Hydroelectric Power: Advantages And Negative Impacts

Abstract

Hydroelectric power as an environmentally friendly way of generating electricity is used widely in all over the world. Along with more and more people are concerned about the environment, people found out not only waste and pollutants can affect the environment. In this report, the principle of hydropower, the advantages, disadvantages and the negative impact on the environment of hydropower will be discussed. Even Hydropower plants are non-polluting to water or air, they affect the environment in many ways.

1. Introduction

1.1 Hydropower

1.1.1What is hydropower? How does the hydropower plant works?

In 2011, 16% of the world's electricity are provided by hydropower, the global capacity was 950 gigawatts, 24% in China, 8% in the U.S., and 9% in Brazil. In worldwide, hydropower capacity has more than doubled since 1970 (Union of concerned scientists, 2019). Hydroelectric power uses gravity and the water cycle, by using the energy of moving water to create electrical power, it is the biggest source of emissions-free, renewable electricity. Sufficient volume water moves in sufficient speed to spin a turbine, which rotate a generator to create electricity. One kilowatt of electricity can be generated by one gallon of water falling one hundred feet per second. Figure 1 shows the processes of a hydro power site, in order to increase the amount of flowing water, a reservoir or dam is used to collect water, an opening in the dam takes advantage of gravity to drop water down through a penstock, the falling water spin the turbine, and causes the rotation of the generator to generate electricity (Union of concerned scientists, 2019).

1.1.2 The benefits of hydropower

1. Green and safe - Compare to the other main sources of electricity, fossil fuel burning and nuclear power, hydro power is green and safe, it is fueled by water, it has a clean fuel source and it does not pollute the air or water. The only pollution occurs in the construction stage of the power plant (Energy informative, 2019).
2. Renewable - Hydro power is a renewable energy, it cannot be used up. The water can be recycled since it does not pollute itself.
3. Reliable - Hydro power relies on water cycle, it is more reliable than fossil fuels that are consumed rapidly. Water is also a domestic source, it does not need to reliant on fuel sources import, as long as there is enough water in the country, hydro power can generate electricity (Office of energy efficiency and renewable energy, 2019).
4. Fast – Some hydro power plants can quickly output from zero to maximum power, it can provide power immediately. So, it can be used as a backup power supply system.
5. Flexible – Energy generation can be controlled by adjusting water flow based on the usage of power in different time period (Energy informative, 2019).

1.1.3 The disadvantages of hydro power

First of all, building a hydro power plant is expensive. The size of a power plant depends on the size power generator and topography of the land. Figure 2 shows an example of a generator, gives an idea of a generator`s size. For example, a deeper dam can store more volume of water in a relatively small land. For a flat area, a dam needs a very wide size to hold enough water. People's homes, important natural areas, agricultural land and archaeological sites may be covered, people relocated may be required. Secondly, when droughts happens, hydro power will be affected badly, electrical generation and the price of electricity will be affected. Thirdly, the land which is suitable for reservoirs is limited, suitable reservoirs for hydroelectric power plants started using up currently. Finally and most importantly, it has negative impact to the environment in many ways.

1.1.4 The negative impact to the environment of hydro power

Dams and reservoirs impact fish population, even though there are many ways to minimize the impact such as fish ladders and in-take screens, fish and other aquatic organism still may be harmed by turbines. Hydro power plants changes the temperature of water and may also change the direction of the flow, it may hinder fish migration, it also impact fish and the other animals. It also impact the wildlife in the reservoirs and downstream of the plants, reservoir water is more likely to stay than river water, with more sediment and nutrients. It provides a more suitable live environment for excessive aquatic weeds, which can crowed out other animals and plants in the river. Additionally, hydro power makes water evaporate faster than river water.

Dams and reservoirs do not discharge pollutant, but it do discharge greenhouse gases. A study published in Bioscience focused 267 reservoirs in six continents, the result shows carbon dioxide (CO_2), methane (CH_4) and nitrogen oxides (N_2O) is discharged from reservoirs. This new study proves that reservoirs are the main emitters of methane, which is a very active greenhouse gas. The sediment in the reservoir releases methane bubbles, which then pass through the entire body of water and rise to the surface of the reservoir. The water conservancy dam can no longer be regarded as a clean and green source of electricity (Claire, 2017).

2. A Hydro Power Plant Example

2.1 Three Gorges Dam

2.1.1 Introduction to Three Gorges Dam

Three Gorges Dam is a dam located on Changjiang River in Yichang, Hubei province in China. It is 2335 meters long, and the maximum height is 185 meters. 28 million cubic meters of concrete and 463,000 metric tons of steel were incorporated into its design. Three Gorges Dam has three main purpose: flood control, hydro power and navigation improvement. The units of the Three Gorges Hydropower Station are arranged on the rear side of the dam. A total of 32 sets of 700,000 kW hydro-generator units are installed, including 14 on the left bank, 12 on the right bank, and 6 on the right bank. There are also two 50,000-kilowatt power units. The total installed capacity is 22.5 million kilowatts, and the annual power generation is about 100 billion kilowatts (Three Gorges Dam, 2019).

2.1.2 The Negative Environmental Impact of Three Gorges Dam

In the surrounding area of Three Gorges Dam, there are 6,400 plants, 3,400 insects, 300 species of fish and more than 500 terrestrial vertebrates. These species and the environment they lives in are impacted by the dam, the ecosystem of the region is threatened. Since the water flow above the dam is slow, most of the sediment will now settle there, rather than flowing downstream, and the downstream sediment will be reduced. Accumulation of benthic sediments can cause biological damage and reduce aquatic biodiversity. Researchers at NASA have found that the Three Gorges is creating a lake effect that reduces rainfall in the surrounding area while increasing rainfall in the surrounding mountains. In areas with increased rainfall, temperatures drop by an average of 1.2 degrees Fahrenheit (less than 1 degree Celsius) because the clouds limit the amount of sunlight reaching the ground (How stuff works, 2019).

3. Conclusion

Hydropower is a renewable and non-pollutant discharge way of electricity generation, however, it impacts the environment in many ways, such as the wildlife, the species around the plant's area and the greenhouse gas emission. Wind power generation and solar power generation should be widely used in the future.