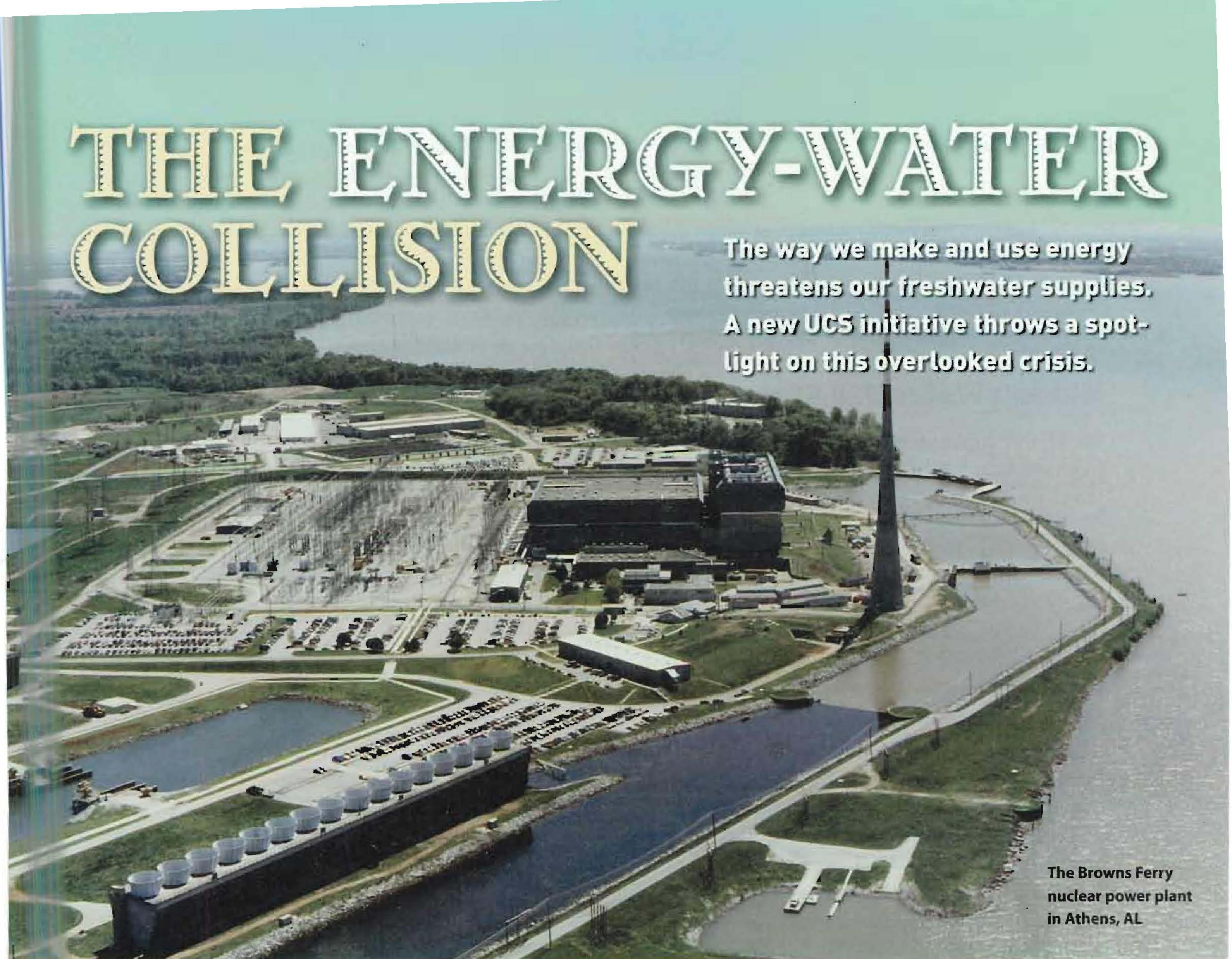
THE ENERGY-WATER COLLISION

The way we make and use energy threatens our freshwater supplies. A new UCS initiative throws a spotlight on this overlooked crisis.



The Browns Ferry nuclear power plant in Athens, AL

By John Rogers and Erika Spanger-Siegfried

When it comes to energy and water, it's hard to have one without the other—producing energy uses water, and providing freshwater uses energy. Power plants, for example, use water to cool the steam that spins electricity-generating turbines; fuel producers use water in the mining of coal, extracting of petroleum, and growing of crops for biofuels. Conversely, using water in our communities requires energy to get it there, treat it, heat it, and more. Because of these links between energy and water, problems for one resource can create problems for the other, and the energy-water connection can easily turn into a collision.

The energy choices we make today and in the future will therefore have a major impact on our water supplies and the energy sources that depend on them. UCS has launched a new initiative to examine the nexus between water, energy, and climate change, and to identify and promote clean-energy solutions that can reduce global warming emissions while protecting our water supplies. What follows are just some of the findings of our initial research.

Thirsty for Power

The U.S. electricity system requires an enormous amount of water to function: just one day's worth of electricity generation requires more than 140 times the water used by New York City. More than half of the country's nuclear power reactors, and almost half of our coal-fired power plants, use "once-through" cooling, meaning they withdraw water from nearby water bodies, pass it through the plant to cool the steam, and return it to the source. Each of these plants withdraws between 20 and 60 gallons of water for each kilowatt-hour of electricity it generates, far exceeding the amount of water used in homes directly (see the sidebar on p. 8).

Some plants lose large amounts of withdrawn water to evaporation. For example, just one typical 600-megawatt coal-fired power plant loses more than 2 billion gallons of water

Photo: Nuclear Regulatory Commission

annually—an amount that could fill more than 3,000 Olympic-sized swimming pools.

In Hot—and Dirty—Water

Water discharged from a coal or nuclear plant is hotter—by an average of 17 degrees Fahrenheit (°F) in summer—than when it entered the plant. Half of all coal plants report releasing water in the summer at peak temperatures of 100°F or more. This thermal pollution can stress or kill fish and other wildlife.

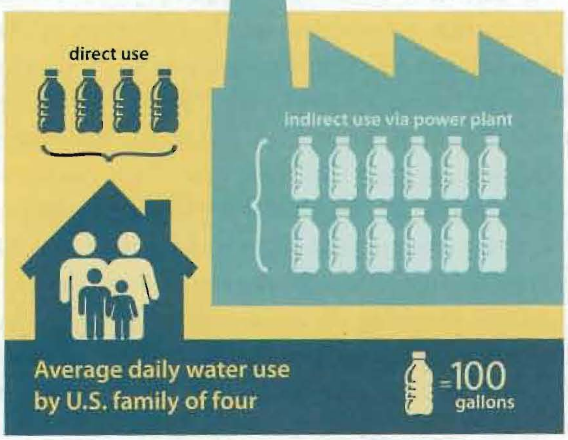
Thermal pollution is not the only danger to water supplies, however. Arsenic, mercury, lead, and other toxic substances contained in coal plant waste can severely contaminate drinking water supplies. Mountaintop-removal coal mining has buried almost 2,000 miles of Appalachian headwater streams—some of the most biologically diverse streams in the country. And while natural-gas-fired power plants are less water-intensive than coal or nuclear plants, extracting gas from shale deposits can affect water quality and strain water supplies in local communities.

Hidden Water Use at Home

We all use hundreds of gallons more than we may realize.

Between the kitchen, bathroom, laundry, and yard, the average U.S. family of four uses about 400 gallons of freshwater per day—not including the water required to generate the electricity this family uses. Assuming their home is powered by a coal-fired or nuclear power plant that takes lake or river water for once-through cooling, this family's electricity use requires an additional 600 to 1,800 gallons of freshwater per day. Just one load of hot-water laundry (using an electric washer and hot-water heater) uses 3 to 10 times more water at the power plant than inside the washer itself.

This indirect—but massive—water use related to energy consumption underscores the need to invest in water- *and* energy-saving appliances at home—which will save consumers money in the long run while protecting our natural resources. In addition, consumers can support cleaner electricity generation by purchasing "green power" (from low-water resources such as wind) from their electric utility.




Water-dependent power plants have had to reduce their output during times of drought—when electricity demand is often at its highest.

Water Unrest

Water supply conflicts are growing across the United States, particularly in the West, where farmers, electric utilities, cities, and other water users all compete for the same limited resource. Even without factoring in the exacerbating role of climate change (see below), conflicts over water are considered highly likely in major Southwest cities such as Albuquerque, Denver, Las Vegas, and Salt Lake City by 2025.

Such tensions are not confined to arid regions. In the Southeast, drought has brought simmering disputes between states like Georgia, Tennessee, Alabama and Florida over the rights to key rivers to a boiling point in recent years. By 2030, electric capacity is predicted to grow nearly 30 percent in the western United States and 10 percent in the Southeast—a trend that raises the difficult question: With what water?

Climate Complications

Compounding the issue of competing water demands are the effects of global warming. Increasing climate variability—in the form of extreme heat and extended drought, in particular—is already testing the resilience of energy and water systems in some regions. Further climate change will pose far-reaching challenges. The Northeast and Midwest, for example, can expect

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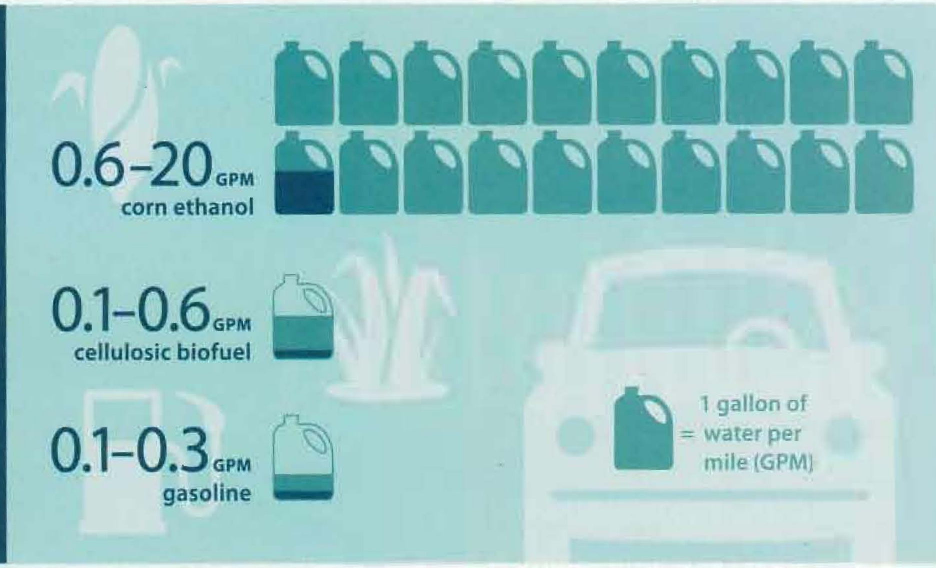
Water required to produce transportation fuels

Running a typical car (getting the equivalent of 24 miles per gallon of gasoline) on corn ethanol can require one-half to 20 gallons of water per mile—or more—depending on the water used for irrigation. "Cellulosic" biofuel would require less than one gallon of water per mile. Gasoline, while not a renewable resource, requires the least water: less than half a gallon for extracting and refining oil.



changes in seasonal precipitation patterns including more spring flooding and extended summer drought. In the Southeast, instances where water is too warm for power plants to use for cooling may become much more frequent. The Southwest can expect far less runoff and precipitation, especially in the warm months, while longer, more severe droughts will leave arid areas even drier.

Since 2004, water stress has forced at least a dozen U.S. power plants to temporarily reduce their power output or shut down entirely. The Browns Ferry nuclear plant in Alabama, for example, was forced to cut the power output of all three of its reactors for nearly five straight weeks this summer when nearby water temperatures hit 90°F—all while cities in the region were experiencing high power demands due to heavy use of air conditioning. This and other water-related shutdowns have prompted at least eight states to reject new power plant proposals.

Avoiding a Disastrous Collision

A number of technologies can help the United States shift to a low-carbon, low-water energy system. The easiest to implement are also the most cost-effective: energy- and water-efficient appliances, buildings, and vehicles. Old coal and nuclear power plants can also be made more water-efficient with cooling technologies that could reduce water withdrawals by two orders of magnitude (though more water would be lost to evaporation than before).

Shifting to non-fossil-fuel sources of energy could further reduce our water use—if we make the right choices. Biofuels, for example, have the potential to reduce the environmental impacts associated with gasoline use, but the "water footprint" of conventional biofuels such as corn ethanol can be very large (see the diagram above). Creating a single gallon of corn-based ethanol consumes, on average, about 100 gallons of freshwater—some 15 to 30 times more than it takes to produce a gallon of gasoline. In some regions, ethanol production can take three or more times that amount, depending on irrigation needs. However, the water requirements for producing a gallon of "cellulosic" biofuel from low-water grasses or waste wood may require as little as 2 to 10 gallons of water. Non-plant fuel sources such as animal waste or even garbage could lower the water requirements of biofuel production even further.

Wind turbines and solar photovoltaic panels can generate electricity without any water, while concentrating solar power plants, which traditionally require significant amounts of water, can avoid straining water supplies by using dry cooling (albeit at a higher cost).

As our new energy-water initiative continues, UCS will work with decision makers and other important stakeholders—representing agriculture, fishing, river protection, water conservation, and clean energy, among others—to ensure government policies support energy solutions that reduce both carbon emissions and the strain on our freshwater supplies. Working together, we can not only avoid the worst impacts of climate change, but also make our energy supplies more resilient in the face of a water-constrained future.

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Our fact sheet, *The Energy-Water Collision: 10 Things You Should Know*, provides more detailed information on the impacts described in this article, as well as other aspects of our energy and water use. Read it online at *www.ucsusa.org/energy-water.*

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