cannot help all at once
- Needs to balance interest, politics
- Needs to set priorities

**States**

- Want autonomy, regional  
development
- Are responsible to their people
- Accept tasks and duties

- Have limited resources
- Have less access to information,  
resources
- Have differing background, experience
- Depend on national policy, regulations

**Private Sector**

- Has experience, knowledge
- Can provide local value
- Can be fast, efficient
- Can deal with people

- Needs to survive – earn
- Needs to prioritize resources
- Needs financing, answer banks
- Needs to economize on indirect cost (red tape)

**Framework**

Capacity Building / Rules&Regulations / Funding

**Inputs**

- Consolidated data
- Training (for Trainers)
- Survey, Design
- Finance, Grants
- Information
- Standards, Specifications
- Quality (Certification)



# We want to develop Village Hydro

## What Do we need

## What can we Do

From whom, when, Important / urgent

### Government

Enabling Framework  
Tariff, Incentives, Rules

### Government

Tasks of RE Agency  
Guide, Government

### States

Develop Villages

### Private Sector

Develop Projects



## Five Guidelines for Renewable Energy

- Provide citizens **sufficient** energy at **sustainable** cost
- Encourage citizens to **contribute** to electricity **service**, help the **Weak**
- Give **priority** to viable **distributed generation** from Renewable Energy Sources
- **Prefer private** to public development in Renewable Energy generation
- Ensure proper **standards**, attractive financing and continuous **training**



Find the documents: <http://1drv.ms/1rtNPat>



Think BIG - Start small - Scale Fast