

# **Micro Hydro Pumped Storage, Wind Power , and Photovoltaic Combination For Rural or Remote Area Electrification**

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## **Abstract**

Renewable Energy in the world today is increasingly becoming the main choice for Power Plant because of its low fuel cost and friendly for environment. In many small towns or villages of developing countries in Asia and Africa, is still widely used oil-fired diesel generator that has high fuel cost and not environmental friendly. Of course the diesel generator must be replaced with renewable energy power plants to reduce the cost. This paper described the new concept of renewable energy implementation using a combination of Micro Hydro Pumped Storage Power Plant, Wind Power Plant, and Photovoltaic connected into a micro grid system to meet the electricity needs of the rural or remote areas that are not reached by major power lines.

Hydro Electric Power Plant (HEPP) is a favorite power generation because it's cheap and able to operate quickly. However, this HEPP can only be built in certain locations, and usually in the mountains far from load centers. While the rivers are located near load centers usually ramps and do not have enough head for ordinary HEPP. To build a hydro power plant close to concentration of the load in a remote area, can use small-scale Hydro Pumped Storage. Pumped Storage commonly used is to construct two water storage, upper storage and lower storage. But this paper will explain the concept of Pumped Storage using river as lower storage, so it just need to build storage in the upper hills or plateau close to the river. Water from turbine is discharged to river and water from river is pumped to upper storage.

In rural areas or small towns, the peak load is more common at night, making it suitable to implement pumped storage to meet peak load for a few hours. Pumped Storage will connect with several Wind Power Plants and Photovoltaic Power Plants in a micro grid system, and some of electricity produced by the two plants will be used to pump water slowly from river into the upper storage except during peak times. With the pumped storage, PV quite operate on during the day and do not need to use batteries that are expensive and usually quickly broken. Using this concept, operation and maintenance cost can be reduced and demand for electricity in the areas that do not have a hydro power plant potential still to be fulfilled.