CALIFORNIA
AMERICAN WATER

The Energy-Water Nexus:
Vicious Cycle or Integrated Solution?

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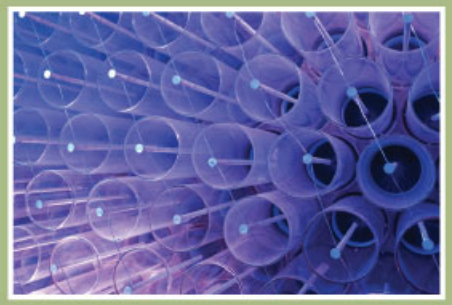
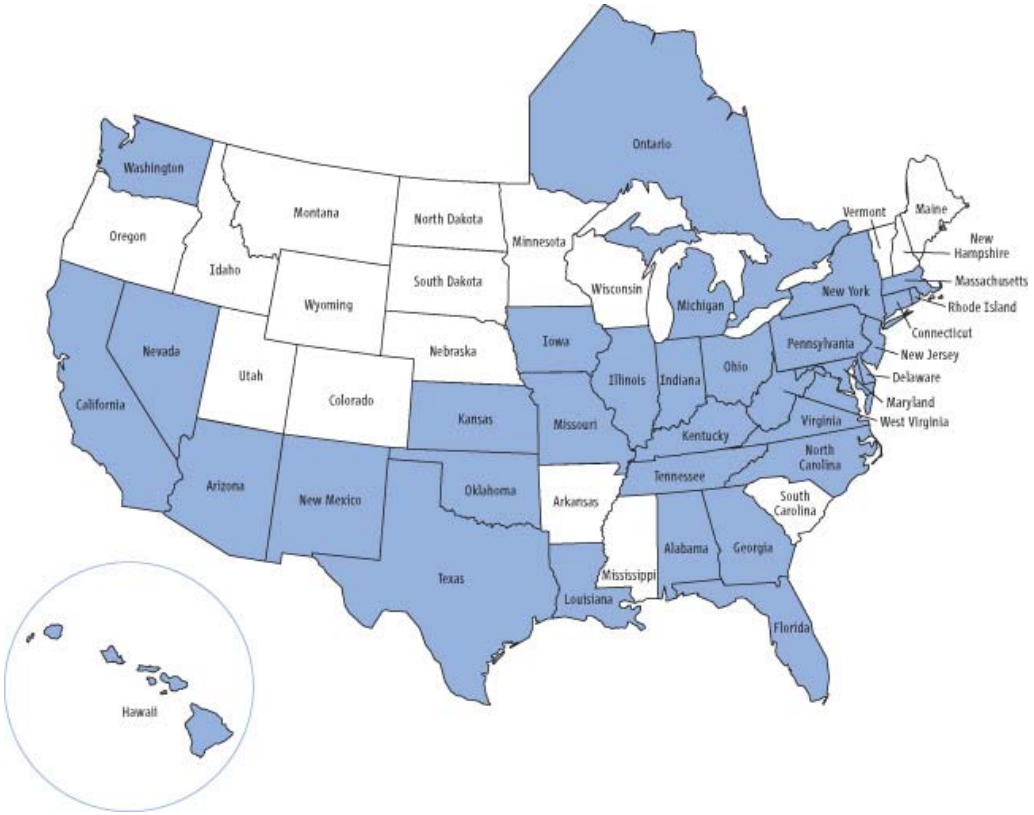


American Water



- Founded in 1886
- Largest investor-owned water and wastewater provider in the United States
- Serves approximately 15 million people
- Operations in 32 states and Ontario, Canada
- Approximately 7,000 employees

Energy and Water: The Vicious Cycle

- Water and energy are the two most fundamental components of modern civilization ... BUT
- We consume prodigious amounts of water to generate electricity
- We consume huge amounts of energy to produce, treat and deliver clean drinking water
- Water supply constraints are limiting solutions for generating more electricity
- Energy constraints and high prices are limiting efforts to supply more clean water
- **Therein, lies the rub …**

Water and Energy Intensity

- **Water is increasingly energy-intensive to produce**
  - Pumping from deeper aquifers
  - Moving from more remote locations
  - Local supply sources such as desalination and recycling
- **Energy is increasingly water-intensive to produce**
  - Fossil fuel-based resources still account for 90% of electricity and these power plants can require a lot of water
  - “Once-through” cooling is still a prominent feature of power generation
  - Any return to nuclear power means a huge uptick in water use

Impact on Water of Changing Transportation Fuel Mix

- **Electric Plug-In Vehicles**
  - Reduces carbon emissions, yes – but …
  - Generating electricity for vehicle use withdraws 10 times as much water as does producing gasoline
  - Electric vehicles consume up to three times as much water per mile as gasoline-driven vehicles
- **Biofuels for Vehicles**
  - Production cycle for biofuels – growing irrigated crops through pumping biofuel into a car – can consume 20 times more water per mile traveled than the production of gasoline
- **Strategic Trade-Off or Morton's Fork?** Reducing dependence on imported oil increases dependence on domestic water – so is the choice reduced air emissions or greater reliance on scarce water supplies?

A New Mindset

- Water is ultimately more important than oil – it's an absolute of life and it has no substitute
- Yet, we are rapidly moving into a difficult era of water sustainability
- Answer is two-fold: increasing water supply and decreasing per capita demand
- Is this the new mindset?

  "Someday, we might look back with a curious nostalgia at the days when profligate homeowners wastefully sprayed their lawns with liquid gold to make the grass grow, just so they could burn black gold to cut it down on the weekends. Our children and grandchildren will wonder why we were so dumb"

  – Michael Webber

  Scientific American: October 22, 2008

Possible Solutions According to Scientific American

- Integrate U.S. energy and water policymaking processes
  - Prevent energy policymakers from assuming all the water they "need" will be there
  - Prevent water policymakers from assuming all the energy they "need" will be there
- Create a U.S. Department of Water – comparable to DOE
- Have a Plan for Integrated Policymaking
  - Energy planners in the room when water policy is made
  - Water planners in the room when energy policy is made
- Cross-Fertilization on Climate Change Legislation
  - Assess impacts of carbon taxes, cap-and-trade programs on water supply
- Innovative Technologies that Reduce Consumption
  - Dry-cooling for power plants
  - Drip irrigation for agriculture
  - Recycling and stormwater recapture for local supply enhancement
  - Advanced membranes for desal and water treatment
  - Intelligent monitoring systems
  - Residential solar water heating
- Price Water at its True Value – Prevent Blasé Waste of Water

California Solutions

- California Department of Water Resources (DWR)
- State Water Plan Update 2009
  - Water generates one-third of California's electricity
  - Water delivery and use consumes about one-fifth of California's electricity
  - Objective 9 – Reduce the energy consumption of water and wastewater management systems to mitigate greenhouse gas emissions
  - DWR implementing Governor's directive to achieve a 20% per capita reduction in water use by 2020

DWR Water Plan Update 2009 – Related Actions

1. Water use efficiency reduces not only water demand but, in many instances, reduces energy demand as well, which in turn can lead to reductions in GHG emissions.
2. Water utilities should adopt policies promoting recycled water use – ultimate goal of recycling 23% of municipal wastewater by 2030.
3. Local agencies and governments should implement cost effective, energy efficiency measures in water system infrastructure projects.
4. Urban communities should invest in facilities to capture, treat and reuse ___ acre-feet per year statewide of urban storm water runoff.
5. Water and wastewater utilities should identify and build renewable generation projects that can be co-located with existing water system infrastructure.
6. State government should establish a public goods charge for funding investments in water efficiency that reduce GHG emissions.

State Water Plan: On the Horizon for Local Utilities

1. Large water and wastewater utilities should conduct an assessment of their carbon footprints.
   - Consider strategies to reduce GHG emissions
   - Utilities should join the California Climate Action Registry to take advantage of existing framework/process for calculating their carbon footprint
2. Water-Energy Sub-Team of the Governor's Climate Action Team (WETCAT) will assess a reasonable energy reduction target for water and wastewater systems.
   - Reduction in electricity consumption would in turn reduce the GHG emissions associated with this amount of electricity generation
3. California Energy Commission, in collaboration with WETCAT, will develop tools and protocols to evaluate, measure, and verify the energy impacts of water system and end use conservation and efficiency activities/programs.

"20 by 2020" Multi-Agency Team

- 2/28/08: Gov. Schwarzenegger sends letter to Legislature on the need to "fix" the Sacramento-San Joaquin Delta – source of water for 25 million Californians
- First item is a conservation goal: reduce statewide per capita use of water by 20% by 2020
- Subsequent Executive Order in June tasks a multi-agency team to develop and implement a plan for the reduction
- Current urban use is about 8.7 million acre-feet per year; 20% reduction is about 1.74 million acre-feet per year
- California DWR, Dept. of Public Health, California PUC, State Water Resources Control Board and California Energy Commission have produced two draft technical memos, which have informed the process.

20 x 2020 Agency Team Results

- **To date: research has shown that non-agricultural water use statewide stands at 192 gallons per capita per day**
- **20% reduction means a decline to 154 GPCD**
- **Two important considerations have been adopted:**
  1. Conservation targets calculated on a regional basis, not individual utility or water agency – hydrologic regions allow for consideration of evapotranspiration zones and current conservations levels.
  2. Utilities will get credit for past conservation efforts: 2000 has been selected as the base year, not 2008.
- **Regional target reductions for the 10 hydrologic regions range from 9% (SF Bay Area) to 44% (Colorado River Region)**
- **Math logic works: greater populated areas use less water per capita, have lower reduction targets.**
- **Next steps: finalize research, refine plans and performance metrics; State Water Board action; legislative action**

California Air Resources Board – AB 32 Scoping Plan

- **AB 32: Global Warming Solutions Act of 2006**
  - Reduction in greenhouse gas emissions to 1990 levels by 2020
  - Means a reduction for every man, woman and child in California from 14 tons of CO_2 per year to 10 tons per year
- **ARB Climate Change Draft Scoping Plan – June 2008**
  - Contains 18 preliminary recommendations to meet reduction goal
  - Water sector's goal is 4.8 million metric tons by 2020:
    - Water use efficiency – 1.4
    - Water recycling – 0.3
    - Water system energy efficiency – 2.0
    - Reuse urban runoff – 0.2
    - Increase renewable energy production – 0.9

California PUC – Water Action Plan

- **Objective #2: Strengthen Water Conservation Programs to a Level Comparable to those of Energy Utilities**
- **Action Items:**
  - Educate water industry stakeholders regarding policies and practices which reduce water and energy consumption.
  - Work toward a 10% reduction in energy consumption by water utilities.
  - Collaborate with the California EPA to reduce GHG emissions.
- **CPUC will identify and assess options for water utility energy efficiency strategies:**
  - water pumping, purification systems
  - water processes such as desalination
  - system leaks, poorly maintained equipment, defective meters, unused machines left idling, improperly operated systems

Water-Related Energy Use in California

	Electricity (GWh)	Natural Gas (Mill. Therms)
Water Supply and Treatment		
Urban	7,554	19
Agricultural	3,188	
End Uses		
Agricultural	7,372	18
Residential	27,887	4,220
Commercial		
Industrial		
Wastewater Treatment	2,012	27
TOTAL	48,012	4,284
2001 Consumption	250,494	13,571
Percent of Statewide Energy Use	19%	32%

Source: California Energy Commission, .Integrated Energy Policy Report., Sept. 2005, p. 121.

CPUC Energy-Water Programs

- **Embedded Energy-Efficiency Pilot Programs**
  - $6.4 million program with large public water agencies designed to extract energy savings from water conservation programs
  - One-year pilot programs for SoCal Edison, PG&E and Sempra – participating water agencies are SDCWA, MWD of Southern Calif.; Santa Clara Valley WD, Sonoma County Water Agency, East Bay MUD
- **CWA Petition to Include PUC-Regulated Water Utilities**
  - $1.3 million test program on well, booster pumps - six water utilities
  - Demonstrate potential improvements in wire-to-water operational efficiency
  - Combination of induction motors, variable speed drives, SCADA systems
  - Awaiting Commission decision
- **Renewable Energy Projects by Water IOUs**
  - Hydro and mini-turbines, solar photovoltaic systems, wind turbines, fuel cells
  - In discussions with energy utilities

Global Warming Potential of GHGs Produced by Water Utilities

Greenhouse Gas	CO_2 Equivalent	Sources
Carbon dioxide (CO_2)	**-**	**Combustion of hydrocarbons, direct and indirect**
Methane (CH_4)	**21 x CO_2**	**Combustion of hydrocarbons, direct and indirect; WW treatment**
Nitrous oxide (N_2O)	**310 x CO_2**	**Combustion of hydrocarbons, direct and indirect; WW treatment**
R-134a	**1,300 x CO_2**	**Leakage from vehicle and building air conditioning units**
Sulfur hexafluoride (SF_6)	**23,900 x CO_2**	**Insulator in high voltage electrical applications**

SOURCE: Climate Leaders

One Approach – Climate Leaders

- **A voluntary EPA partnership with U.S. companies to develop long-term, comprehensive climate change strategies**
  - Inventory corporate GHG emissions
  - Set corporate-wide GHG reduction goals
  - Measure and report GHG emissions to EPA
- **For more information and a list of Climate Leaders partners, please visit www.epa.gov/climateleaders**

Creating a GHG Inventory

- **Conduct inventory using internationally recognized protocol (United Nations IPCC-Intergovernmental Panel on Climate Change), which includes:**
  - Stationary Combustion: Fuels burned on-site for Furnaces, On-Site Generators, Hot Water Heaters, Engine Driven Devices (e.g. pumps), etc.
  - Mobile Combustion: Cars, Trucks, Boats & Planes
  - Fugitive Emissions: Refrigeration and Air Conditioning Units, Process emissions, Landfill emissions
  - Indirect Sources: From the fuels used to produce Purchased Electricity or Steam

Major Sources of Water Utility GHGs

A typical water utility will find that the majority of its GHG emissions come from:

- **Purchased electricity (chiefly for pumping)**
- **Fuel for fleet vehicles**
- **Natural gas, diesel, fuel oil for engine driven pumps, generators, and heating**
- **De minimis amounts from: fugitive emission from HVAC units, process emissions, and minimally used fuels, e.g. LPG**

AW Inventory of GHG Emissions

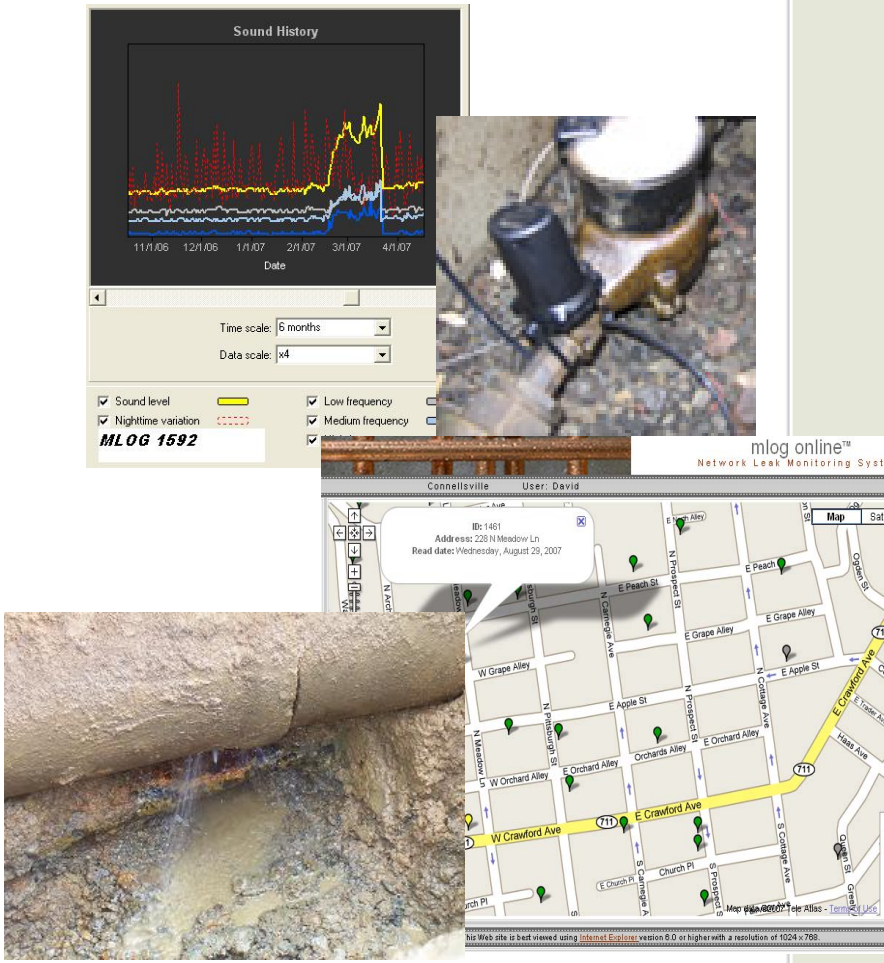
Emissions Source Category	Fuel	Quantity	Units	Emissions (Metric Tons CO2e)	Percent Total Emissions
Stationary Combustion	Natural Gas	5,102,952	therms	26,998	3.60%
	Diesel	341,981	gallons	3,457	0.50%
Mobile Combustion	Gasoline	2,409,305	gallons	22,591	3.00%
	Diesel	401,922	gallons	4,053	0.50%
Purchased Electricity	Electricity	1,089,424,091	kWh	691,011	92.40%
Total Emissions				**748,110**	**100.00%**

Emissions in metric tons CO_2e includes CO_2, N_2O and methane emissions

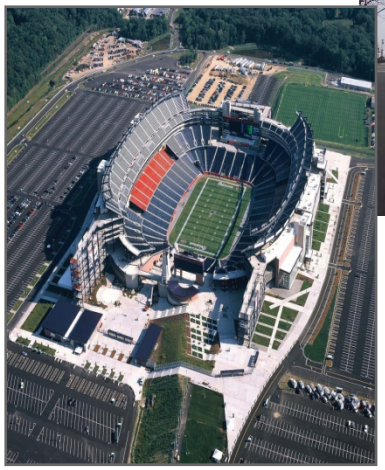
Emissions from flared methane gas and HVAC were both <0.5%

Non-Revenue Water

- American Water has a goal of reducing non-revenue water
- Need to track and translate NRW reductions into GHG reductions
- Research on acoustic leak detectors (M-LOG) in Connellsville, PA has resulted in a 12% reduction in NRW over the past year
- Pressure management to reduce surges that lead to leaks



Water Conservation / Reuse



- **Maximize conservation efforts**
  - Education
  - Conservation tariff structures
- **Need to maximize reuse opportunities**
  - Annually, AW recycles nearly 2 billion gallons of water
  - On-going research on reuse water quality
- **WaterSense**
  - In Camden, NJ, AW is working with the Carpenter's Society to demonstrate water saving appliances and fixtures

Conclusions

- Addressing climate change makes good business sense
- Water utilities are not just the recipients of the effects of climate change, *they are also part of the problem!*
- Climate Leaders (and similar programs for municipal systems) provide a structured mechanism for documenting and reducing GHGe
- For American Water, 92.4% of GHGe is indirect from electrical use and 3.5% from vehicle fuels
- Multiple mechanisms exist to reduce GHGe including leak reduction, conservation, pump efficiency improvements, energy audits, pressure management, procurement, fleet management, efficient lighting and air conditioning.