Water-Energy Nexus

Pressures and drivers
USGCRP and DOE priorities
DOE's WETT

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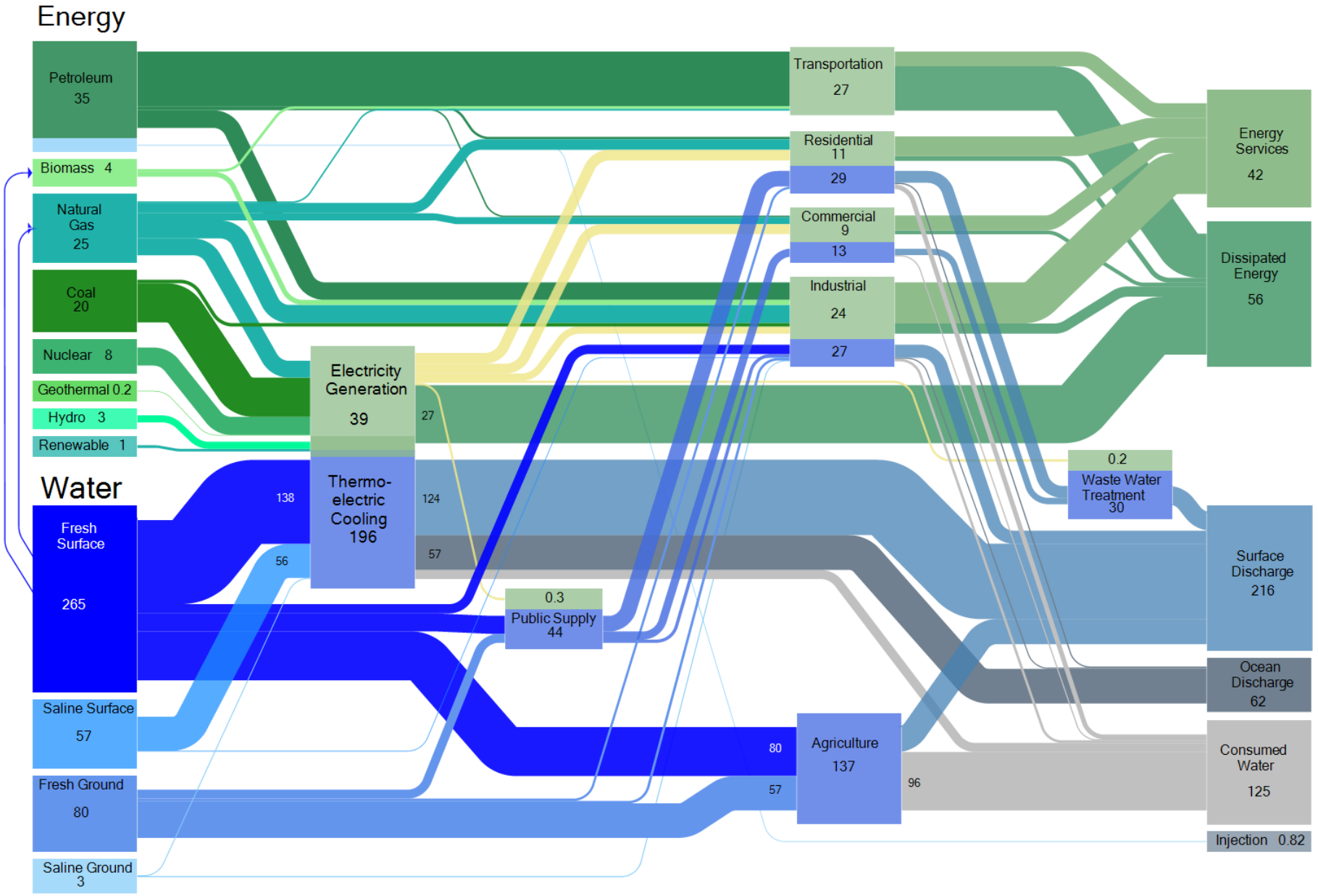
DOE

Pressures and drivers

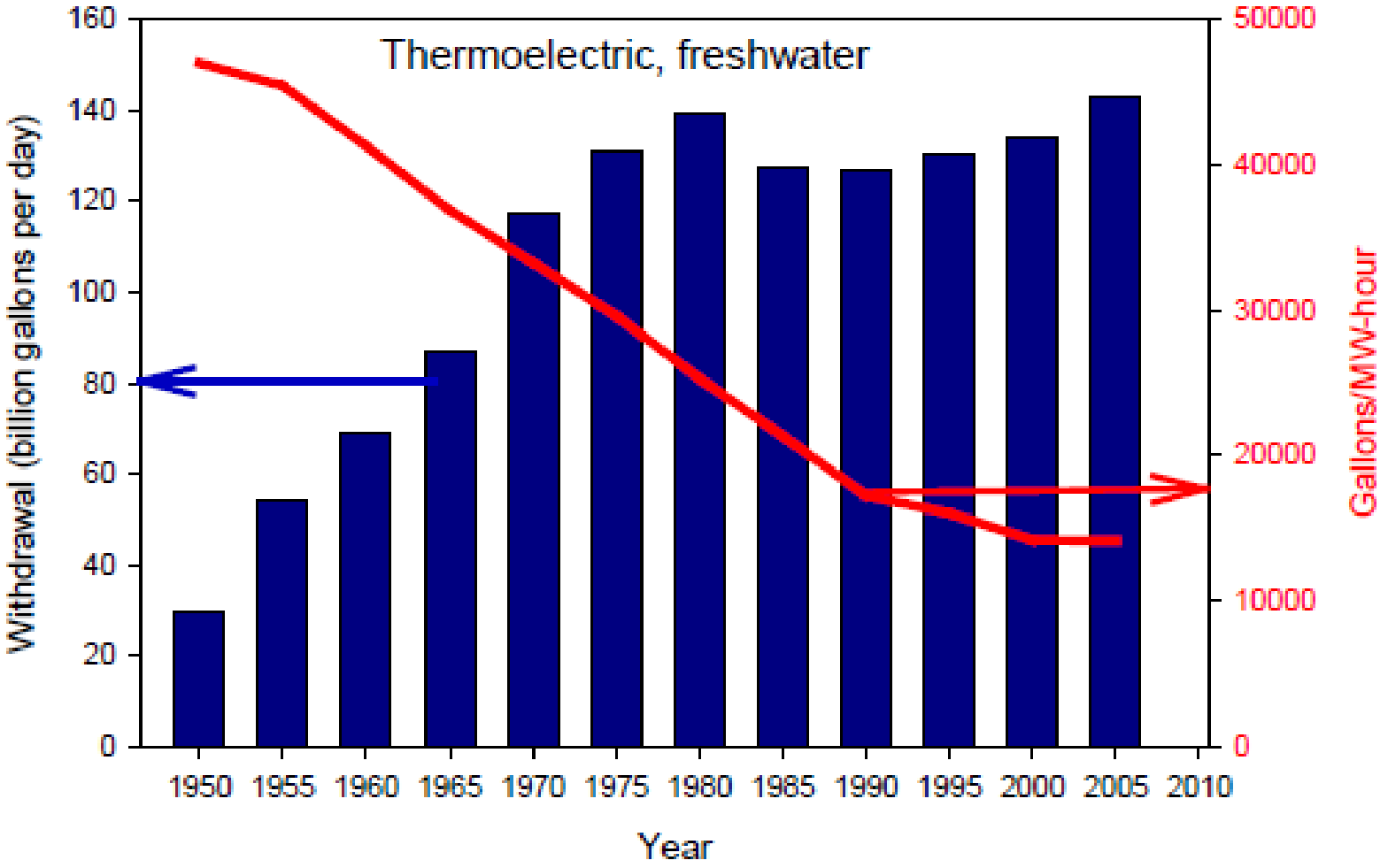
- IPCC and NCA – science gaps
  - Projections involving water have most uncertainty
  - Models are non-convergent for water
- Stressors
  - Energy and water infrastructure interdependence
  - Shocks (e.g., blackouts) compounded when water and energy availability are both stressed to collective limits
- Utilities and planners
  - Worry most about droughts and water supply
  - Coastal zones vulnerable, esp for designing sustainable infrastructures considering future extremes
- DOE high priority “water-energy nexus”
  - Secretary of Energy formed a task team on this topic

2011 Estimated U.S. Energy-Water Flow Diagram



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

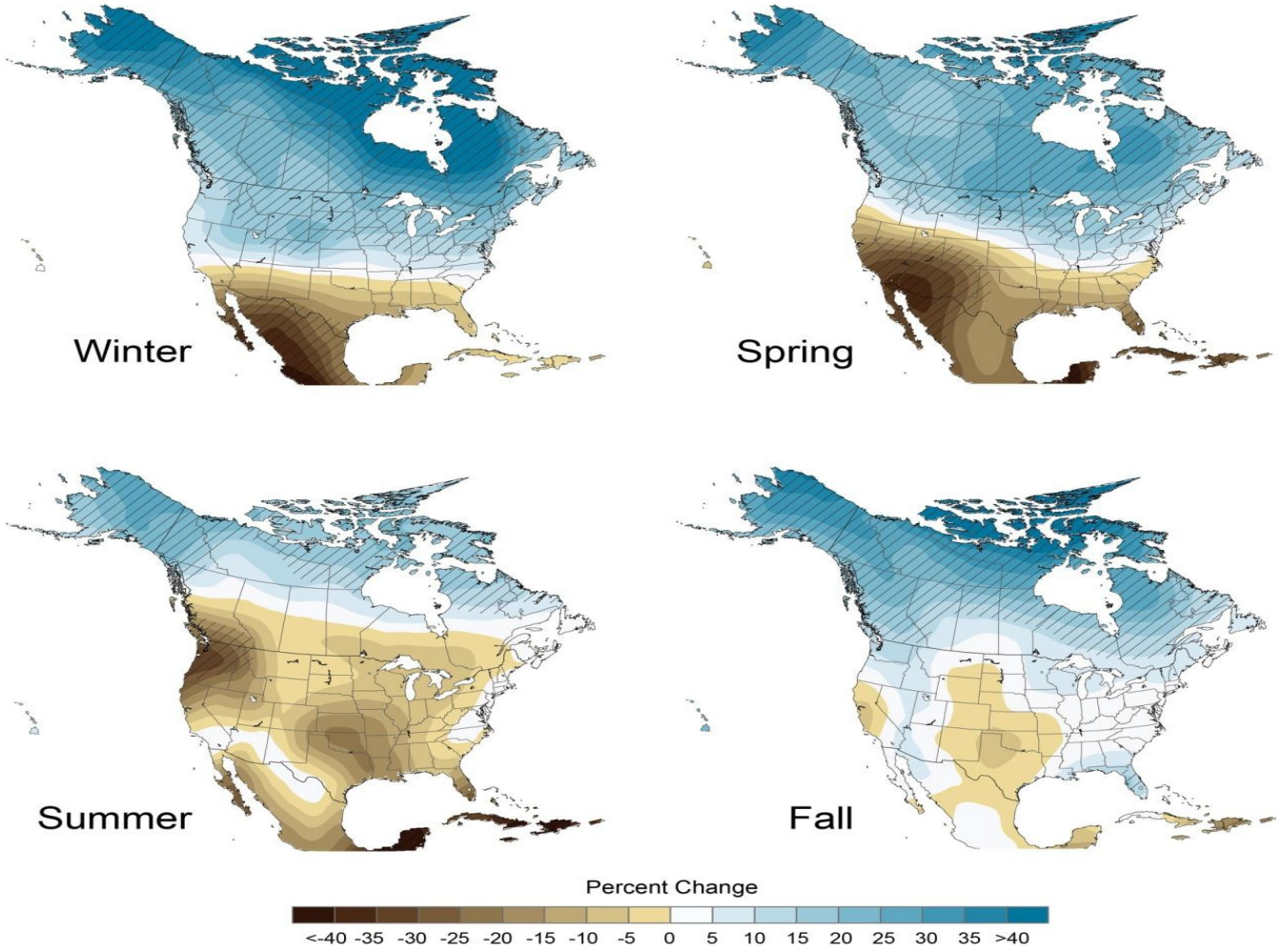
Water Use for Electricity Generation and Other Sectors: Recent Changes (1985-2005) and Future Projections (2005-2030). Saline withdrawals not included. Source: EPRI (2011)



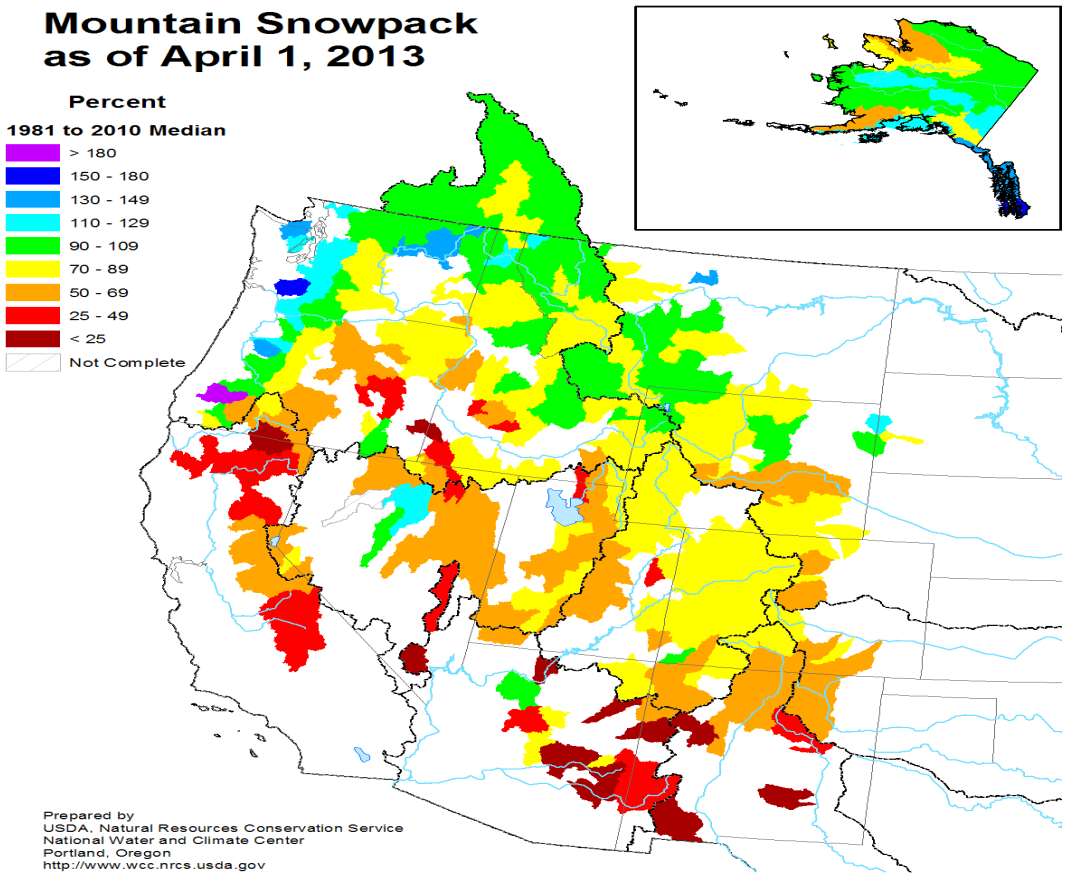
USGCRP

- Mandate/mission
  - Scientific research coordination: IGIM, Adapt, Obs, Health, etc.
  - Sustained assessment: NCA, GCIS
  - Adaptation
  - Communicate and educate
- New drivers
  - Inform decisions: inform risk modeling
  - President's Climate Action Plan (PCAP)
  - Big data, tools, informatics
- Science priorities: FY2013, FY2014, FY2015,..
  - FY2013 Integrating theme (extremes, thresholds, tipping points)
  - FY2014: coupled earth/human modeling; actionable science
  - FY2015: Drought; Arctic; Modeling (seasonal-decadal)
  - FY2016: (some combination with new drivers)
- Major science issues
  - Modeling and data infrastructure: resolution, computing, modularity, assimilation, ...
  - Multiple stressors: IA, IAV, water-energy, human component interdependence, uncertainty quantification
  - Linkage to other communities: economics, food supply, land use change, demographics, political risk analysis, conflict, etc.

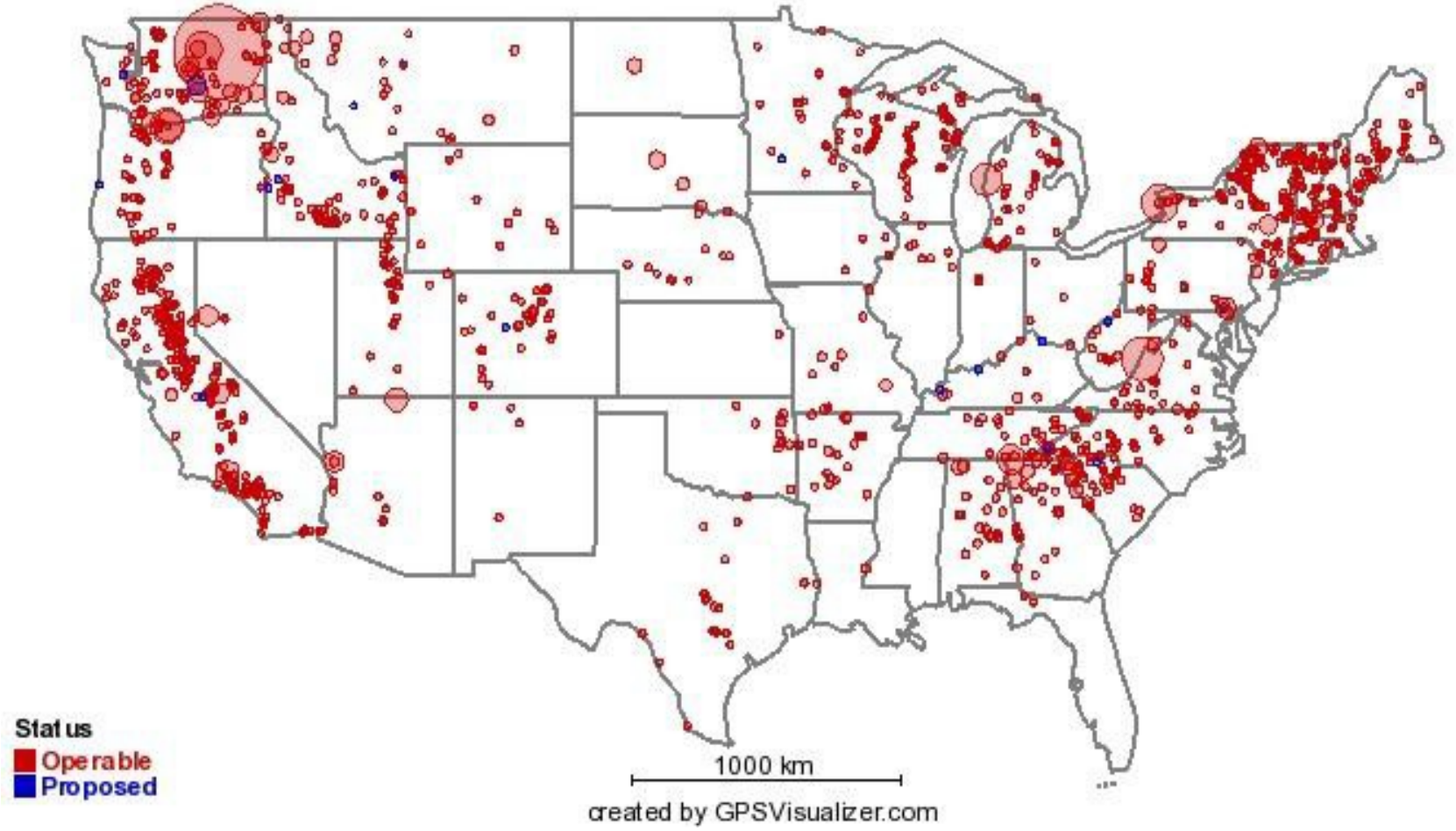
Projected future changes in precipitation by 2080-2099, relative to average seasonal precipitation in 1961-1979 under the A2 emission scenario and simulated by 15 climate models. Hatched areas show areas with highest confidence in the projected change. Source: USGCRP (2009)



Mountain Snowpack in April 2013 as a Percent of Historical Median (1981-2010). Source: USDA Natural Resources Conservation Service (2013)



Location and Operating Status of U.S. Hydropower Plants. Size of dot indicates nameplate capacity. Data Source: EIA Annual Electric Generator Report (2012 - Early Release)



DOE – Water Energy Tech Team

- Systems analysis involving water-energy interdependence, climate
- Technology design scenarios, insertion, and value added
- Individual technology development
- Short term: IAV / Wx coupling – for emergency mgmt (plans)
- Longer term: System model interdependence
  - Physical earth system model for extremes (including droughts)
  - Integrated assessment (IA)
  - Impacts, adaptation, vulnerability (IAV)
- Issues receiving attention now
  - Do the right models exist to tackle the new set of problems
  - Data infrastructure: common ontologies, gridding, etc.
  - Data assimilation
  - Uncertainty quantification methodologies
  - Compatibility with risk models in the public and private sectors