

Water Consumption in the Production of Ethanol and Petroleum Gasoline

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Abstract

We assessed current water consumption during liquid fuel production, evaluating major steps of fuel lifecycle for five fuel pathways: bioethanol from corn, bioethanol from cellulosic feedstocks, gasoline from U.S. conventional crude obtained from onshore wells, gasoline from Saudi Arabian crude, and gasoline from Canadian oil sands. Our analysis revealed that the amount of irrigation water used to grow biofuel feedstocks varies significantly from one region to another and that water consumption for biofuel production varies with processing technology. In oil exploration and production, water consumption depends on the source and location of crude, the recovery technology, and the amount of produced water re-injected for oil recovery. Our results also indicate that crop irrigation is the most important factor determining water consumption in the production of corn ethanol. Nearly 70% of U.S. corn used for ethanol is produced in regions where 10–17 liters of water are consumed to produce one liter of ethanol. Ethanol production plants are less water intensive and there is a downward trend in water consumption. Water requirements for switchgrass ethanol production vary from 1.9 to 9.8 liters for each liter of ethanol produced. We found that water is consumed at a rate of 2.8–6.6 liters for each liter of gasoline produced for more than 90% of crude oil obtained from conventional onshore sources in the U.S. and more than half of crude oil imported from Saudi Arabia. For more than 55% of crude oil from Canadian oil sands, about 5.2 liters of water are consumed for each liter of gasoline produced. Our analysis highlighted the vital importance of water management during the feedstock production and conversion stage of the fuel lifecycle.