ENERGY IMPACTS ON GEORGIA'S WATER RESOURCES

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REFERENCE: Proceedings of the 2003 Georgia Water Resources Conference, held April 23-24, 2003, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, The University of Georgia, Athens, Georgia.

Abstract. The link between Georgia's energy and water resources is profound. According to state statistics, Georgia's energy industry is the largest water user, outside of the agricultural sector. Similarly at the national level, the electric industry follows closely on the heels of irrigation as the largest water user in the U.S. Georgia's electricity supplies threaten state water resources that affect important aspects of the state's tourism, agriculture and fishing industries.

A comparison of different energy supply technologies, including renewable supplies and energy efficiency measures, shows that complementary water and energy saving goals can be met, resulting in net water savings. State water policy needs to support a shift toward sustainable energy practices that conserve rather than squander limited water supplies.

INTRODUCTION

This report highlights how Georgia's current electricity system threatens state water resources and discusses the need for both statewide water policy and energy policy to support a shift toward sustainable energy practices that conserve rather than squander limited water supplies. With significant state policy debate underway to determine how to manage Georgia's water resources and increased attention on how to meet the state's future energy needs, this topic is timely.

ELECTRIC GENERATION IN GEORGIA

Most of the electricity generated in Georgia comes from coal-fired and nuclear power plants. Figure 1 lists the state's electric generation by energy source according to the Energy Information Administration. Only a negligible amount of electricity has been generated on the grid in Georgia and the Southeast from non-hydroelectric, renewable energy sources (such as solar, wind, and other biomass fuel sources), despite resource availability.

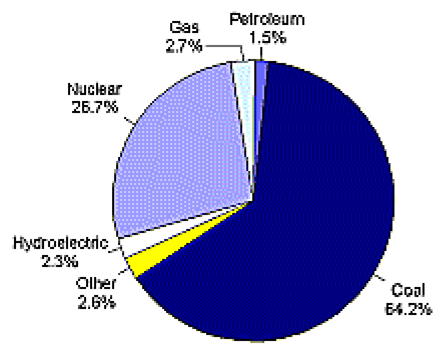

Figure 1. Georgia industry generation by energy source, 1999 (Energy Information Administration).

Water Use by Electric Industry

Georgia's fossil fuel and nuclear power plants require massive quantities of water to operate, as evident in Table 1. These power plants must be located next to large bodies of water or have significant water resources continuously and readily available to create steam to power the turbines. A portion of that water is consumed (transformed to steam) and therefore lost to the supply sources from which it was withdrawn. For instance, according to the U.S. Nuclear Regulatory Commission, nuclear Plant Hatch withdraws an average of 57 million gallons per day from the Altamaha River and actually "consumes" 33 million gallons per day that is lost primarily as water vapor. Additionally, all nuclear reactors must have large, continuous water supplies to cool the nuclear fuel rods in the reactor core to prevent a catastrophic meltdown accident.

Plant Hammond, a mid-sized coal plant with a nameplate capacity of 953 megawatts, is permitted by the Georgia Environmental Protection Division (EPD) to withdraw a monthly average from the Coosa River of 655 million gallons per day. Plant Yates, a slightly larger coal plant with a capacity of 1487 megawatts, is

Table 1. Sampling of Georgia's Power Plants Surface Water Permits and Use 2000

Plant / Type	Size--Generator Nameplate Capacity (megawatts)	Surface Water Source	Permitted Monthly Average (gallons per day)	Reported Monthly Average* (gallons per day)
Plant Branch / Coal	1746.2	Lake Sinclair	1,245,000,000	984,340,000*
Plant Yates / Coal	1487	Chattahoochee River	700,000,000	523,000,000*
Plant Kraft / Coal, Natural Gas	355.9	Savannah River	267,000,000	267,000,000*
Plant Vogtle / Nuclear (2 reactors)	2320	Savannah River	85,000,000	68,670,000*
Plant McIntosh / Natural Gas	640	Savannah River	130,000,000	130,000,000*
Plant Hatch / Nuclear (2 reactors)	1721.8	Altamaha	85,000,000	62,500,000*

*Accurate accounting is needed to validate of actual reported plant consumption figures.

permitted by EPD to withdraw 700 million gallons per day from the Chattahoochee River.

Groundwater use for these power plants is often considered as consumptive use, according to the EPD, as the water withdrawn is not returned to the originating source. Many of Georgia's power plants withdraw from both surface and groundwater sources. For instance, in addition to surface water withdrawals from the Savannah River, nuclear Plant Vogtle is permitted to use a monthly average of 6 million gallons per day from the Cretaceous Sand aquifer and nuclear Plant Hatch is permitted to use over 1 million gallons per day from the Floridan aquifer.

This profligate use of water resources by Georgia's energy industry is increasing as the state continues to issue extensive permits for major, new power plants, while these plants compete for water for other important needs that are vital to our state's economy and quality of life, such as agriculture and fishing.

Table 1 shows a sampling of surface water use values currently permitted for various types of fossil and nuclear-fueled power plants, based on Georgia Environmental Protection Division 2000 data.

Some reported monthly averages show that a particular plant used the same volume of water every month for years in a row at volumes matching exactly the maximum volumes they were permitted by EPD to use. This points to a need for state water use and consumption records to be checked against variables such as usage fluctuation during peak production, downtime for maintenance, and usage fluctuations by comparable types of plants.

Table 2 shows that on average, nuclear, coal, and oil-based power consume large amounts of water resources, in marked contrast to renewable energy supplies and even in comparison to other more traditional fuel supplies such as natural gas. It should be noted that varying types of cooling systems used at power plants greatly affect water consumption rates.

Biomass energy, which has potential as a renewable source in Georgia if done properly, can be used to produce electricity, heat, or liquid fuels from organic matter such as wood, crops, and agricultural residue. Studies by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy show that substantially less water would be required by various biomass operations than current conventional power plants. A technology likely to be used in the near-term, biomass co-firing, was shown to produce negligible

Table 2. Water Consumption* Rates for Electric Generation Sources

Technology	Gallons per kilowatt hour (g/kWh)
CONVENTIONAL SOURCES	
Nuclear	0.62
Coal	0.49
Oil	0.43
Combined Cycle Natural Gas	0.25
RENEWABLE SOURCES	
Solar	0.030
Wind	0.001
Biomass	See information in text

*Through evaporative loss, not including water that is recaptured and treated for further use

increases in water consumption when compared to coal-only operation. Solar and wind energy supplies also available in the Southeast require the least amount of water resources among the different types.

Energy Efficiency

Energy efficiency technologies provide important water conserving opportunities. For example, certified EnergyStar appliances often reduce energy and water consumption at the same time. EnergyStar clothes washers use 30-50% less water and 50% less energy per load. These and other energy efficiency measures offer direct impacts of reduced water consumption which, when adopted by a large consumer population, offer significant, aggregate impacts.

Also, the adoption of energy efficient practices and technologies reduces system-wide energy needs, thereby reducing the water requirements of the electric system as a whole. For example, where peak energy savings are gained from the installation of energy efficient measures, this creates a reduced need for new peak (or seasonal) power plants to be built.

Implementation Costs

Several studies have been done that analyze the feasibility of implementing energy efficiency practices and clean energy technologies. Research by the Department of Energy on direct costs and benefits of both moderate and advanced scenarios of energy efficiency and clean energy implementation measures estimates that annual energy bill savings will exceed the sum of annualized policy implementation costs and incremental technology investments. Their findings are consistent with many economic-engineering studies and with the views of many economists.

A recent report outlining clean, affordable energy policies for the Southeast estimated a modest increase in electricity costs up to 2010 when compared to a "business-as-usual" course of action and by 2020, a decrease in total annual electricity costs in the region by 1.7%. Many energy efficiency measures cost significantly less than conventional power sources, thereby offsetting any increased marginal costs associated with renewable supplies.

The direct cost benefit analysis summarized above does not include macro-economic impacts to society. Added benefits of water quality, enhanced energy security, and improved air quality (that also improves water quality) can be achieved with significant investments in energy efficiency and renewable energy and are therefore important attributes to factor into implementation decisions. Similarly, external costs are important to consider. An example of an external cost on water quality associated with conventional power plants is the "thermal" pollution that occurs as a result of water withdrawn from supply sources and returned at higher temperatures than the originating source. Another example of an external cost on water quality is degradation of water quality linked to the use of hazardous chemicals in some facilities that can pose problems for surrounding water bodies. Also, there are external costs related to airborne emissions linked to coal-fired power plants that contaminate waterways with toxic mercury and other contaminants that are not adequately regulated.

RECOMMENDATIONS

With many of Georgia's power plants being among the largest water users in Georgia, the state should incorporate water efficiency and water quantity criteria into its energy planning so that water conserving energy supply choices and energy efficiency investments are made. Similarly, state water policy planning should address energy generation concerns.

For example, low-water consuming renewable supplies should be tapped, consumers should be educated on both energy saving and water conserving practices, and state energy policy incentives to advance the development of energy efficiency and renewable supplies should be implemented.

Additionally, water-intensive "once-through" cooling systems at many existing plants can be retrofitted to be re-circulating. Dry cooling systems do not rely on water as a coolant and use significantly less volumes of water than even closed-cycle, re-circulating systems. State water policy should require use of these water-conserving technologies.

The State should take measures to verify the accuracy of water use reporting that includes water consumption and water return figures while developing sound water policies for the energy industry.

SUMMARY

Profligate use of water resources and high consumption for energy generation is becoming increasingly problematic as the State of Georgia is pressured to provide water to support other important needs that are vital to our state's economy and quality of life. Speculative power production occurring in the region compounds this water supply problem. Statewide water policy and energy policy need to be framed in such a way that supports a shift toward sustainable energy practices that conserve rather than squander limited water supplies.

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