



Highlights of [GAO-10-116](#), a report to Chairman, Committee on Science and Technology, House of Representatives

Why GAO Did This Study

In response to concerns about the nation's energy dependence on imported oil, climate change, and other issues, the federal government has encouraged the use of biofuels. Water plays a crucial role in all stages of biofuel production—from cultivation of feedstock through its conversion into biofuel. As demand for water from various sectors increases and places additional stress on already constrained supplies, the effects of expanded biofuel production may need to be considered.

To understand these potential effects, GAO was asked to examine (1) the known water resource effects of biofuel production in the United States; (2) agricultural conservation practices and technological innovations that could address these effects and any barriers to their adoption; and (3) key research needs regarding the effects of water resources on biofuel production. To address these issues, GAO reviewed scientific studies, interviewed experts and federal and state officials, and selected five states to study their programs and plans related to biofuel production.

GAO is not making any recommendations in this report. A draft of this report was provided to the Departments of Agriculture (USDA), Energy (DOE), and the Interior (DOI); and the Environmental Protection Agency (EPA). USDA, DOE, and DOI concurred with the report and, in addition to EPA, provided technical comments, which were incorporated as appropriate.

View [GAO-10-116](#) or [key components](#). For more information, contact Anu Mittal or Mark Gaffigan at (202) 512-3841 or mittala@gao.gov or gaffiganm@gao.gov.

ENERGY-WATER NEXUS

Many Uncertainties Remain about National and Regional Effects of Increased Biofuel Production on Water Resources

What GAO Found

The extent to which increased biofuels production will affect the nation's water resources depends on the type of feedstock selected and how and where it is grown. For example, to the extent that this increase is met from the cultivation of conventional feedstocks, such as corn, it could have greater water resource impacts than if the increase is met by next generation feedstocks, such as perennial grasses and woody biomass, according to experts and officials. This is because corn is a relatively resource-intensive crop, and in certain parts of the country requires considerable irrigated water as well as fertilizer and pesticide application. However, experts and officials noted that next generation feedstocks have not yet been grown on a commercial scale and therefore their actual effects on water resources are not fully known at this time. Water is also used in the process of converting feedstocks to biofuels, and while the efficiency of biorefineries producing corn ethanol has increased over time, the amount of water required for converting next generation feedstocks into biofuels is still not well known. Finally, experts generally agree that it will be important to take into account the regional variability of water resources when choosing which feedstocks to grow and how and where to expand their production in the United States.

The use of certain agricultural practices, alternative water sources, and technological innovations can mitigate the effects of biofuels production on water resources, but there are some barriers to their widespread adoption. According to experts and officials, agricultural conservation practices can reduce water use and nutrient runoff, but they are often costly to implement. Similarly, alternative water sources, such as brackish water, may be viable for some aspects of the biofuel conversion process and can help reduce biorefineries' reliance on freshwater. However, the high cost of retrofitting plants to use these water sources may be a barrier, according to experts and officials. Finally, innovations—such as dry cooling systems and thermochemical processes—have the potential to reduce the amount of water used by biorefineries, but many of these innovations are currently not economically feasible or remain untested at the commercial scale.

Many of the experts GAO spoke with identified several areas where additional research is needed. These needs fall into two broad areas: (1) feedstock cultivation and biofuel conversion and (2) data on water resources. For example, some experts noted the need for further research into improved crop varieties, which could help reduce water and fertilizer needs. In addition, several experts identified research that would aid in developing next generation feedstocks. For example, several experts said research is needed on how to increase cultivation of algae for biofuel to a commercial scale and how to control for potential water quality problems. In addition, several experts said research is needed on how to optimize conversion technologies to help ensure water efficiency. Finally, some experts said that better data on water resources in local aquifers and surface water bodies would aid in decisions about where to cultivate feedstocks and locate biorefineries.