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Overview of the Energy-Water Nexus in the U.S.

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The Water-Energy Nexus: Sustainability and Global Challenges
Beijing, April 17, 2014

U.S. DEPARTMENT OF ENERGY | NNSA Nuclear National Security Administration

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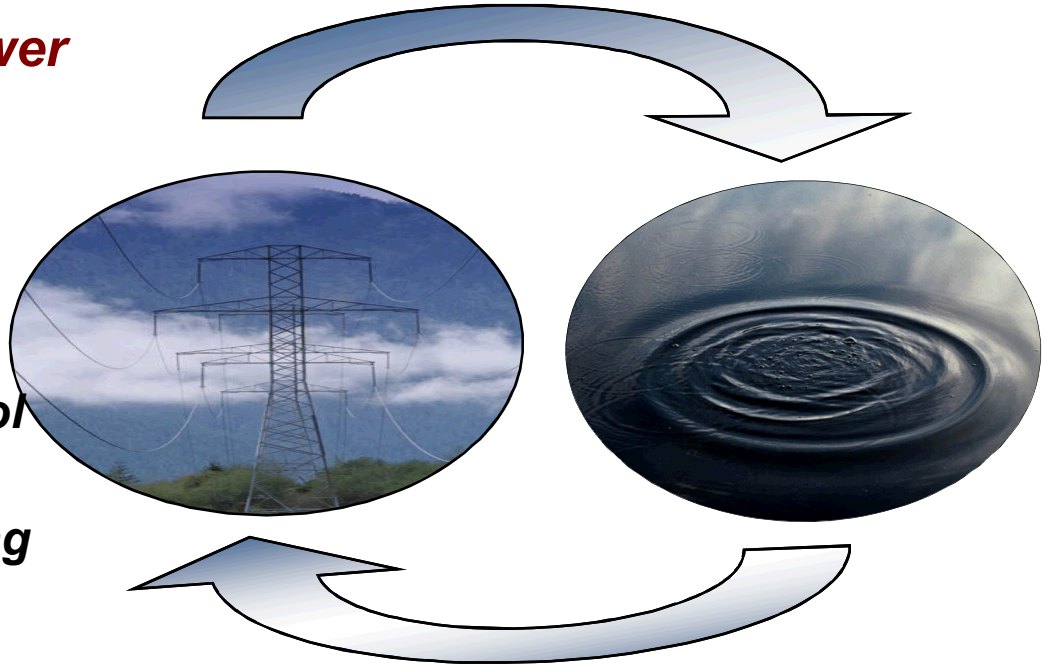
Energy-Water Nexus

Energy and power production requires water

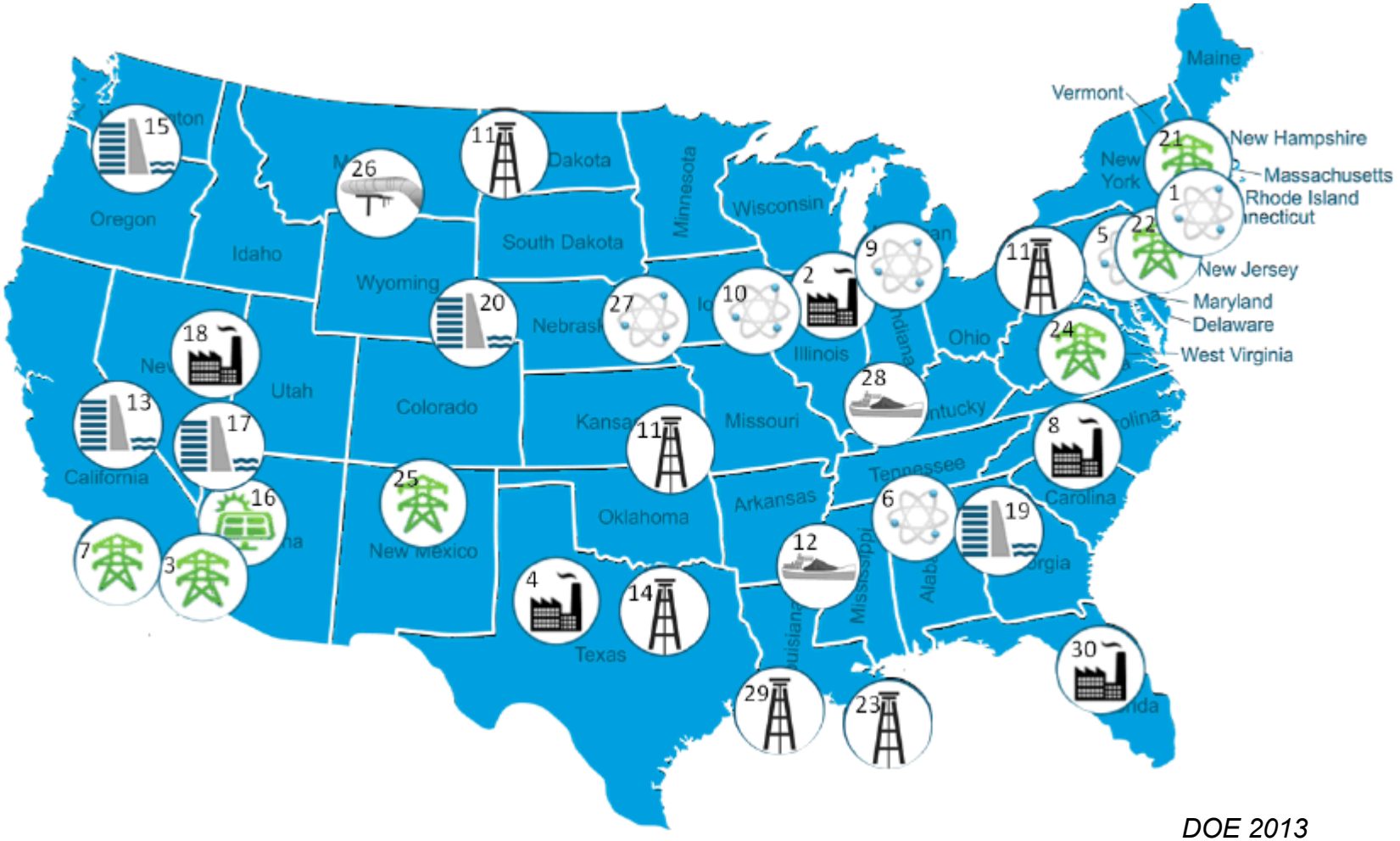
- ***Thermoelectric Cooling***
- ***Emission Control***
- ***Energy Minerals Extraction/Mining***
- ***Fuel Processing (fossil fuels, H_2,biofuels)***



Water production, processing, distribution, and end-use requires energy

- ***Pumping***
- ***Conveyance***
- ***Treatment***
- ***Distribution***
- ***Use Conditioning***

Energy-Water Nexus in the News



DOE 2013

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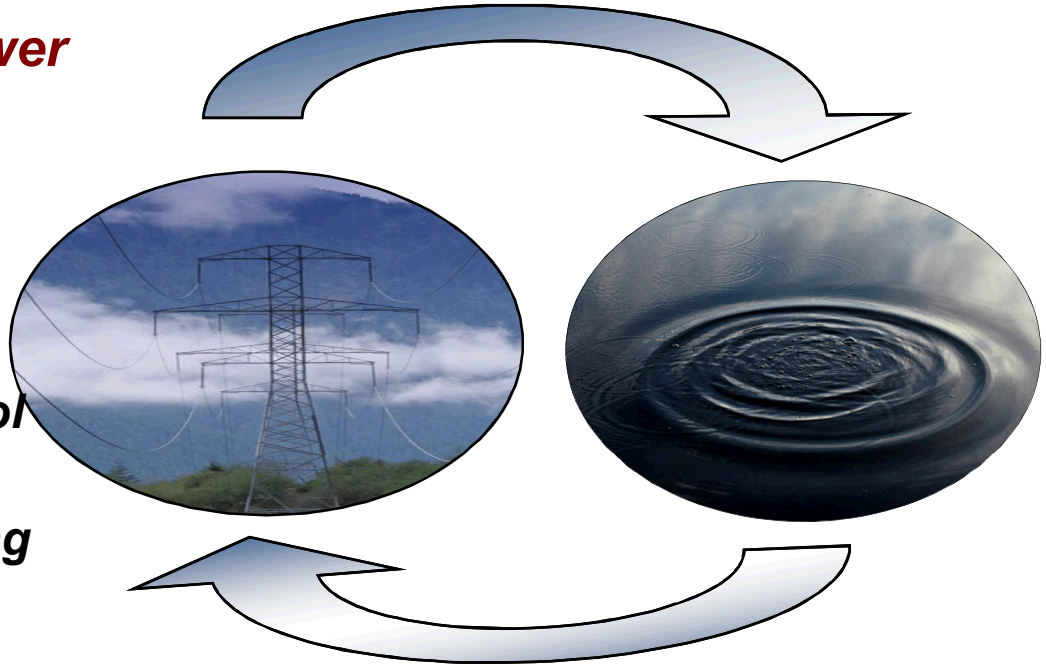

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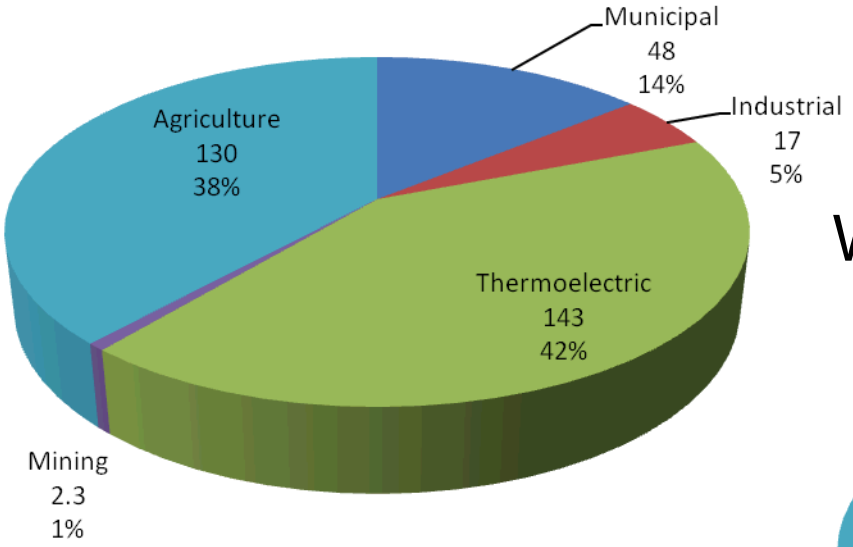
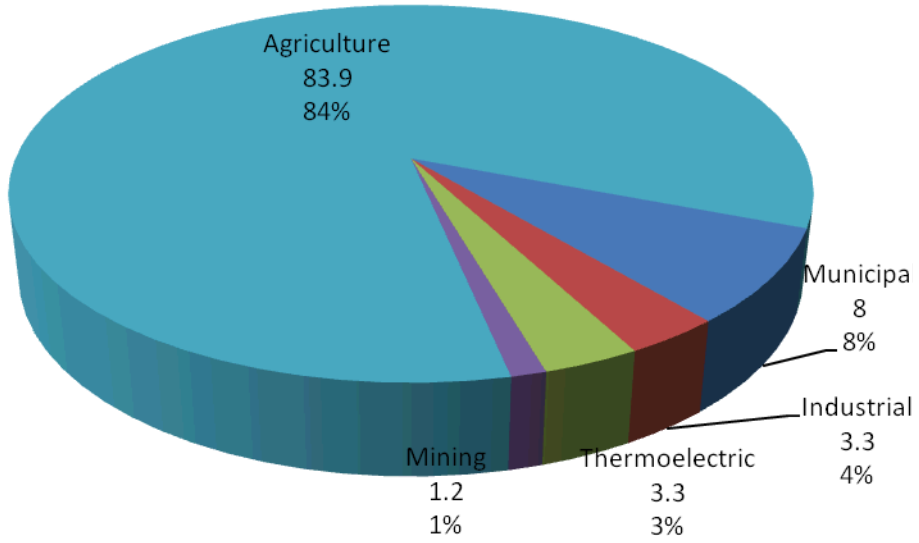
Water for Thermoelectric Power Generation

Water Withdrawal (1,290 Mm^3/d)
2005



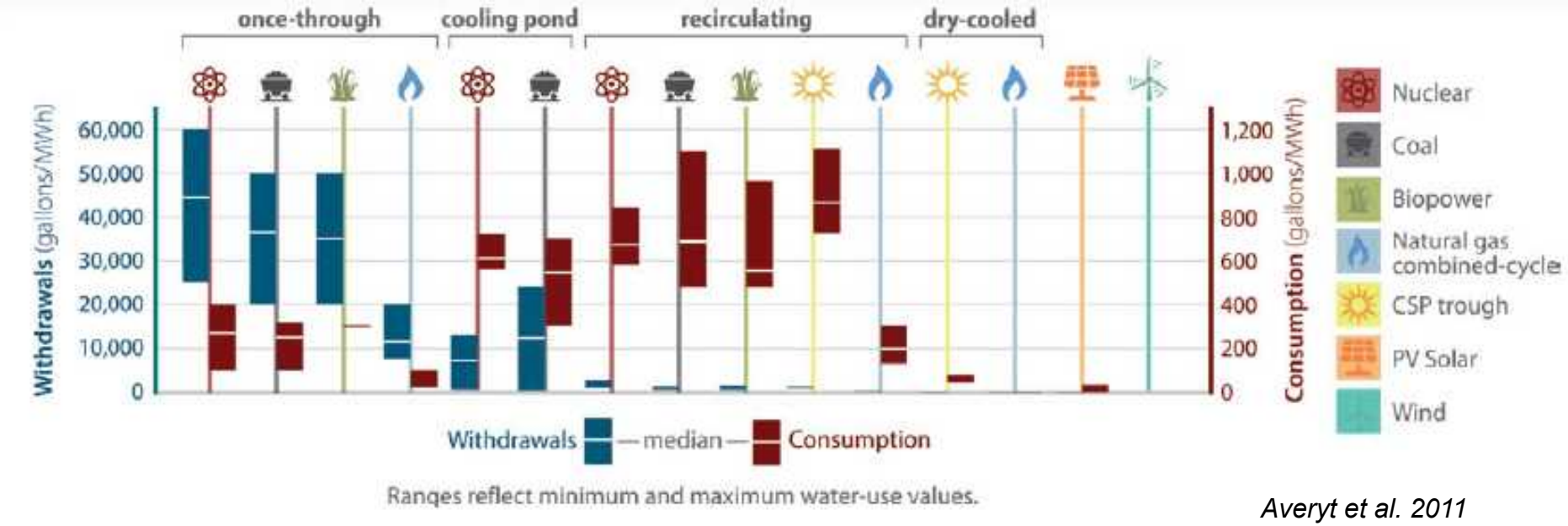
Water Consumption (390 Mm^3/d)
1995



~4 Mm^3/d Consumed in Mining and Fuel Processing

Water for Thermoelectric Power

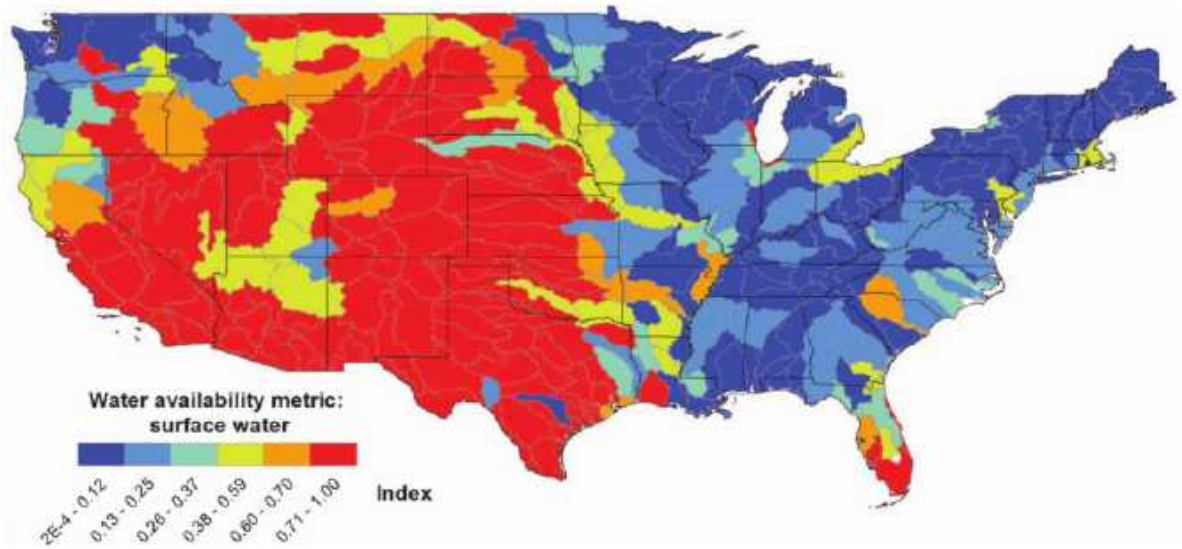
- Water use influenced by:
  - Fuel type,
  - Cooling type,
  - Emission controls,
  - Age, and
  - Location



Averyt et al. 2011

Siting of New Thermoelectric Development

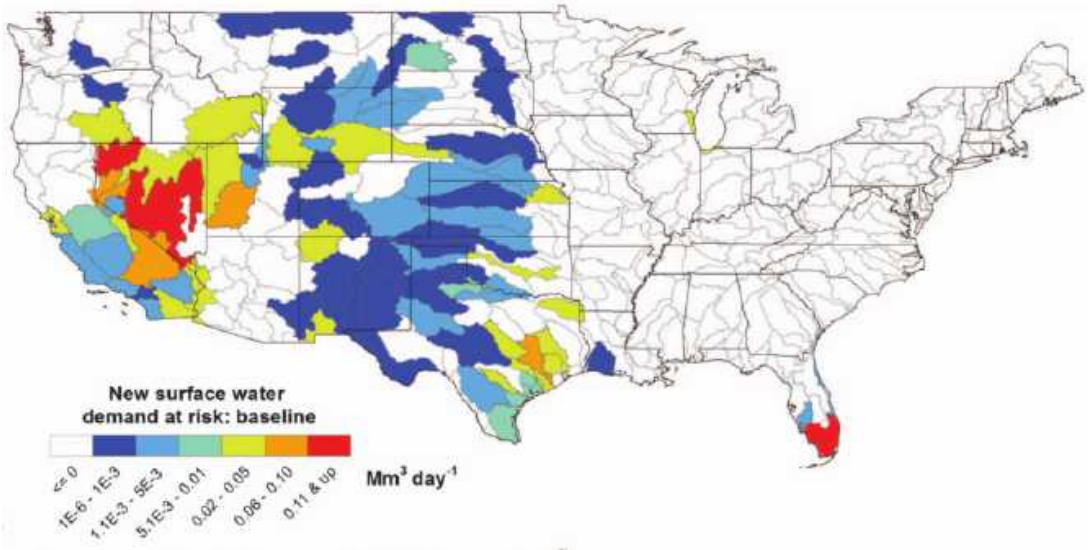
Surface Water Availability



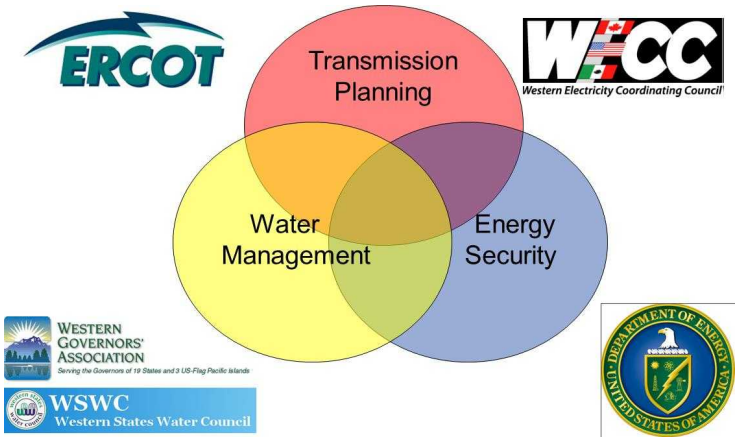
Limited Water Available in the Western U.S. for New Development

Tidwell et al. 2012

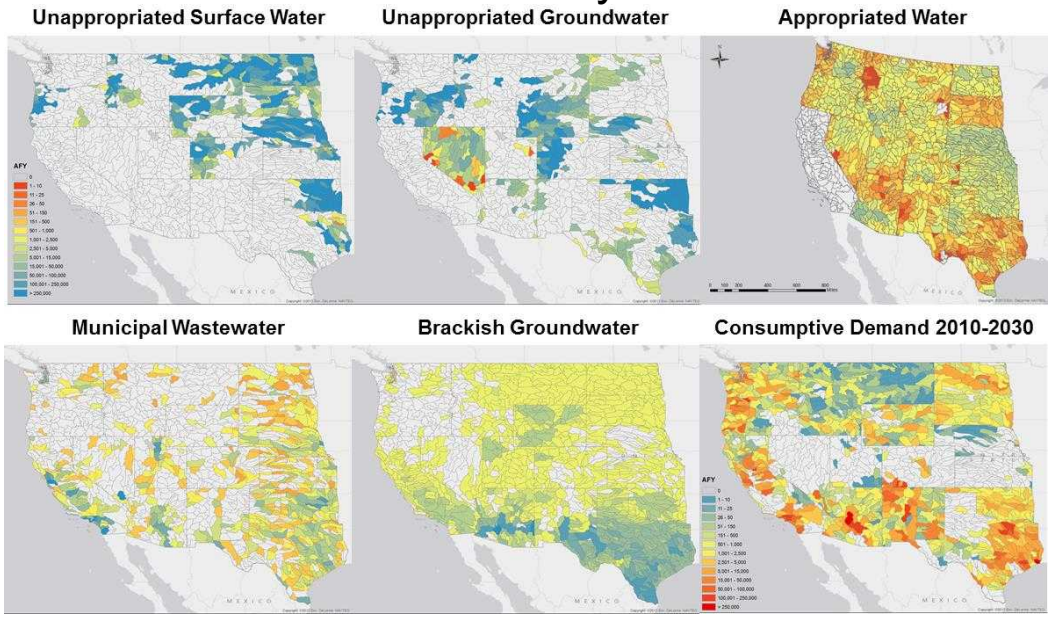
25% of New Thermoelectric Water Use Will Occur in Water Limited Basins in Absence of Integrated Planning



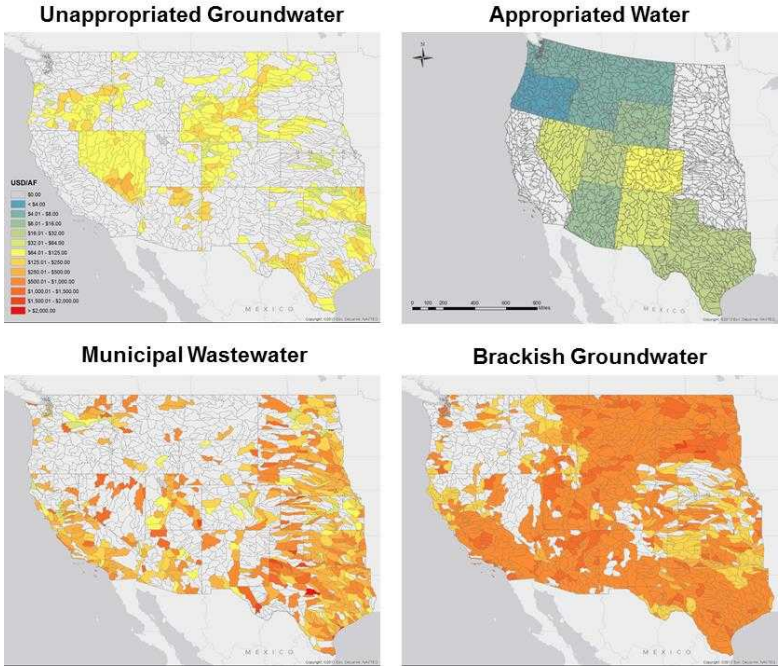
Integrated Energy-Water Planning

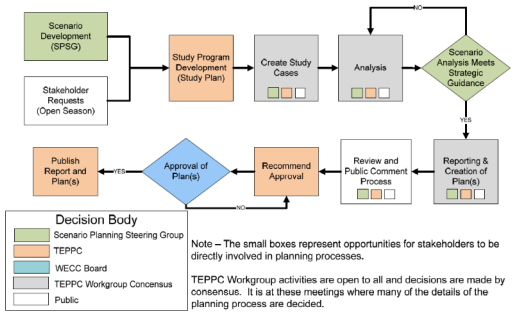


Water Availability Metrics



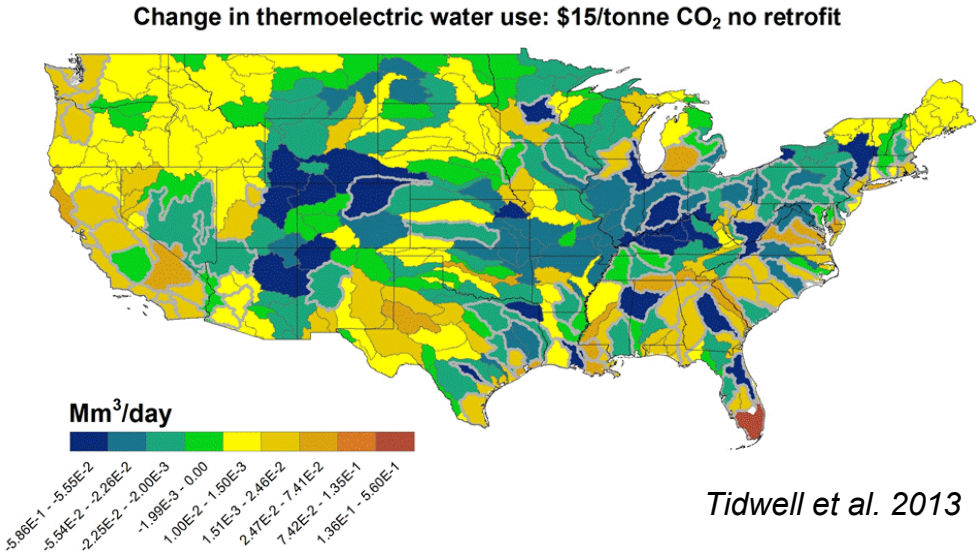
Water Cost Metrics



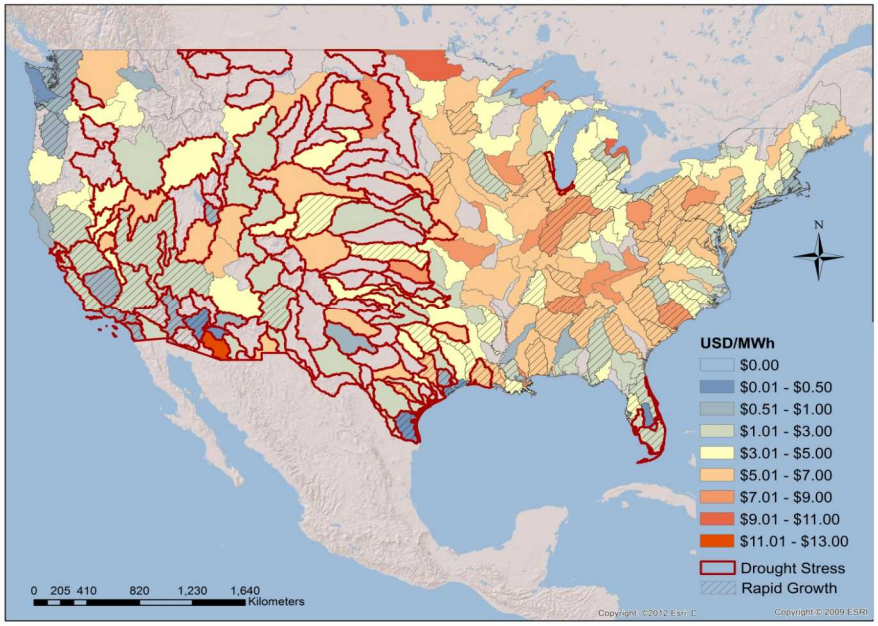


Water from Retiring/Retrofitting Plants

Retiring Old Coal Plants and Replacing with Natural Gas Combined Cycle Would Yield Significant Water Savings



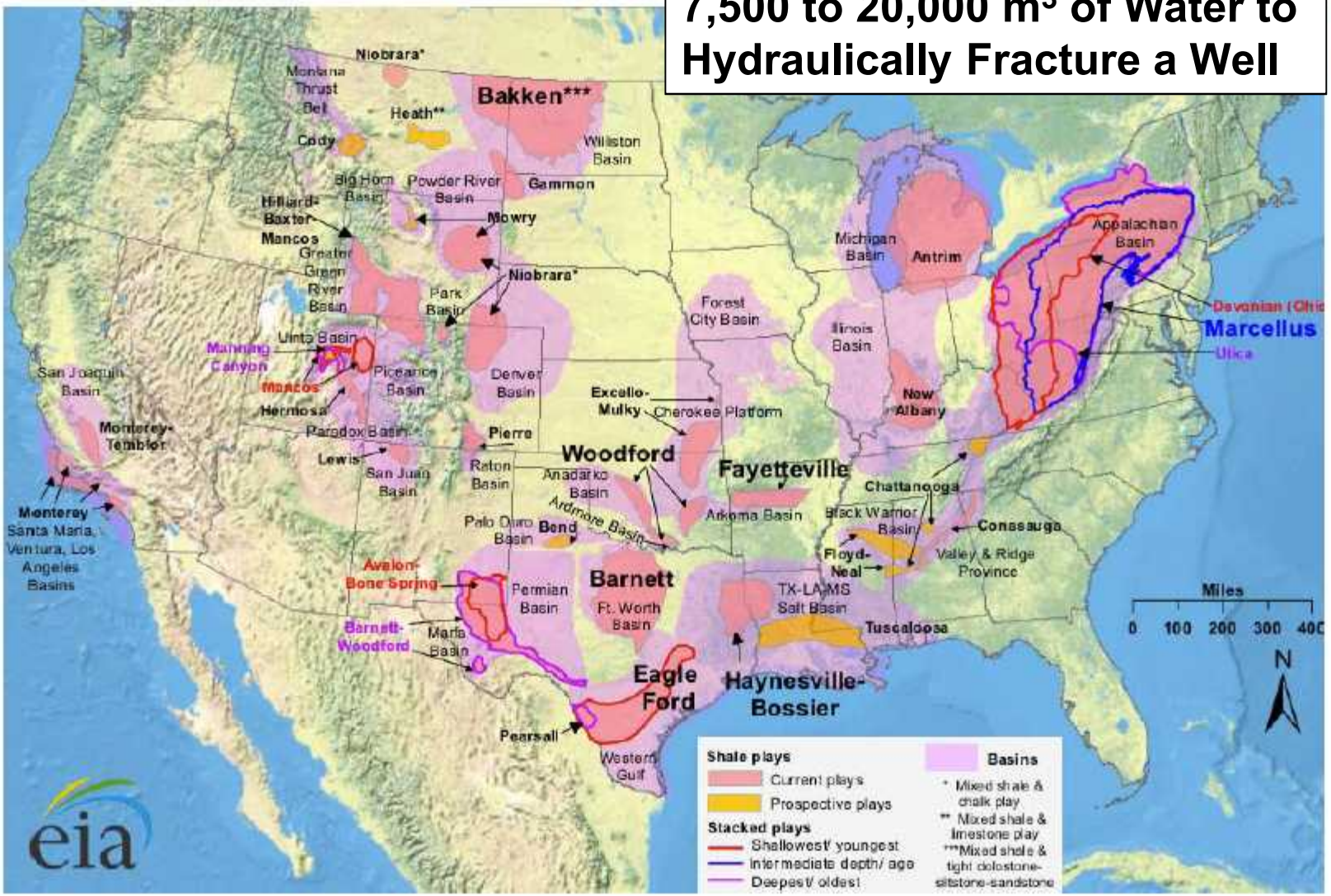
Tidwell et al. 2013



Over One-Half of Existing Power Plants Could be Retrofitted to Dry Cooling or Non-Potable Water Use at a Cost of Less Than 10% of Current Generating Expenses. Many of These Plants are in the Western U.S.

Gas and Oil Shale Development

7,500 to 20,000 m^3 of Water to Hydraulically Fracture a Well



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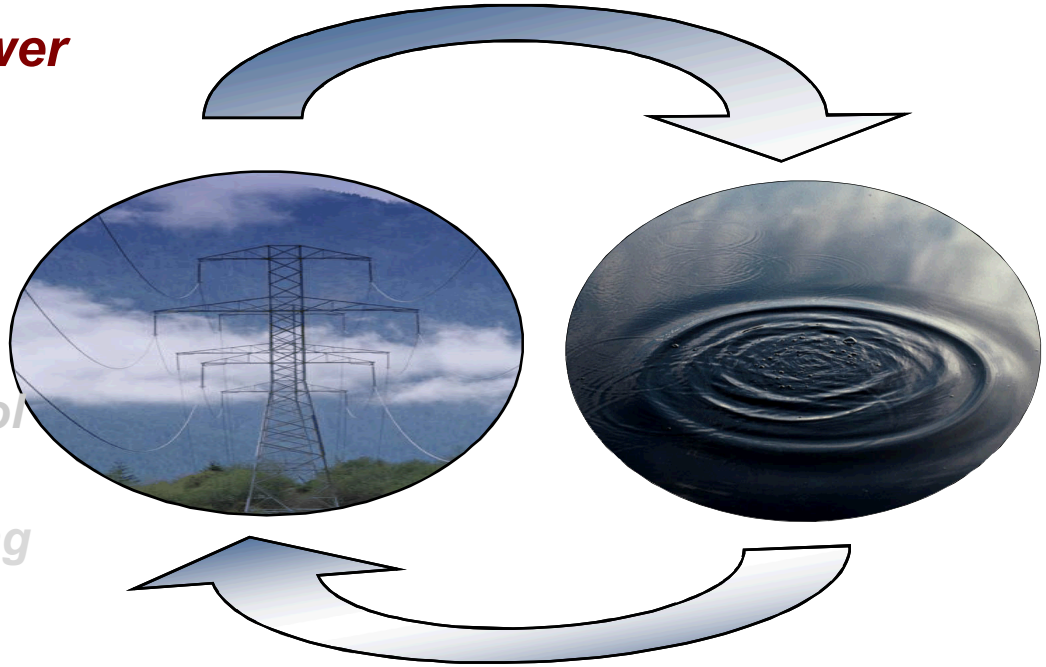

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Water Utility Energy Use

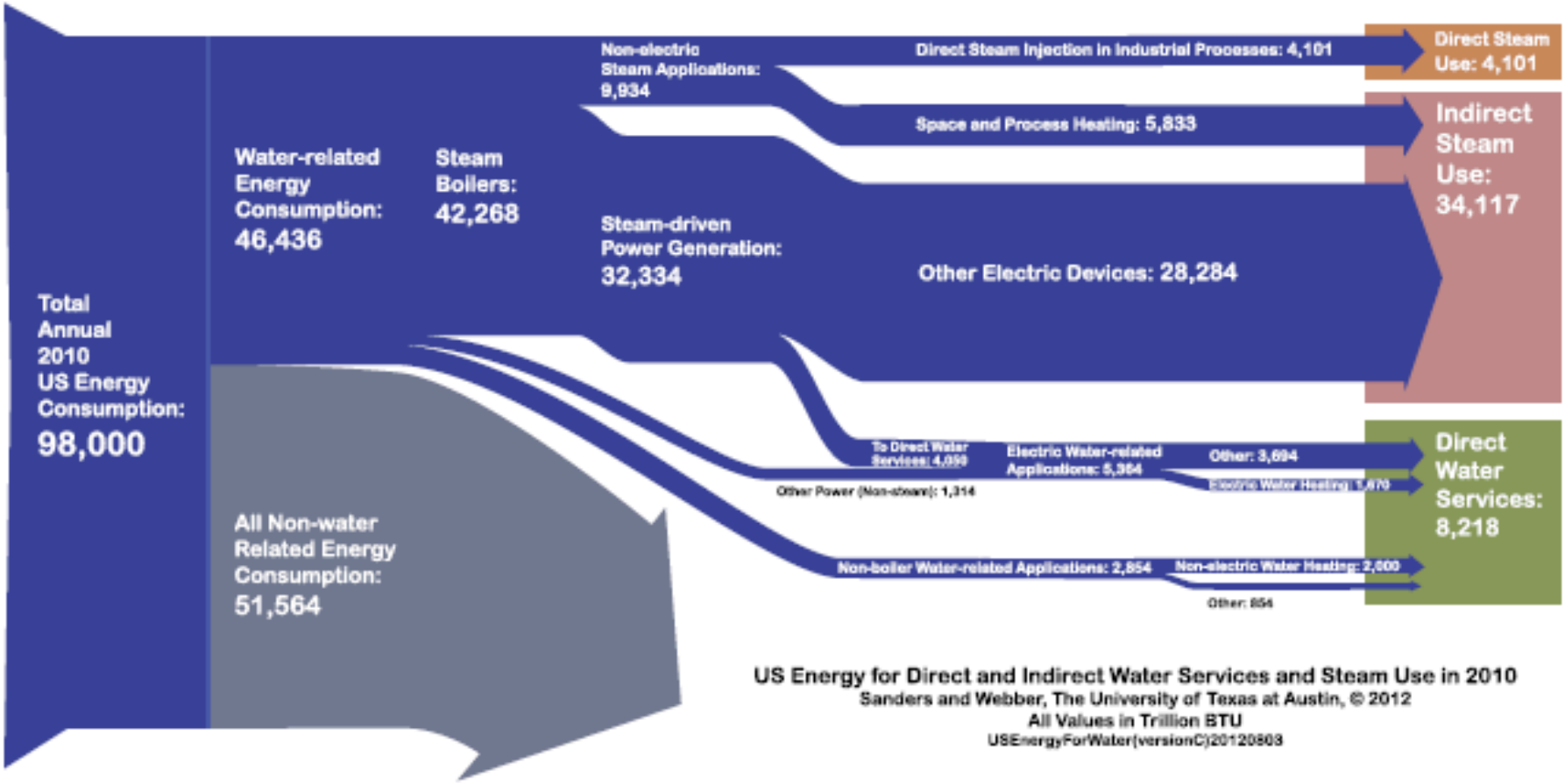
- Drinking water accounts 1% of total electricity use in the U.S.
- Wastewater use 0.8%

(EPRI 2013)

- Water and wastewater account for 35 percent of typical U.S. munic-ipal energy budgets,
- 25–40 percent of the operating budgets for wastewater utilities
- 80 percent of drinking water processing and distribution costs

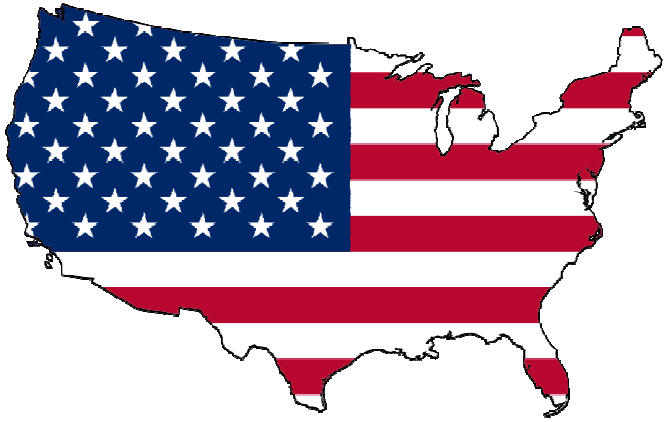
(NYSERDA, 2008)

Energy for Water



- Water services account for 12.6% of energy consumption in U.S.
  - 8.2% for heating, chilling, treating, etc. water
  - 4.4% for direct steam applications

Energy-Water Nexus



- A challenge that we both share
- We are not that different
  - Share similar climates
  - Use similar energy and water technologies
  - Share similar opportunities to manage the energy-water nexus
  - Share similar concerns over the impacts of climate change
- However the scale of the problem does differ