Energy-Water-Land Interactions Under Global and Regional Change: A DOE Perspective

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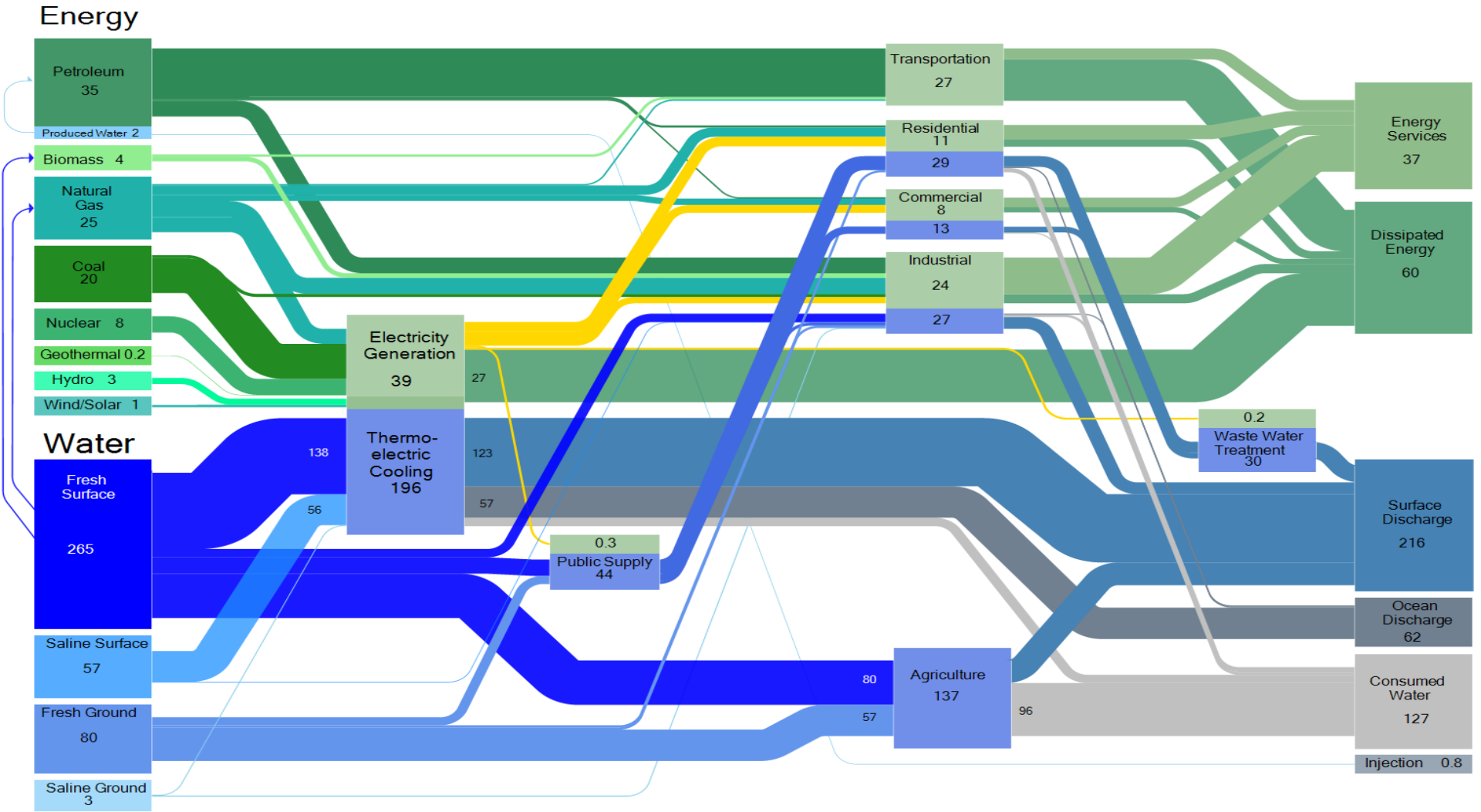
Drivers Behind Growing DOE Interest

- Recent weather extremes have highlighted vulnerabilities
- Considerable interest on the Hill
- GAO report
- Interest within OSTP and more broadly within the Administration
- Expanding topic within USGCRP with early work led by DOE (NCA)
- Bi-lateral and multi-lateral agency collaborations emerging with DOE
- **A Secretary of Energy that sees this as a high priority**
  - Supporting a Department-wide effort at integration and coordination through formation of the WETT

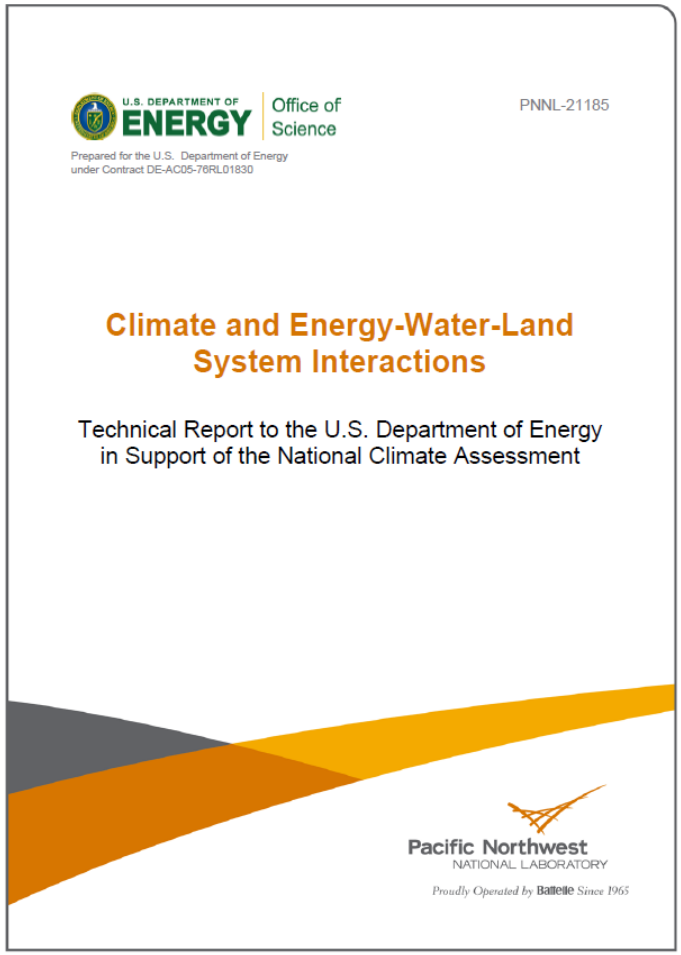
The Interconnected Energy-Water System

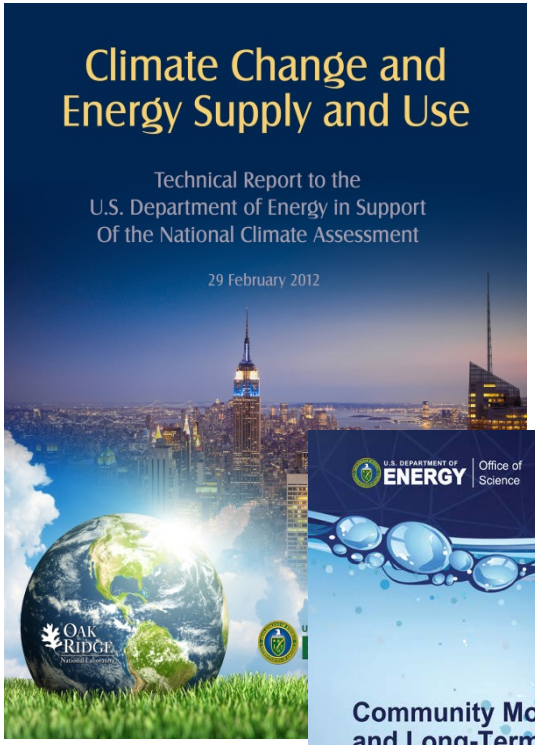
2011 Estimated U.S. Energy-Water Flow Diagram

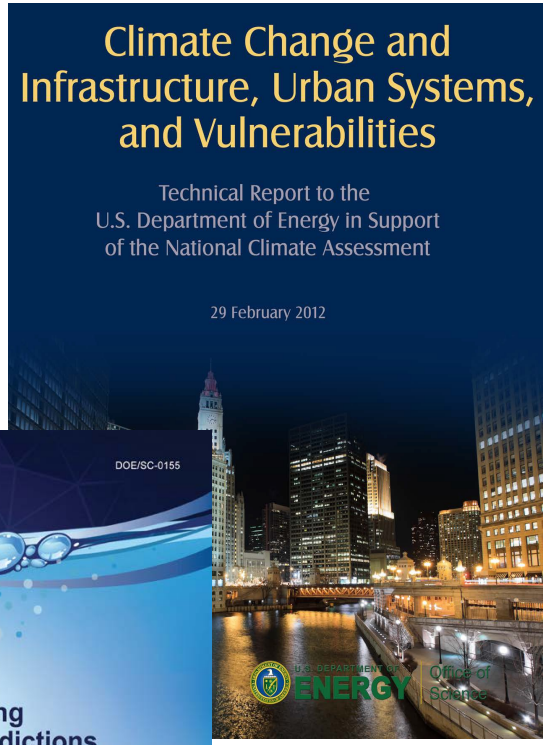


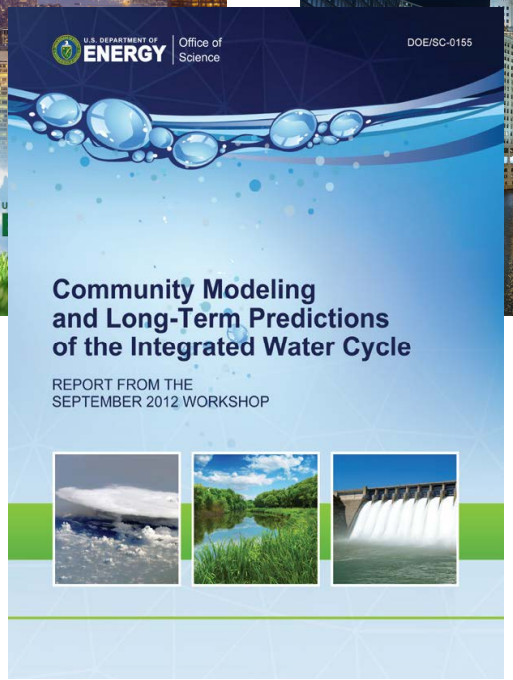
Energy reported in Quads/year. Water reported in BGD.

BER Foundations Helped Set the Stage



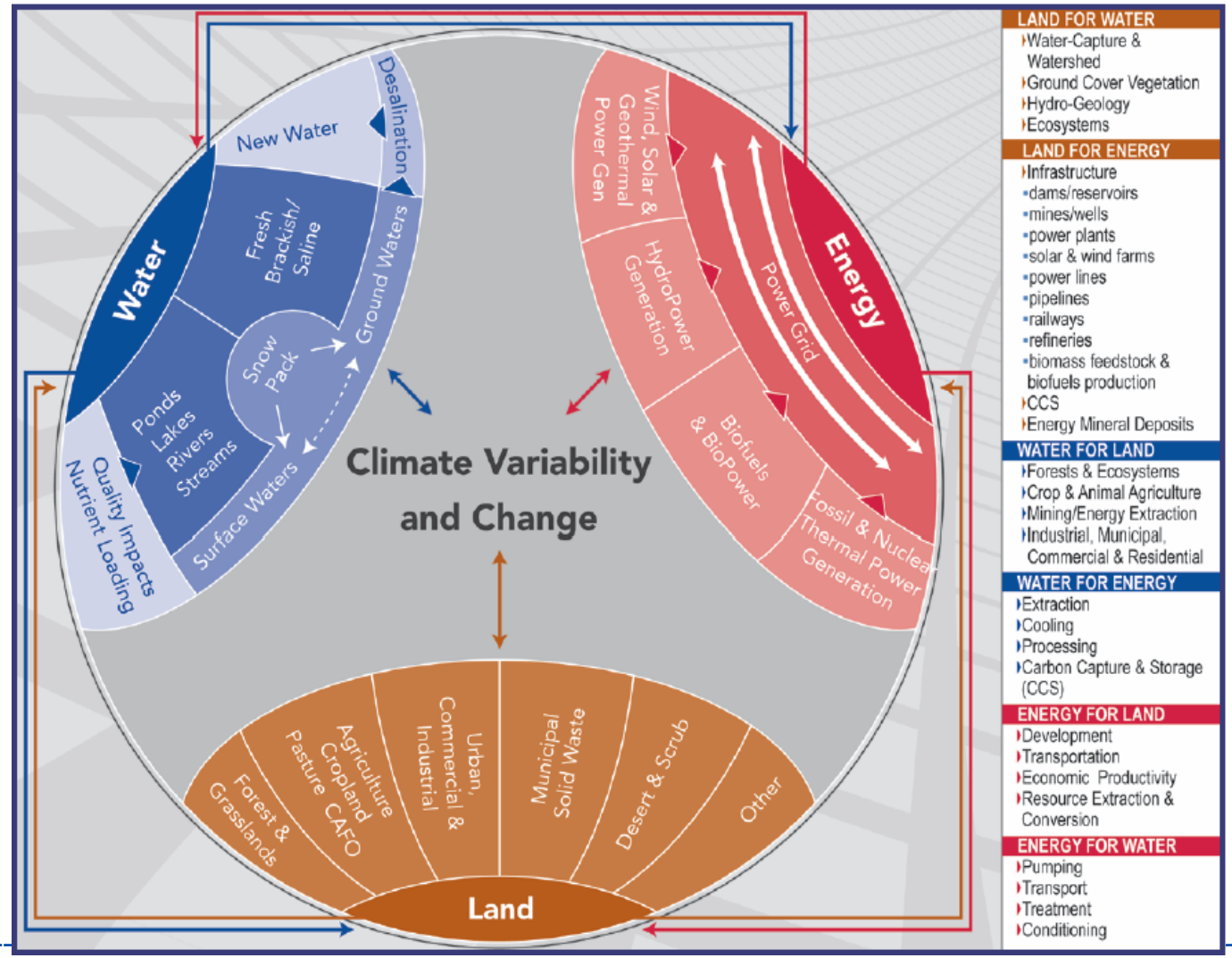






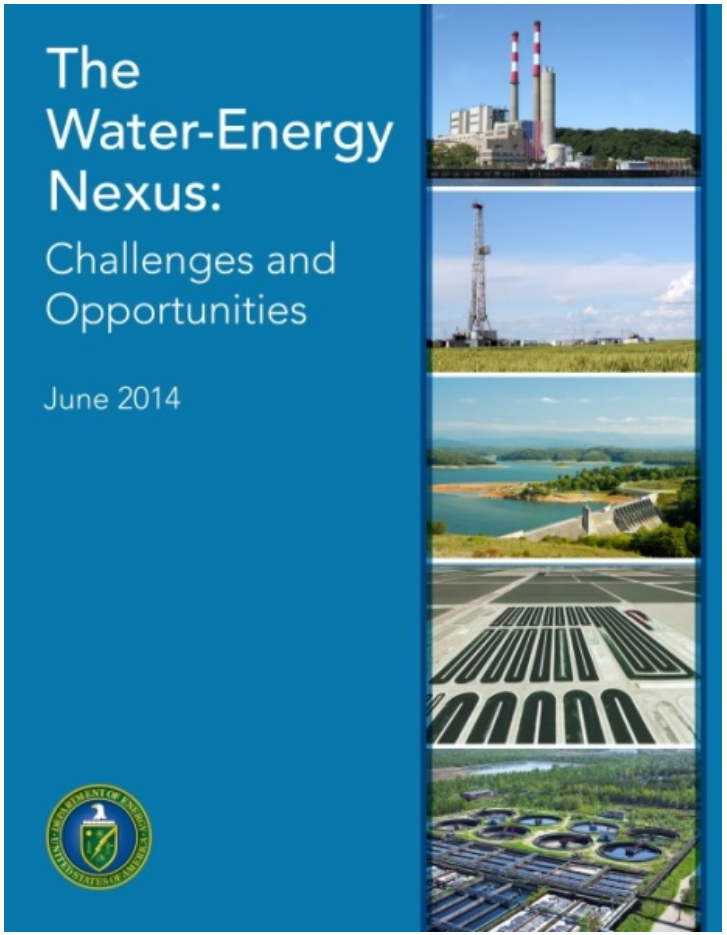
But More than Just Energy and Water

Energy, Water, and Land System Interactions



Release of a New, June 2014 Report

http://www.energy.gov/articles/department-energy-releases-water-energy-nexus-report



Report Underpinned by Broad Intersection of Programs, Labs, and Interagency Engagement

Programs in WETT

- CI
- EERE
- EIA
- EPSA
- FE
- IA
- IE
- IN
- NE
- OE
- SC

Lab CROs & Designees for Input into WETT Report

- Ames
- ANL
- BNL
- INEL
- LANL
- LBNL
- LLNL
- NETL
- NREL
- ORNL
- PNNL
- SNL
- SRNL

Capture of Big Ideas Summit Teams & Perspectives

- *Sustainable and Secure Water Management*
- *Climate Change Science and Adaptation*
- *Systems Integration*

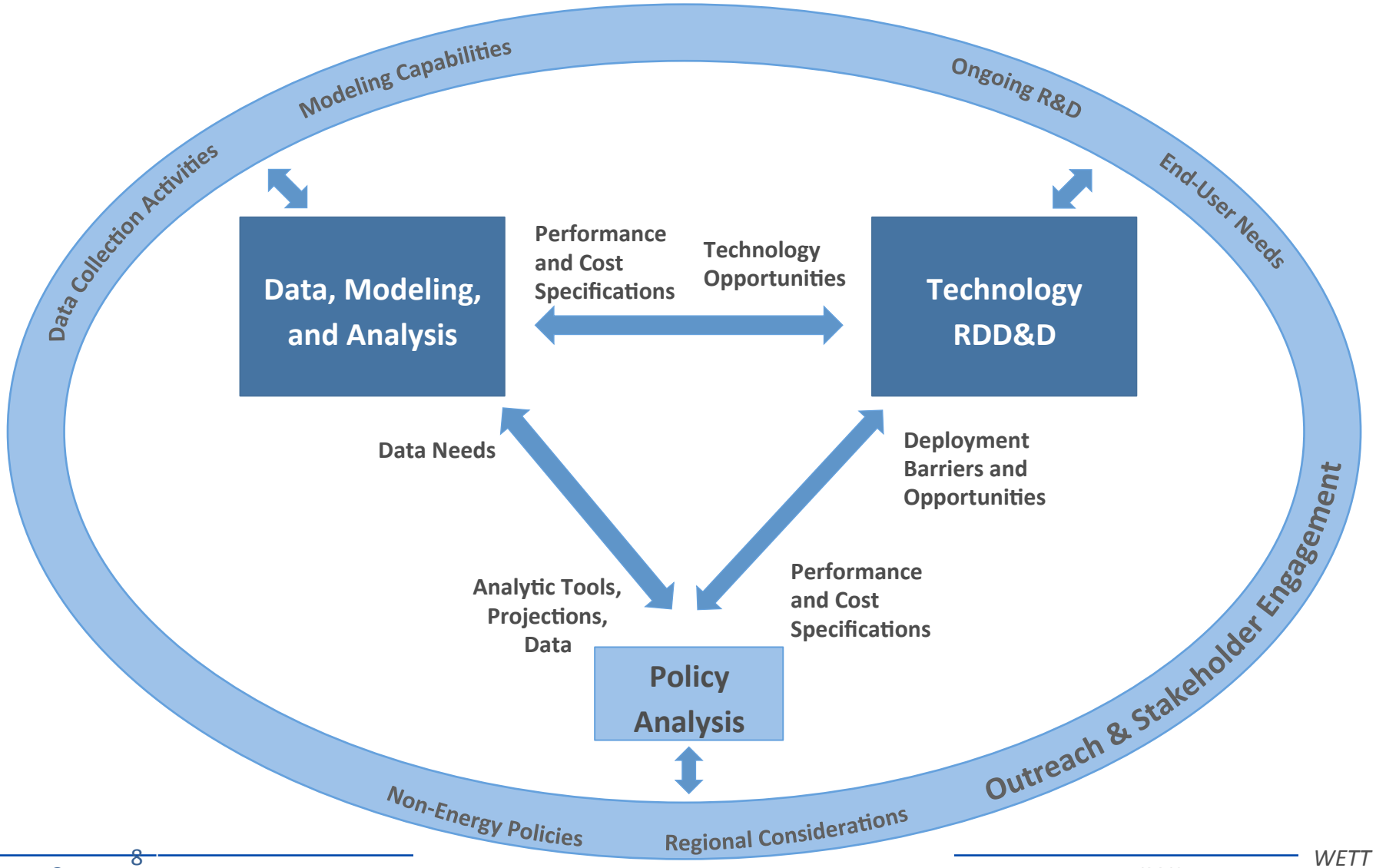
31 Participants Spanning 11 Labs for the May 5-6th WETT Insights Workshop in DC

- ANL
- BNL
- INEL
- LANL
- LBNL
- LLNL
- NETL
- NREL
- ORNL
- PNNL
- SNL

Interagency Engagement (Selective Parts and Overall)

- USGCRP
- CENRS
- DHS
- EPA
- DOI
- DOD/ACE
- NOAA
- NASA
- USDA
- Other

The Report Has Four Main Emphases



Data, Modeling and Analysis (DMA) Reflects a Strong Use-Inspired Dimension

User/Societal Needs

- National and regional-scale assessments
- Sustainable development planning
- Investment and siting decisions
- Adaptation strategies
- Technology analysis and R&D insights

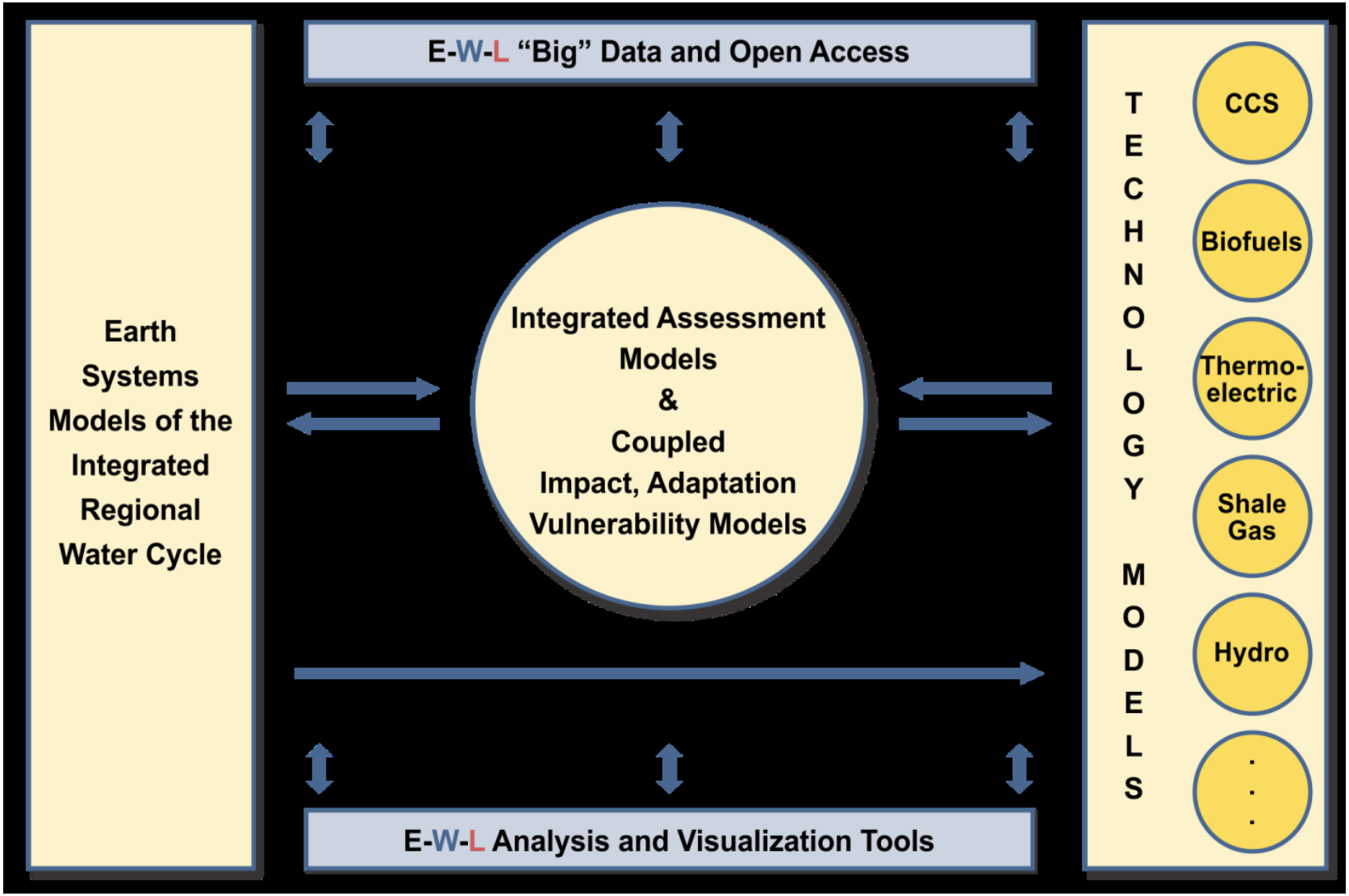
Current Capabilities

- Integrated modeling of human and Earth systems
- Modeling and analysis of human systems
- Modeling and analysis of Earth systems
- Crosscutting modeling & analysis methodologies
- Computation, software, observations, and the user interface

Priorities for Modeling and Analysis

- Robust projections, analyses, and scenarios at decision-relevant scales
- Characterization of uncertainty and risks
- Modeling and analysis of extreme events
- Interoperable modeling, data, and analysis platforms
- Confronting models with observations and using observations to improve projections

A Conceptual Framework Linking the Main DMA Elements



A Representative Set of Opportunities From the Report

Technology Research Development, Demonstration, and Deployment	Data, Modeling, and Analysis
Water-Efficient Cooling	Layered Energy Resilience Data-Knowledge System
Treatment, Management, and Beneficial Use of Non-Traditional Waters	Integrated Multi-System, Multi-Scale Modeling Framework and IAV Modeling
Sustainable Water Utilities:	IAV Strategic Research and Analysis
Improving Water Efficiency and Quality in Bioenergy Systems	Energy Resilience Analysis Consortiums
Optimized Water and Energy in Industrial and Commercial Systems:	
Policy Analysis	
Outreach and Stakeholder Engagement (Including International)	

A Sankey-Centric View of the Integrated Challenges…DMA, Technology, Policy, Outreach

Energy Technology Pathways

Climate Change

Mitigation

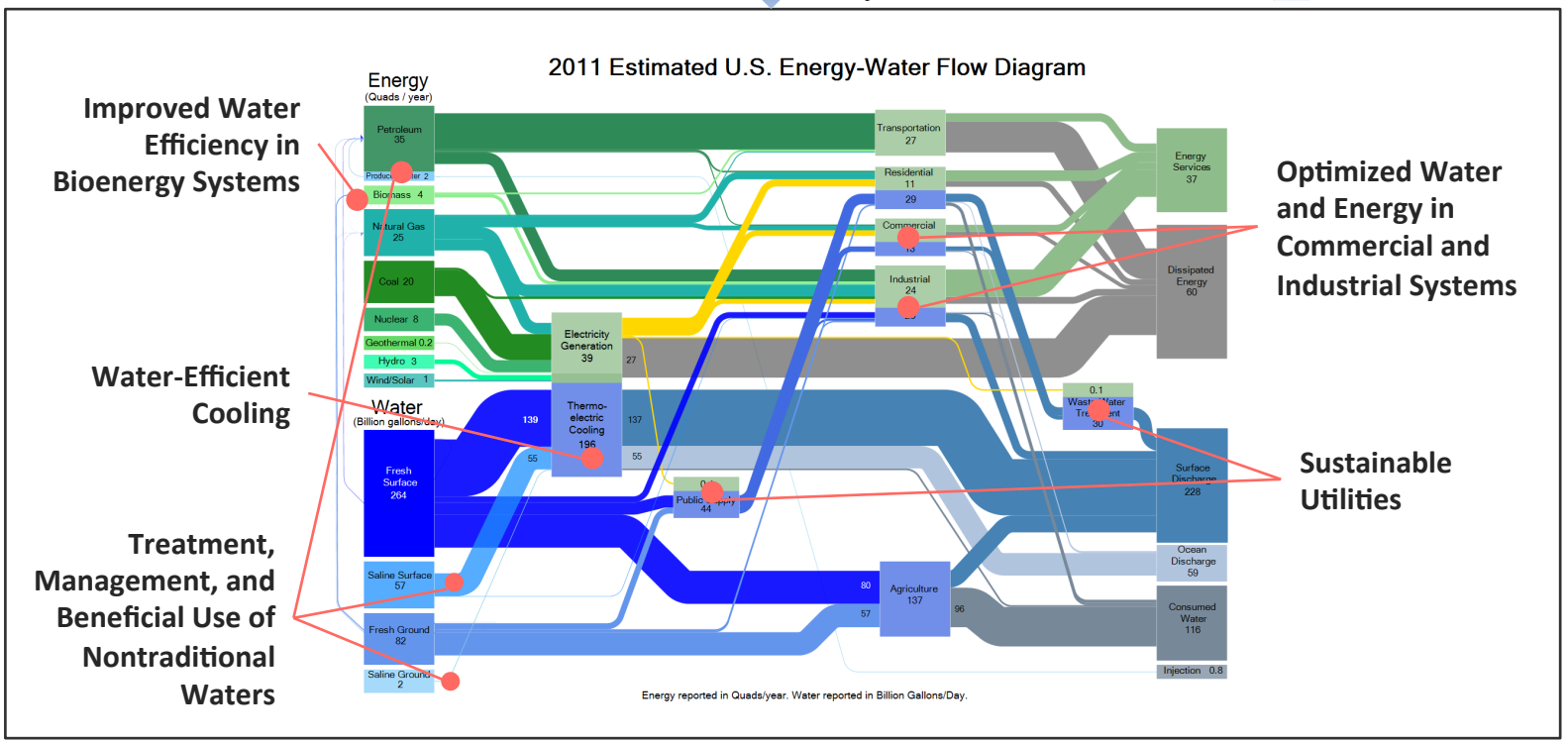
Adaptation

Regional Economic Development

Improved Water Efficiency in Bioenergy Systems

Water-Efficient Cooling

Treatment, Management, and Beneficial Use of Nontraditional Waters



Optimized Water and Energy in Commercial and Industrial Systems

Sustainable Utilities

Policy and institutional Changes

Land Use & Land Cover Change

Stakeholder and Consumer Preferences

Population/Migration

Urbanization & Infrastructure Dynamics

Summary

- A broader DMA focus on **IAV and energy (and coupled system) resilience and dynamics**
- **Substantial implications for IAMs and coupled IAV component and stand-alone models**
- **Entry through the energy-water-land lens** provides a powerful and critically important , interdependent, risk-sensitive theme for DOE and its partners
- Toolsets should enable:
  - Improved representation and more insightful analyses of **cross-sector processes and interdependencies** that are characteristic of how the real world behaves
  - Improved **regional and temporal resolution** that are required for IAV and corresponding decision support
  - Dynamic analysis for **adaptation decision support**…. recalling that not much is "deterministic" when humans are involved
  - A focus on **risk-based insights**
  - Understanding of complex issues at **the mitigation-adaptation interface** (biofuels as just one example).

Next Steps?

- Build coalitions and collaborations across agencies and research partners (upcoming topic for USGCRP all-hands meeting - topic of "food" is also on the table)
- Evaluate "cornerstone" capabilities while building flexible connections/frameworks that can engage a broader set of communities and participants
- Leverage existing, nascent efforts (scenarios, RMEP, etc.)
- Engage academic community more fully
- Assess priorities and pursue funding strategies