Pumped Hydro Storage

Re-Energy
Learning Activity
Grade Level 7-12

Main Objectives

Learners will learn about the importance of a pumped hydro facility and design and build a model.

Learning Outcomes

By the end of this activity, learners will:

- Understand the concept of mechanical energy storage
- Design and test their own pumped hydro storage design and gain and understanding of how to maximize stored power

Length of Activity

1 - 2 hours

Materials List

Mechanical Energy Storage Backgrounder
Toy motor
Voltmeter and wires
Cup/jug (to pour water over the turbine if not using a second motor)
Bucket or container (to capture the water)
Pumped Hydro Storage Worksheet

Introduction

There are many factors that contribute to building a pumped hydro facility to maximize the energy output. Some of these factors include water flow (natural or human-made), heigh difference between reservoirs and size of reservoirs (how much water is available). When designing a facility, all these factors must be considered, especially when used for energy storage applications. In this activity, learners will design their own pumped hydro facility and attempt to maximize the stored power. Use a toy motor and wires to measure the voltage with a voltmeter.

Pumped hydro uses two reservoirs at different heights and moves water between these reservoirs. During times when electricity is needed, water moves from the higher reservoir through a turbine generator to the lower reservoir. During times when electricity is not needed, an electric motor pumps water from the lower reservoir to the higher reservoir.

Procedure

Before you begin: Please review the Mechanical Energy Storage backgrounder as a class.

Step 1: Research pumped hydro storage designs and build your own.

Note: You want your design to be durable and withstand the weight of the water. The main component required for pumped storage is a turbine generator, which will produce the energy. When creating your design, consider what you will use for the turbine blades, how you will secure the blades, and what blades will spin around.
Tip: There are many examples on the internet. Some possible blade examples include cardboard, spoons, cans, or cups.

Step 2: Test your pumped hydro storage build.

In real-life pumped storage, there is a pump to move the water back to the top after being discharged. For more complexity, you may design a system that harvests energy when the water is released from the upper reservoir and moves the water back to the top.

a. You need a pump or something to move the water to do so. Two voltmeters are required, one to measure the energy released (positive value) and one to measure the energy required to charge (negative value).

For simplicity, you can measure the energy released from the water, then calculate the energy required to move the water back to the top (i.e., what is the work). Once you find this value, subtract from the energy output and to determine the net energy for the system.
Tip: Calculate the work required to move the water, and calculate the losses due to the pump.

Step 3: Using your worksheet, write down your trial observations.

Step 4: Compare your design with your peers to assess what worked and what did not.

a. Are there any changes or modifications you would make?
b. What do you notice about the net energy?
c. Is it overall positive? Or overall negative?