

ACTIVITY 3: Hydroelectric vs. Coal Powered Electricity

Activity Objective: Develop and write an essay with graphic charts to determine if the environmental advantage of hydroelectric power is worth the related social and environmental costs. Explain why it is worth the costs or why not.

Materials: Chapter 10, paper, computer, printer, Internet Access

Definition: Hydroelectric power plants provide clean energy compared to a coal-fired plant. Hydroelectricity is converting the energy of flowing water into the mechanical energy of a turbine to turn an AC hydroelectric generator to generate electricity. Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and an AC generator. The power extracted from the water depends on the flow volume coming from the head of water or the difference in height between the source and the water's outflow.

Hydroelectric Advantages

- **Flexibility:** Hydropower is a flexible source of electricity since stations can be ramped up and down very quickly to adapt to changing energy demands
- **Low power costs** The major advantage of hydroelectricity is elimination of the cost of fuel. The cost of operating a hydroelectric station is nearly immune to increases in the cost of fossil fuels such as oil, natural gas or coal, and no imports are needed.
- **Suitability for industrial applications:** some plants are created to serve specific industrial enterprises. Dedicated hydroelectric plants are built to provide the substantial amounts of electricity needed for aluminum electrolytic plants.
- **Reduced CO₂ emissions:** hydroelectric dams do not burn fossil fuels, they do not directly produce carbon dioxide.
- **Reservoir Use:** Reservoirs provide facilities for water sports, and become tourist attractions themselves. Large hydro dams can control floods.

Hydroelectric Disadvantages

- **Ecosystem damage and loss of land:** Hydroelectric power stations use dams that would submerge large areas of land due to the reservoir requirements. Power stations result in submersion of extensive areas upstream of the dams, and can destroy biologically rich and productive lowland and riverine valley forests, marshland and grasslands. Damming interrupts the flow of rivers and can harm local ecosystems.
- **Siltation and flow shortage:** When water flows it has the ability to transport particles heavier than itself downstream, which has a negative effect on dams and subsequently their power stations, particularly those on rivers or within catchment areas with high siltation. Siltation can fill a reservoir and reduce its capacity to control floods along with causing additional horizontal pressure on the upstream portion of the dam. Some reservoirs can become full of sediment and useless or over-top during a flood and can fail.
- **Methane emissions (from reservoirs):** reservoirs of power plants in tropical regions can produce substantial amounts of methane because of plant material in flooded areas decaying in an airless environment, and forming methane, a greenhouse gas.

- Relocation: need to relocate the people living where the reservoirs are planned.
- Failure risks: Dam failure and hydroelectric power station failures.

REVIEW VIDEOS:

Energy payback time (EPBT) of water electric generation: Energy transfer and efficiency

<https://www.youtube.com/watch?v=FHWbsUJNcXk>

Energy returned on energy invested (EROEI) of water power: Returns on renewable energy investments: <https://www.youtube.com/watch?v=gQnCbR8ty1s>

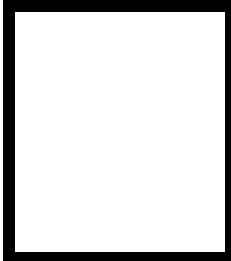
Procedure:

1. Work as partners or small teams.
2. Research the efficiency and advantages and disadvantages of both hydroelectric and coal-fired electricity generation.
3. Create a list of advantages and disadvantages for a coal-fired electricity generating plant.
4. Write the essay that answers the following question: Why it is worth the costs to build a hydroelectric plant to replace a coal-fired facility or why not.



RUBRIC

4 World-Class Learner	3 Proficient Learner	2 Developing Learner	1 Emergent Learner
Learner at this level has gone beyond mastery of knowledge, skills, & attitudes described in project. World-class learner consistently exhibits high-quality performance.	Learner at this level has had opportunities to apply knowledge, skills, & attitudes of component of project. Proficient learner has mastered essential attributes, thus proving mastery.	Learner at this level has been exposed to & had opportunity to apply knowledge, skills, & attitudes of project. Developing learner may have only a few essential attributes to master before mastery.	Learner at this level may or may not have been exposed to knowledge, skills, & attitudes required by academic standards of the project.



- 1= Emergent Learner
- 2 = Developing Learner
- 3 = Proficient Learner
- 4 = World-Class Learner