



Synapse
Energy Economics, Inc.

Water Constraints on Energy Production: Altering our Current Collision Course

Civil Society Institute Webinar Presentation

September 12, 2013

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Full report:

- **Whited, M.; F. Ackerman, and S. Jackson (2013) *Water Constraints on Energy Production: Altering our Current Collision Course.***

<http://www.synapse-energy.com/Downloads/SynapseReport.2013-06.CSI.Water-Constraints.13-010.pdf>

Related reports for the Civil Society Institute by Synapse Energy Economics:

- Fisher, J. et al. (2011) *Benefits of Beyond BAU: Human, Social, and Environmental Damages Avoided through the Retirement of the US Coal Fleet.*
<http://www.synapse-energy.com/Downloads/SynapseReport.2011-01.23.Beyond-BAU-Retirement-of-the-US-Coal-Fleet.10-048A.pdf>
- Keith, G. et al. (2011) *Toward a Sustainable Future for the U.S. Power Sector: Beyond Business as Usual 2011.*
<http://www.synapse-energy.com/Downloads/SynapseReport.2011-11.CSI.BBAU-2011.11-037.pdf>

See also:

- Averyt, K., et al. (2011) *Freshwater Use by U.S. Power Plants: Electricity's Thirst for a Precious Resource.*
http://www.ucusa.org/assets/documents/clean_energy/ew3/ew3-freshwater-use-by-us-power-plants.pdf
A report by the Union of Concerned Scientists with assistance from Synapse Energy Economics.



Outline of Presentation

1. Water Quantity: vulnerabilities of the electric sector
2. Water Quality: threats to our water supply
3. Recommendations



Water Quantity Issues

Lake Ray Hubbard
Source: Flickr, crowt59

Withdrawal vs. Consumption

Withdrawal

Water that is withdrawn but does not evaporate is typically returned to the source or other natural water body

Consumption

The portion of the withdrawn water that is removed from the immediate water environment, typically through evaporation

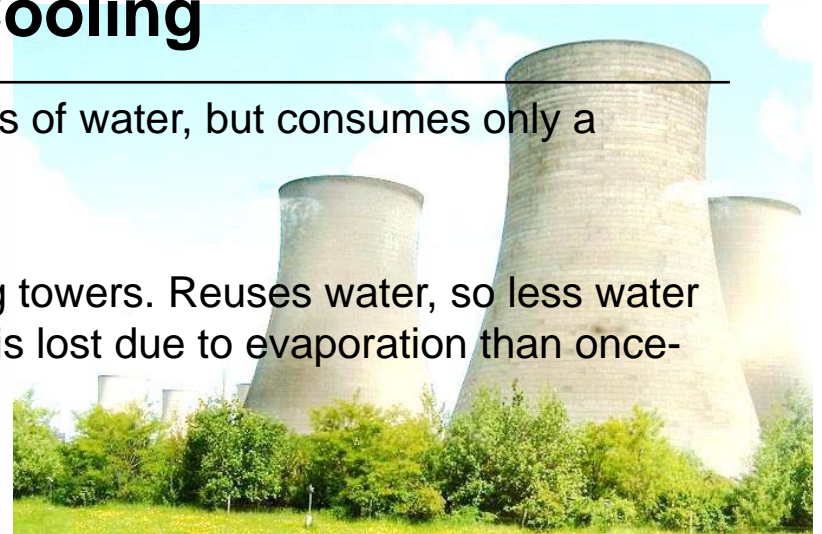
Power Plant Cooling

Once-through

Withdraws vast amounts of water, but consumes only a fraction of it

Recirculating

Usually involves cooling towers. Reuses water, so less water is withdrawn, but *more* is lost due to evaporation than once-through



Thermoelectric

**~90% of our
Electricity**

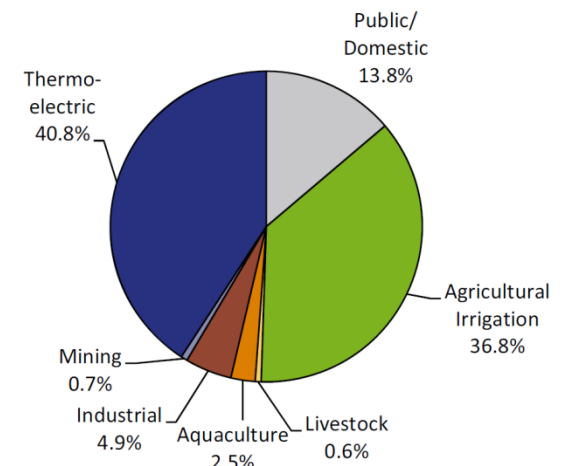
Primarily:

- Coal
- Nuclear
- Natural Gas

Power plants = 41% of freshwater withdrawals in US

Additional water is used for fuel extraction, processing, transporting, storage

Freshwater withdrawals in the U.S. in 2005



Source: Kenny et al. (2009)

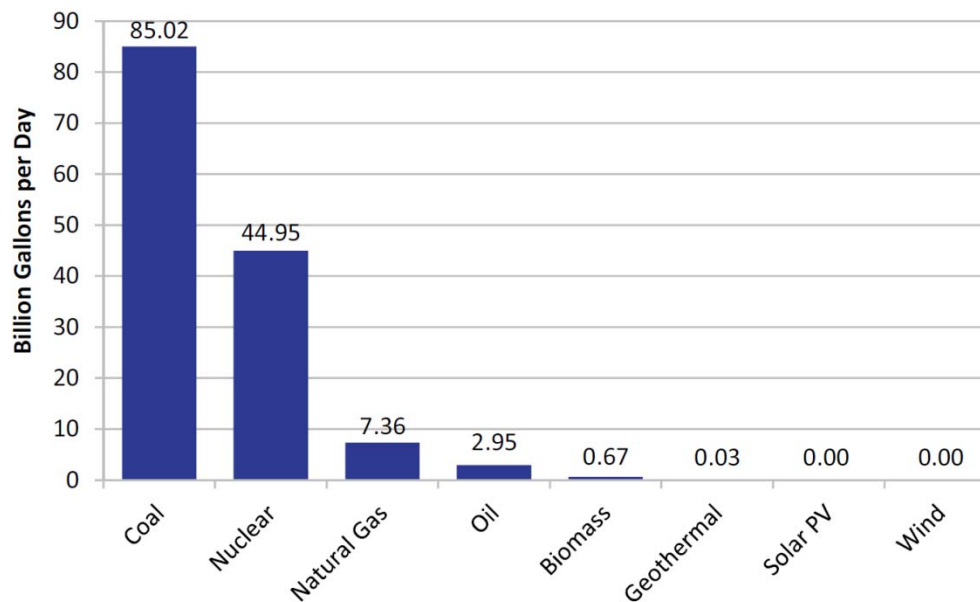
Hydroelectric

**~7% of our
electricity**

- Crucial in some areas (Northwest)
- Dependent on adequate water flows

Operational Water Use by Generator Type

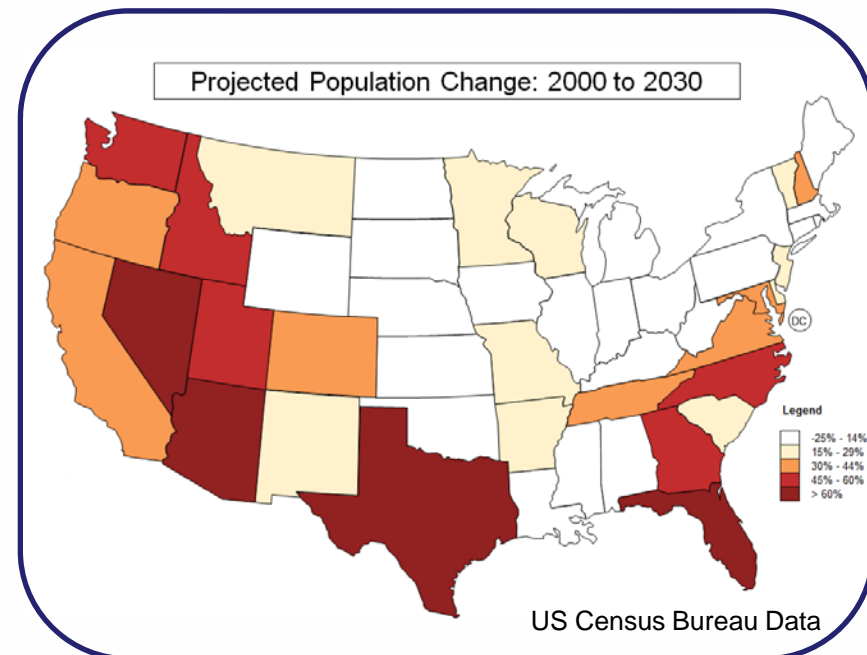
Estimated Daily Water Withdrawals for Electricity in the United States



Source: Estimated by Synapse Energy Economics using the Union of Concerned Scientists' UCS EW3 Energy-Water Database V.1.3, 2012. Database sources include EIA data and Macknick et al (2011) withdrawal coefficients.

Growing Demands

- Population growth and rising electricity demand, largely in Western/Southwestern states where water is already scarce
- Can we support additional thirsty power plants here?
- Water claims by power plants constrain consumptive use upstream (for agriculture, urban development, etc.)
- Trade-offs between economic growth, agricultural production, and electricity generation?



Drought & Heat Waves

Forced Curtailments

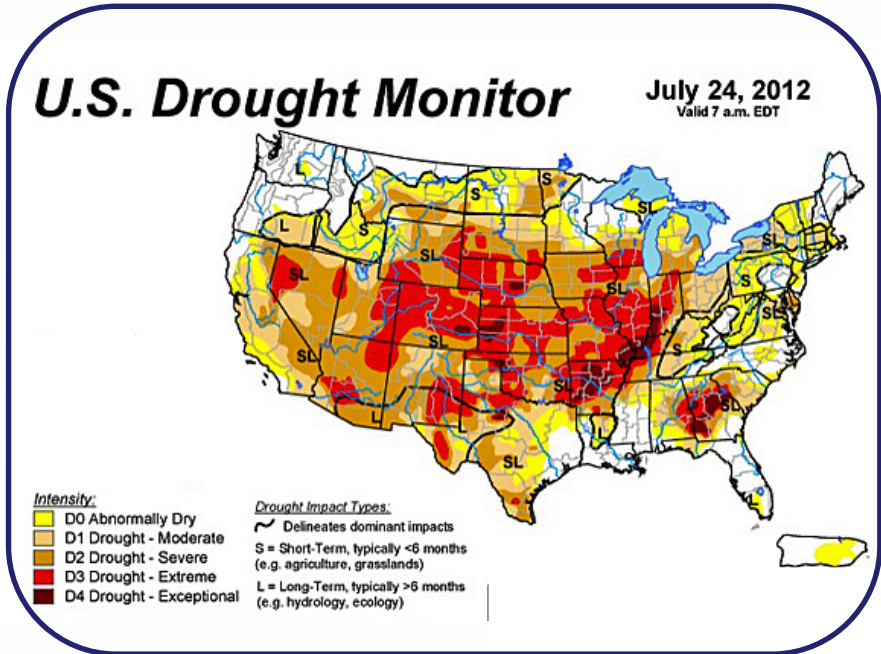
- Inadequate water
- Water too warm

Examples

- Millstone Nuclear Reactor (2012)
- Texas (2011)
- Tennessee (2007)

Costs to Consumers

- New infrastructure (pipes groundwater purchases)
- Purchased power



Technological Change

316(b) regulatory action

- 316(b) Clean Water Act: more power plants using recirculating cooling systems
- Withdrawals may decrease, but consumptive use will increase

Carbon capture & sequestration

- Retrofitting existing plants could increase water consumption rates
 - 83% for coal plants
 - 91% for natural gas plants

Legal Uncertainty

Intersectoral conflict

- Costly legal battles
- 9,000 MW “at risk of curtailment if their water rights are recalled to allow the available water to be used for other purposes.” -NERC

Climate Change

Shifting precipitation patterns

- Some regions becoming more arid
- Seasonal flows of rivers becoming more erratic
- Likely to have reduced river flows during summer when electricity demand is highest

Hotter temperatures

- Increases electricity use, particularly for air conditioning
- Reduces efficiency at which power plants operate



Inadequate Data Collection & Reporting

Power plant data

- Past exemptions for nuclear power plants
- Many inaccuracies

USGS data collection

- Methodologies for water use vary from state-to-state
- Long delay in reporting
- Water consumption no longer reported
- Budget constraints and limited staff availability

National water census

- Will it be fully funded?



Water Quality Issues

Mountaintop removal destroys entire watersheds



Vivian Stockman
www.ohvec.org

Coal Mining

Pollutants released

- Ammonia, sulfur, sulfate, nitrates, nitric acid, tars, oils, fluorides, chlorides, sodium, iron, cyanide, arsenic, magnesium, selenium...

Health impacts

Mountaintop removal counties have worse health outcomes, vs. other Appalachian counties

- Higher cardiovascular disease mortality
- Higher birth defects
- More days of poor physical health, mental health, limited activity

Community & environment

Loss of community – and watersheds – from mountaintop removal is hard to measure, impossible to ignore

A valley fill in progress



Vivian Stockman
www.ohvec.org

Is nuclear power the answer?

- The 1979 breach in the Church Rock, NM uranium mill tailings pond dam
- Radioactivity released into the Puerco River: 3 times as much as at released at Three Mile Island



*EPA Photo, Wikimedia Commons
Church_Rock_uranium_mill_tailings_dam_breach.jpeg*

Fracking: Cheap gas and dirty water

Fracking Fluids

- Drilling fluid (drillers' mud) needed for well drilling
- Fracking fluid, water mixed with sand and proprietary chemicals, injected to fracture rocks
- Natural pathways, or faulty well construction, can allow migration of fracking fluid into groundwater

Methane leaks

Can migrate into water supplies

- Infamous cases of flammable tapwater
- Explosions can result from methane buildup

Wastewater

Enormous volume of “produced water” requires disposal

Even at its best,
fracking pollutes water



Fracking: what you don't know might hurt you

Regulation

Laws have not kept up with the growth of fracking

- Underground injections are exempt from many regulations

Chemicals

Chemicals are often toxic, and frequently trade secrets

- Congressional report: 750 different fracking fluid components
- Companies do not always know which chemicals they are using

Disclosure

Only 6 states allow disclosure of trade secret information to doctors treating patients exposed to fracking fluid

- 4 of those states require doctors to sign confidentiality agreements
- They may not be able to discuss secret chemicals with the patients

A photograph showing a white truck overturned on its side in a wooded area at night. The truck is positioned on a steep, grassy slope. The scene is illuminated by artificial lights, likely from emergency responders, casting a glow on the truck and the surrounding vegetation. The background is dark, with some distant lights visible. The text "A truck full of fracking chemicals, becoming a water quality problem" is overlaid in yellow at the top of the image.

A truck full of fracking chemicals,
becoming a water quality problem

*Wetzel County (WV) Action Group
Ed Wade Jr.*

Power plants and water quality

Weak regulations

Scrubbers

Coal plant scrubbers produce polluted wastewater

- Governed by effluent limitation guidelines, not yet finalized

Coal ash ponds

Can cause huge, toxic ash spills

- Governed by new ash disposal regulations, not yet finalized

Cooling Water

Massive cooling water intakes for once-through cooling can damage aquatic ecosystems, kill fish

- Governed by weak regulations under Clean Water Act

Thermal Pollution

Warm water from once-through cooling discharges also damages ecosystems

- Also weakly regulated

Recommendations

Water risks

- Systematically assess risks associated with water dependency for electric generation
- Evaluate threats to water quality

Planning

- Conduct long-term water resource planning
- Power plant construction and retrofits should include water resource adequacy assessments and opportunity costs of water

Policies and funding

- Encourage investments in renewable technologies and efficiency
- Discontinue subsidies for thirsty energy technologies

Data and regulation

- More information needed on chemicals in treated wastewater and fracking fluids
- Tighten regulations on use of chemicals, mine reclamation, and uranium mining