Water and Energy: Altering Our Current Collision Course

INTRODUCTION

Water is increasingly becoming a limiting factor on U.S. energy production and a key obstacle to maintaining both electricity output and public health and safety. The constraints range from insufficient water supplies to meet power plants' cooling and pollution control needs—a challenge likely to be exacerbated by climate change, population growth, and competition from other sectors—to the high costs of energy-related water contamination and thermal pollution.

On behalf of the Civil Society Institute, Synapse Energy Economics examined multiple water-related issues facing the U.S. electricity industry. The study revealed that our diminishing water resources are both limiting the nation's energy supplies and being threatened by power plant operations and fuel production, and that policymakers must take action to address these major risks from energy- water interactions. This policy brief provides background information on the known challenges, identifies critical information gaps, and outlines policy recommendations for regulators and policymakers.

Read the full Synapse report here: http://www.synapse-energy.com/Downloads/SynapseReport.2013-06.CSI.Water-Constraints.13-010.pdf.

BACKGROUND

Currently, 97 percent of the nation's electricity comes from thermoelectric or hydroelectric generators, which rely on vast quantities of water to produce electricity.

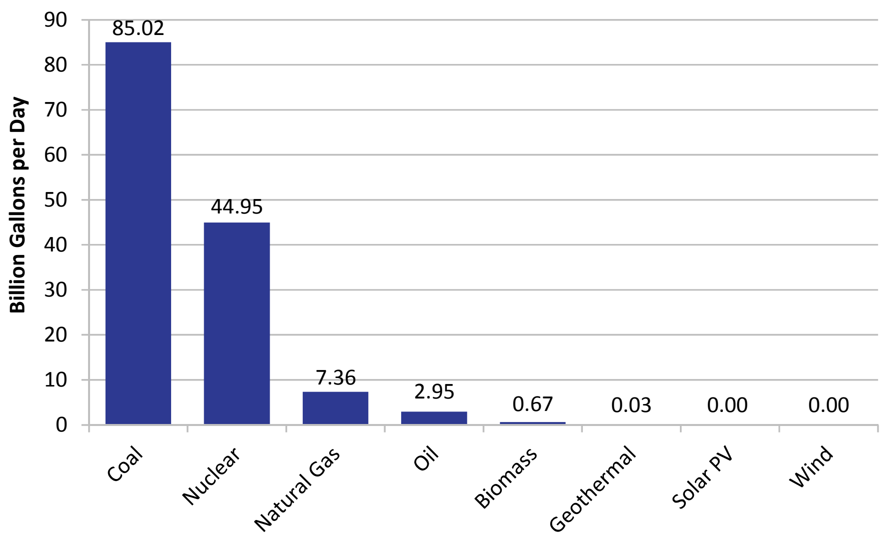
Today's electric power system was built on traditional, water-intensive thermoelectric and hydroelectric generators. The water requirements of this energy system are enormous. Once-through cooling of large power plants withdraws staggeringly large quantities of water from rivers, lakes, and estuaries; it is a luxury that only the wettest areas can afford. Closed-cycle cooling, using cooling towers or ponds, reduces withdrawals but actually increases consumption, via evaporation. In arid regions, even this is a burden on limited water supplies.

Going forward, the traditional abundance of our water resources will decline due to growth in population and municipal water demand, coupled with pressures from industry and agriculture, drought, and climate change. Legal challenges and environmental regulations will increasingly challenge the massive water withdrawals and consumption levels of coal, nuclear, and natural gas generators, particularly when alternatives that require little water, such as wind and solar, are readily available.

Extraction and production of fuels for thermoelectric generation—primarily coal, uranium, and natural gas—threaten to contaminate water resources with toxic chemicals, impacting both ecosystems and human health. Coal mining, today largely surface mining, often involves the extraordinarily damaging processes of mountaintop removal and valley fills, which destroy communities, streams, and ecosystems. Uranium mining, a once and future hazard, creates long-lasting radioactive risks, and has caused extreme damages to miners' and nearby communities' health. Natural gas, with the explosive growth of fracking, has brought us flammable tap water and carcinogenic contamination of groundwater in the unlucky host communities. Yet despite the risks associated with such energy technologies, the EIA expects generation from thermoelectric sources to increase through 2035 under existing energy policies.

Energy production in a water-constrained world

Figure 1. Estimated Daily Water Withdrawals for Electricity Generation in the United States



Source: Estimated by Synapse Energy Economics using the Union of Concerned Scientists' UCS EW3 Energy-Water Database V.1.3, 2012.

The amount of water available to serve diverse needs is a growing concern across the country, from the arid western states to the seemingly water-rich Southeast. Thermoelectric generation compounds the stress already faced by numerous watersheds and adds additional risk for the future.

- Thermoelectric plants withdraw 41 percent of the nation's fresh water—more than any other sector
- On an average day, water withdrawals across the nation amount to an estimated 85 billion gallons for coal plants, 45 billion gallons for nuclear plants, and 7 billion gallons for natural gas plants
- Coal mining consumes between 70 million and 260 million gallons of water per day
- Natural gas fracking requires between 2 and 6 million gallons of water per well for injection purposes

If current trends continue, water supplies will simply be unable to keep up with our growing demands. Factors that are likely to exacerbate the problem include climate change, water shortages, and carbon capture and sequestration (CCS). For example, CCS is projected to increase water consumption rates for existing coal plants by 83 percent and natural gas plants by 91 percent. Failure to address these constraints now is bound to lead to further intersectoral conflicts and forced plant shutdowns that will jeopardize electricity production and constrain economic growth in the future.

Energy's impacts on water quality

Energy-sector impacts on water quality are significant, and are likely to increase if the United States continues to rely heavily on thermoelectric power plants. The following are just a sample of the impacts associated with fuel production and use:

- Coal mining: Elevated and unsafe levels of arsenic and other heavy metals have repeatedly been found in drinking water in coal mining areas.
- Uranium mining and milling: Runoff from uranium mine tailings is contaminated not only with uranium and other radioactive materials, but also with toxic heavy metals.
- Natural gas production: Seepage of fracking fluids into groundwater has contaminated drinking water with toxic chemicals such as benzene.
- Thermal pollution: Once-through cooling systems withdraw water from rivers, lakes, and estuaries, use it for cooling, then discharge it at a much higher temperature. These thermal discharges can harm phytoplankton, accelerate the growth of bacteria, increase algal blooms, and otherwise disrupt fish habitats.

The coming collision between growing water demands and dwindling water supplies, brought on by water-intensive energy technologies and continuing population growth, poses a challenge to our current water consumption path. This challenge is likely to be exacerbated by additional factors that are more difficult to measure or predict, including the conflicting needs of agriculture, cities, and power plants; future regulatory actions; and the impacts of climate change on water availability. These "unknown" challenges are discussed below.

The information gap: Data needs for sustainable energy planning

Synapse identified several critical data deficiencies that need to be addressed to support successful energy planning and policymaking:

- Power plant data collection and reporting: Plant-level water usage data are of insufficient quality and detail. Many power plants, such as nuclear power plants, have historically been exempt from reporting their water use to the EIA, while other plants fail to report reasonable estimates of water use. Outdated forms used by the EIA have contributed to reporting inaccuracies. U.S. Geological Survey data—an essential source for water planning—have several critical shortcomings. These data deficiencies limit the ability of government agencies and industry analysts to identify trends in water use.

- Climate change impacts and uncertainty: Climate change is worsening energy-water imbalances, but it is difficult to measure this crucial impact. Despite the massive and ever-expanding body of research, crucial questions about the pace of climate change remain uncertain, perhaps inescapably so.
- Reporting of chemicals used in fracking: Gas producers often designate the identities of the fracking chemicals they use as "proprietary information" or "trade secrets." Many known toxins and carcinogens are used in fracking, but determining which chemicals are used in any particular well is a challenge. More than half of the states with fracking activity currently have no disclosure requirements for fracking chemicals. Only six states allow disclosure of trade secret information to health care providers who are treating patients exposed to fracking fluid.
- Flue gas desulfurization (FGD, or scrubber) wastewater: The data measuring the effectiveness of FGD wastewater treatment are inadequate across the power plant sector. Problems include inconsistent definitions of what is considered "wastewater" across the industry, and wide variation in the levels of treatment systems.

Policy Recommendations

Continued reliance on water-intensive electric generation technologies puts consumers and regional economies at risk of interruptions in electricity supply or on the hook for costly infrastructure investments. To ensure a reliable, cost-effective supply of energy, these water-related risks must be fully accounted for in energy planning and regulation. Further, energy policy and federal research and development funds should support an electric generation mix that:

- Minimizes risk associated with water dependency, fuel costs, and capital costs,
- Produces the least amount of pollution (taking into account the technology's fuel cycle), thereby protecting human health and the environment , and
- Cost-effectively addresses climate change.

These criteria would provide policymakers a framework to systematically assess the design, construction and operational risks of grid-related technologies.

At a minimum, we recommend that regulators and policymakers:

- Conduct long-term water resource planning on a regional basis and across sectors, including projections of future water needs and the possible impacts of droughts and climate change on water availability
- Require that proposals to construct new power plants or retrofit existing plants include water resource adequacy assessments and incorporate the future opportunity cost of water in a power plant's cost estimates
- Perform electric generation risk assessments related to the ability of power plants to continue operation during heat waves and extended droughts

- Encourage existing power plants to explore alternative cooling technologies and water resources, such as cooling with reclaimed or brackish water, using thermal discharges to desalinate water, or installing air cooling systems
- Incorporate the cost of alternative cooling technologies, the water sources required to operate them, and anticipated carbon prices in analyses of the economic viability of thermoelectric plants in an increasingly water- and climate-constrained world
- Encourage investments in energy efficiency and renewable technologies that require little or no water use
- Review all federal and state water subsidies and continue to provide subsidies only if they are supported by a thorough assessment of the social and economic impacts of water supply on agricultural, municipal, industrial, and indigenous tribal uses of water, as well as the energy sector

In addition, information about and regulation of the water quality impacts of fuel extraction and wastewater disposal must be strengthened. In particular:

- More information is needed regarding the chemicals present in treated wastewater and fracking fluids
- Regulations regarding the use and storage of such chemicals must be tightened
- Mine reclamation needs to be held to high standards, restoring or replacing the previously existing ecosystems
- Any renewal of uranium mining needs to be carefully regulated to control the dangers of radioactive contamination

What will it cost?

The needed regulations are expensive; there is no doubt that compliance with them will raise the market prices of fossil fuels and uranium. It is commonly argued that we can't afford such costs, that the need for low-cost energy trumps the desire for environmental protection. This view is mistaken: we are already paying the costs of widespread health and environmental damage, in the intolerable impacts on the fracked, strip-mined, and otherwise harmed communities. At present, however, the costs are borne by the host communities where the fuels are found, while the benefits of cheap energy are enjoyed by producers and consumers everywhere.

The "polluter pays principle"—or, in more academic terms, the basic framework of environmental economics—calls for internalizing the external costs of energy production. If fuel production and use imposes costs on third parties, such as mining communities, those costs should be included in the price of energy. This is not making energy more expensive. Rather, it is admitting how expensive to someone, in health and environmental terms, energy already is—and then asking why anyone other than the energy producers and consumers should pay such costs.

Once the environmental costs of conventional fuels are recognized, it becomes clear that energy efficiency and renewable energy are bargains by comparison. These clean alternatives cause little if any harmful environmental impacts. On a full-cost accounting basis, clean energy would win out as the least-cost solution and solution that harbors the least risk, as our energy system would no longer threaten (or be vulnerable to) the quantity and quality of our water.