Electricity Generation and Production in California

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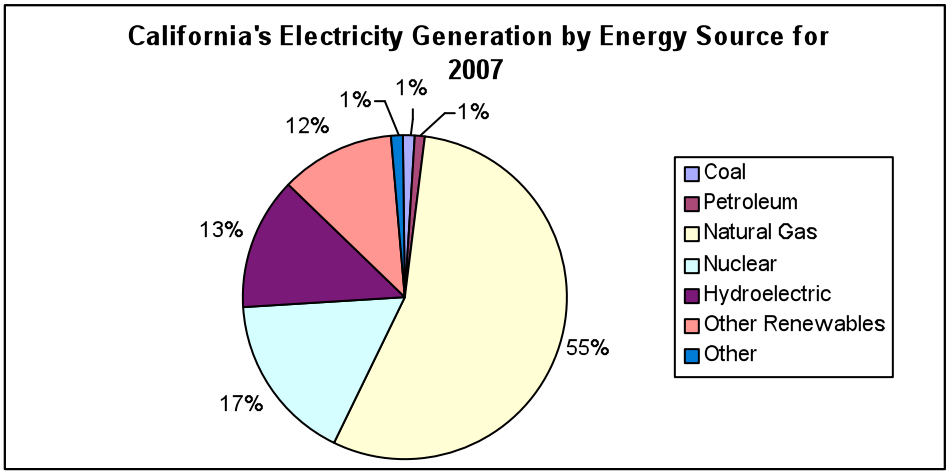
Comparison of Water Usage

As the most populous state in the nation, California has a significant annual electricity demand. In 2007, California generated 210,847,581 megawatts-hours (MWh) of electricity to power homes, businesses, and industrial facilities, and other key infrastructure.[1] In order to meet this demand, California relies on a mixture of energy sources, such as natural gas, nuclear, hydroelectric, and petroleum. Each of these energy sources, in turn, requires varying amounts of water and land in order to be mined, processed, and transported.



Natural Gas: The dominant fuel source in California, which accounts for nearly 55% of the electricity generated in the state. Although California relies significantly on natural gas resources, in 2006, only 13.5% of the natural gas that is utilized comes from in-state sources. The remainder came from other domestic and foreign sources. According to a study by Herbert Inhaber (2004), natural gas, coal, and petroleum systems require an average of 90 cubic meters of water per megawatt-hour (MWh) of electricity produced. This is a sufficient volume of water to fill two average-sized bathtubs.

Nuclear Power: Nearly 17% of the state's electricity comes from nuclear power plants, which are located up and down the coast to ensure ready access to a reliable water source. Nuclear power plants primarily utilize water as a coolant to keep the reactor at a stable temperature; however, significant quantities are needed for this. Nuclear power plants require about 130 cubic meters of water per MWh of electricity produced.

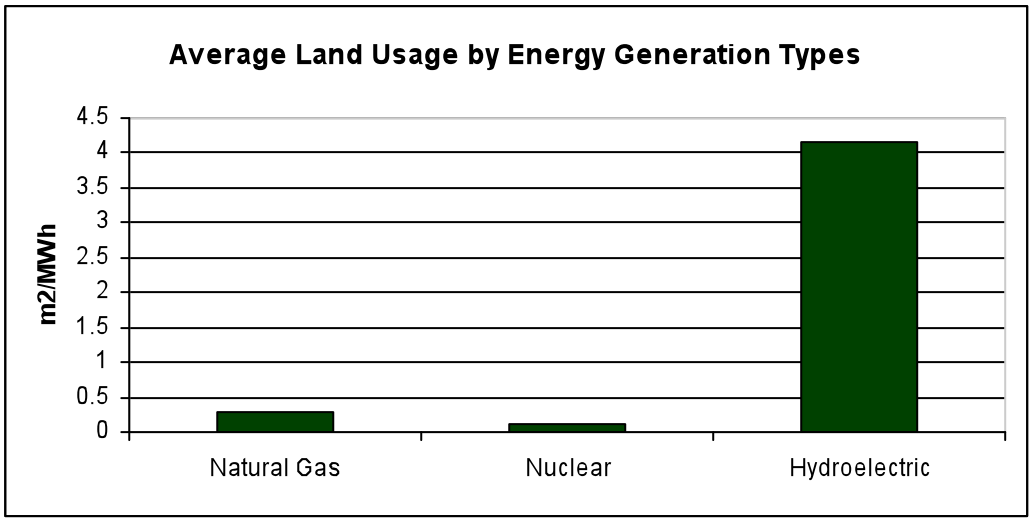
Hydroelectric: The third most relied upon energy source includes production from dams and pumped water storage, which supply 13% of the state's electricity. This type of electricity production requires vast quantities of water, estimated at nearly 11,500 cubic meters of water per MWh.

Over 90% of the water withdrawn for electricity generation in California is saline, or saltwater.[2]

One of the less relied upon fuel sources has been categorized in the above graph as "Other Renewables", which includes the burning of municipal solid waste, landfill gas, and wood waste. Since each of these fuels requires separate processing procedures, it is difficult to determine the water consumption requirements for each of these fuels.

Comparison of Land Usage

The land use intensities of each of these types of electricity production vary widely based on each facility's specific design and location. However, some studies have been completed to provide estimates of the land intensity of electricity production for each type of these energy sources, which can serve as a way to better understand the scale of ecological impact for these developments.



Natural Gas: The amount of land that is transformed for natural gas production ranges from approximately 0.25-0.35 square meters per MWh of electricity produced. This means that in order for California to produce the 22.9 million MWh of electricity that it generated from natural gas in 2007, nearly 1,700 acres of land was transformed from a previous use to natural gas development.[3]

Nuclear Power: Nuclear power requires a lower intensity of land use than natural gas since a smaller amount of fuel is needed to generate the same amount of electricity. This is due to the heightened energy content of uranium. A comparative study showed that approximately 0.10-0.15 square meters of land is transformed per MWh of electricity produced from a nuclear power plant.

Hydroelectric: Electricity generation from hydroelectric production requires the greatest amount of land of any of the generation technologies that have been discussed so far. A hydroelectric reservoir in Colorado requires 4.1-4.2 square meters of land transformation per MWh of electricity produced. Using this land intensity, it means that nearly 28,000 acres were transformed for hydroelectric energy production. However, it should be kept in mind that once land is converted for hydroelectric purposes it is a one-time loss rather than a regular annual loss of land.

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[1] Energy Information Administration, Form EIA-860, "Annual Electric Generator Report." Energy Information Administration, Form EIA-861, "Annual Electric Power Industry Report." Energy Information Administration, Form EIA-923, "Power Plant Operations Report" and predecessor forms.
[2] Hutson, Susan, N. Barber, J. Kenny, K. Linsey, D. Lumia, M. Maupin. United States Geological Survey (USGS). 2004. "Estimated Use of Water in the United States in 2000".
[3] Vasilis Fthenakis, H.C. Kim. 2009. "Land Use and Electricity Generation: A Life-Cycle Analysis". Renewable and Sustainable Energy Reviews. Vol. 13, pp. 1465-1474.