Even coal and nuclear plants are vulnerable to climate change

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Many modern power plants have a hidden weakness. They need water to stay cool. Lots of water. In the United States, coal, gas and nuclear plants account for roughly 40 percent of the nation’s freshwater use, drawing from rivers and lakes to prevent their turbines from overheating.

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Associated Press

Sweet, sweet cooling water.

Yet this water could prove increasingly hard to come by. Over the next 50 years, if global warming proceeds apace, many rivers will get warmer or reduce their flow. That, in turn, could lead to shortages of cooling water, forcing many plants to shut down. A new study in Nature Climate Change projects that, starting in the 2030s, the generation capacity of these thermal plants could drop by up to 16 percent in the United States and by up to 19 percent in Europe. The likelihood of “extreme reductions” of output at most plants, including shutdowns, would nearly triple.

That would be a big deal. Right now, about 91 percent of electricity in the United States comes from these “thermoelectric” plants that burn coal, gas, or nuclear fuel to generate steam and spin turbines around. (In Europe, thermal plants produce about three-quarters of all electricity.) The majority of these power plants were expected to stick around for decades to come. But, if this new study is accurate, some of these plants may be less reliable than we thought.

There are two ways a cooling-water shortage could occur in a warmer world. First, the study notes, many rivers are expected to see reduced flow, which means there will be less water available in the first place. Elsewhere, water temperatures will rise, which would make the water unsuitable for cooling down power plants — not least because the United States and Europe have strict rules on the temperature of water that the plants can discharge back into freshwater lakes and streams. (This is done in order to prevent disruptions to ecosystems.)
Already, there are small glimpses that this could be a problem. Last summer, for instance, the Browns Ferry Nuclear Power Plant in Alabama had to shut down twice because the adjacent Tennessee River hit temperatures of 90 degrees. Older plants, particularly coal and nuclear plants that use “once-through cooling” systems will be especially prone to shutdowns, the study notes, though even newer gas plants and plants with cooling towers could be at risk.

Here’s a map from the Nature study showing expected changes in river flows in Europe and the United States under two different scenarios. (These scenarios come from the IPCC: B1 is where the world stabilizes its emissions by mid-century; A2 is where carbon-dioxide emissions keep rising, albeit at a slower rate than we’re currently emitting.) Places like the U.S. Southeast and France get hit particularly hard:

“The worst-case scenarios in the Southeast come from heat waves where you need the power for air conditioning,” said Dennis Lettenmaier of the University of Washington, one of the paper’s authors. “If you have really high power demand and the river temperature’s too high so you need to shut your power plant down, you have a problem.”

Now, there are quite a few ideas in the works for making power plants less reliant on freshwater — some nuclear plants in countries like Sweden and China, for instance, are located near the sea and use saltwater for cooling. And newer, more efficient natural gas plants need less water overall than do coal or nuclear facilities. But this is less help for existing power plants. It’s a reminder that a great deal of our infrastructure was built for a world with a very particular climate. Even a small tweak to those temperatures can cause a fair bit of disruption.