

Energy-Water Nexus

Thushara Gunda, Stephanie Kuzio, Kate Klise, and Nicole Jackson
Energy Water Systems Integration

Developing science-based engineering solutions, guided by robust understanding of natural and human engineered systems

We use a multi-disciplinary, systems approach to evaluate intersections and interactions between natural, engineered, and social systems.

Our activities span data-to-decision pipelines:

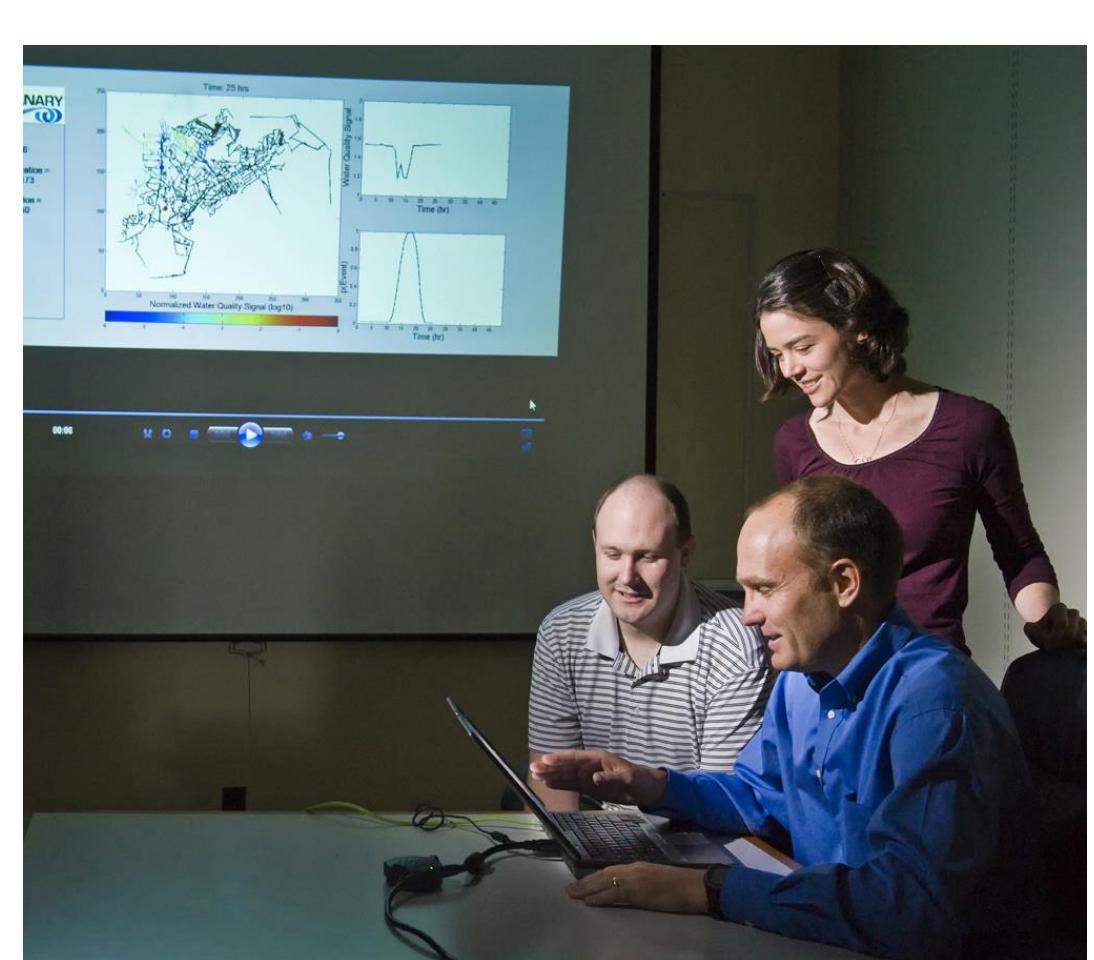
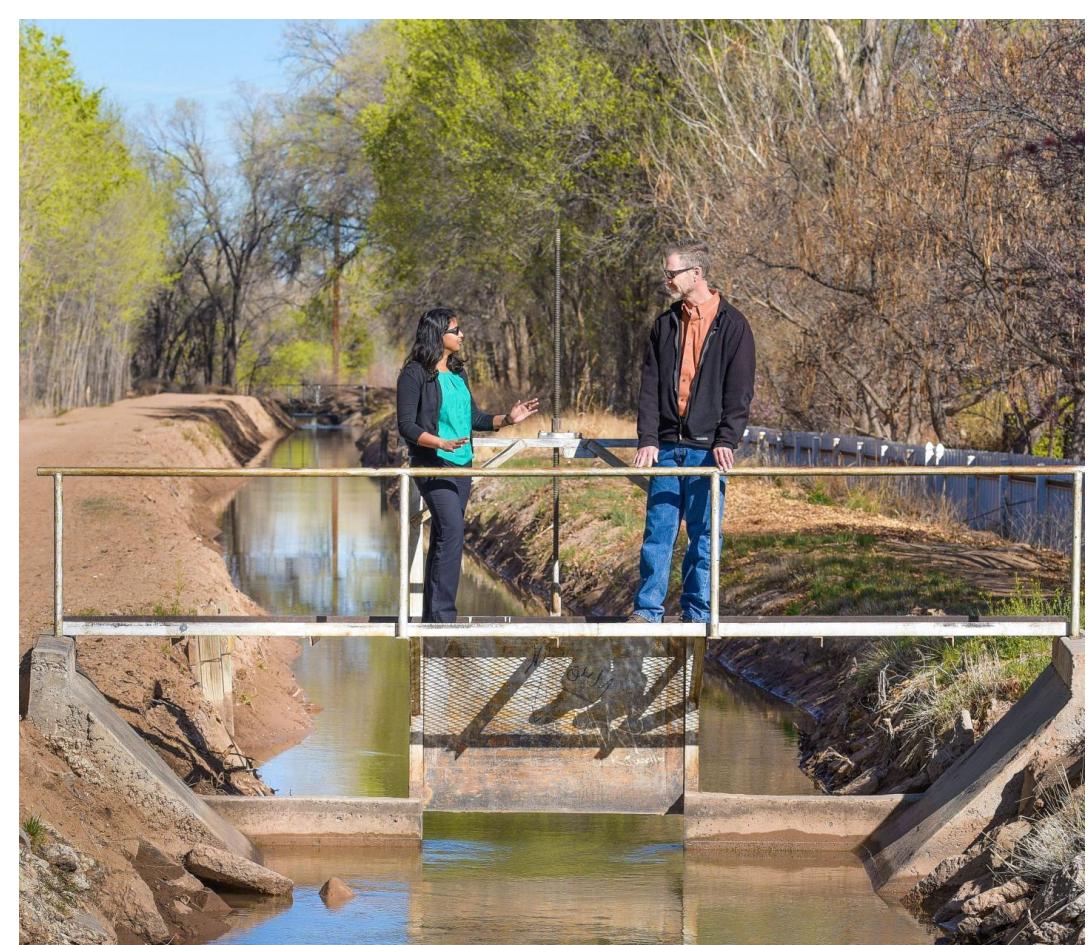
- Climate impacts to energy systems
- Coupled human behavior and engineered systems
- Infrastructure resilience
- Carbon neutral transition requirements

Sandia has developed diverse capabilities in support of customer priorities:

- Open-source software development
- Physics-informed modeling and simulations
- Decision support tools

This multi-disciplinary team includes:

- Environmental engineers
- Hydrologists
- Mechanical engineers
- Civil engineers
- Data scientists
- Applied mathematicians
- Economists



Contact Us

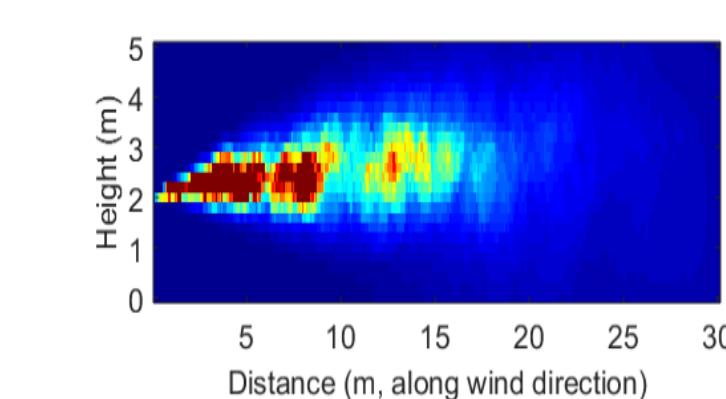
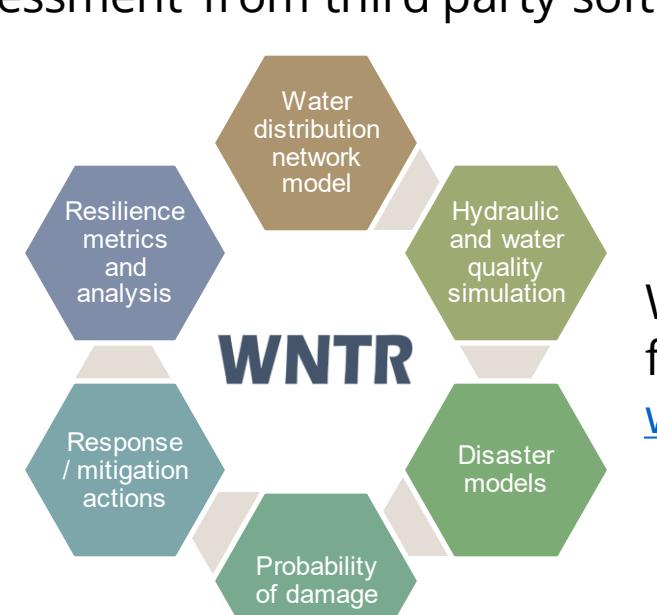
Thushara Gunda, tgunda@sandia.gov

Resilience Analysis

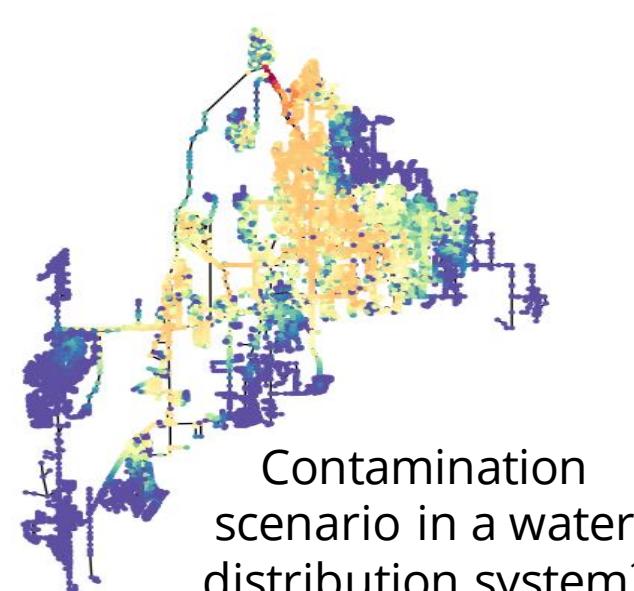
- Develop standard methods and metrics to guide infrastructure resilience analysis
- Sensor placement optimization has been applied to monitor water distribution system, chemical facilities, and fugitive methane emissions



The flexible software framework integrates simulations or impact assessment from third party software

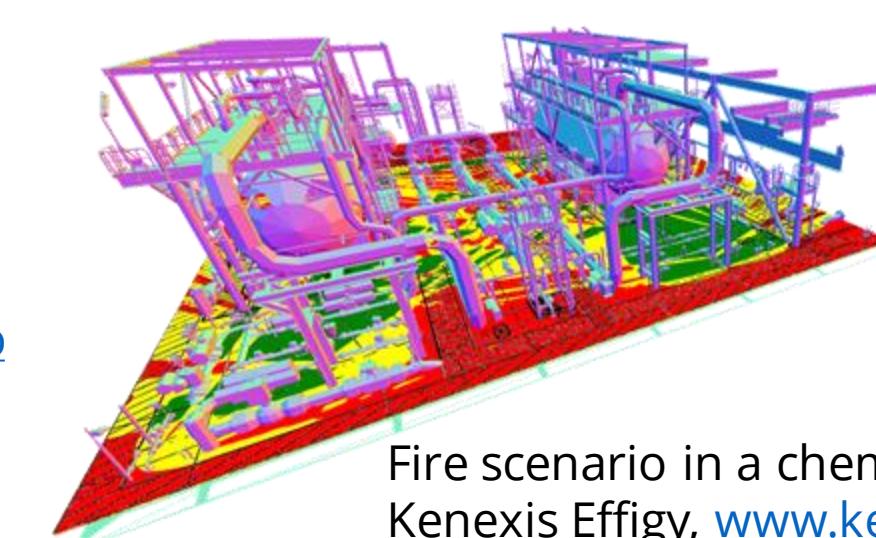


Gas leak from a production well pad
Modified Gaussian plume simulation



Contamination scenario in a water distribution system¹

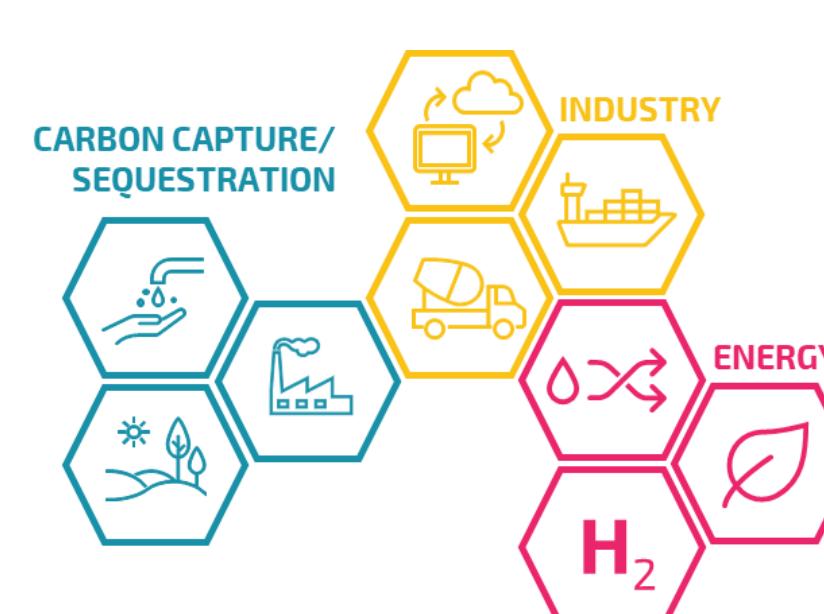
Water Network Tool for Resilience
wntr.readthedocs.io



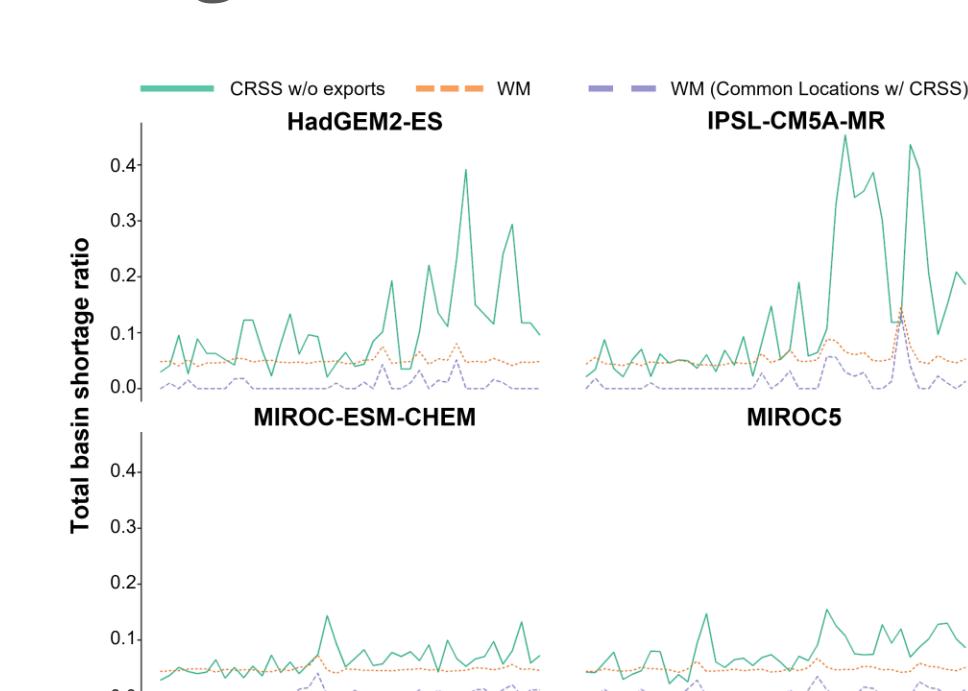
Fire scenario in a chemical facility
Kenexis Effigy, www.kenexis.com/software/effigy/

Climate Impacts

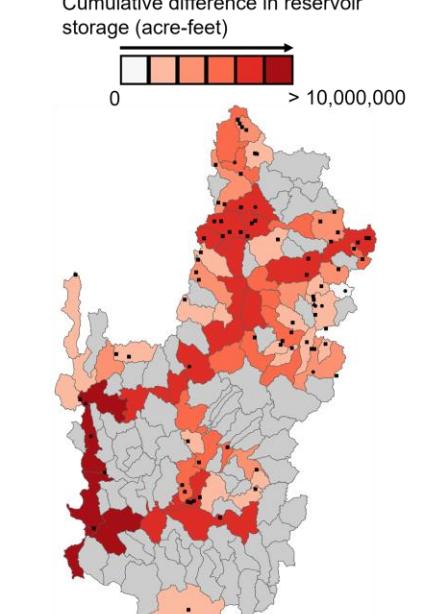
- Increase awareness of the diverse ways that water will influence transitioning towards carbon neutral activities
- Evaluate the sensitivity of water management models to different future hydrologic and climate conditions



Water plays critical direct and indirect roles across key sectors critical to carbon neutral transitions
energy.sandia.gov/watersrole



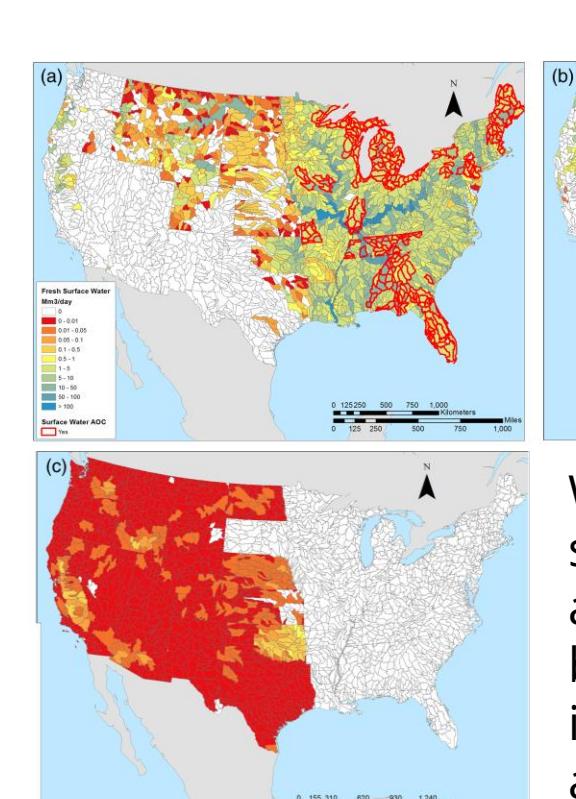
Projected water scarcity for the Colorado River Basin using different climate and water management models. Higher values mean less water is available in the basin.



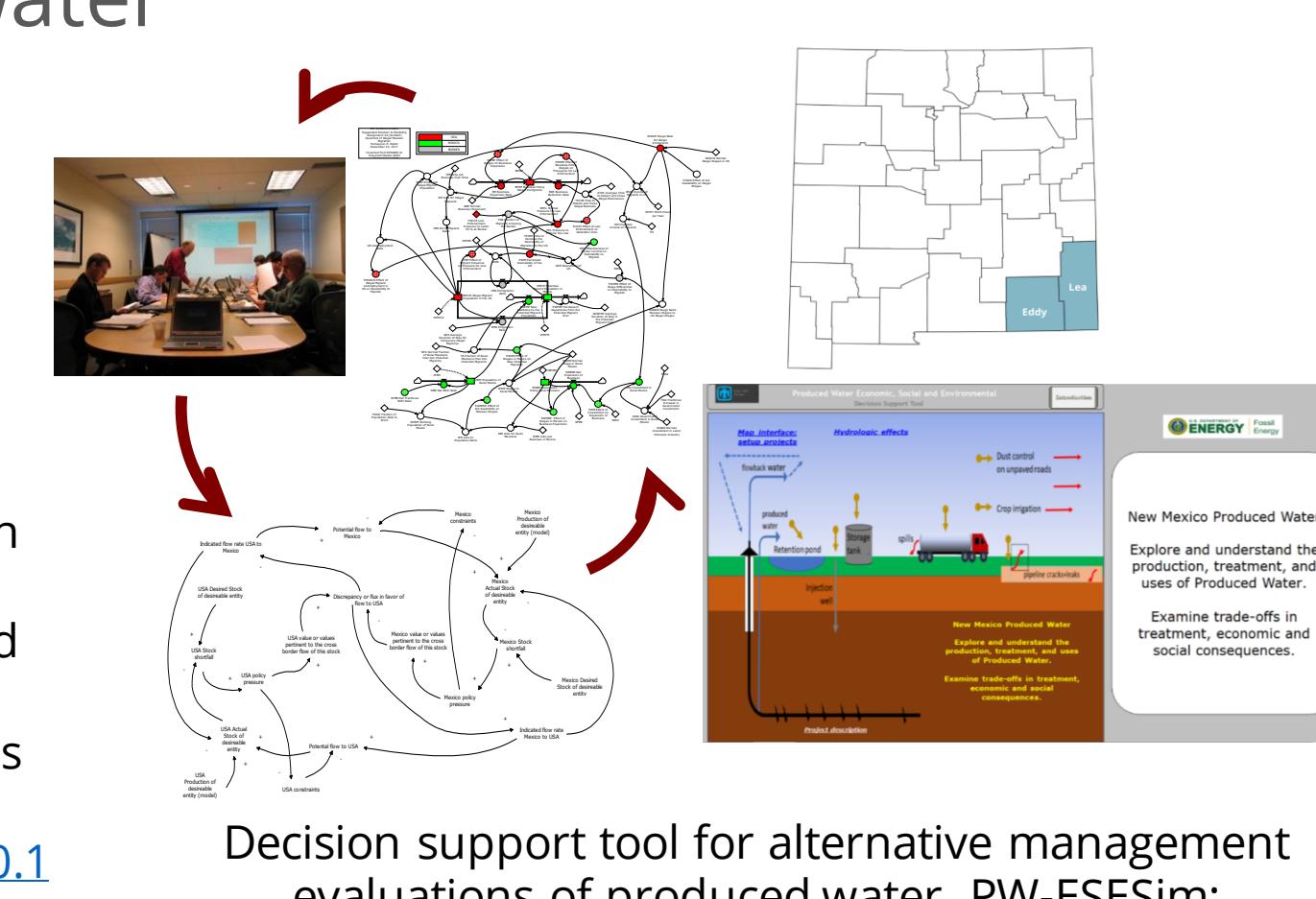
Comparison of reservoir storage available in the Colorado River Basin depending on water management model used.

Water Management

- Estimate water availability, cost, and changes in consumptive use across different source waters
- Develop quantitative assessments of economic, societal, and environmental tradeoffs in alternative management strategies for produced water



Water availability of (a) fresh sw, (b) fresh gw, and (c) appropriated water; red and blue outlined watersheds indicate those designated as areas of concern.
iopscience.iop.org/article/10.1088/1748-9326/aa9907/meta



Decision support tool for alternative management evaluations of produced water. PW-ESESim: <https://www.osti.gov/servlets/purl/1868149>