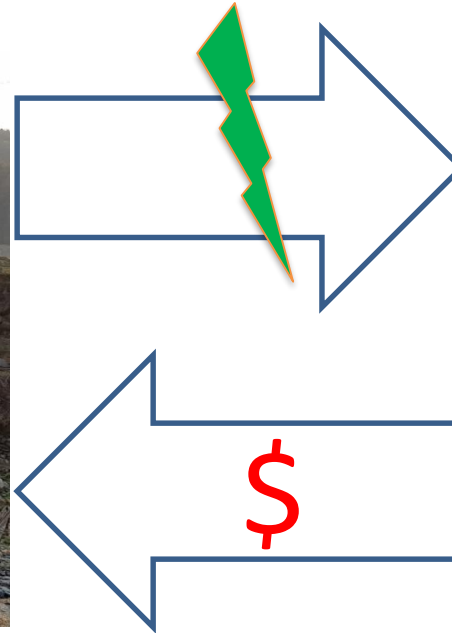


Grid Interconnection of Micro Hydropower: Experience Sharing from Nepal



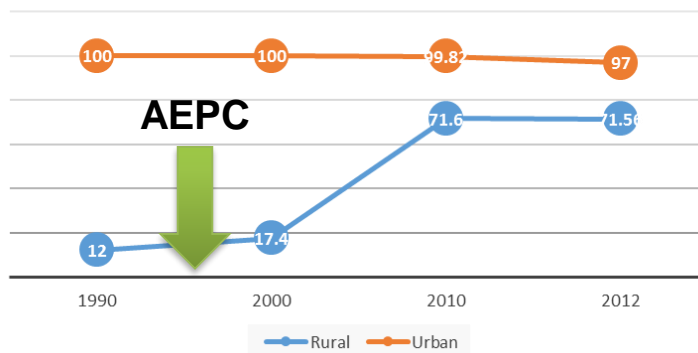
Jiwan Kumar Mallik
Renewable Energy for Rural Livelihood (RERL), Nepal

Asia Clean Energy Forum 2018
June 7, 2018

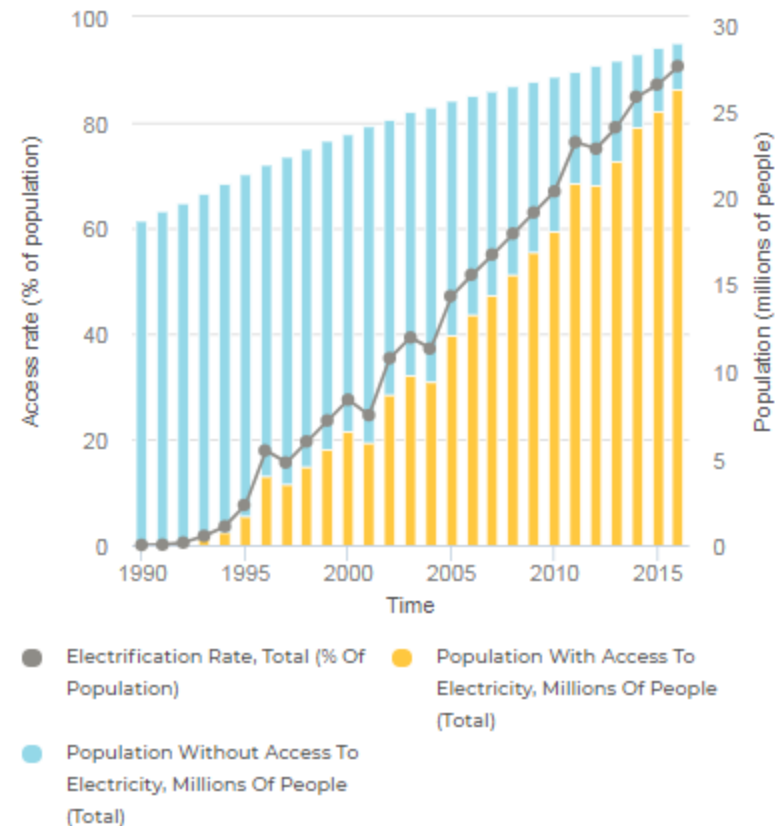
Setting the Scene

- Though access to electricity is above 90%, the per capita energy consumption is just 190kWhr and it is below the average of South Asia
- The electricity access is below Tier 3 of the Multi Tier Framework.
- There is limited possibility to add further Micro/Mini Hydro.
- Thus Interconnection of MHP to MHP or MHP to national grid will help to increase per capita energy consumption and Tier level.
- However, you have to be careful while distorting already running MHPs.

Access to electricity , historical trend



90.7% of population have access to electricity - unreliable



Source: ESMAP, World Bank

Energy Access through MHP Interconnection

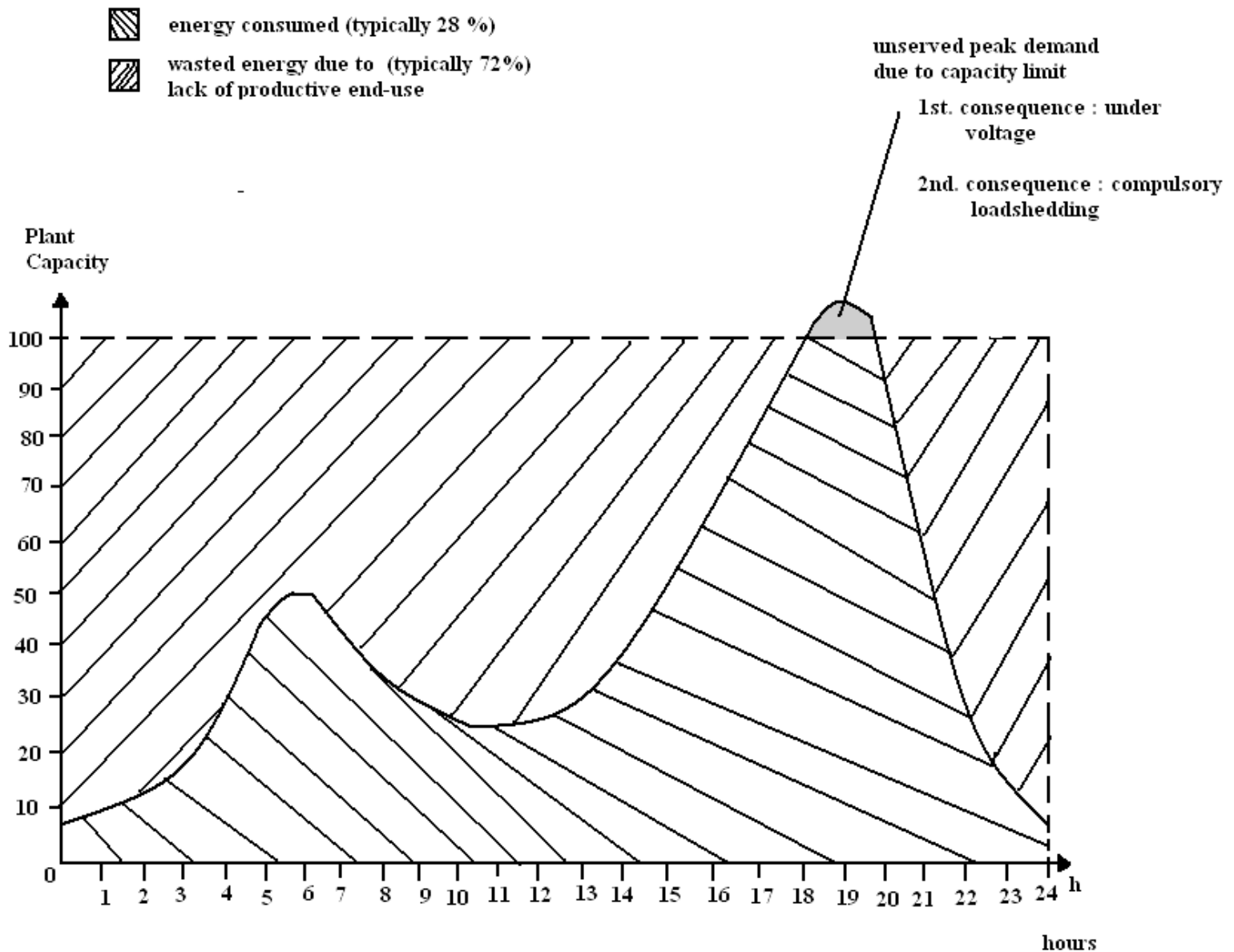
- It is not always necessary to add new generation asset for Energy Access
- Surplus-deficit energy can be managed by interconnecting MHP to MHP



Interconnected MHP Clusters in Nepal

Name of Cluster	Number of Projects Inter-Connected	11 kV Transmission (distance of inter-connection)	Rated Capacity (kW)	Status
Baglung Local Grid	6 MHPs	7 km	9-23 kW	Completed in 2011
Gulmi Local Grid	2 MHPs	1.5 km	135 kW and 83 kW	Completed in 2014
Taplejung Local Grid	5 MHPs	40 km	36 kW to 95kW	In-progress: July 2018

Need for Grid Interconnection of MHP



Policy Breakthrough: MHP Interconnection with Grid



Advocacy
initiated in
2011



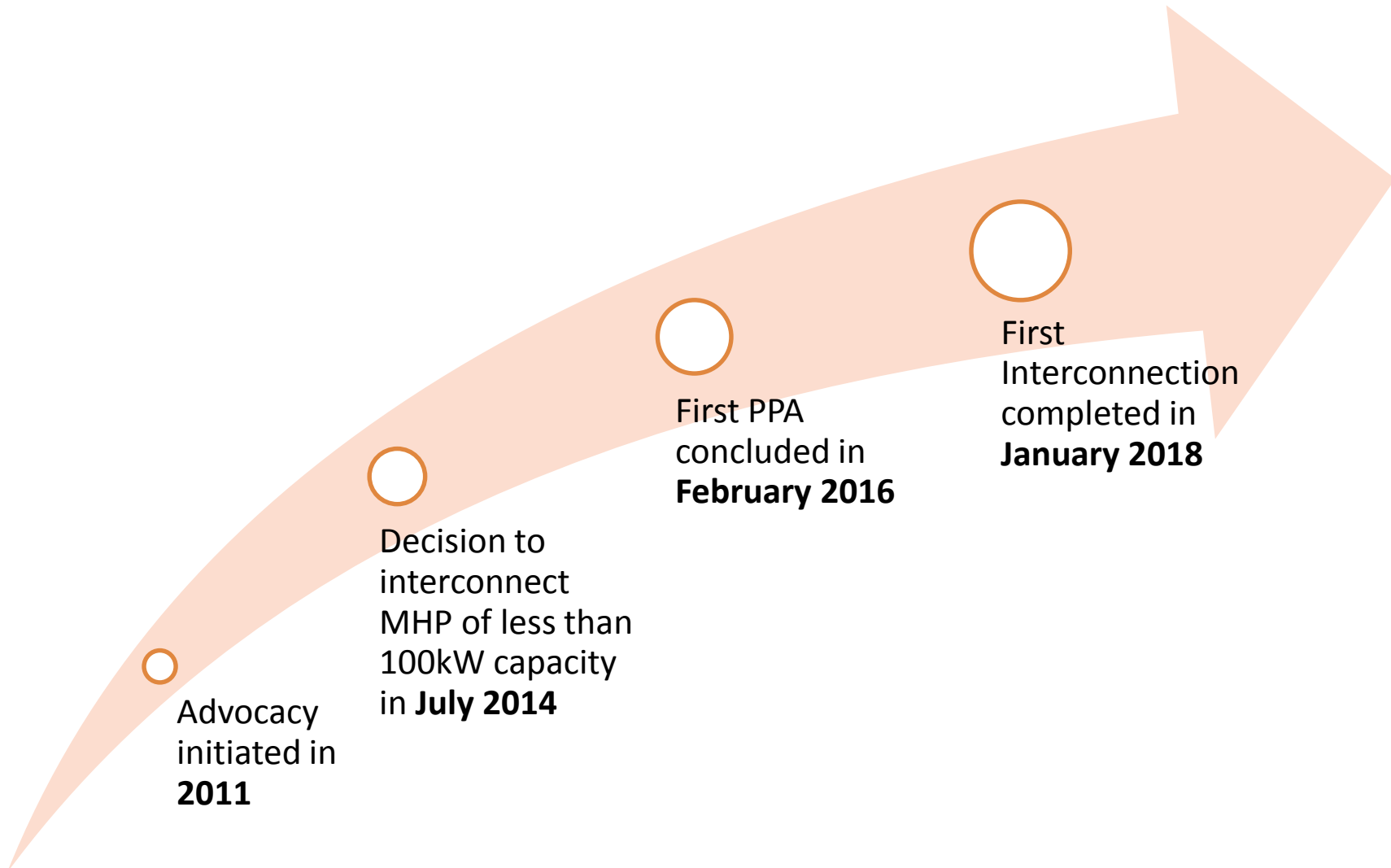
Decision to
interconnect
MHP of less than
100kW capacity
in **July 2014**



First PPA
concluded in
February 2016

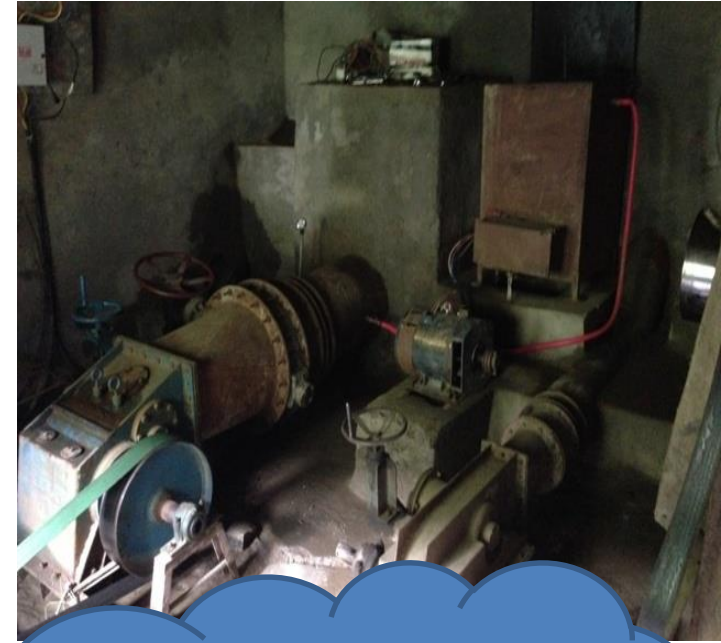


First
Interconnection
completed in
January 2018



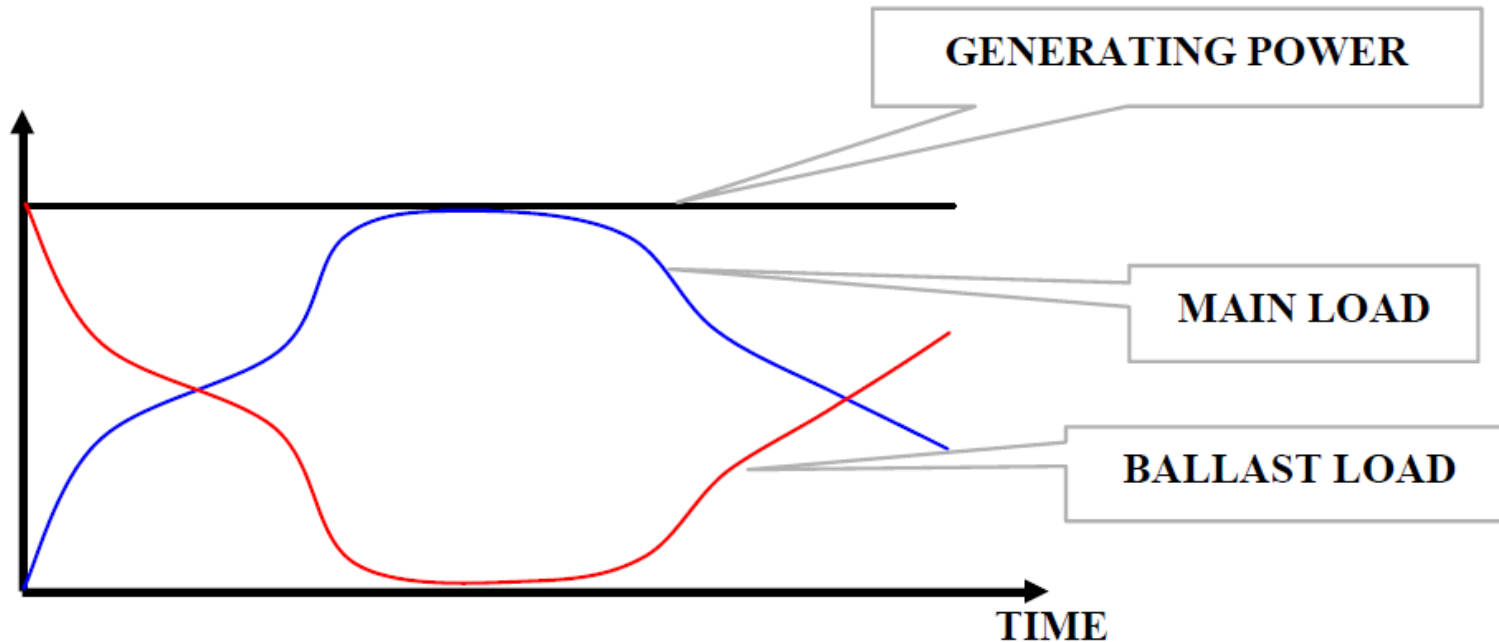
Pilot Grid Interconnection Project: Salient Features

- Capacity: 23 kW
- Design discharge of 370 lps and gross head of 11.4 meters
- Construction of MHP completed in June 2013
- The national grid encroached its catchment during construction and all 240 HHs potential consumers switched to the national grid
- PPA rate- USD 4.8 cents/kWhr for 8 months (wet season) and USD 8.4 cents/kWhr for 4 months (dry season)
- Total Annual Energy Generation of 178,245 kW-hr



After breakthrough of the Syaurebhumu Grid Interconnected MHP, two more MHPs of 40kW and 90kW have been interconnected to the Grid

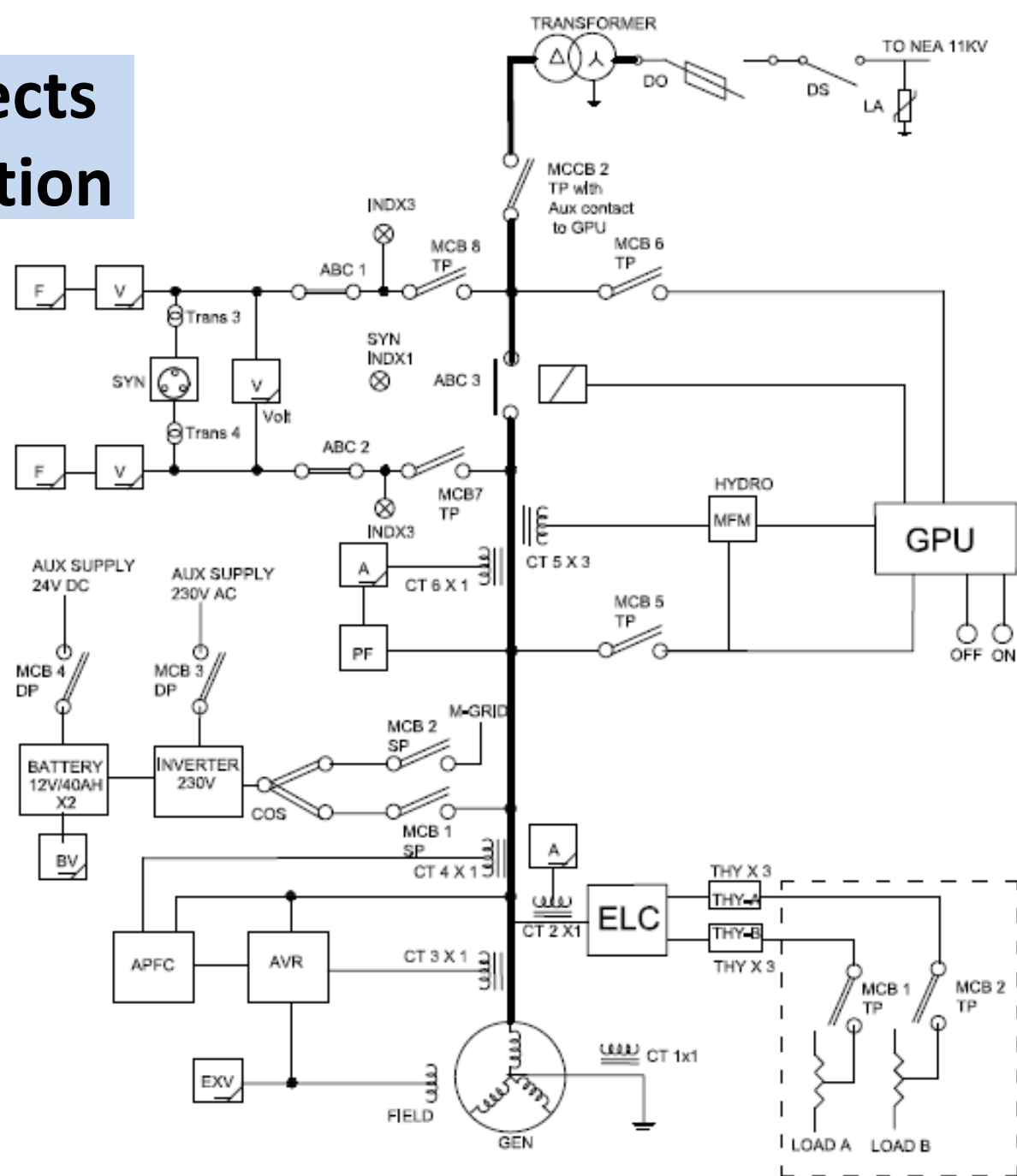
Electronic Load Controller (ELC) as the Governor



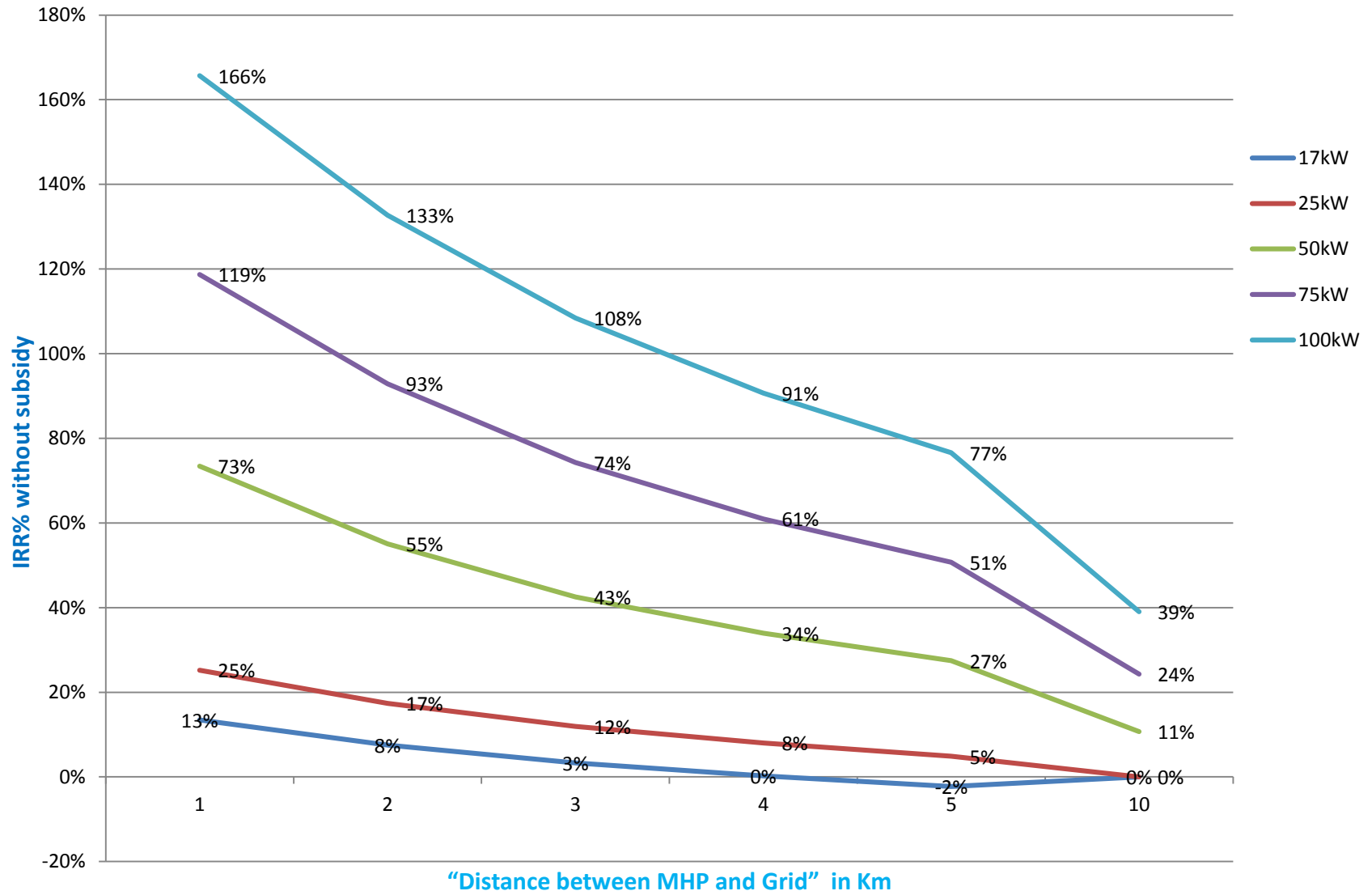
The technology for interconnection of Micro Hydro to the Grid is different than Large Hydro

IRR with ELC- 20.85%
IRR with Governor-13.28%

Technical Aspects of Interconnection

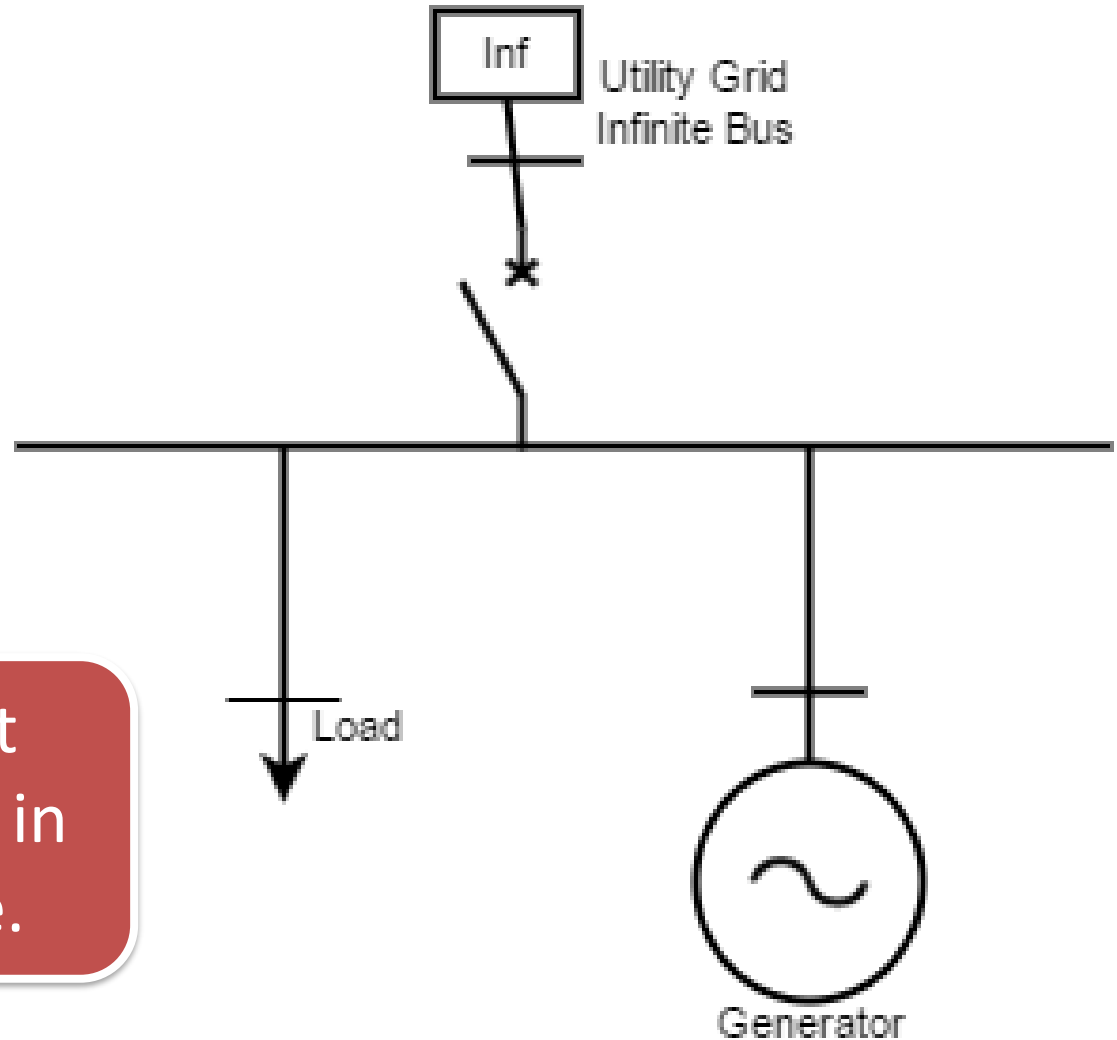


Sensitivity Analysis



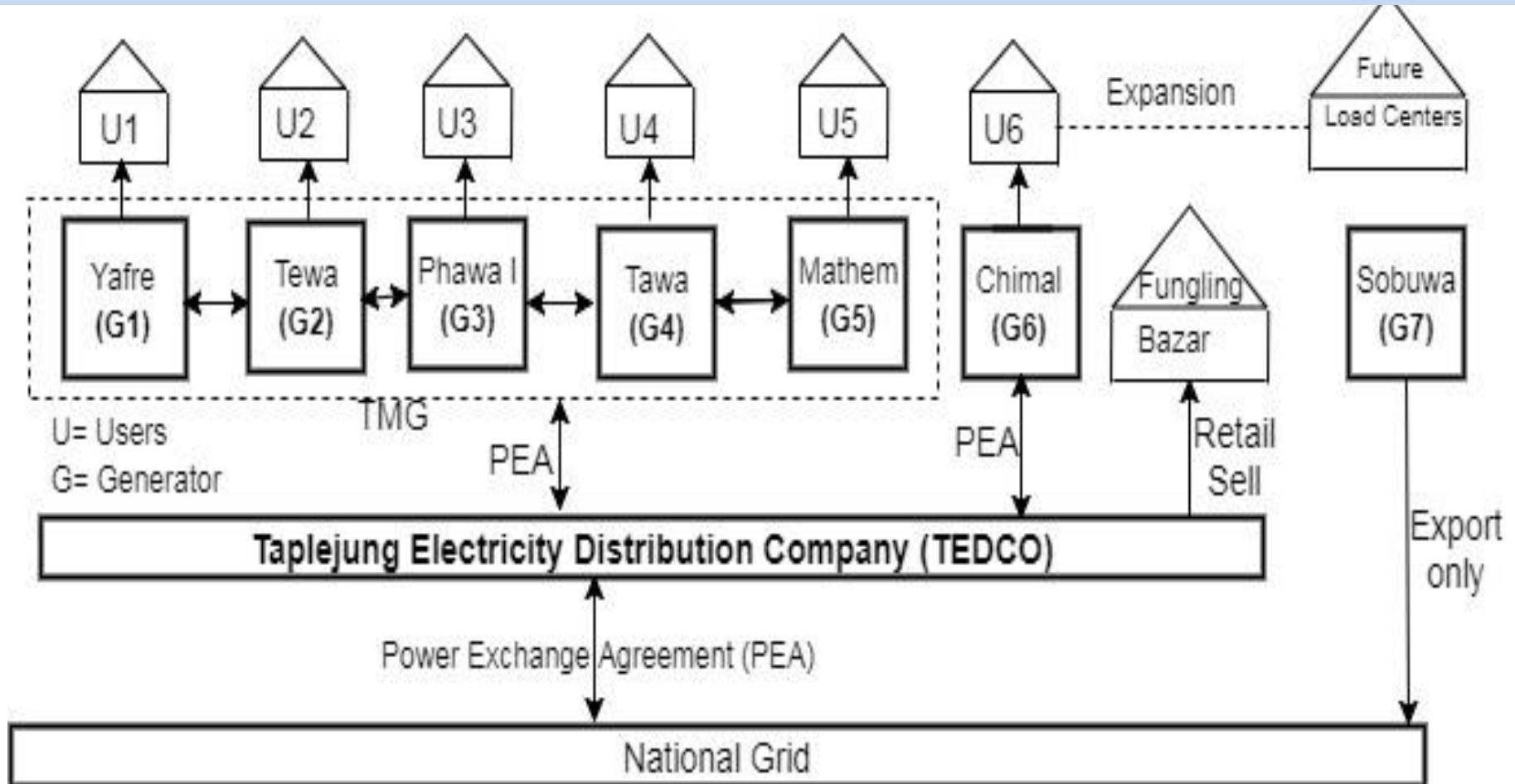
Only interconnection cost has been considered in CAPEX (cost of construction of MHP not included)

Business Model for Interconnection



Here, MHPs cannot use/sell electricity, in case of grid outage.

Power Purchase Agreement (PPA) vs Power Exchange Agreement (PEA)



Allow the MHP owner to be the *Prosumer* of electricity in their vicinity, rather than an IPP

Impact of Grid Interconnection of MHP

- The voltage of feeder line increased, and thus enhanced the power quality of feeder line.
- Distributed generation helped to minimize the power loss of T&D by injecting power near the load center.
- Plant load factor increased significantly, and therefore increased the economic sustainability of the MHP.
- Redundant MHP is utilized to generate revenue for local development.

Challenges of Grid Interconnection of MHPs

- Simple connectivity – a solution of compact device
- Sustainability – Involvement of the Private Sector
- Finding subsidy for Interconnection until the technology is readily available in the Nepalese market
- Distribution Grid Code – Code for connectivity
- PEA/SPPA policies
- Moving analog to digital ELC with Droop characteristics

Replication of Nepal's Learning in Pakistan

- Nepal has supplied many ELCs to Pakistan for off-grid MHPs
- Concept of Local Grid is initiating by AKRSP Pakistan in Chitral district
- Two local grid in two different valleys
- 7 MHPs of capacity ranges between 50kW to 800kW in 15 Km length
- Techno-institutional learning's of Nepal shall be exchanged with AKRSP Pakistan to avoid pitfalls and leap-frog to advance stage.



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