Energy & Water Nexus:
Availability & Impacts

US EIA 2010 Energy Conference

"Short-Term Stresses, Long-Term Change"

April 6 – 7, 2010; Washington, DC

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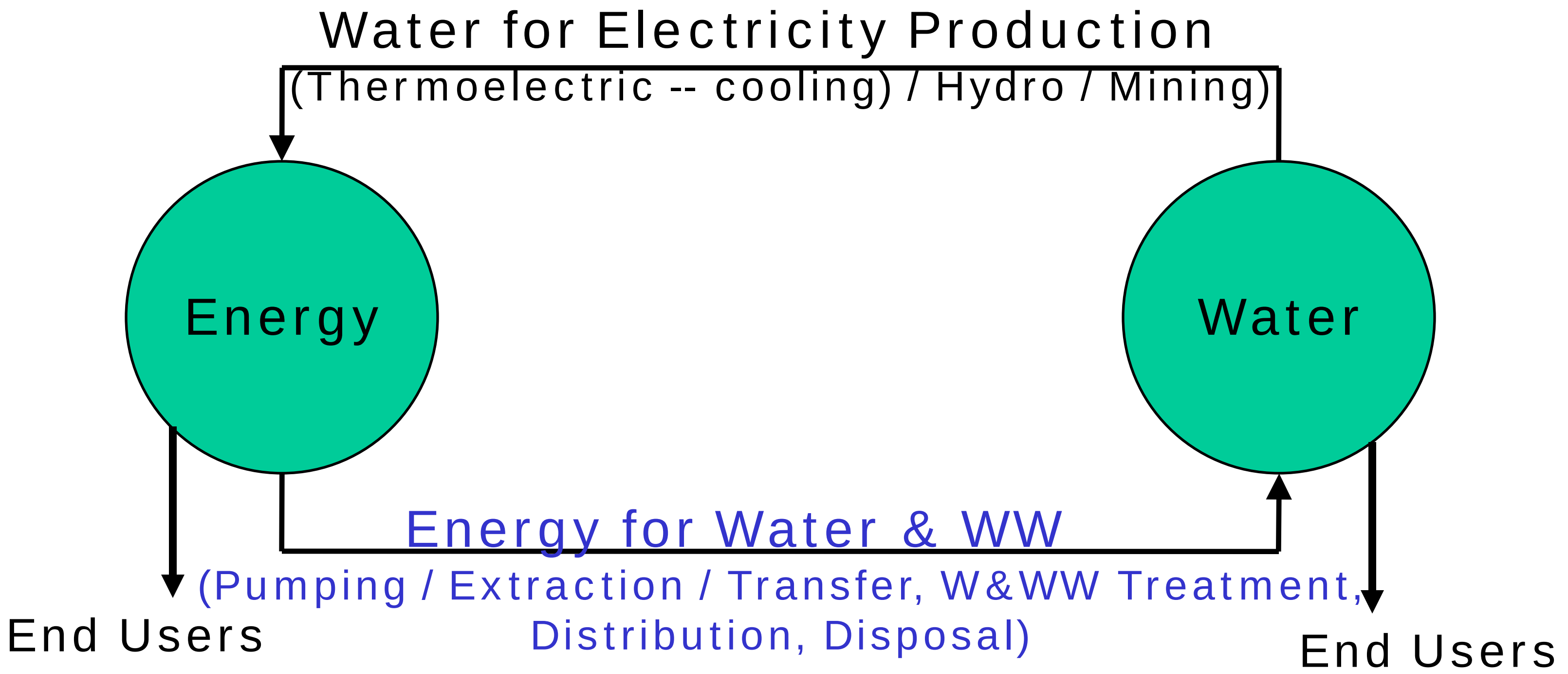
- Water-Energy Link



Reliability & Sustainability of Both Entities Linked with Each Other Strongly

- Typical Urban Water Cycle

- Energy & the Water Sector

Worldwide Water Pumping

~ 7% of World's Total Energy Use

→ ~ Energy Use in Japan &Taiwan Combined

U.S.* 3% of Total Electricity Use for Pumping
+1% for Treatment of W&WW

Water Facilities 161,000 (Public & Private)
~ 60,000 POWT Systems, Serves 92% of Population

WW Facilities 16,225 (~ All Publically Owned)

For U.S. Water Cycle**: 521 x 10^6 MWhr

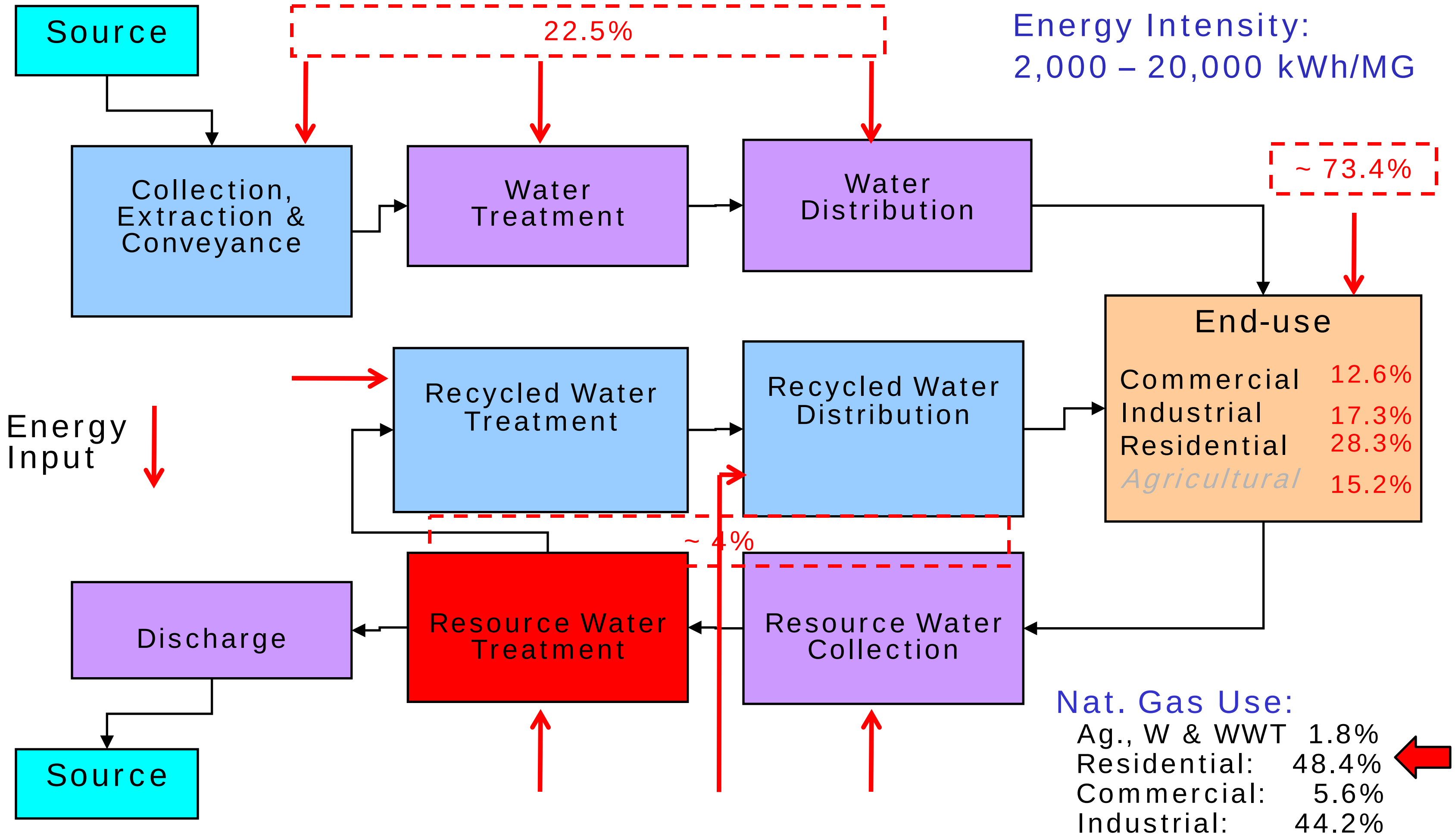
13% of All Electricity Produced in the U.S.

→ 290 M Metric Tons CO_{2e} GHG Emissions

* EPRI, 2002

** River Network, 2009

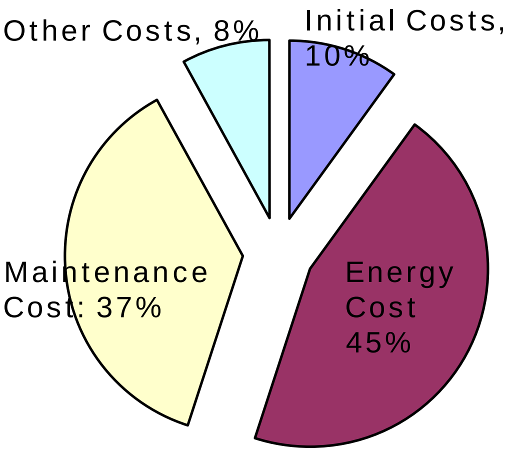
• Energy Input in Typical Water Cycle



- Major Energy User in the Water Systems

Electric Pump/Motors –

Single Largest Category Electric End-Use,
Consumes 23% of all Electricity Sold in the U.S., &
Generally Most Inefficient (Survey Finds Eff. Range 5 – 80%)



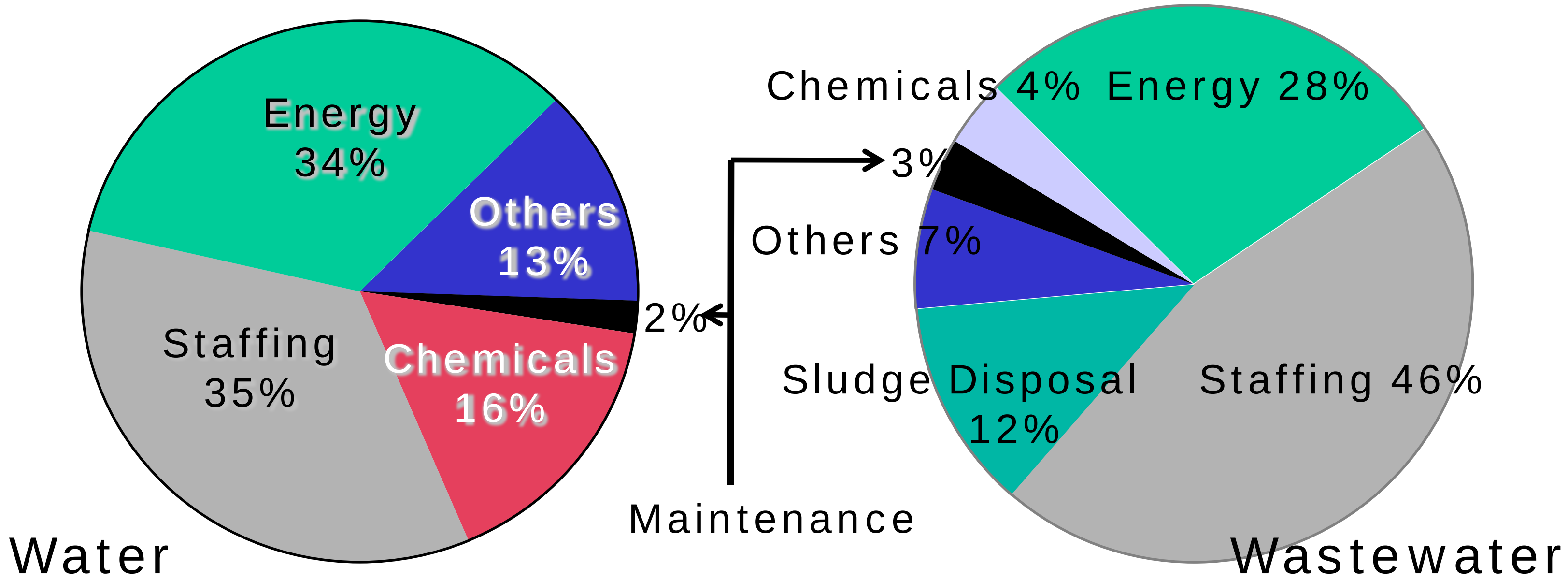
Life Cycle Cost of Pump
(Source: World Pumps – Jan 2008)

Water Treatment	90%
WW Treatment	
Aeration	55%
Pumping	14%
Solids Handling	14%
Others (lighting, belt press, clarifiers, return sludge handling etc)	

- Electricity Use @ W&WWTP Level

Energy Costs:

Could be as High As 80% of Plant's Energy Costs,
40 – 55% of W&WW Utilities' Operating Budget,
2nd after Staffing, &
One of Five Top Rated Concerns.



- Reducing Energy Use @ W&WW Facilities

  Water Conservation & Water Use Efficiency,

  Repairing / Replacing Leaking & Damaged Pipes & Equipment,

  Energy Efficient Buildings, Lighting, & HVAC Systems,

  Reducing Process Energy Usage,

  Replacing / Retrofitting Aging Equipment with More Efficient Technologies

  (VFDs, More Efficient Pumps & Motor Systems, etc.)

  Improving Electrical Load Management through Scheduling or Control modifications, &

  Adding System Flexibility with Storage.

- Emerging Challenges in W-E Nexus

Increasing Population

→ More Water & Energy Needs

Traditional Water Sources →

Dwindling Supplies + Deteriorating Quality + New Contaminants + Environmental & Regulatory Constraints (i.e. Stringent Regulations)

→ Energy Intensive Technologies (UF, MF, UV, Ozone, MBRs, Desalination)

Water Related Energy Demand is Increasing @ Much Faster Rate – May be 50% More by 2030

New Kids on the Block

GHG Emissions / Climate Change Impacts, → Carbon Neutrality; &

Sustainability Considerations

- Measures Needed - Water Side

Short-Term Actions

Aggressively Increasing Water Conservation, Water Use Efficiency, & Water Leak Detections;

Expanding Water Storage & Improved Coordination between Stored and Other Water Supplies;

Developing Conjunctive Use Management Plans;

Water Efficiency in Ag. Sector by Applying All Feasible Efficient Water Management Practices;

Increasing Use of Recycled Water

Developing Other Local Resources - Desalination

Long Term Strategies include

→ R&D and Monitoring & Evaluation Activities

Evaluating Long Terms Impacts of CC on Future Water Supply through Expanded Monitoring and Atmospheric Observations,

Identifying Research Needs to Help Reducing Vulnerability to Climate Change, etc.

- Future Water & WW Treatment Systems

  Sustainability through Holistic Water-Energy Management Approach,

  Incorporate Broader Vision & Flexible Engineering Design Over the System's Life Span in Terms of:

  Treatment Capacity
  Capital Investment & Operating Costs
  Source Water Quality
  Effluent Standards, &
  Biosolids Management

  Wastewater Treatment Systems will Serve as Resource Centers to Recover & Reuse:

  Water, Energy, Nutrients, & Heavy Metals

- Emerging Considerations in Sustainable Water Systems

    Water Transfers vs. Developing Local Water Sources,

    Demand & Constraint Based Advanced Transport & Treatment Management Systems,

    Innovative & EE Treatment Processes & Technologies,

    Advanced Sensors and Real Time Monitoring of Raw Water Quality for Instantaneous Treatment Process Control & O&M Optimization;

    New Design, Management, & Operational Philosophies (e.g. Decentralized Treatment Systems);

Better Coordination

    Among Resource Management Agencies to Identify and Address Energy Implications of Water Policy Decisions.

Learn from Others

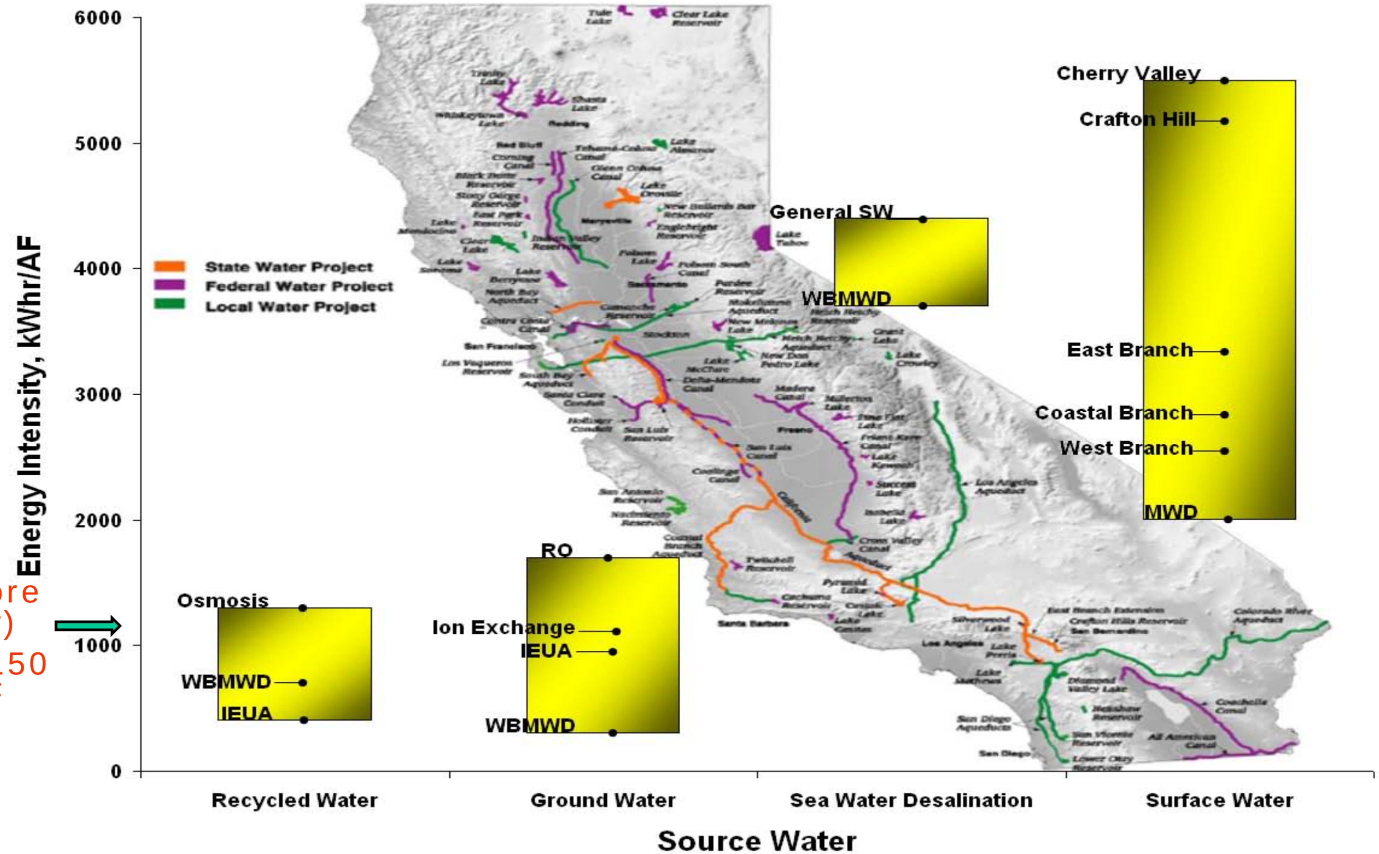
    Oil Industry - Avoid Racing to the Pump
    Explore Alternatives

• Future Water Resources Development

– On Case by Case Basis

(Singapore NEWater)

900 – 1,150 kWh / AF



• Renewable Energy Helps Saving Water

(gal / kWh)

Wind	0.001
PV Solar	0.030
Oil	0.43
Coal	0.49
Nuclear	0.62
Hydro	18.27

Avg. Water Use / Loss:

Hydro vs. Thermal:
18.27 vs. 0.47 (Gal/kWh)

- Government can Help Accelerating the Water-Energy Systems' Sustainability by Supporting:
  - RD&D Programs
  - Technology Transfer Activities, and
  - Education, Information Dissemination & Out Reaching