Overview of Energy Use in the Drinking Water and Wastewater Industries

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ENERGY STAR Water & Wastewater Focus

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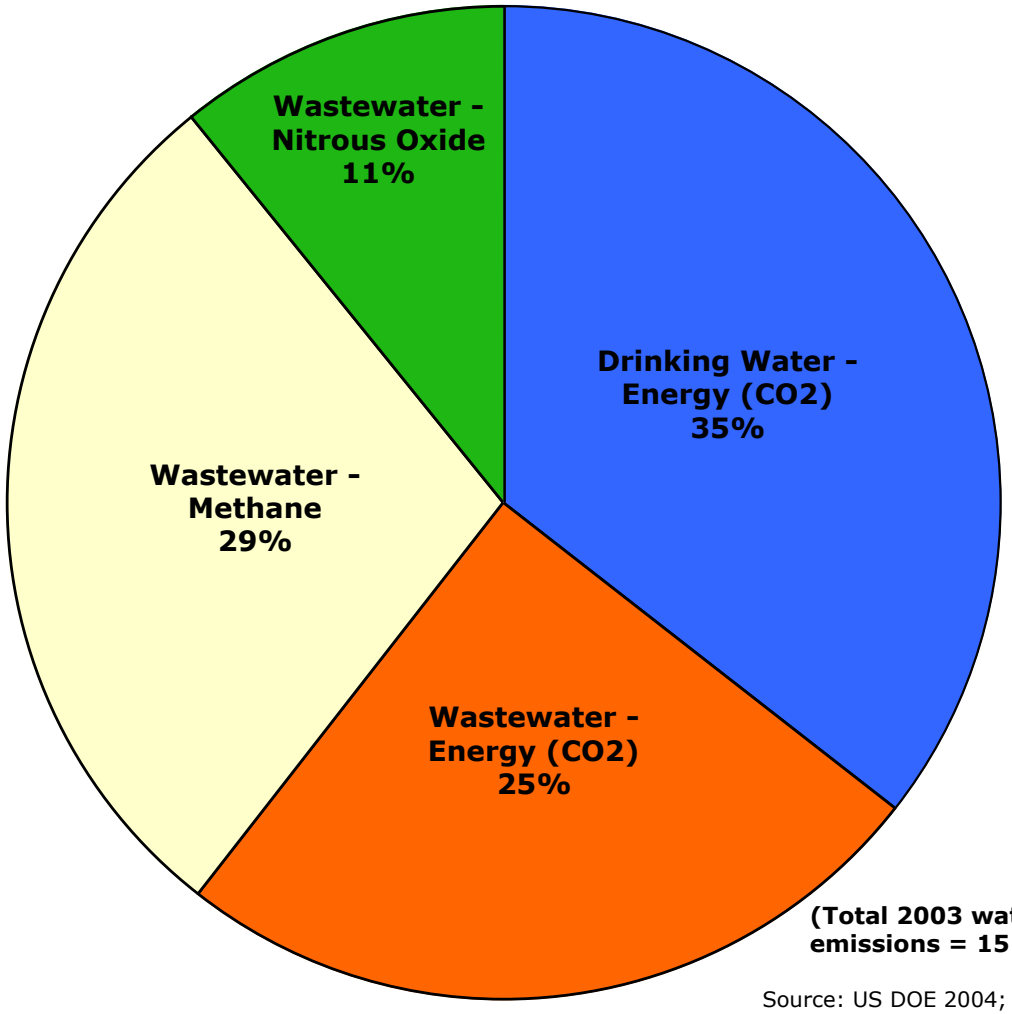
Outline

- Overview
- How and where energy is used in this sector
- Benchmarking considerations

Overview

- To inform EPA's efforts, LBNL compiled available energy-use statistics and analysis
- Typical municipality: 1/3 of energy is consumed by drinking water and wastewater systems
- U.S. total:
  - 50 billion kWh/year
  - $4 billion electricity bill
  - 60% drinking water / 40% wastewater
  - 1% of U.S. greenhouse gas emissions

2003 Greenhouse Gas Emissions



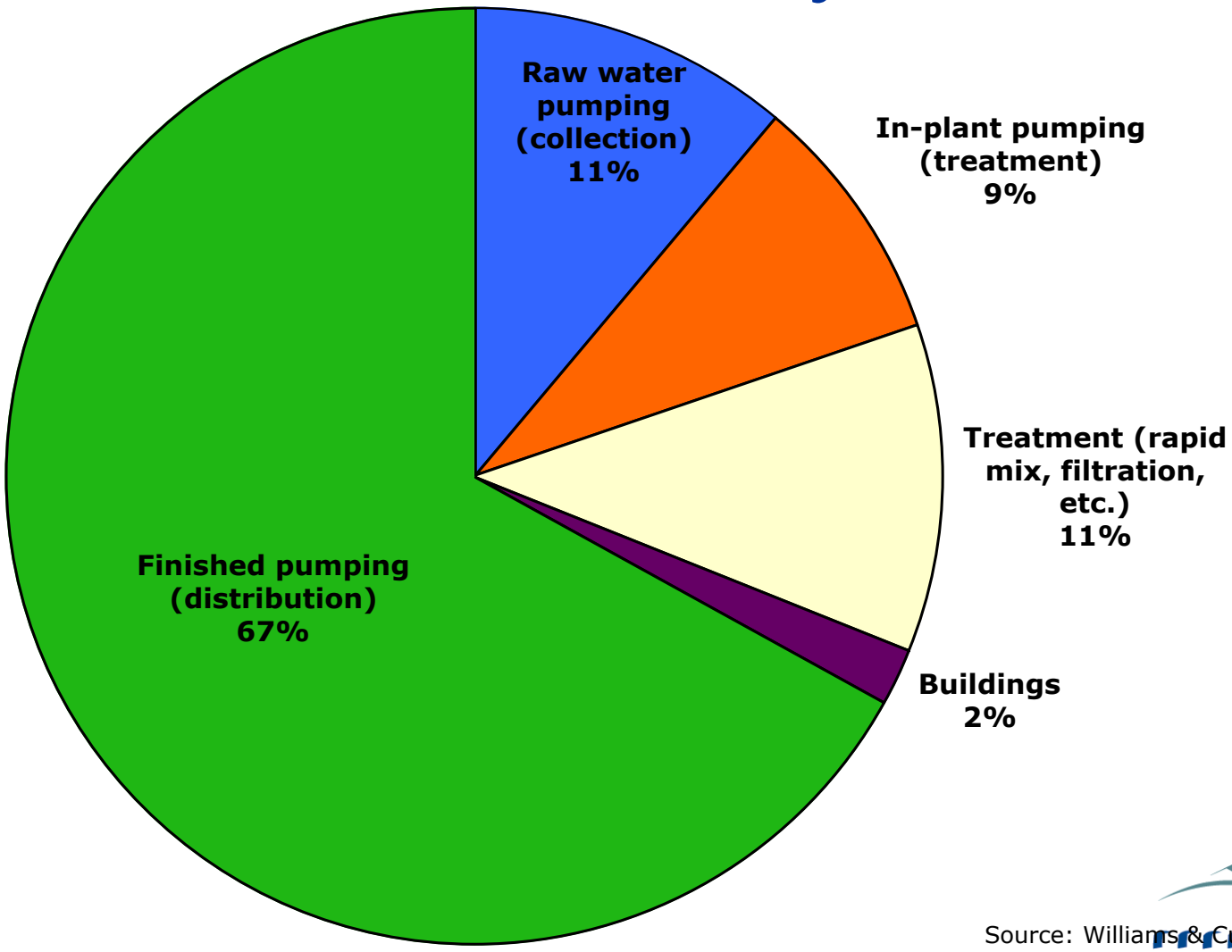
(Total 2003 water/wastewater emissions = 15 MMTCE)

Source: US DOE 2004; energy consumption estimates based on EPRI (2000).

Drinking Water Systems

- 161,000 public drinking water systems in U.S.
- 80% of population served by 3,900 large systems
- Large systems tend to use surface water, small systems tend to use groundwater
- Most energy is used for pumping
- Energy use affected by: population, water source, quality, climate, topography, storage, …

Allocation of Energy in Typical Surface Water System

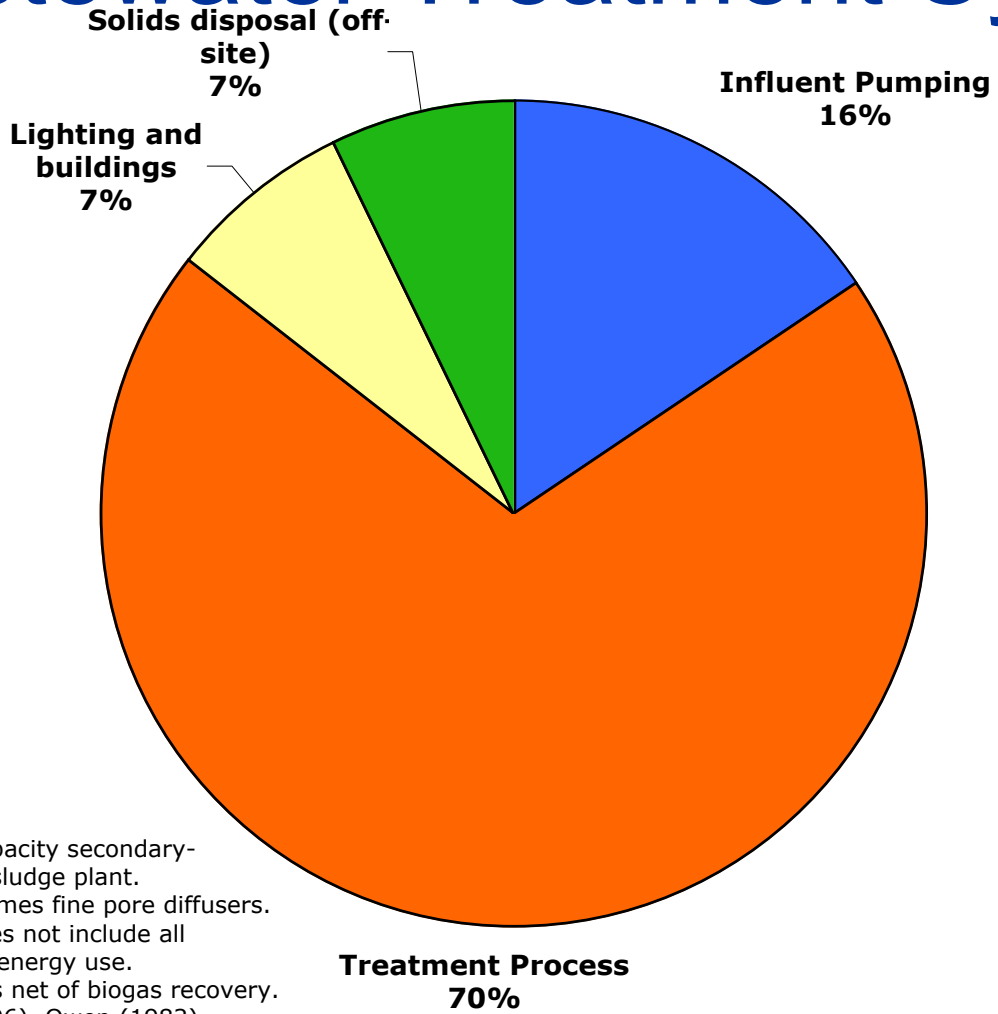


Source: Williams & Culp 1986

Wastewater Treatment Systems

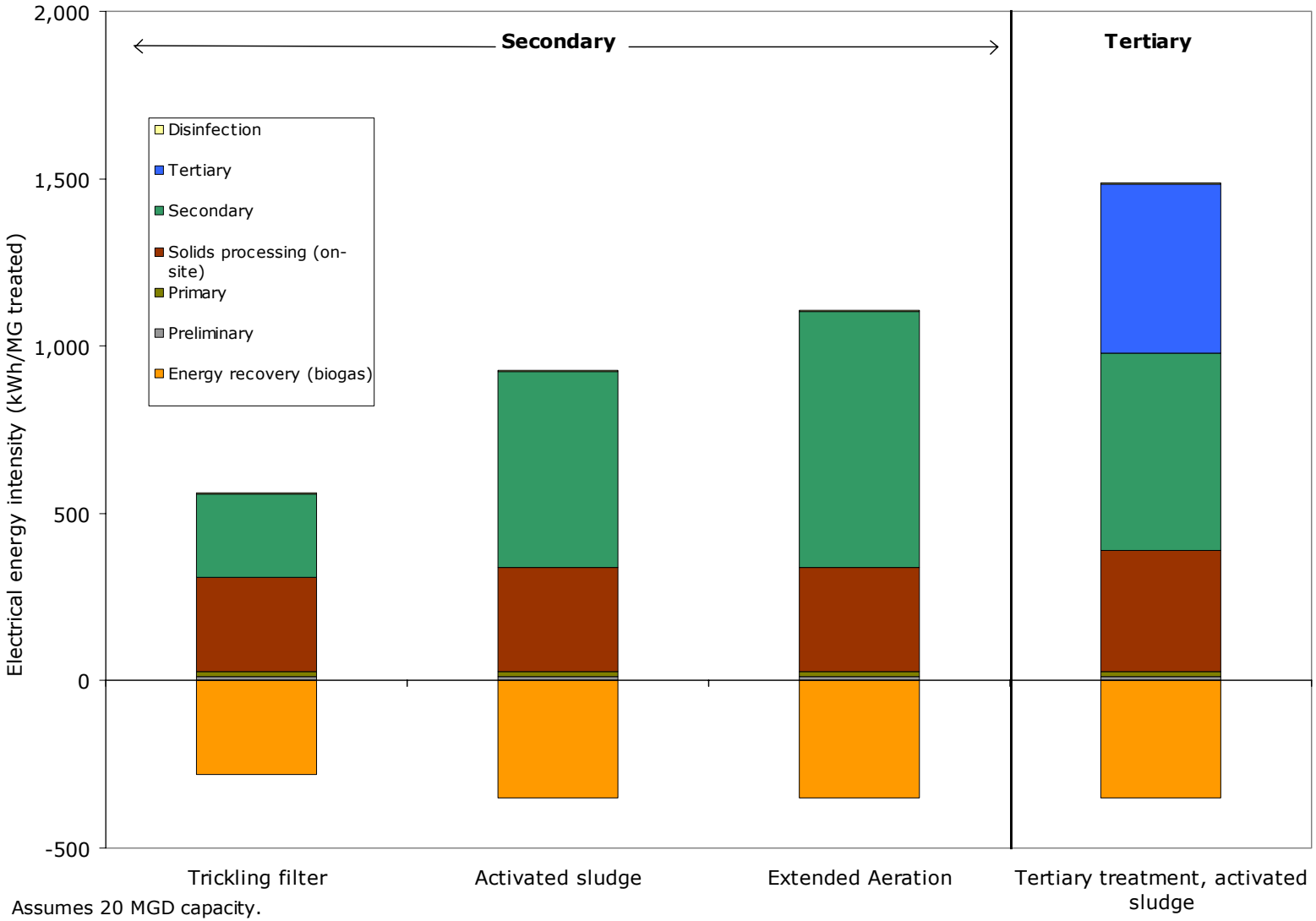
- 16,000 Publicly Owned Treatment Works
- 85% of wastewater treated by 10% of plants
- Energy use dominated by treatment process
  - 70% of flow is treated with activated sludge
- Higher levels of treatment use more energy
- Biogas can be recovered to generate power
- Energy use affected by: population, influent loading, effluent quality, process type, …

Allocation of Energy in Large Wastewater Treatment System



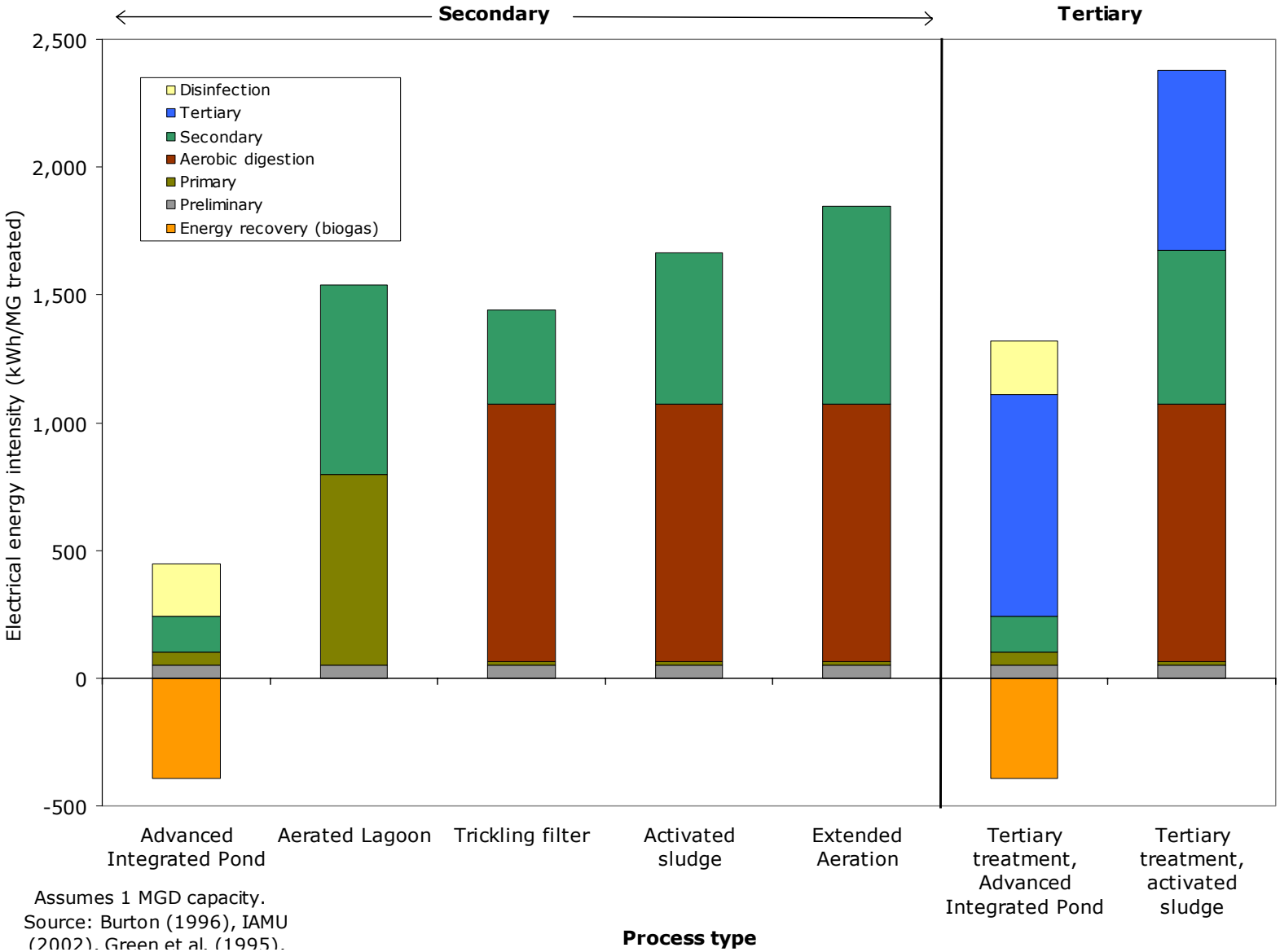
Notes:
Assumes 20 MGD capacity secondary-treatment activated sludge plant.
Sludge aeration assumes fine pore diffusers.
Influent pumping does not include all collection lift-station energy use.
Process energy use is net of biogas recovery.
Sources: Burton (1996), Owen (1982)

Process Energy Use in Large WW Plant



Assumes 20 MGD capacity.
Source: Burton (1996), Green et al. (1995)

Process Energy Use in Small WW Plant



Assumes 1 MGD capacity.
Source: Burton (1996), IAMU (2002), Green et al. (1995).

Energy Savings Opportunities

- Drinking Water
  - Motors, drives, pumps, controls
  - 15% savings readily achievable, 30% possible
- Wastewater
  - Process control, motors, pumps, blowers, biogas
- Out-of-plant opportunities
  - Unaccounted for water
  - Water end-use efficiency
  - Solids disposal

Energy Performance Benchmarking

- Goal: Quantify energy used to provide a service
- Must clearly define boundaries:
  - Type of service
  - Which energy consumption to include
- Based on measured data where practical
- Normalize for factors beyond utility's control
  - Population
  - Volume of water/wastewater delivered/treated
  - Mass of pollutants removed

ENERGY STAR Benchmarking

- Use as basis for energy management program
- Recognize excellent energy performance
- Apply to both existing and new plants
- Complement other benchmarking systems
- Include as many out-of-plant uses as practical (water collection, lift stations, effluent disposal)
- Measure performance at several levels (system, plant, process)