



Cross Sectoral Energy Water Solutions

**NAS Roundtable on Sustainability
Energy Water Nexus**

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There Are Good and Bad Tradeoffs At the Energy Water Nexus (Quality)

- **Energy affects water quality (good and bad)**
 - Energy is used to treat (clean, move, heat,...)
 - Energy pollutes water (thermal, chemical,...)
- **Water affects energy quality (good and bad)**
 - Improved efficiency at power plants (thermoelectric, solar PV, ...)
 - Improved recovery for oil and gas production
 - Degraded power generation in heat waves



There Are Good and Bad Tradeoffs At the Energy Water Nexus (Quantity)

- **With sufficiently abundant, clean and affordable energy, our water problems are solved**
 - Long-haul transfer, desalination, deep wells,...
- **With sufficiently abundant, clean, and affordable water, our energy problems are solved**
 - Biofuels, hydro,...
- **Coupled infrastructures causes cross-sectoral problems**
 - Water constraints become energy constraints
 - Energy constraints become water constraints



Cross-Sectoral Integration Holds Promise For Saving Energy and Water

- **We can use the water sector to solve energy problems**
- **We can use the energy sector to solve water problems**



The Water Sector Can Be Used To Solve Energy Problems

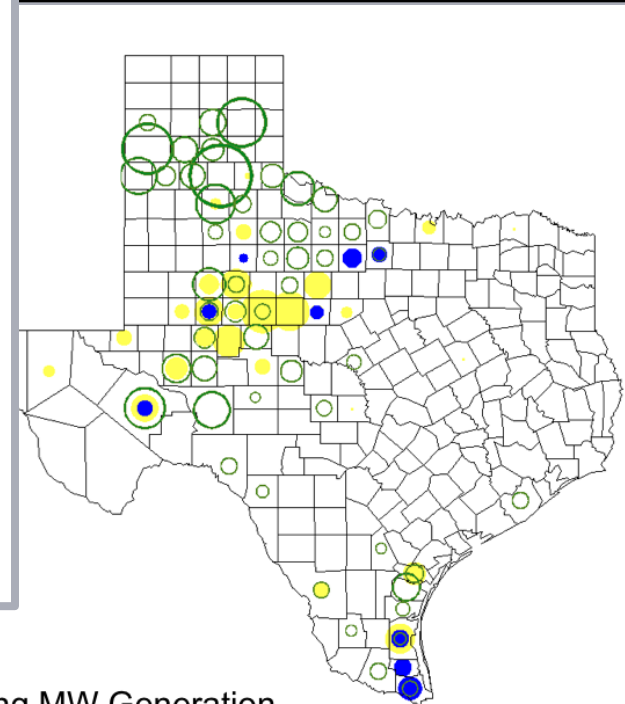
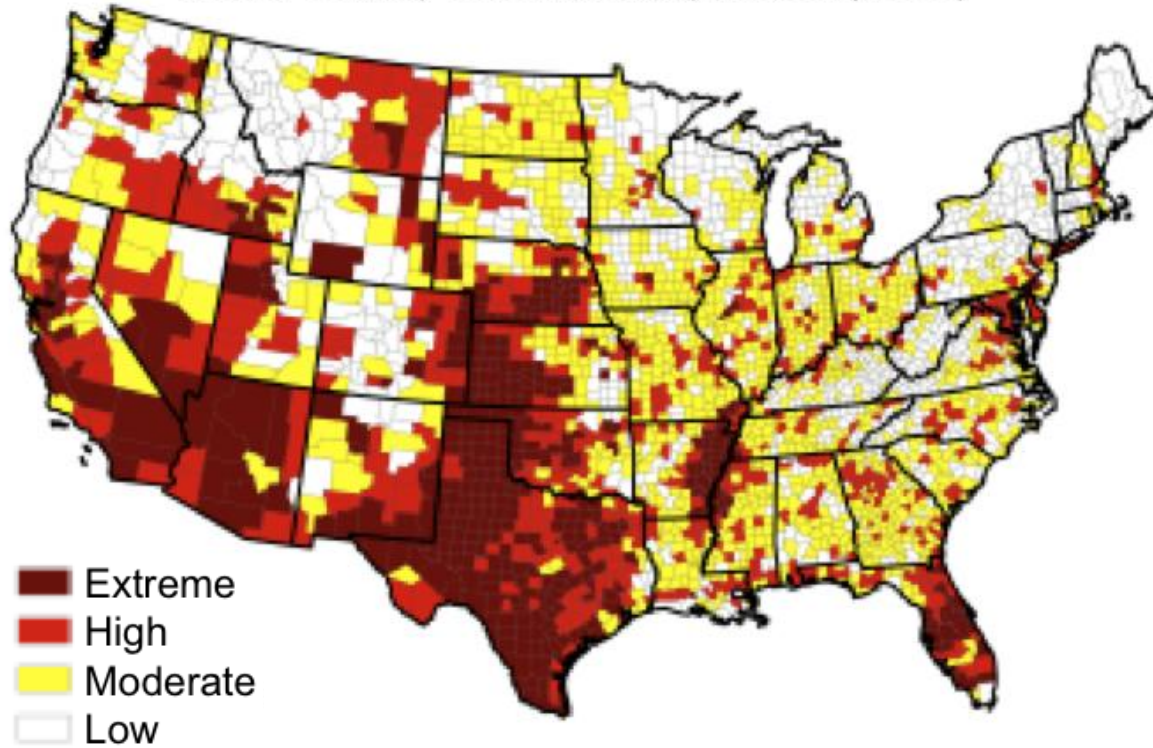
- ***Energy Recovery from WWTPs***
 - Use wastewater treatment to generate biogas
- ***Integrating Renewables with Water Treatment & Desal***
 - Abundant saline/brackish water
 - Abundant wind and solar radiation
 - 1000 hours of negative pricing in Texas because of abundant wind
 - Provide solutions to challenges of each technology
 - Desal addresses intermittent, off-peak nature of wind
 - Wind addresses high marginal energy of desalination



Water Problems and Wind/Solar Problems Are Often Co-Located

[NRDC]

Water Supply Sustainability Index (2050)



Courtesy: Mary Clayton

Power plants can use reclaimed water for cooling

- Many thermoelectric power plants use non-fresh water for cooling
- In 2010, 46 U.S. power plants used reclaimed water for cooling
- Reclaimed water has advantages
 - Drought-resistant
 - Can be abundant
 - Can be safe
- Reclaimed water can pose operational challenges



Courtesy: Ashlynn Stillwell

Power Plants Can Use Reclaimed Water for Cooling



Sand Hill Energy Center, Austin, TX
Credit: Austin Energy

Palo Verde Nuclear Plant, Arizona
Credit: Wiki Commons

Integrating Power Plants and Desalination Saves Energy

- ***Powerplants can preheat water feedstream***
 - Increases throughput for membrane systems
 - Reduces energy for distillation systems
 - Example: Abu Dhabi's desal plant
- ***Saline/brackish water for cooling solar PV systems***
 - Improves PV performance
 - Preheats water for higher throughput
 - Example: El Paso, TX test systems



The Energy Sector Can Be Used To Solve Water Problems

- ***Dry- and/or hybrid cooling At Large-Scale Implementation***
 - Spares water for many other users
 - An economical approach for drought resiliency
- ***Integrating Energy, Air Quality & Water For Dispatching***
- ***Incorporating Water Into Grid Planning***
- ***Energy Industry's Needs as a Driver for Water Efficiency***
 - Towards efficient water markets



The Oil & Gas Industry Could Become the Oil, Gas and Water Industry

- ***Daily liquids production:***
 - Oil extraction: 7 MMBD
 - Wastewater injection: 47 MMBD
 - 2 billion gallons per day (~2% of daily consumption)
- ***Capturing Flared Gases for On-Site Water Treatment***
 - Up to 1/3 of gas production is flared (N. Dakota)
 - 3 wastewater streams: muds, flowback, produced
 - Flow rates decrease, TDS levels increase with time
 - Using flared gases for treatment via thermal distillation: reduces trucks, increases water supply, reduces flares, ...



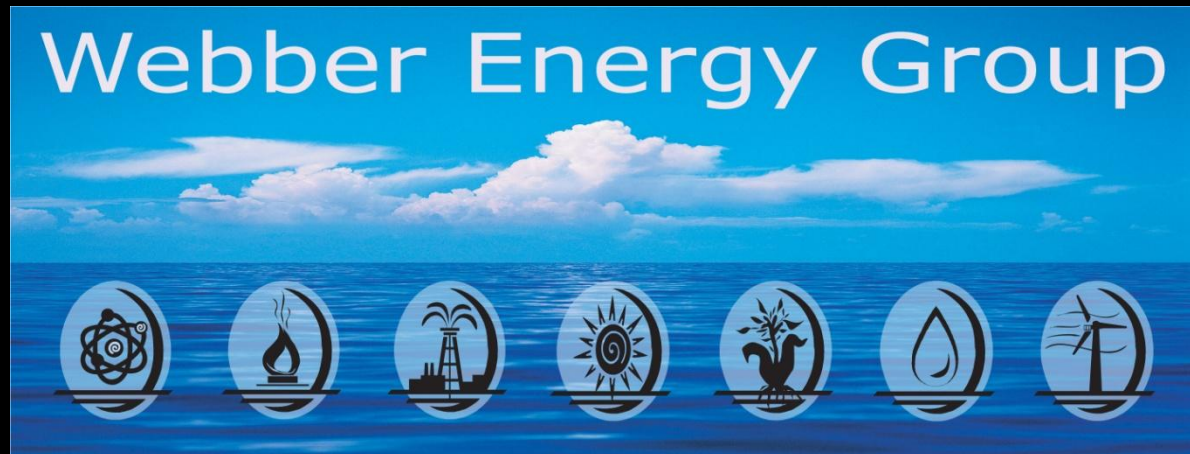
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