Energy and water are interrelated

- We use water for energy
  - Cooling during power generation
  - Liquid fuels production

- We use energy for water
  - Treatment and disinfection
  - Distribution
  - Heating
Energy and water policies are disjointed

• Funding and oversight mechanisms are separate
  – Energy planners assume they have the water they need
  – Water planners assume they have the energy they need

• Hierarchy of policymaking is dissimilar
  – Energy: top-down powerful federal energy agencies
  – Water: bottom-up powerful local water agencies
Water use for energy varies with cooling method

Water for coal power generation

- Open-Loop
  - Withdrawal: 132,000 L/MWh
  - Consumption: 1,100 L/MWh

- Cooling Pond
  - Withdrawal: 1,700 L/MWh
  - Consumption: 1,500 L/MWh

- Air-Cooling
  - Withdrawal: 0 L/MWh
  - Consumption: 0 L/MWh

- Cooling Tower
  - Withdrawal: 2,100 L/MWh
  - Consumption: 1,800 L/MWh

[EPRI, CEC]
Texas has its own electricity grid

Interconnections of the North American Electric Reliability Council in the Contiguous United States, 1998

It's like a whole other country.
Texas and Australia are similar in population, yet Texas uses more electricity

Population: 21.5 million
Electricity Consumption: 266 TWh

Population: 24.8 million
Electricity Consumption: 405 TWh

[Energy in Australia, ERCOT]
Large power plants are large water users

Generation Capacity (kW) | Water Consumption (gal/kWh)

Texas consumes 157 billion gallons (595 billion liters) of water to produce 400 billion kWh annually (more than any other state)

[TWDB]
Energy use for water treatment varies with treatment type

- National average (without distribution)

<table>
<thead>
<tr>
<th>Water Collection and Treatment</th>
<th>kWh/ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Treatment</td>
<td>60</td>
</tr>
<tr>
<td>Groundwater Treatment</td>
<td>160</td>
</tr>
<tr>
<td>Brackish Groundwater Treatment</td>
<td>1,000-2,600</td>
</tr>
<tr>
<td>Seawater Desalination</td>
<td>2,600-4,400</td>
</tr>
</tbody>
</table>

- Often over half of a city’s total energy consumption goes toward water and wastewater treatment
Distribution constitutes a large portion of energy use for water

- Distribution averages 85% of total energy use
- Less for gravity fed systems
- More for long-haul transfer

[EPRI]
Most of average American residential water use is outdoors.

U.S. Residential Water Use

- Outdoor: 59%
- Indoor: 35%
- Leak: 5%
- Unknown: 1%
- Other domestic: 3%
- Bath: 2%
- Dishwasher: 2%
- Faucet: 18%
- Shower: 19%
- Clothes Washer: 25%
- Toilet: 31%
Rights to surface water in Texas vary with geography

Municipal Water Rights (ac-ft/yr)

- Large cities and river authorities hold large rights
- Availability for new water rights depends on existing allocations

[TCEQ]
Energy use for wastewater treatment varies with treatment type

- National average

<table>
<thead>
<tr>
<th>Wastewater Treatment</th>
<th>kWh/ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trickling Filter</td>
<td>250</td>
</tr>
<tr>
<td>Activated Sludge</td>
<td>340</td>
</tr>
<tr>
<td>Advanced Treatment without Nitrification</td>
<td>400</td>
</tr>
<tr>
<td>Advanced Treatment with Nitrification</td>
<td>500</td>
</tr>
</tbody>
</table>

- Wastewater treatment plants show economies of scale with larger treatment facilities
Large wastewater treatment plants are near large populations

- Wastewater treatment alone requires **25% more energy** per volume than water treatment and distribution combined.

- Unit energy **kWh/ML** varies widely with plant size.

[Wastewater Treatment (MGD) map]

[Source: TCEQ, EPA]
Texas does not measure electricity consumption for water and wastewater

- Energy for water and wastewater treatment estimated based on national averages
  - 2.1-2.7 billion kWh to treat 1.5 trillion gallons (5.7 trillion liters) of water annually
  - 1.8-2.0 billion kWh to treat 1.2 trillion gallons (4.5 trillion liters) of wastewater annually

- Significant data gap of energy for water
Saving water means saving energy

• **Conserving water saves energy** needed for treatment and distribution, as well as wastewater treatment

• **Water reuse may also save energy**, depending on application
  – Reclaimed water for irrigation reduces energy for potable treatment
  – Direct potable reuse requires energy-intensive membrane treatment

• **Conserving energy saves water** needed for cooling during electricity generation
Energy and water policy decisions affect one another

• **Air-cooling** of power plants
  – Reduces water consumption
  – Reduces power plant efficiency

• **Stricter standards** for water and wastewater treatment
  – Reduces risk to human health
  – Increases energy use

• **Distant water supplies or desalination**
  – Reliable water source
  – Large distribution or treatment cost and energy use
Tradeoffs exist between energy, water, and carbon

• Greenhouse gas emissions contribute to climate change

• Changing climate alters the hydrological cycle

• Inadequate water quality or quantity leads to more energy-intensive water supplies
Texas Legislature and U.S. Congress have proposed legislation at the nexus

• HB 4206 – Texas State Legislature
  – Would require evidence of water availability when evaluating power plant permit applications and siting

• S 531: Energy and Water Integration Act of 2009
  – Calls for assessment of water use in electricity
  – Initiates R&D funding for brackish water desalination energy use

• American Clean Energy and Security Act of 2009
  – Requires changes to electricity generation sources with implications for water use
Policy recommendations center on integrating energy and water policies

• Require that applications for new power plants include an analysis of the water footprint

• Incentivize implementation of less water-intensive power plant cooling technologies

• Provide state-approved guidance to water suppliers and wastewater treatment providers to quantify energy use and cost savings associated with water conservation.

• Conservation and efficiency in both sectors

• Fill data gaps
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END

Ashlynn S. Stillwell

NSF Graduate Research Fellow
Department of Civil, Architectural, and Environmental Engineering

The University of Texas at Austin
ashlynn.stillwell@mail.utexas.edu

http://www.webberenergygroup.com