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ENERGY AND WATER

Preliminary Observations on the Links between Water and Biofuels and Electricity Production

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Highlights

Highlights of GAO-09-862T, a testimony before the Subcommittee on Energy and Environment, Committee on Science and Technology, House of Representatives

Why GAO Did This Study

Water and energy are inexorably linked—energy is needed to pump, treat, and transport water and large quantities of water are needed to support the development of energy. However, both water and energy may face serious constraints as demand for these vital resources continues to rise. Two examples that demonstrate the link between water and energy are the cultivation and conversion of feedstocks, such as corn, switchgrass, and algae, into biofuels; and the production of electricity by thermoelectric power plants, which rely on large quantities of water for cooling during electricity generation.

At the request of this committee, GAO has undertaken three ongoing studies focusing on the water-energy nexus related to (1) biofuels and water, (2) thermoelectric power plants and water, and (3) oil shale and water. For this testimony, GAO is providing key themes that have emerged from its work to date on the research and development and data needs with regard to the production of biofuels and electricity and their linkage with water. GAO's work on oil shale is in its preliminary stages and further information will be available on this aspect of the energy-water nexus later this year.

To conduct this work, GAO is reviewing laws, agency documents, and data and is interviewing federal, state, and industry experts. GAO is not making any recommendations at this time.

View GAO-09-862T or key components.
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What GAO Found

While the effects of producing corn-based ethanol on water supply and water quality are fairly well understood, less is known about the effects of the next generation of biofuel feedstocks. Corn cultivation for ethanol production can require from 7 to 321 gallons of water per gallon of ethanol produced, depending on where it is grown and how much irrigation is needed. Corn is also a relatively resource-intensive crop, requiring higher rates of fertilizer and pesticides than many other crops. In contrast, little is known about the effects of large-scale cultivation of next generation feedstocks, such as cellulosic crops. Since these feedstocks have not been grown commercially to date, there are little data on the cumulative water, nutrient, and pesticide needs of these crops and on the amount of these crops that could be harvested as a biofuel feedstock without compromising soil and water quality. Uncertainty also exists regarding the water supply impacts of converting cellulosic feedstocks into biofuels. While water usage in the corn-based ethanol conversion process has been declining and is currently estimated at 3 gallons of water per gallon of ethanol, the amount of water consumed in the conversion of cellulosic feedstocks is less defined and will depend on the process and on technological advancements that improve the efficiency with which water is used. Finally, additional research is needed on the storage and distribution of biofuels. For example, to overcome incompatibility issues between the ethanol and the current fueling and distribution infrastructure, research is needed on conversion technologies that can be used to produce renewable fuels capable of being used in the existing infrastructure.

With regard to power plants, GAO has found that key efforts to reduce use of freshwater at power plants are under way but may not be fully captured in existing federal data. In particular, advanced cooling technologies that use air, not water, for cooling the plant, can sharply reduce or even eliminate the use of freshwater, thereby reducing the costs associated with procuring water. However, plants using these technologies may cost more to build and witness lower net electricity output—especially in hot, dry conditions. Nevertheless, a number of power plant developers in the United States have adopted advanced cooling technologies, but current federal data collection efforts may not fully document this emerging trend. Similarly, plants can use alternative water supplies such as treated waste water from municipal sewage plants to sharply reduce their use of freshwater. Use of these alternative water sources can also lower the costs associated with obtaining and using freshwater when freshwater is expensive, but pose other challenges, including requiring special treatment to avoid adverse effects on cooling equipment. Alternative water sources play an increasingly important role in reducing power plant reliance on freshwater, but federal data collection efforts do not systematically collect data on the use of these water sources by power plants. To help improve the use of alternatives to freshwater, in 2008, the Department of Energy awarded about $9 million to examine among other things, improving the performance of advanced cooling technologies. Such research is needed to help identify cost effective alternatives to traditional cooling technologies.