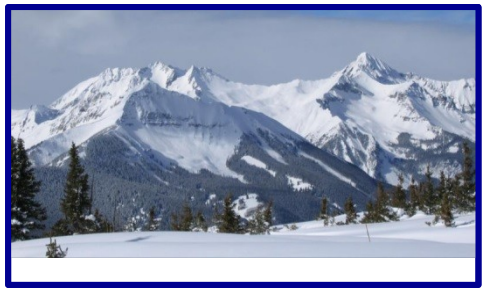
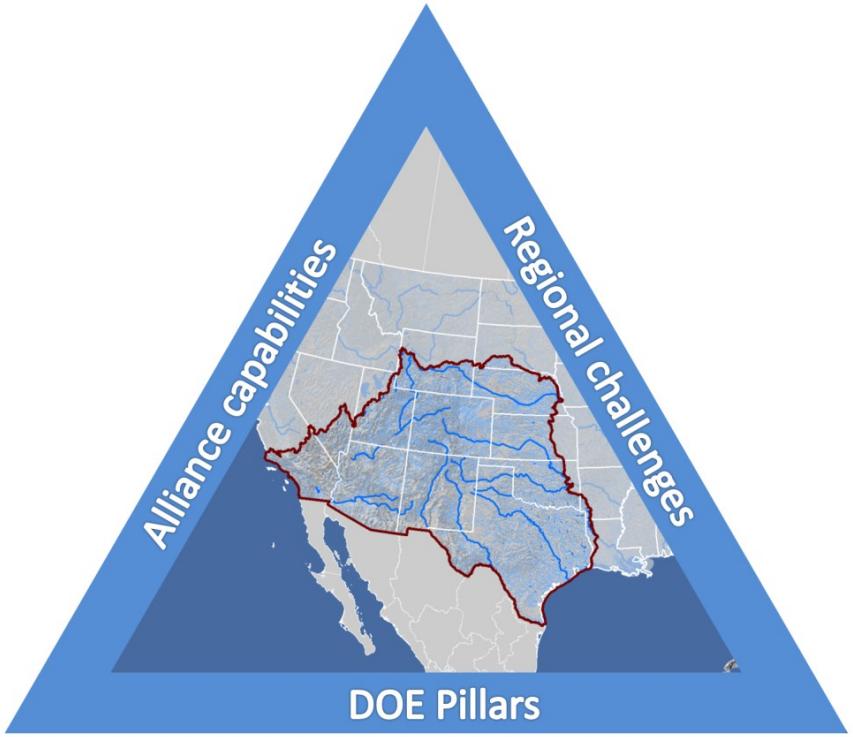
Southwest & Rocky Mountain South (SWaRMS) Water-Energy Nexus Alliance





July 2016

Status and Progress

Southwest and Rocky Mountain South - SWaRMS Water-Energy Nexus Alliance

A consortium of stakeholders led by local national laboratories to address major water-energy challenges in this region

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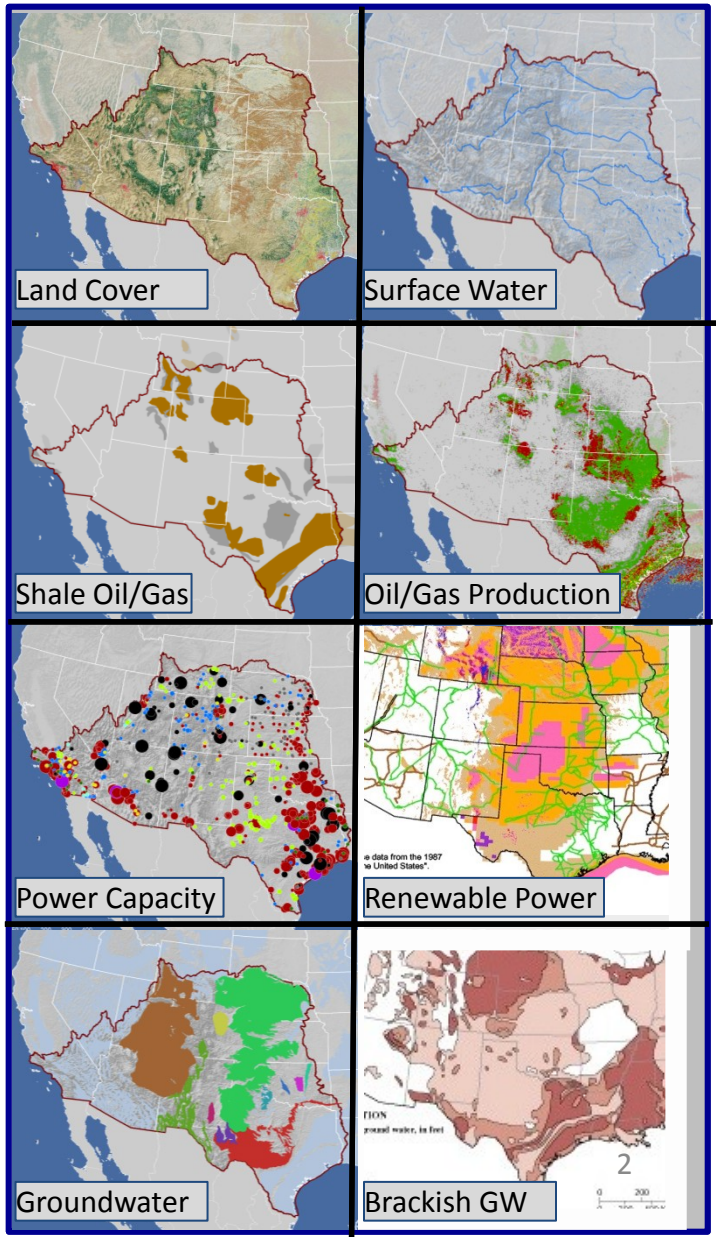
Key Drivers

- Increasing intense and common drought
- Disruptive events: fire, floods, infrastructure failure
- Rapid energy development (unconventional fuel, etc.)
- Growing population
- Interstate and international compacts

Opportunities

- Abundant brackish and produced water supplies
- Novel cooling and other next-generation technologies
- Renewable energy insertion
- Adaptation planning and resource management with advanced vulnerability and impacts assessments

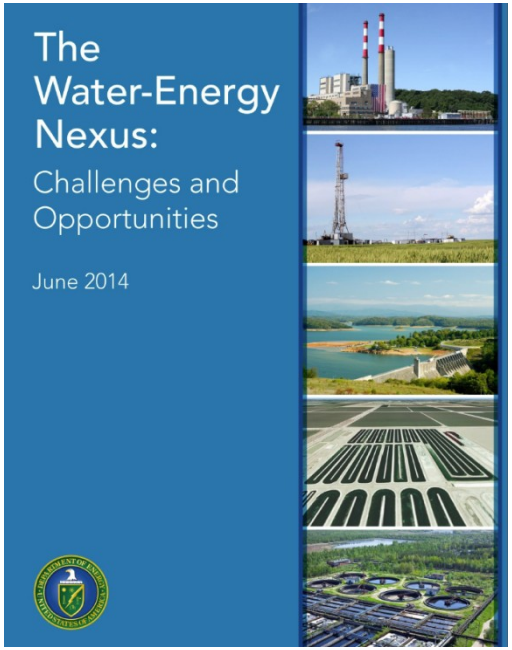
The SWaRMS region serves as an excellent test-bed for nationally important water-energy challenges and opportunities

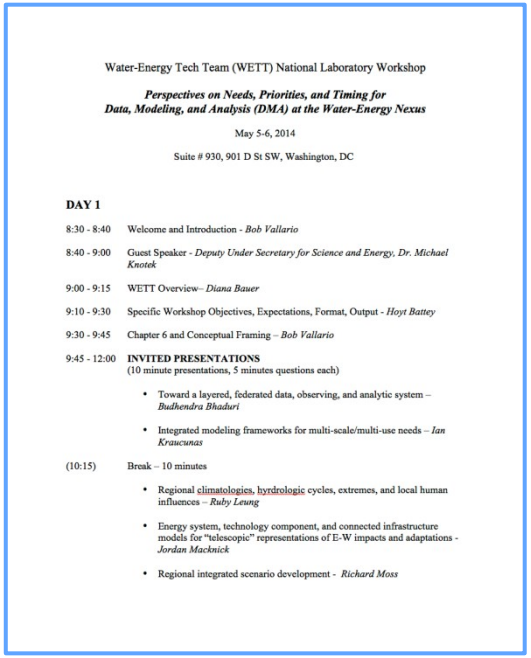


Southwest and Rocky Mountain South - SWaRMS Water-Energy Nexus Alliance

Key Drivers for establishment:

- **DOE Big Ideas Summits – March 2014 and 2015**
- **DOE Water-Energy Nexus Report –June 2014**
- **DOE Water Energy Tech Team National Laboratory Workshop – May 2014**





Water-Energy Tech Team (WETT) National Laboratory Workshop

Perspectives on Needs, Priorities, and Timing for Data, Modeling, and Analysis (DMA) at the Water-Energy Nexus

May 5-6, 2014

Suite # 930, 901 D St SW, Washington, DC

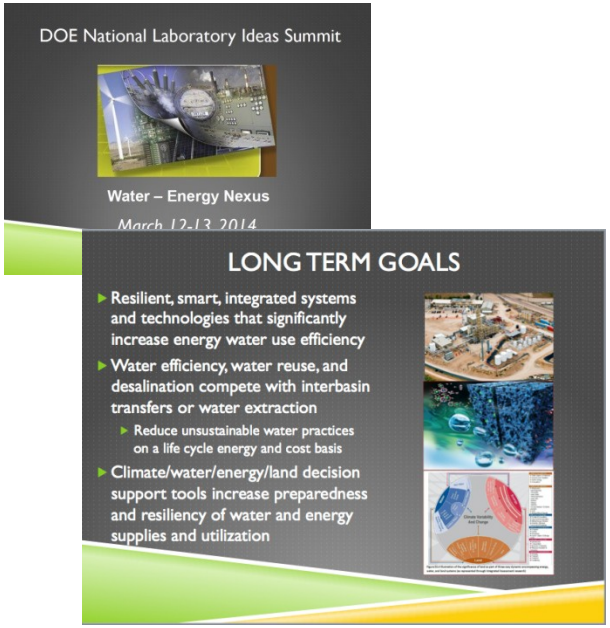
DAY 1

8:30 - 8:40	Welcome and Introduction - *Bob Vallario*
8:40 - 9:00	Guest Speaker - *Deputy Under Secretary for Science and Energy, Dr. Michael Knotek*
9:00 - 9:15	WETT Overview– *Diana Bauer*
9:10 - 9:30	Specific Workshop Objectives, Expectations, Format, Output - *Hoyt Battey*
9:30 - 9:45	Chapter 6 and Conceptual Framing – *Bob Vallario*
9:45 - 12:00	**INVITED PRESENTATIONS** (10 minute presentations, 5 minutes questions each)

- Toward a layered, federated data, observing, and analytic system – *Budhendra Bhaduri*
- Integrated modeling frameworks for multi-scale/multi-use needs – *Ian Kraucunas*

(10:15) Break – 10 minutes

- Regional climatologies, hydrologic cycles, extremes, and local human influences – *Ruby Leung*
- Energy system, technology component, and connected infrastructure models for "telescopic" representations of E-W impacts and adaptations - *Jordan Macknick*
- Regional integrated scenario development - *Richard Moss*



DOE focus on government, national laboratory, university, and industry consortia to address regional water energy challenges:

- *Enhance the reliability and resilience of energy and water systems*
- *Reduce water use for energy*
- *Reduce energy use for water*
- *Address environmental impacts of energy development on water resources*

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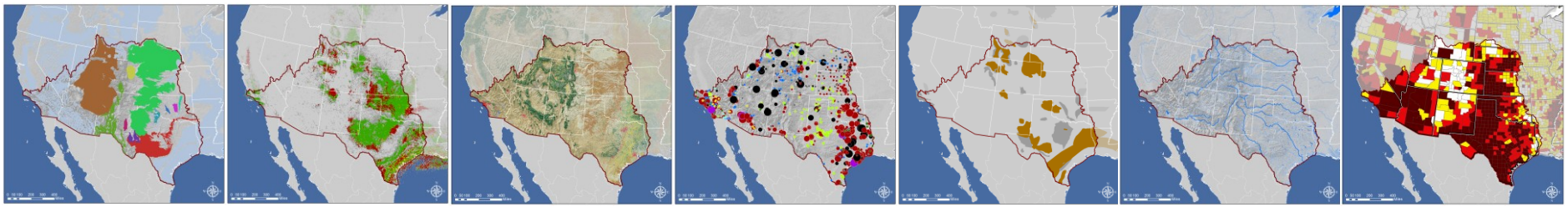
Southwest and Rocky Mountain South - SWaRMS Water-Energy Nexus Alliance

Mission (Draft):Total Water-Energy Management

With sparse and near-fully subscribed water availability in the SWaRMS region, the alliance will focus on integrating modeling and data analysis capabilities, advancing deployment of new technologies, and actively engaging stakeholders to enable optimal planning and management of regional water and energy resources



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Strategy Kickoff Meeting – June 24, 2014

- **Los Alamos National Laboratory**
- **Sandia National Laboratories**
- New Mexico State Engineer
- New Mexico Secretary of Energy, Minerals and Natural Resources
- US Bureau of Reclamation
- US Bureau of Land Management
- Public Service Co. of New Mexico
- New Mexico Oil and Gas Association
- NM US Senators' Staff (all)
- NM US Representatives' Staff (all)
- Nature Conservancy
- New Mexico Water Resources Research Institute

- University of New Mexico
- New Mexico Tech University
- New Mexico State University
- New Mexico EPSCOR
- University of Texas, El Paso
- University of Nevada Las Vegas
- University of Arizona
- Texas A&M University
- Southwest Water Technology Cluster

- Regrets from:
  - **National Renewable Energy Laboratory**
  - Colorado School of Mines
  - University of Texas, Austin

Outcomes:

- **Unilateral support of participants for an integrated, multi agency, regional, research and development program to address unique energy and water issues in the Southwest and Southern Rocky Mountains**
- **Emergence of regional water energy themes**

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Colorado Energy Water Food Meeting – August 4, 2015

- **National Renewable Energy Laboratory**
- **Sandia National Laboratories**
- University of Colorado
- Colorado State University
- Colorado School of Mines
- Environmental Protection Agency
- US Department of Agriculture - ARS
- US Bureau of Reclamation
- US Geological Survey
- NIST
- NOAA
- Colorado Energy Office
- Boulder Wastewater
- Colorado Springs Utilities
- Colorado Department of Agriculture
- Western Resource Advocates
- XCEL Energy
- City of Boulder

Colorado Center for Renewable Energy Economic Development

Outcomes:

- **Support of the need for an integrated, multi agency, regional, research and development program to address region specific energy and water issues**

- **Unique CO focus on challenges:**
  - **Increasing variability in all dimensions**
  - **Downstream surface water user impacts on both agriculture and municipalities**
  - **Need for on-site, real-time measurement and monitoring (biocides, inhibitors, frack flowback, etc.)**
  - **LCA relative to energy-water-food**
  - **Water treatment, waste water reuse and energy generation, alternative water storage and distribution, use of renewables for water treatment**
  - **Climate change impacts on watersheds and water resources**

Colorado Energy Research Collaboratory

Partners for Clean Energy

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SWaRMS Regional Meeting – September 23, 2015

- **National Renewable Energy Laboratory**
- **Sandia National Laboratories**
- **Los Alamos National Laboratory**
- Anadarko
- Arizona Public Service Co.
- Arizona State University
- Baker Institute Rice University
- Bureau of Reclamation
- Colorado Energy Office
- Colorado School of Mines
- Colorado State University
- Congressman Ben Ray Lujan
- Congressman Ken Buck
- Congressman Ed Perlmutter
- Environmental Defense Fund
- New Mexico Bureau of Geology and Mineral Resources
- NIST
- NOAA
- Office of U.S. Senator Martin Heinrich
- Office of U.S. Senator Cory Gardner
- Office of U.S. Senator Michael Bennet
- Petroleum Recovery Research Center
- Public Service Company of New Mexico
- RMS AWWA WEA Publications Chair
- RWL Water
- State of Colorado
- The University of Texas at El Paso
- University of Colorado, Boulder
- University of New Mexico
- University of Utah
- University of Wyoming
- US EPA-Region 8
- USGS
- Western Resource Advocates
- Xcel Energy

Outcomes:

- **Identification of four key strategic areas to pursue as research opportunities and test beds:**
  1. **The use of alternative water resources, including brackish groundwater and O&G produced water, to meet shortfalls in freshwater supplies**
  2. **Climate change impacts and decision support for energy development planning under changing water supply conditions**
  3. **Reducing the dependency and vulnerability of the energy system on freshwater resources, as it relates to the development of the transportation sector, thermoelectric generation, and hydropower**
  4. **Co-management of energy and water resources through distributed and centralized infrastructure and operational decision-making frameworks**

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SWaRMS Water-Energy Alliance Research Strategic Case Studies

Multi-disciplinary approach to addressing complex interconnected issues:

- Data, Modeling, and Analysis
- Advanced Technology Development and Deployment
- Policy and Stakeholder Engagement

Topic 1: Alternative Water Utilization

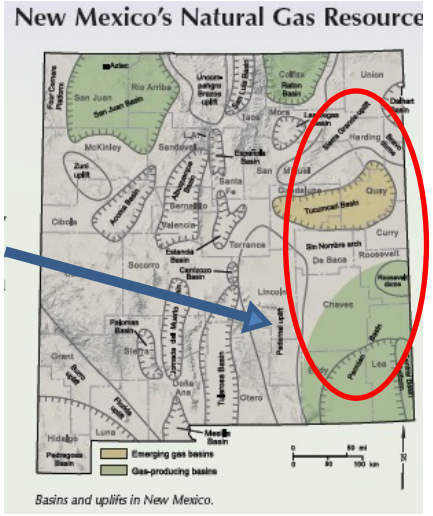
The use of alternative water resources, including brackish groundwater and oil and gas produced water, to meet shortfalls in freshwater supplies

Case Study Activities

- Development of standardized process to identify, characterize, and facilitate use of alternative water resources for beneficial uses
- Replicable within and beyond SWaRMS region
- 3-4 case study locations to capture diversity in water characteristics and regional demands

- DMA: *Characterize resource, demands, economics*
- Tech: *Demonstration platform, tech optimization*
- Engagement: *Local to regional decision-makers*

High Plains/Ogallala aquifer overlaps oil and gas basins



Topic 2: Energy planning under climate uncertainty

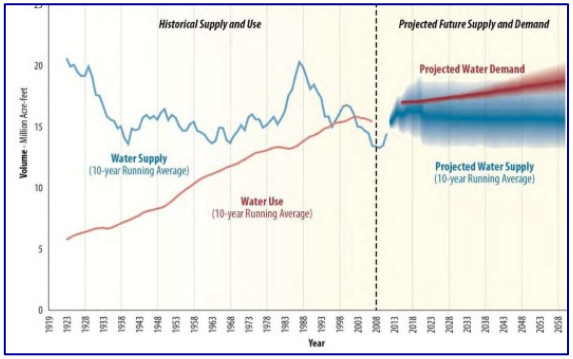
Climate change impacts and decision support for energy development planning under changing water supply conditions

Case Study Activities

- Demonstration of framework to couple natural and engineered systems models to provide useful information to stakeholders regarding energy planning under climate uncertainty
- Strong partnership with regional stakeholders
- 2 case study target locations

- DMA: *Multi-scale modeling, local data collection*
- Tech: *Connections to Alternative Water Utilization*
- Engagement: *Local and regional planners*

Energy: Long-term shortages



Energy: short-term disruptions

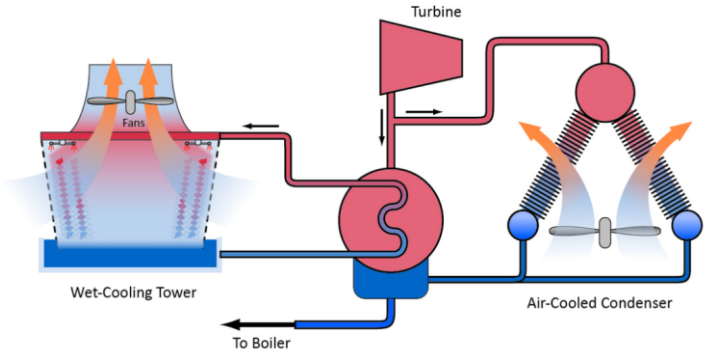
Topic 3: Low-Water Energy

Reducing the dependency and vulnerability of the energy system on freshwater resources for the transportation sector, thermoelectric generation, and hydropower

Case Study Activities

- Development of an integrated planning roadmap for energy systems in the SWaRMS region to minimize freshwater dependence and ensure energy security Focus on 3 sectors (transportation, thermoelectric, hydropower)
- Results and roadmap process would be applied to other challenges within and external to the SWaRMS region

- DMA: *Cost, reliability, and interactions of systems*
- Tech: *Biofuels, electrification, cooling techs, low-head hydro*
- Engagement: *Multiple levels of energy and water planners*

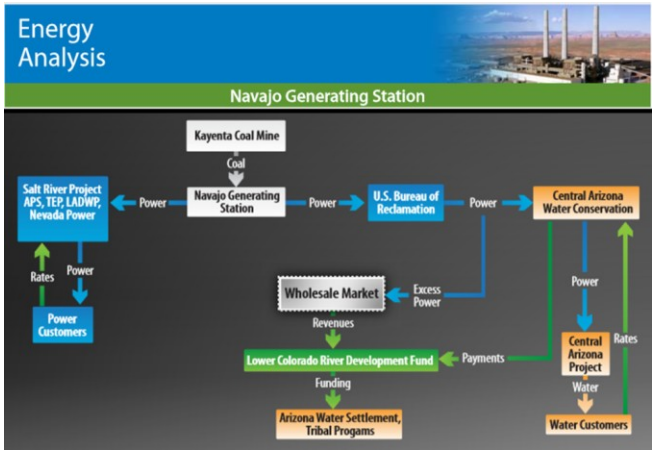


Topic 4: Co-management of energy and water

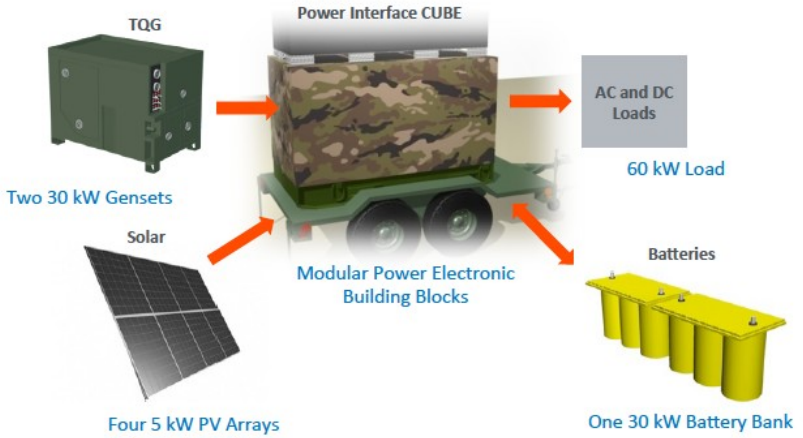
Co-management of energy and water resources through a combination of distributed and centralized infrastructure and operational decision-making frameworks

Case Study Activities

- Architecture development for an energy and water co-management system for two contrasting sites: a rural, decentralized system and an urban, centralized system
- Bring together stakeholders that have complementary interests but have not yet interacted
- Alternative policy frameworks to facilitate co-management

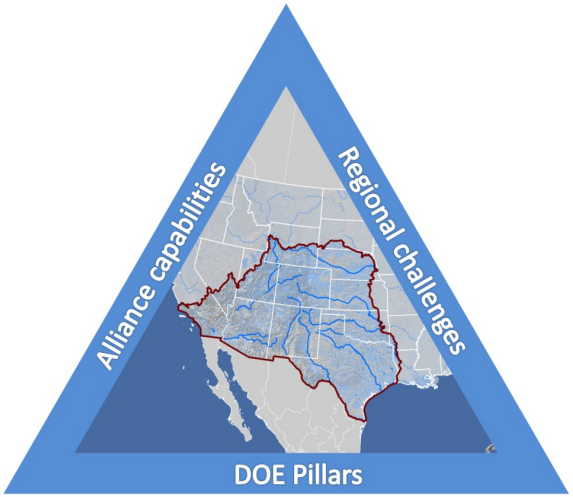


- DMA: *Simulations and multi-systems integration*
- Tech: *Metering and monitoring technologies*
- Engagement: *System operators and engineers*



SWaRMS Water-Energy Alliance Research

- Engaging DOE on SWaRMS regional concept
  - DOE visited LANL, Sandia, and NREL in FY 2015 to discuss EWN implementation at DOE
  - DOE budget for Energy Water increased: FY15 $12M, FY16 $38M, FY17 request of $96M
  - DOE continues to push regional partnerships, using the SWaRMS approach as an example to be emulated by other labs
- Engaging with states and other federal agencies (e.g., NSF, USDA, USGS)
- Proactive stakeholder engagement and case study development



  - Series of White Papers regional research themes identified in June 2014 Santa Fe workshop
  - Case Study research plans and road maps for four strategic research areas
    - Targeted case studies to solicit interest for establishing collaborative research and development projects and partnerships

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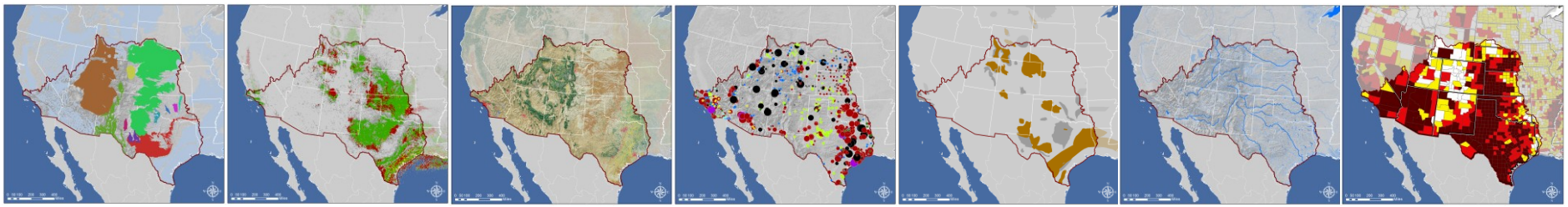
Ongoing steps and future directions

- *Continued engagement with regional and federal stakeholders*
- *Further development of case study research plans and partnerships*
- *Identification of specific test bed research facilities*
- *Regional meetings and forums*
- *Leveraging strategic case studies to undertake long-term projects*



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Thank you!

SWaRMS Organizing Committee

Mike Hightower

Stephanie Kuzio

Tom Lowry

Jordan Macknick

Richard Middleton

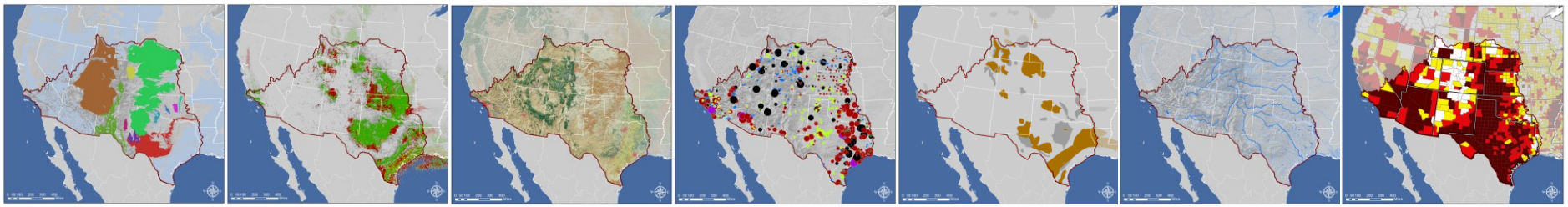
Robin Newmark

Jeri Sullivan Graham

Vince Tidwell

Cathy Wilson

Andrew Wolfsberg



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Topic 1: Alternative Water Utilization
Detailed research questions

Overarching Question: To what extent will non-traditional supplies (brackish groundwater, recycled wastewater, produced water, sea water) of water be utilized to meet future water resource demands in arid/semi-arid environments?

Data, Modeling and Analysis

- How will climate change affect freshwater resources?
- What is the physical availability of brackish groundwater and produced water?
- What are the implications for the energy industry?

Advanced Technology

- What are likely alternative technology pathways?
- What role will regionality play in altering adoption of non-traditional waters and related technologies?

Policy/Stakeholder Engagement

- How will different water use sectors structure their water supply portfolios?
- Can the region remain economically competitive in the face of changing water supplies?