



# New Mexico Research Spotlight Forum

10.17.2019 Grid Resiliency

## Energy-Water Interdependencies

Vincent Tidwell  
Energy Water Systems Integration, 8825  
[vctidwe@sandia.gov](mailto:vctidwe@sandia.gov)  
(505) 844-6025



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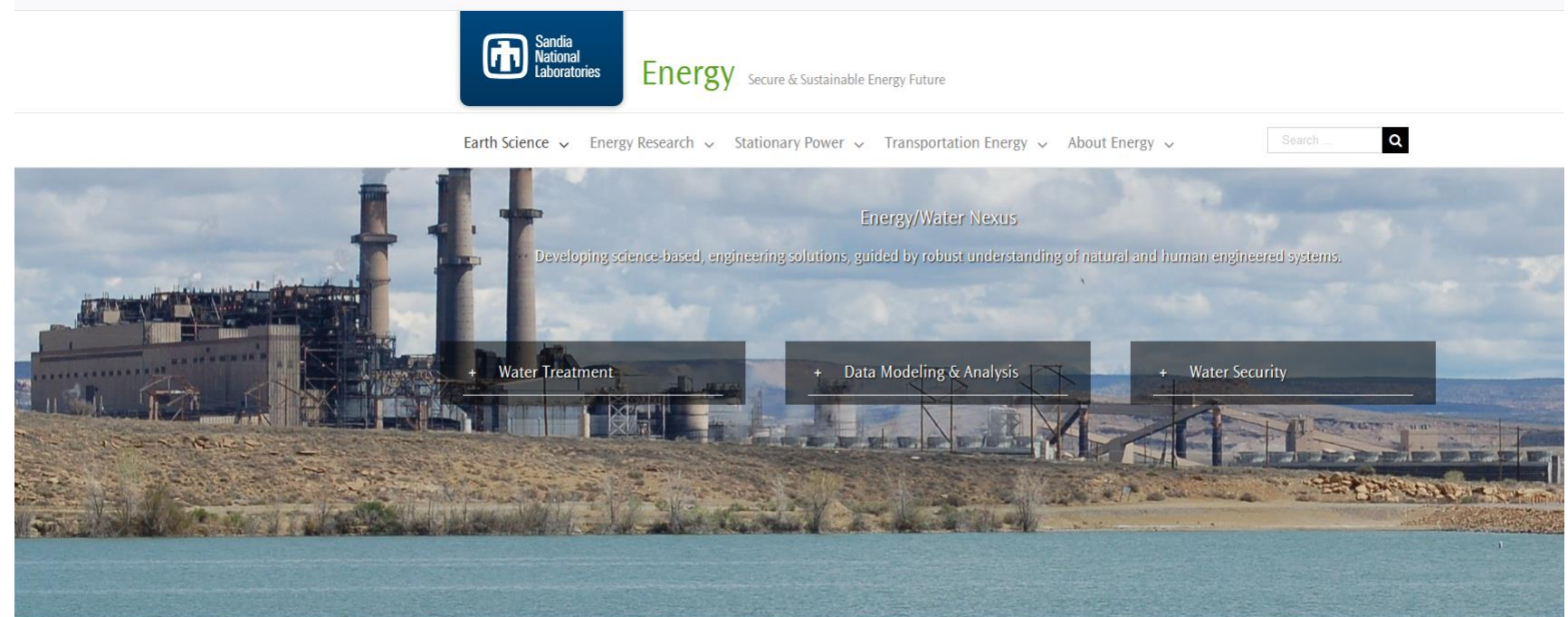
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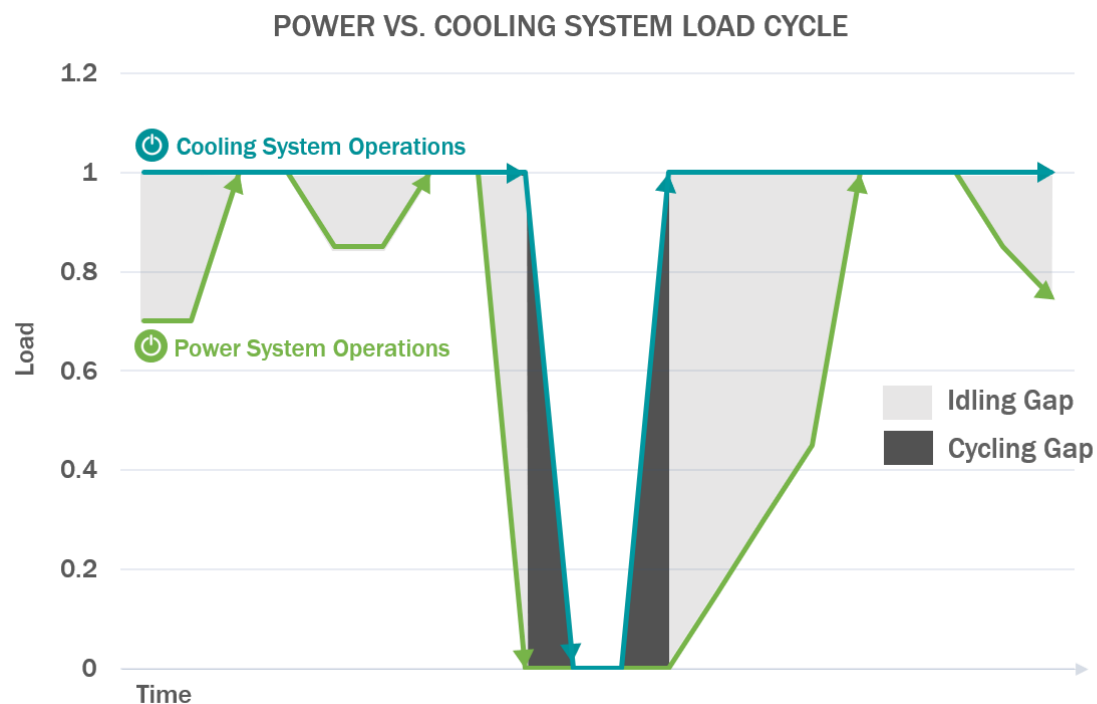
## ABOUT YOURSELF

Dr. Vincent Tidwell is a Distinguished Member of the Technical Staff at Sandia National Laboratories. He has over 20 years of experience conducting and managing research on basic and applied projects in water resource management, collaborative modeling and the energy-water nexus. He played a lead role in realizing a new Crosscut Program on the Energy-Water Nexus within DOE. Recently he led a multi-institutional team to integrate water into long-term transmission planning in the US and identified potential pinch points where water stress could impact energy production internationally. He and colleagues are combining critical infrastructure protection models with climate integrated assessment models to evaluate the resilience of our nation's infrastructure. He is an adjunct professor at the University of New Mexico, New Mexico Tech, and the University of Arizona. He served on Governor Richardson's Blue Ribbon Task Force on water and is a Lead Author for the Water, Energy and Land Use chapter in the 2014 National Climate Assessment (NCA) and the Energy Chapter in the 2018 NCA.

**Keywords:** Energy-Water Nexus; Transmission Planning; Water Availability; Climate Change; Infrastructure Resilience

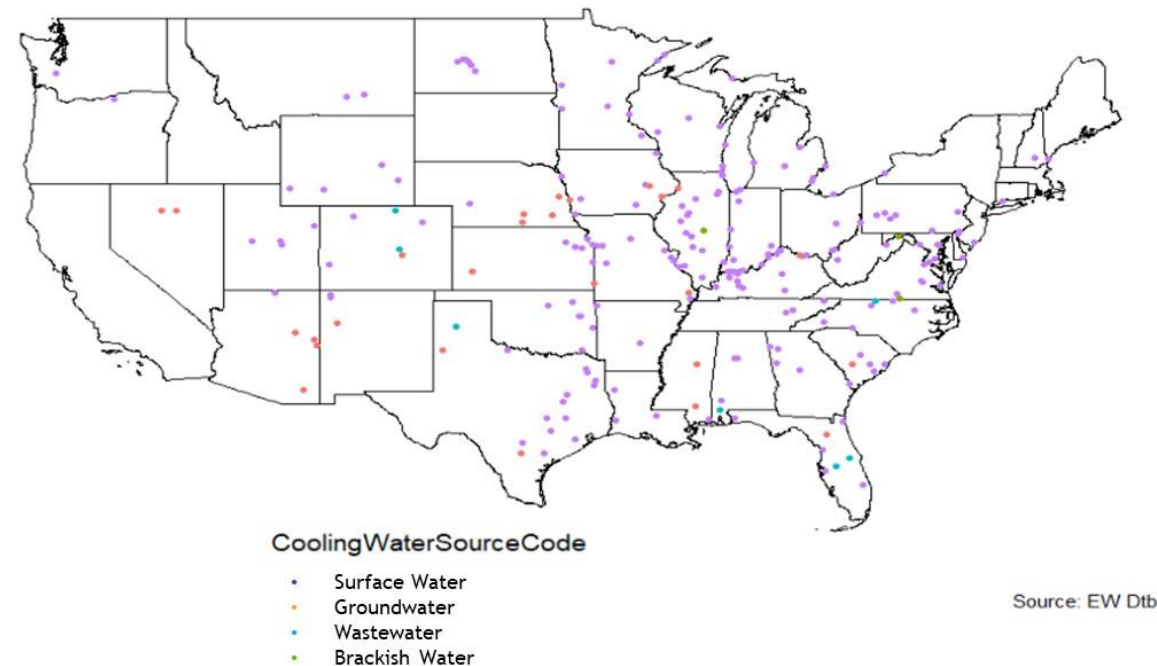


## Power Plant Operational Risks



Cooling and power systems operate differently impacting power plant water intensity

## Water Related Risks Posed to Coal-Fired Power Plants

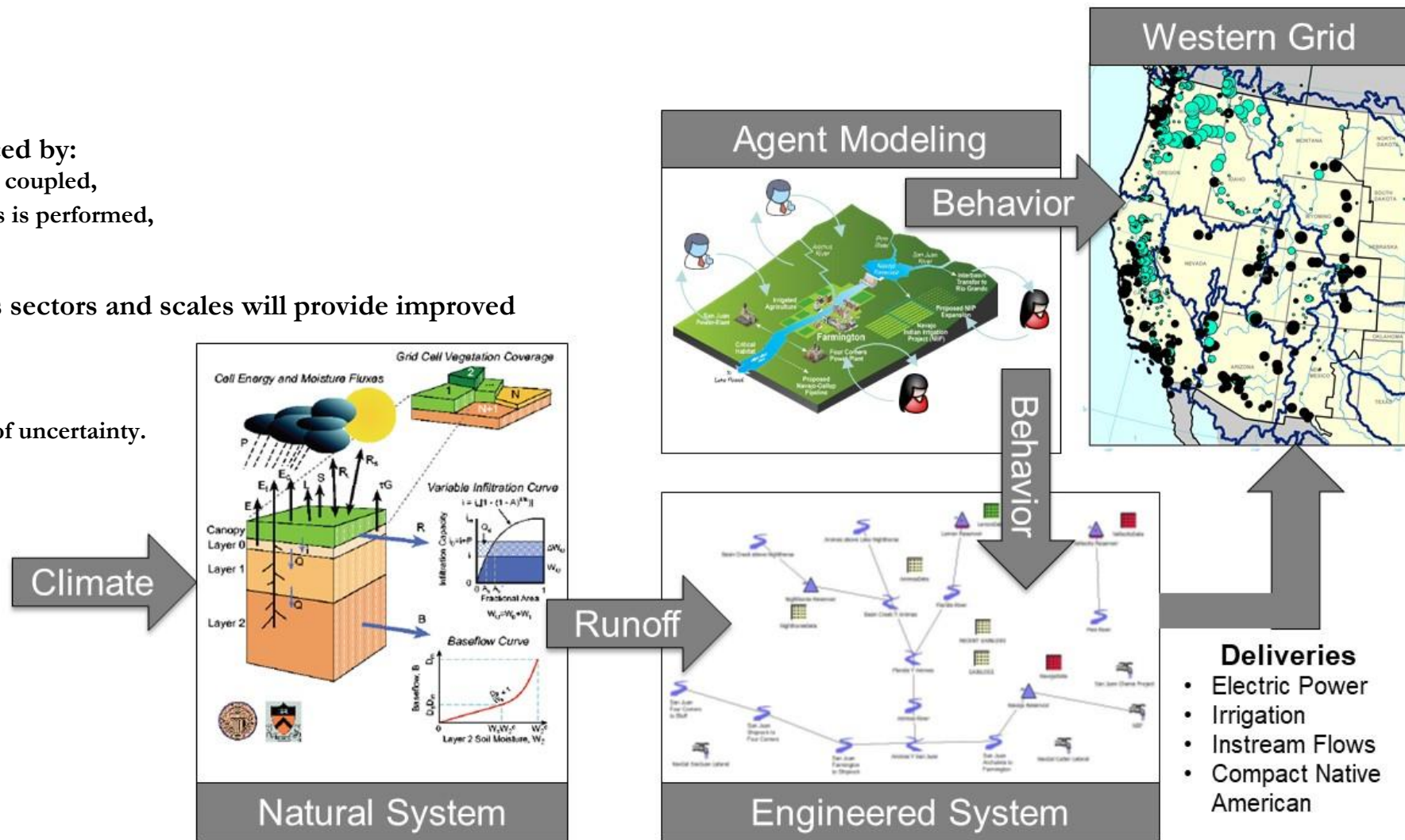


- What are perceived risks?
  - Water Supply
  - Wastewater
  - Storms
- What remedial actions have been taken?
- How does action vary by:
  - Geography,
  - Size of utility, and
  - Water source?

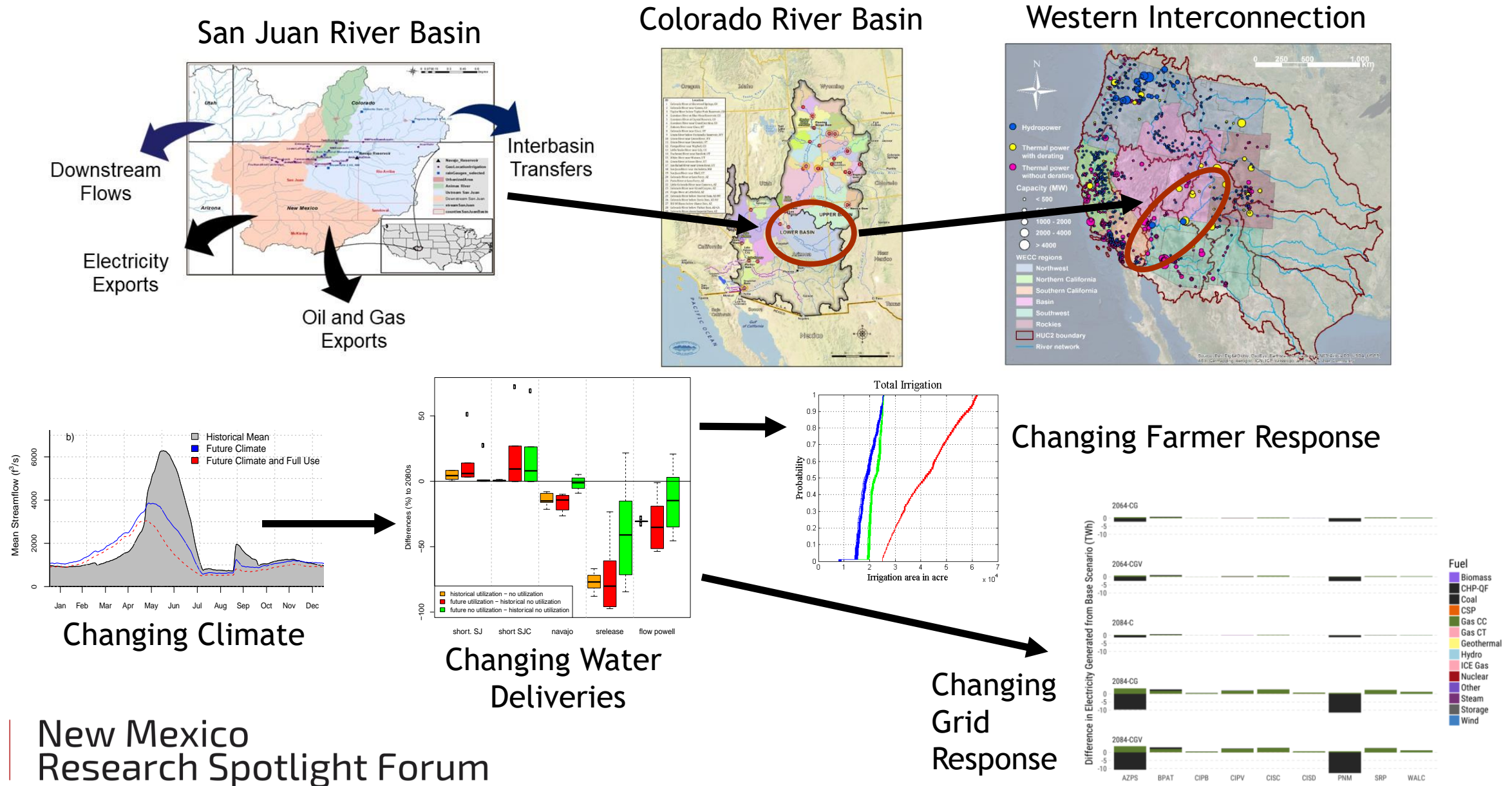


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- Extreme weather,
  - Population,
  - Land Use and
  - Other human/natural factors.
- How model outcomes are influenced by:
- The manner in which models are coupled,
  - The scale(s) at which the analysis is performed,
  - Treatment of uncertainty.
- How systematic integration across sectors and means for characterizing:
- System vulnerabilities, and
  - Preferred adaptive measures,
  - Couched in appropriate bounds of uncertainty.

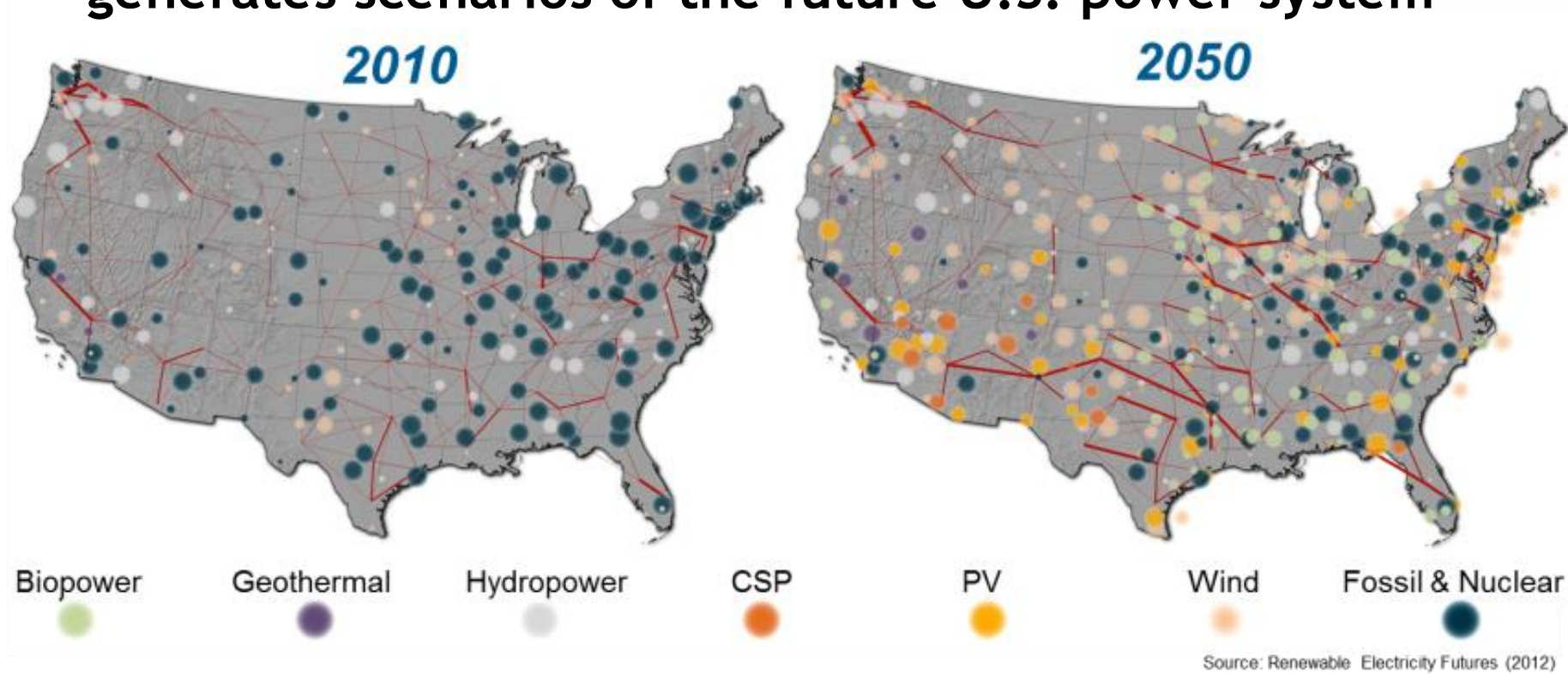


# Integrated Multi-Sector, Multi-Scale Modeling (IM3)



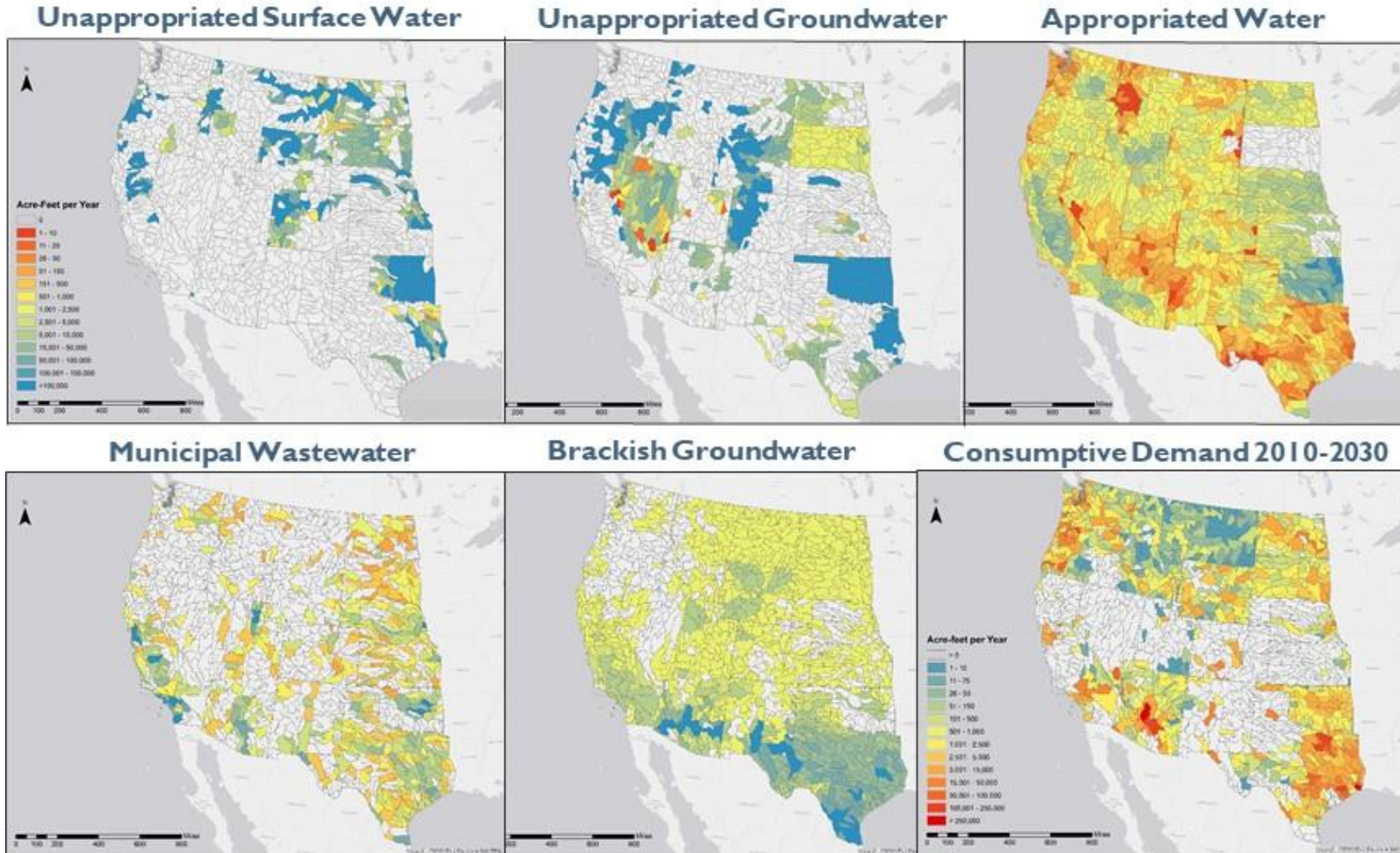


## Regional Energy Deployment System (ReEDS) generates scenarios of the future U.S. power system



ReEDS finds the regional mix of technologies that meet requirements of the electric sector *at least cost*.

## 7 Applied Water Constraints

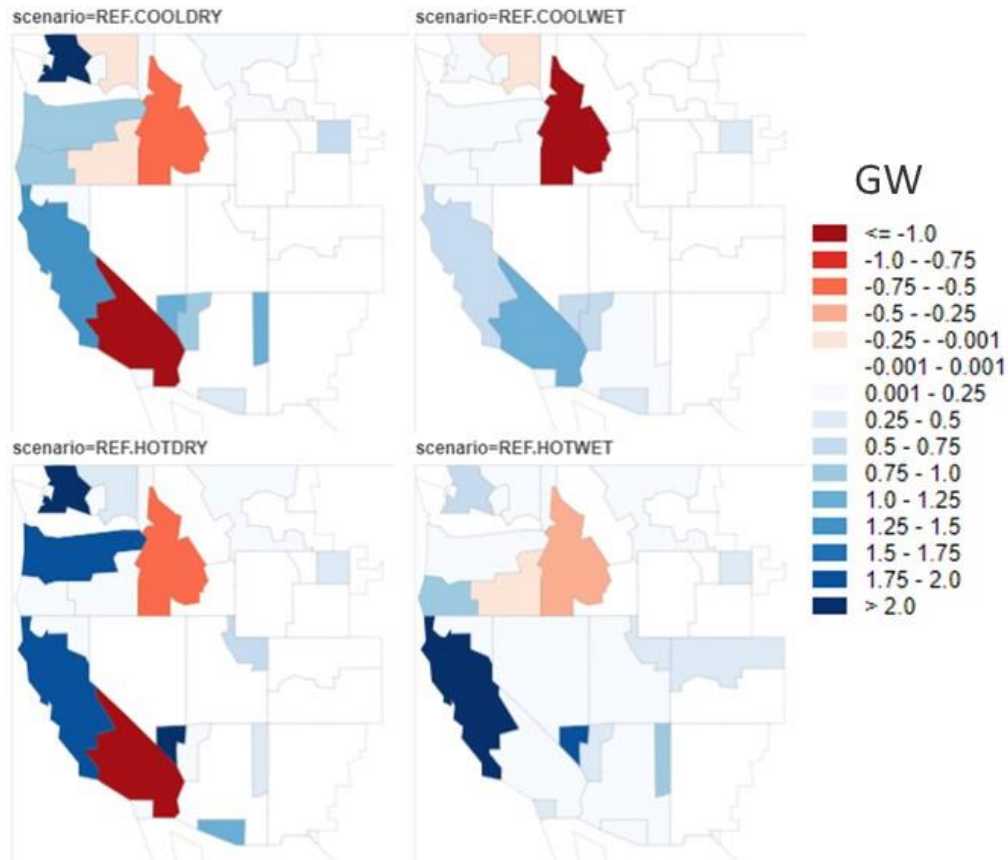


- Water that is available above current use.
- Metrics consider administrative controls. Developed with help of state water managers
- Five different source waters.
- Also mapped water cost and future growth in demand.

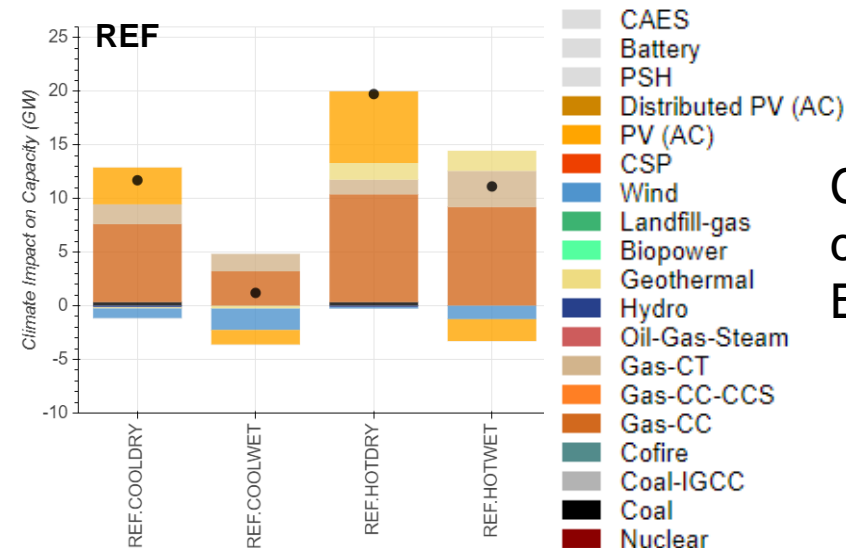
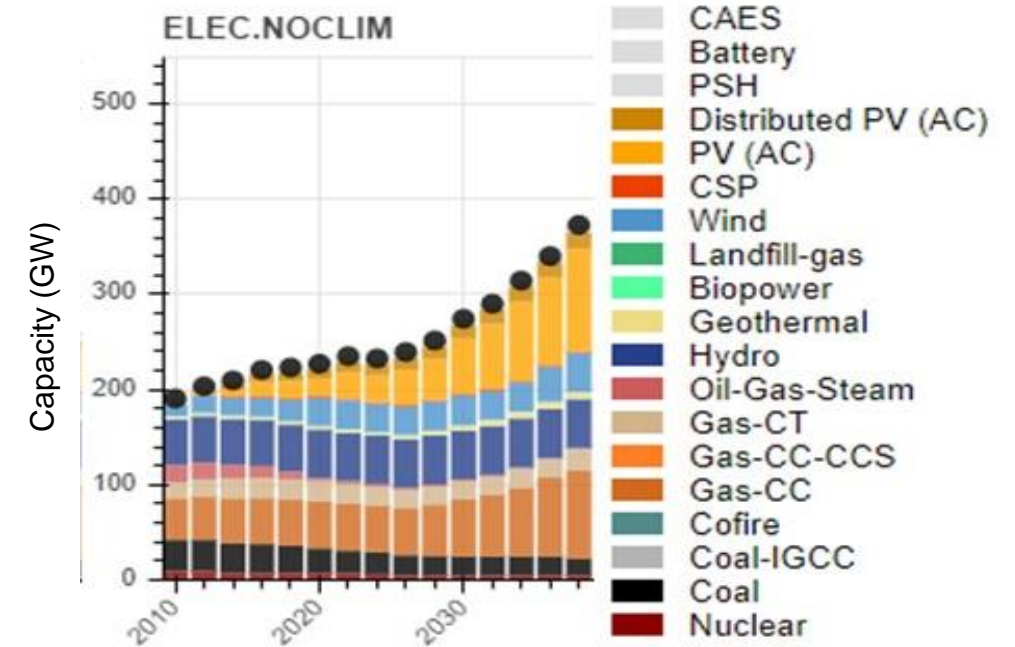


# Impact of Water on Capacity Expansion Decisions

## Climate Impacts on NGCC Capacity



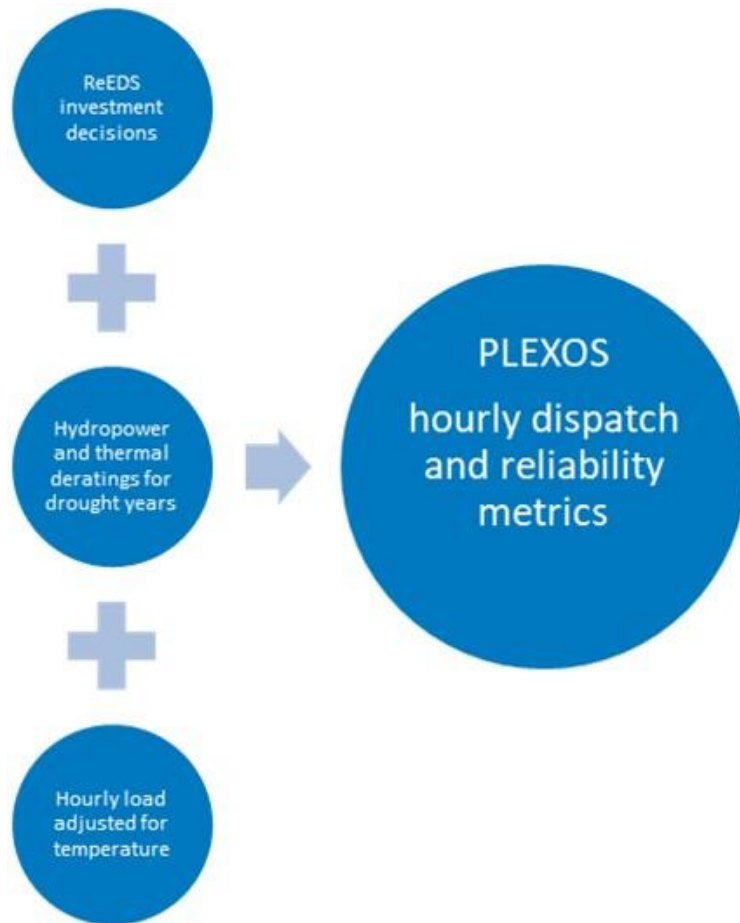
## Capacity Evolution to Match Changing Demand and Climate



Climate Impact  
on Capacity  
Expansion

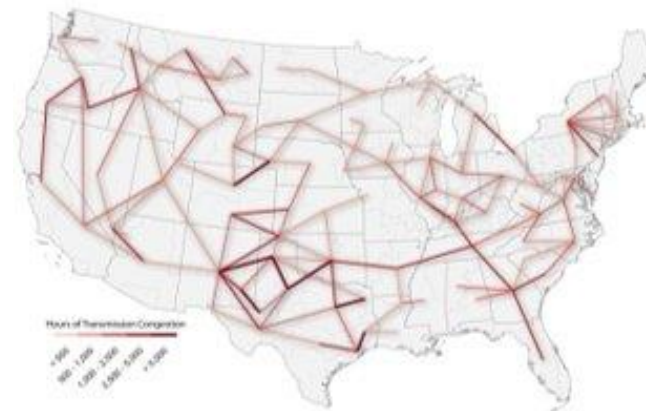


## 9 Production Cost Modeling

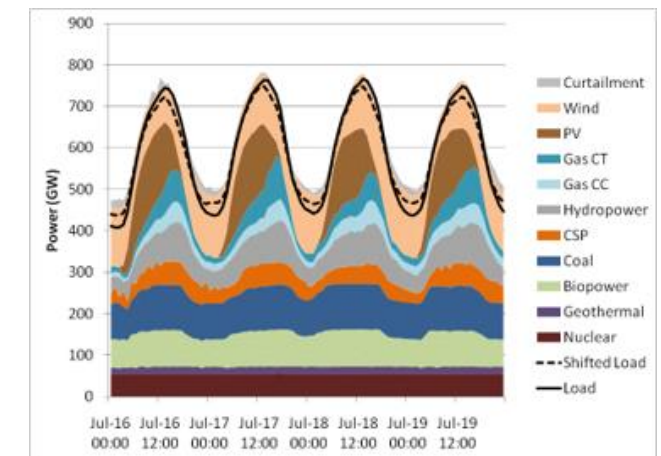


- Simulates operation of electric power system
  - Optimized for total generation cost
  - Hourly or subhourly chronological
  - Commits and dispatches generating units based on:
- Results
  - Prices and total production cost
  - Transmission congestion
  - Dispatch information
  - Emissions
  - Load and reserves served

### Transmission Congestion



### Dispatch Transition



## FUNDING SOURCES

- Department of Energy, Office of Electricity, Transmission Permitting and Technical Assistance (joint with NREL and PNNL)
- Department of Energy, Office of Electricity, Advanced Grid Research and Development (joint with NREL, ORNL, CUNY and NETL)
- Department of Energy, Fossil Energy, Coal Program (through NETL)
- Department of Energy, Office of Science, Biological and Environmental Research (joint with PNNL, NREL)





## RESEARCH NEEDS

- Integration of hydropower operations in Production Cost Modeling
- Further integration of water constraints in Capital Expansion Modeling
- Upscaling of individual reservoir operations in large multi-basin simulation of regional hydrology
- Characterization of water availability in western Canada

