Effects of Water Restrictions on the Thermoelectric Sector in the Northeast of the United States

Topic: Resources and Alternative Technologies
Author: Naci Dilekli
Co-Authors: Faye DUCHIN

Crucial ecosystem services provided by river systems include the provision of cooling waters for thermoelectric production and the dissipation of heat in the discharged water. Recent research on electricity production analyzes how environmental regulations could impact energy production and costs in a region. Operations of individual thermoelectric plants are affected in two ways: First, their efficiency declines with warmer water temperatures, and second, the environmental regulations can restrict water withdrawals if water temperature at the intake location attains a given threshold. Conversion from once-through to cooling-tower technologies can reduce the temperature at discharge, but at higher costs.

This paper proposes a framework for investigating the impacts of legislative restrictions on electricity production on money costs incurred, viewed as the value of the ecosystem services foregone, when withdrawals and discharges of fresh water are impeded. We implement an inter-regional input-output model (the World Trade Model) of the state-level economies of the Northeast region of the United States that distinguishes thermoelectric power sectors by fuel and by cooling technology and that can provide for intra-state and inter-state power transmission. We compare results of a Baseline scenario for 2010 and a scenario that imposes constraints on water withdrawals, using assumptions about legislative actions from an engineering study carried out at the level of individual power plants.
The results quantify the increased costs and changes in the distribution of power production by state, by fuel type, and by cooling technology under alternative assumptions. We conclude that this region is able to satisfy its electric power requirements while fully complying with legislated water restrictions by compensating the loss of output from some plants with unutilized capacities of other plants. In the summer months, however, this is possible only if inter-state transmission is unconstrained by capacity constraints. Incorporating the choice among alternative technologies within an inter-regional input-output model subject to constraints makes it possible to identify low-cost solutions from among a variety of physically plausible responses to climate and legislative constraints.