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How Energy Drains Water Supplies

By KATE GALBRAITH

AUSTIN, TEXAS — The worst single-year drought in the recorded history of Texas has caused cotton crops to wither and ranchers to sell off cattle. It may also hurt power plants, which need vast amounts of water to cool their equipment.

“We will be very concerned” if it does not rain by spring, said Kent Saathoff, an official with the Texas electric grid operator.

The worries in Texas bear out what an increasingly vocal group of researchers has been warning in recent years: that planners must pay more attention to how much water is needed in energy production.

“Water and energy are really linked,” said Henrik Larsen, a water policy expert with the DHI Group, a research and consulting firm based in Denmark. “If you save water, you save energy, and vice-versa.”

Experts call this the “water-energy nexus.” It takes huge quantities of water to produce electricity from a plant powered by nuclear energy or fossil fuels, and it also takes lots of energy to pump and process the water that irrigates fields and supplies cities.

In the United States, 4 percent of all fresh water is consumed in the energy sector, and 3 percent of all electricity used daily goes toward water and wastewater pumping, distribution, and treatment, according to Mike Hightower, a member of the technical staff at Sandia National Laboratories.

A big problem, experts say, is that water is often taken for granted.

“We simply don’t value water in the same way that we value energy,” said Mr. Larsen of DHI. He noted that whereas barrels of oil get shipped around the globe, nobody wants to ship water in the same way.

With needs for both water and energy growing worldwide and climate change threatening to roil rainfall patterns, the issue could grow more pressing.

Given the scarcity of water resources, stronger regional cooperation will be important in making sure power plants are located in the best places, according to Jakob Granit, director of the Stockholm International Water Institute, which has been trying to promote such cooperation among countries in southern Africa.

“We are not very mature on this type of cross-sector analysis,” Mr. Granit said.

The water needs of power plants are actually greater than the raw consumption numbers suggest. According to Mr. Hightower, more than 50 percent of the water withdrawn every day from rivers and lakes in the United States goes toward energy production.

Power plants discharge almost all of that water back into rivers or ponds after it has helped cool the plant (which explains the difference between 4 percent consumption and 50 percent withdrawals).

However, this means that in times of drought, when rivers or reservoirs are drying up, power plants may have trouble finding enough water, even if they end up discharging most of it.

“You don’t just pick these things up and move them,” Mr. Hightower said, referring to power plants.

The water the plants discharge is also warmer and can affect the environment downstream, Mr. Hightower said.

The water-saving technologies in power plants are improving, and there is a trend toward cooling systems in which more water is recycled, said Mr. Larsen of DHI. The potential for improvements is large: A recent paper by University of Texas academics in the journal Environmental Research Letters reports that changing the cooling technologies used by power plants in 11 Texas river basins could reduce the water they divert each year by an amount equivalent to the annual water use of at least 1.3 million people.

Hydroelectric facilities — which account for about 16 percent of global electricity production — are also vulnerable to drought, of course.

Power plants are not the only reason energy production depends on water. Extracting oil and natural gas from the ground with hydraulic fracturing techniques requires prodigious amounts of water.

In Texas, a 2007 study prepared for the state water authorities estimated that drillers in the shale-gas region around Fort Worth could consume 7 to 13 percent of the groundwater from local aquifers in 2025, up from 3 percent at the time of the study.

In Canada, tapping tar sands deep underground consumes half a barrel of water for every barrel of bitumen (viscous oil) produced, according to the Alberta government . That is after taking into account that at least 70 percent of the water used in the operation is recycled.

“We’ve always had this kind of myth of abundance — even Canada, where you think, ‘My gosh, this country’s awash in water,’” said Adèle Hurley, who directs the program on water issues at the University of Toronto’s Munk School of Global Affairs.

The development of many biofuels — which are already under fire for their global effect on land use — also requires large amounts of water, experts say.

All of this adds up to one of the lesser-voiced arguments for certain types of renewable energy — specifically wind turbines and photovoltaic solar panels, like those that go on roofs. (Solar thermal plants require water for cooling.)

Mr. Hightower cited an example of choosing among four low-carbon technologies — carbon capture and storage (the idea of sequestering carbon-dioxide emissions from a power plant underground); nuclear; solar thermal; and wind.

“Of those four, wind is the only one that doesn’t require any water,” he said.

On the biofuel side, algae may be a promising low-water technology, Mr. Hightower said. Energy producers of all types, he added, will need to figure out how to use more nontraditional water sources, like brackish water or wastewater.

Planners are now paying more attention to water constraints on energy production, experts say, as well as to reverse concerns about the amount of energy needed to produce water. Desalination, an important option for countries like Israel where water is scarce, requires a tremendous amount of energy, which helps explain why the process is so expensive.

A major international conference in Bonn in November will look at the energy-water nexus and at how food, which requires large amounts of both, fits into the picture.

“We can’t do business as usual,” Mr. Hightower said. “We’ve got to do some things differently.”