

Exploring Energy-Water Issues in the United States

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Abstract Content:

The project team, comprised of colleagues at Sandia National Laboratories (SNL) and Carnegie Mellon University (CMU) are working together to develop a type of Water Atlas for the Eastern United States, and evaluate potentially low-water use technologies in thermoelectric power generation, respectively. SNL is collecting water availability cost data, and future projected use for four sources of water including surface water, groundwater, municipal wastewater, and shallow brackish groundwater. To date, the SNL team contacted all 31 states of interest to begin collecting water data for the Water Atlas with 88% of the states responding thus far. The CMU team plans to extend and apply the analytical capabilities of the Integrated Environmental Control Model (IECM) to assess the water use requirements of fossil fuel-fired electric power plants using a variety of alternative water treatment and cooling technologies and processes for carbon capture and storage (CCS). The IECM is being applied in conjunction with databases of U.S. power plant characteristics to estimate the water use of electric power plants in a carbon-constrained world by evaluating multi-level water use regulation scenario requirements of electric power generation.

CMU Technical Background & Motivation

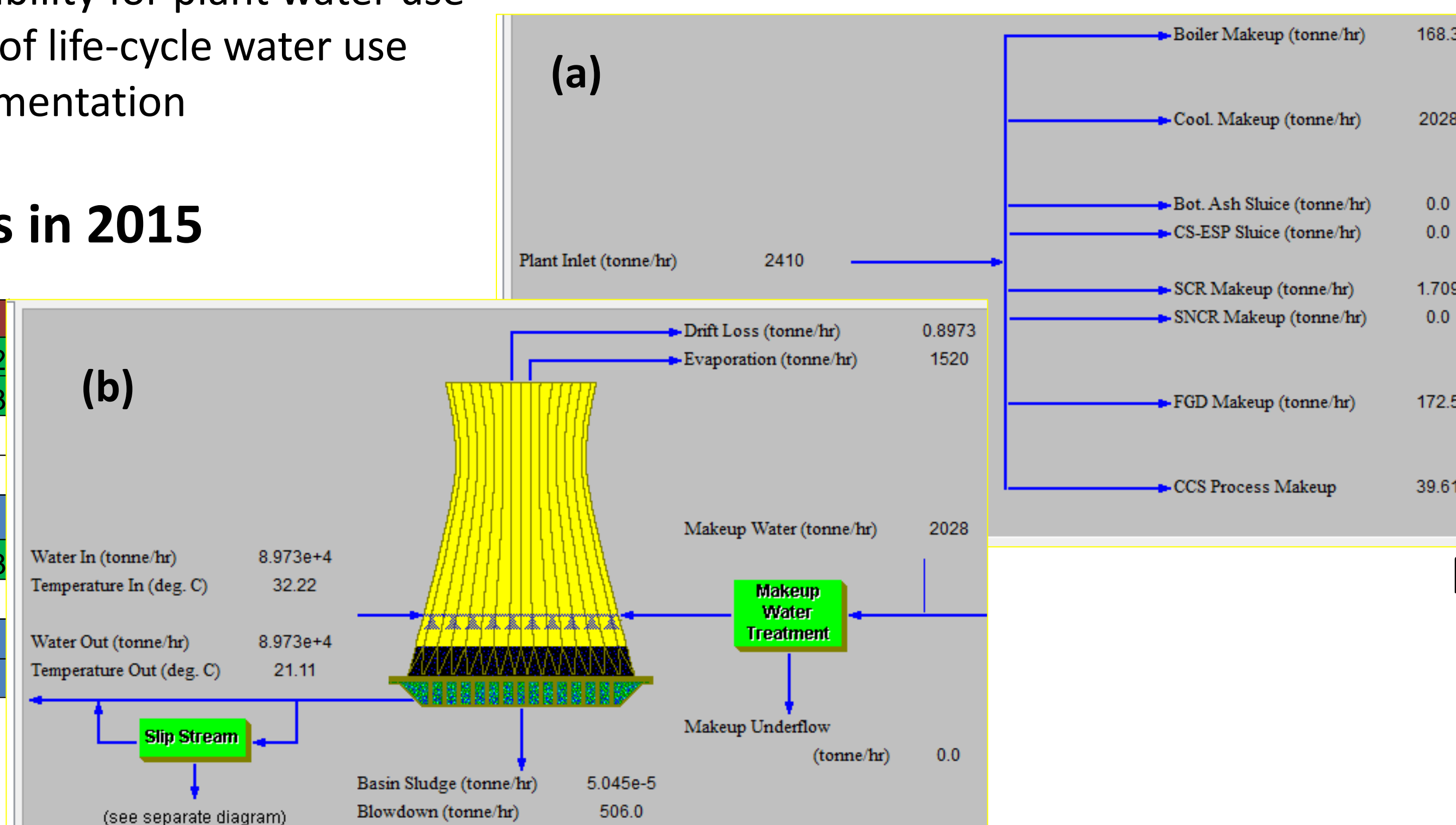
- The CMU team will extend and apply the analytical capabilities of the Integrated Environmental Control Model (IECM) to assess the water use requirements of fossil-fueled electric power plants using a variety of alternative water treatment and cooling technologies;
- Special focus on water needs and impacts of plants with carbon capture and storage (CCS) systems.

Planned CMU Project Tasks

- M1: Model alternative power plant cooling water technologies
- M2: Model water use for direct contact cooler/polishing scrubber
- M3: Estimate and compare plant-level water use for different carbon capture technologies
- M4: Estimate state-level water use for electric power plants
- M5: Evaluate the potential and cost of alternative water sources to provide water use for power plants
- M6: Develop a life-cycle analysis capability for plant water use
- M7: Conduct illustrative applications of life-cycle water use
- M8: Prepare technical and user documentation
- M9: Disseminate project results

Project Schedule and Progress in 2015

Task	1	2	3	4	5	6	7	8	9
M1						M1.1			M1.2
M2						M2.2			M2.3
M3						M3			
M4								M4	
M5									M5
M6					M6.1	M6.2			M6.3
M7							M7		
M8									M8
M9									M9

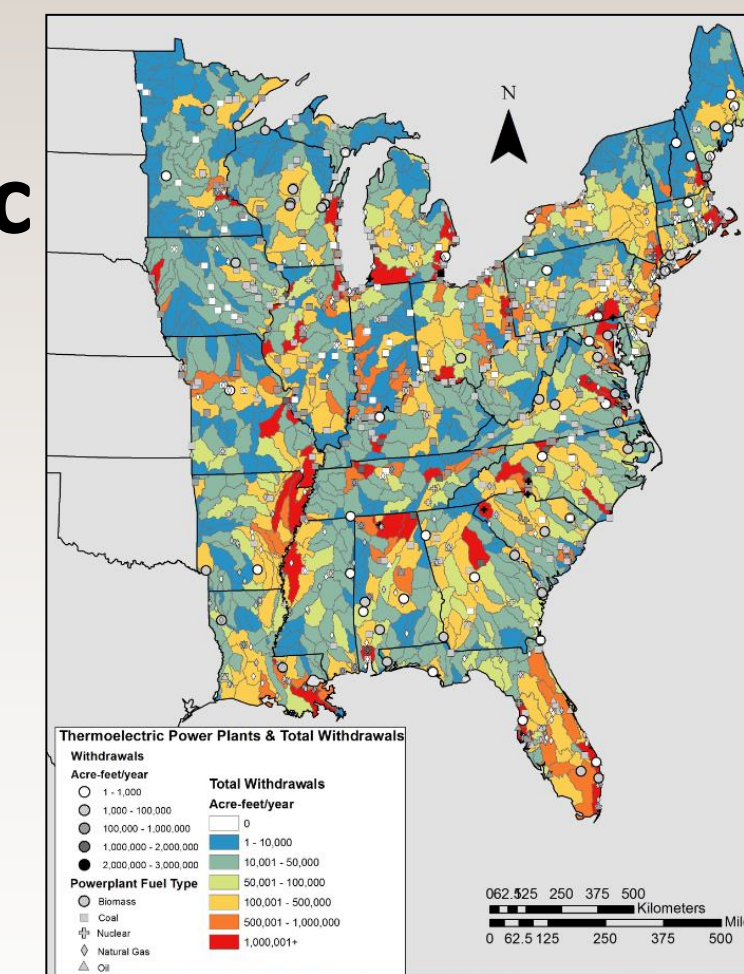


Examples of IECM output screens (a) total water output; (b) cooling tower details

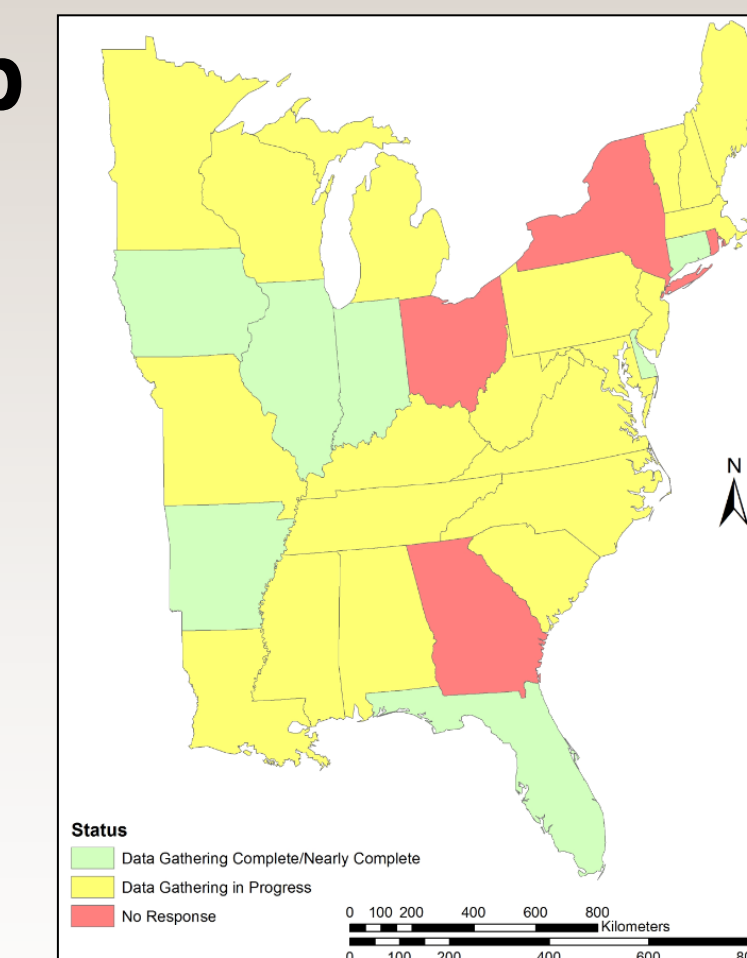
SNL Water Atlas Development

- The SNL team has been collecting data to better understand the linkage between thermoelectric generation and water for the 31 Eastern U.S. States shown below.
- A unique focus of this effort is to expand upon previous work developed for the Western U.S. in a previous, collaborative effort by developing similar water metrics and costs for the Eastern U.S.

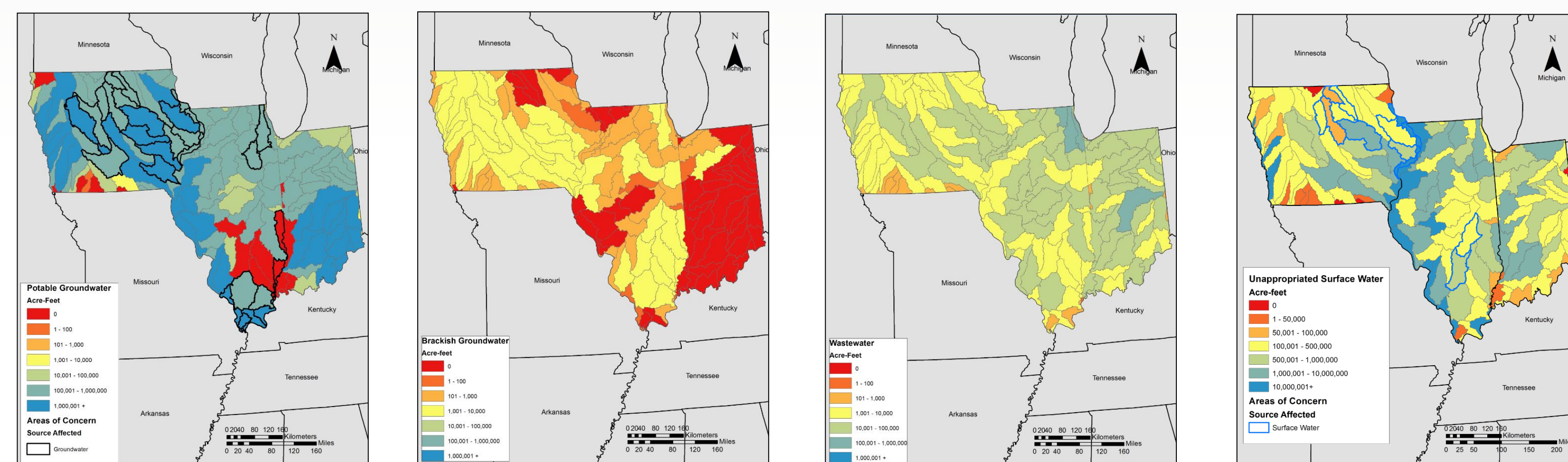
Current Thermoelectric Water Use



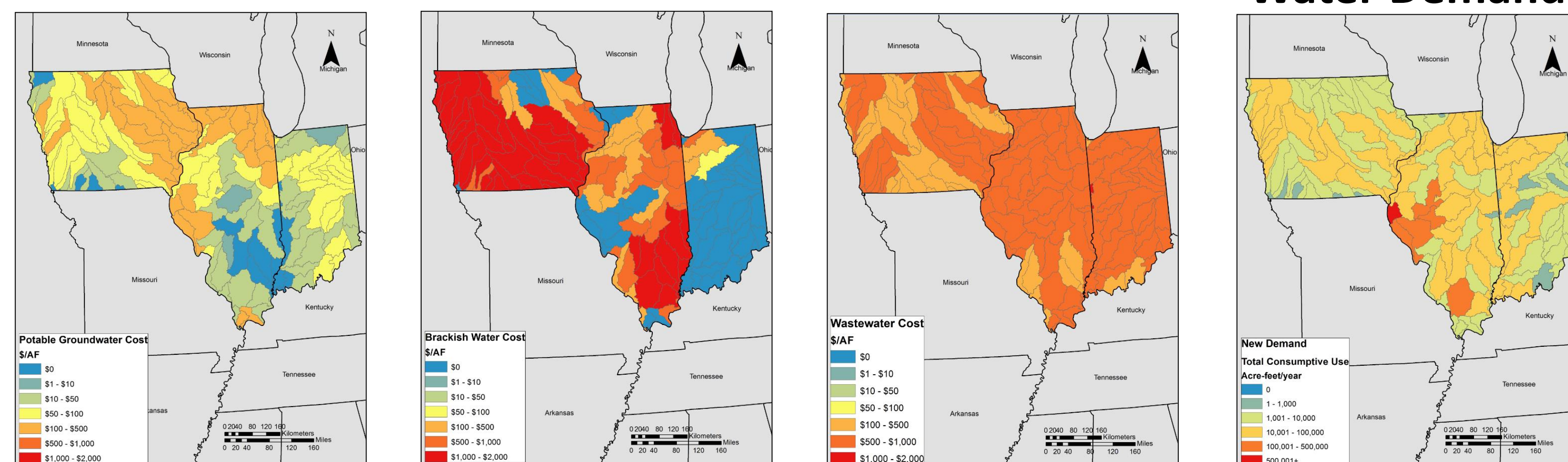
Status Map



Water Metrics



Water Costs



Project Team Summary:

- The CMU team has been working with data collection and model development for: dry/wet hybrid cooling, direct contact coolers used for CO₂ capture processes, life cycle water use, and plant- and state-level water use analyses.
- SNL will continue to develop a database of the water availability data for 31 Eastern U.S. states and plans to deliver this database and associated reporting maps.