Behind the Meter: Implementing Distributed Energy Technologies to Balance Energy Load in Virginia

(Technical Report)

Divergent Appeals for Water Conservation in the Ogallala Aquifer Basin

(STS Research Paper)

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by

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Preface

The existential threat global climate change poses to the American way of life leads many to ask, how may human needs in the U.S. be met more sustainably?

The University of Virginia has committed to reach carbon neutrality by 2030 while the Commonwealth plans to produce 100% of its energy from carbon-free sources by 2050. These commitments are critical for addressing climate change, but there is a great deal of uncertainty about how to achieve the goals. One of the principal challenges associated with decarbonization is the temporal variability of renewable energy generation, which is creating the need to better balance load on the grid by shaving peak demand. We analyzed how innovative load-shifting technologies can be used by large institutions like the University of Virginia to shift load and support state-wide efforts to decarbonize. To do this, we focused on the University's plans for expansion of the Fontaine Research Park, which is a good model for understanding how these technologies could distribute energy load behind the meter. First, we worked to develop a predictive model to forecast when peak demands will occur and understand how interventions, including heat recovery chillers and thermal storage tanks, might be used to balance load. Then, we extended a state-wide energy systems model using the Tools for Energy Modeling Optimization and Analysis (TEMOA) to simulate the ways in which these types of interventions might be scaled to the whole state. Using the energy demand model in conjunction with aggregated institutional energy use data, the team evaluated the effects that broader adoption of distributed energy technologies in Virginia could have on the grid's ability to handle the energy transition.

How have water conservationists in the U.S strived to slow the depletion of the Ogallala Aquifer? The Ogallala aquifer underlies 111.4 million acres across eight U.S states. About 27 percent of U.S. farmland depends on the aquifer for irrigation, and it provides drinking water for 2 million Americans. Intensive irrigation since the advent of mechanized farming has greatly depleted the aquifer. Large agricultural enterprises, independent farmers, conservation nonprofits, and others agree that the depletion of the Ogallala aquifer must be slowed or stopped. These groups disagree intensely about whether and how best to conserve the aquifer. They do so by invoking competing ideas about economic incentives, ecological value, the balance between property rights and the legitimate exercise of state authority, and the present generation's obligations to future generations. Cultivating a holistic understanding of the stakeholders in the Ogallala Aquifer Basin and their values is a crucial step towards crafting and implementing effective water conservation policies. Looking through this lens, we can turn a critical eye toward past attempts at water conservation and understand why some initiatives succeeded, while others failed.

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