Optimization of Water Usage At Petroleum Refineries

Water/Energy Sustainability Forum
Ground Water Protection Council
Salt Lake City, Utah
September 15, 2009

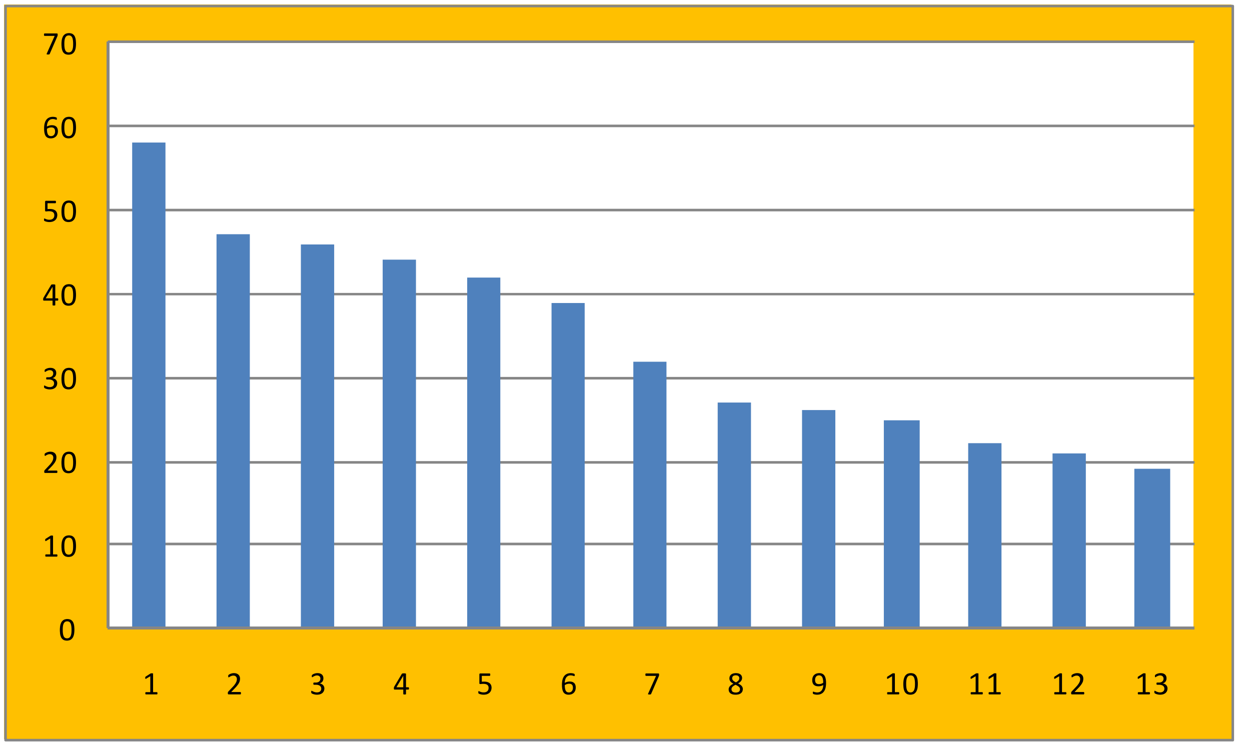
Agenda

- Overview water usage in petroleum refineries.
- Discuss drivers for water conservation.
- Review opportunities to reduce water consumption:
  - Matching supply quality to the demand need.
  - Utilization of municipal wastewater.
  - Zero discharge concepts.

Water Use in Petroleum Refineries

- Adding heat to the processes (steam).
- Removing heat from the process (cooling water).
- Removing salt and impurities from crude.
- Protecting equipment from corrosion.
- Generation of hydrogen (used to remove sulfur from motor fuels).
- Equipment cleaning and maintenance.

Water Usage in the Petroleum Refining Industry



Worst in Class (50-60 gal/bbl) ⟷ Best in Class (10-20 gal/bbl)

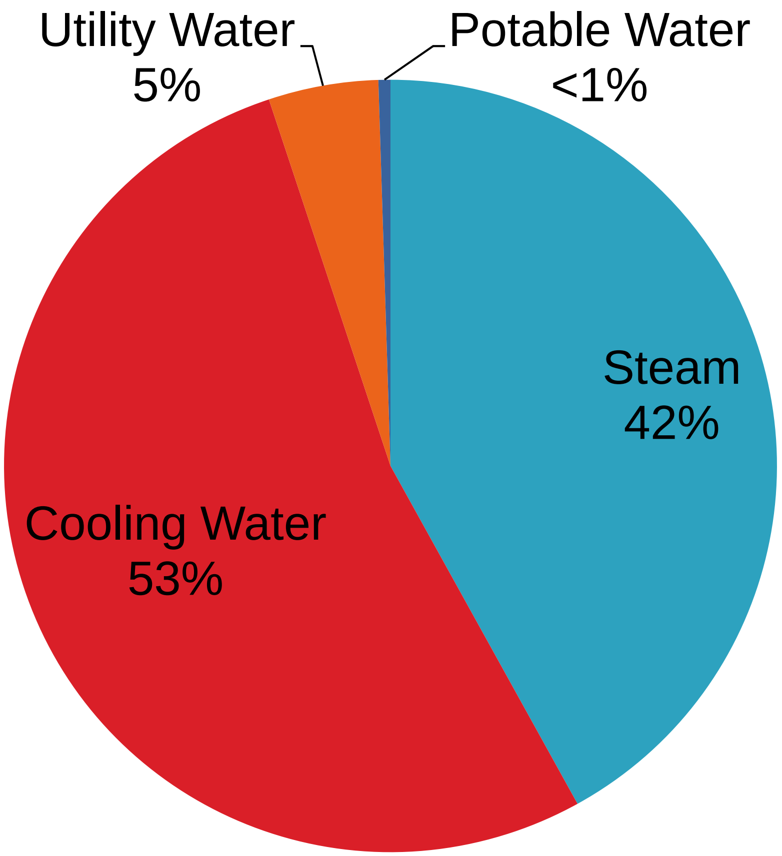
Water usage varies greatly from facility to facility.

Gallons/bbl Doesn't Tell the Story…

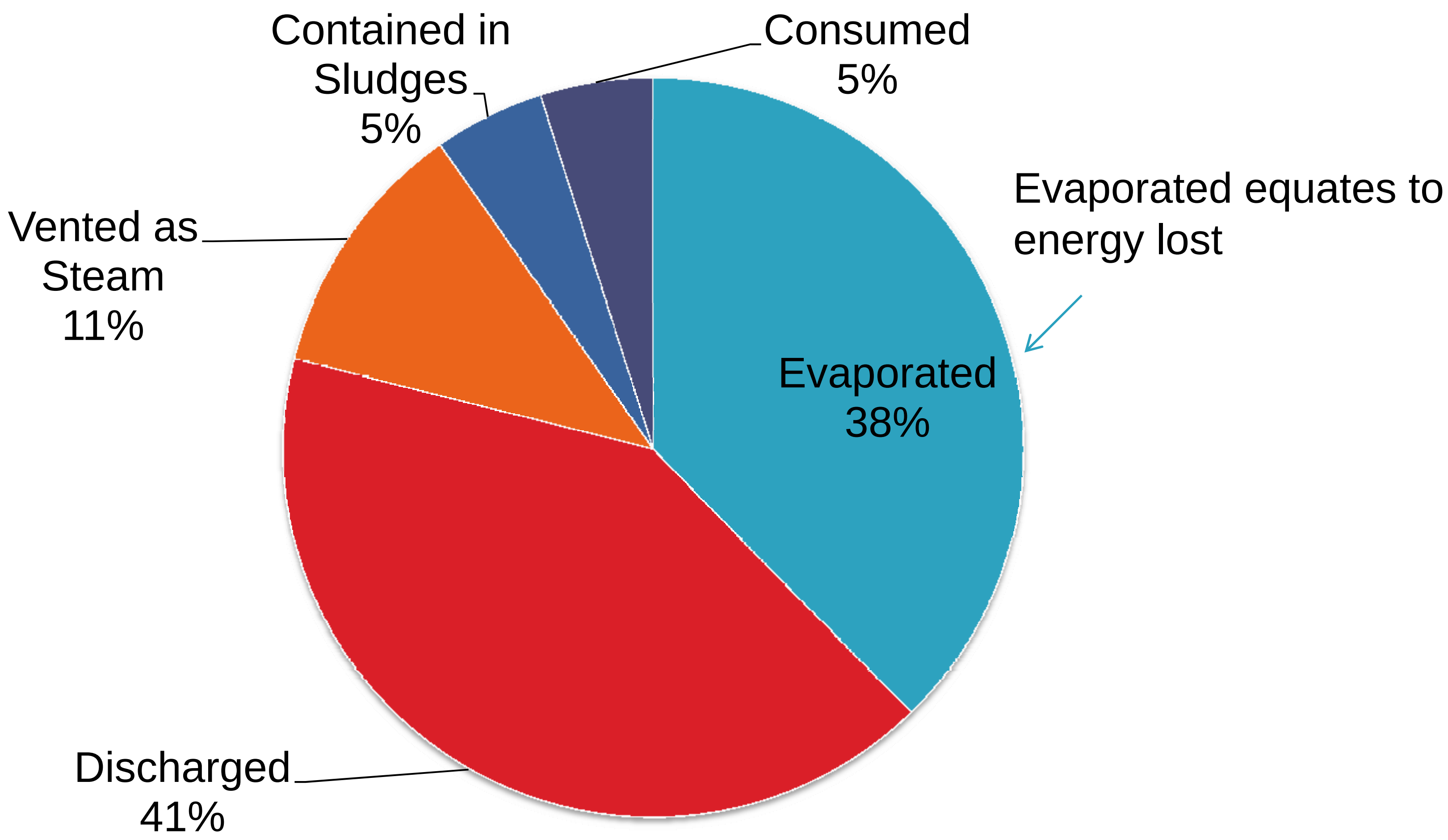
- Raw water quality varies:
  - Target ion concentrations.
  - Hardness.
- Refinery configuration
  - Water usage very linked to energy efficiency of the facility.
- Crude slate
  - Poor quality "price advantaged" crude oil requires more water.

Some refineries have much greater challenges than others in their efforts to control water usage.

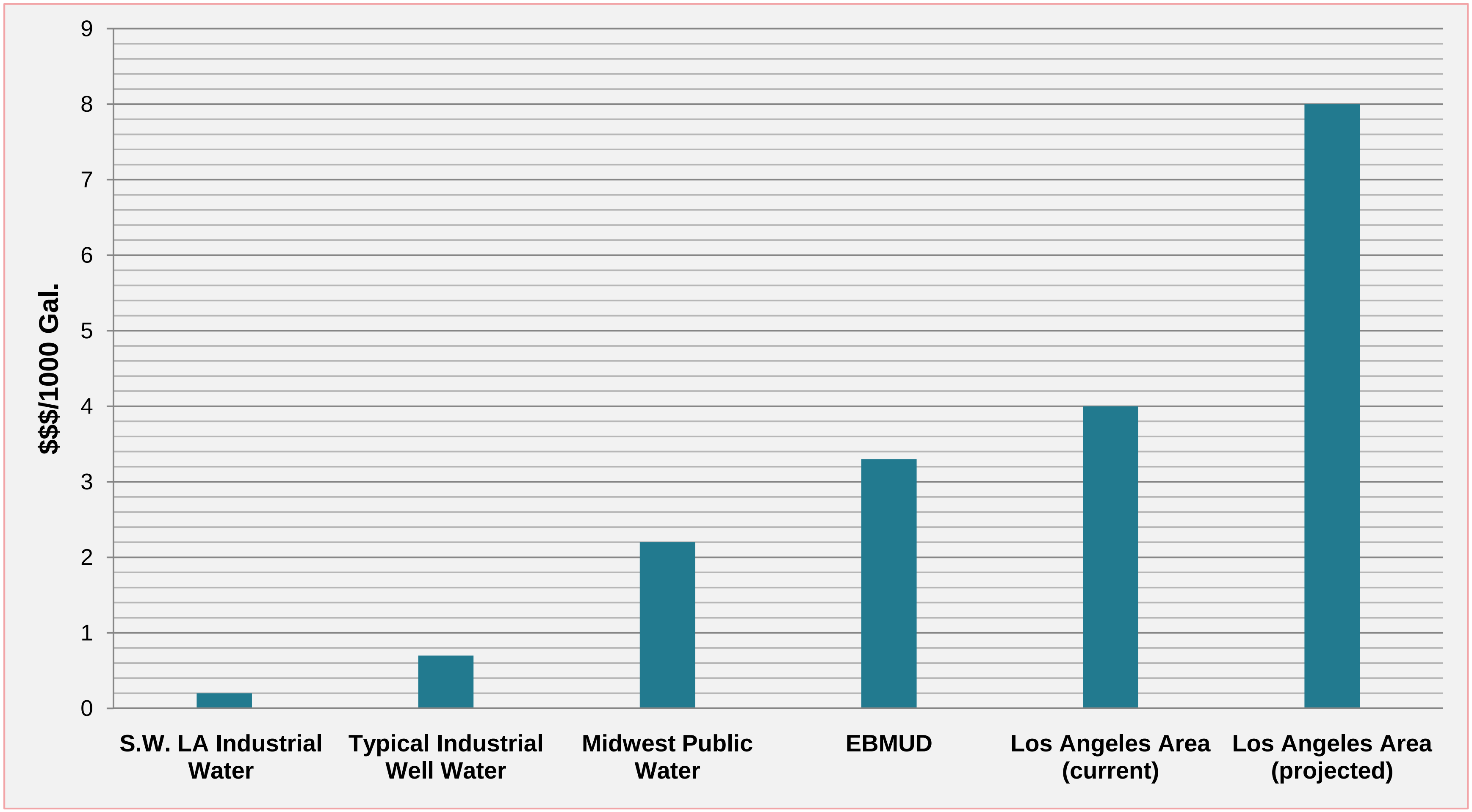
Primary Uses



The Water Used Is:



Cost Drivers



Other Drivers

- Some refineries have had to cut rates due to limited water supply.
  - Direct costs of water may be low.
  - Cost of lost production is very high.

Water Conservation Opportunities

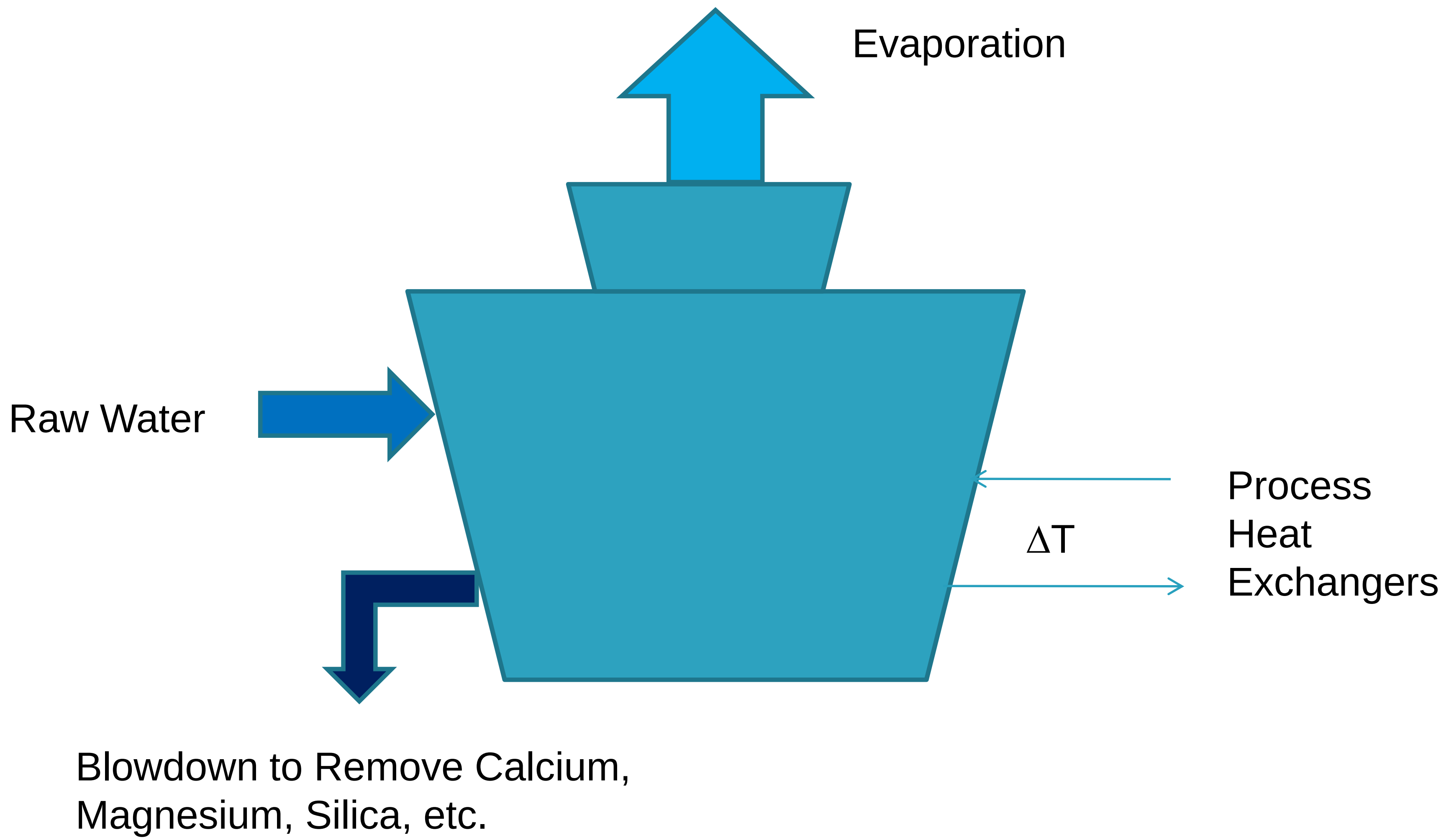
- Matching Water Quality with Process Requirements.
- Treated Municipal Wastewater Reuse Projects.
- “Zero Discharge” Concepts.

Match Water Quality with Process Requirements

- Many facilities utilize water from more than one source.
- All facilities generate reusable wastewater streams.
- Better quality water sources should be supplied to processes that can benefit from them.

Cooling Tower Example

Cooling Towers



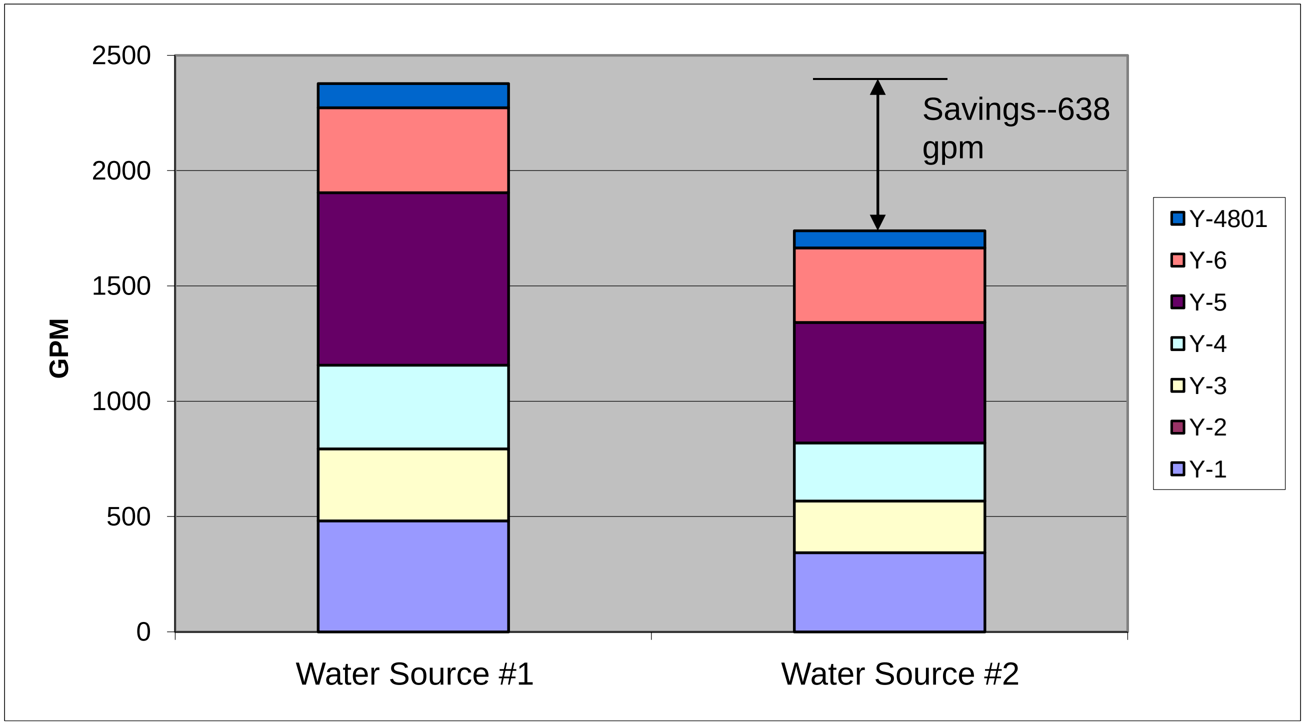
Considerations

- Cooling towers must be “blown down” to prevent problem ions from concentrating to the point that they form scale when heated in process exchangers.
- Depending on water quality, cooling tower blowdown ranges from 10 to 30% of the raw water make up rate.
- Water sources with lower problem ion concentrations result in reduced blowdown rates, resulting in water savings.
- Water with higher problem ion concentrations can still be used in processes where the water will not be heated .

Alternate Sources of Cooling Tower Make-up

- Reverse osmosis unit reject (from boiler water treatment).
- Cold steam condensate.
- Excess boiler feedwater.
- Alternate water supplies.

Cooling Tower Example

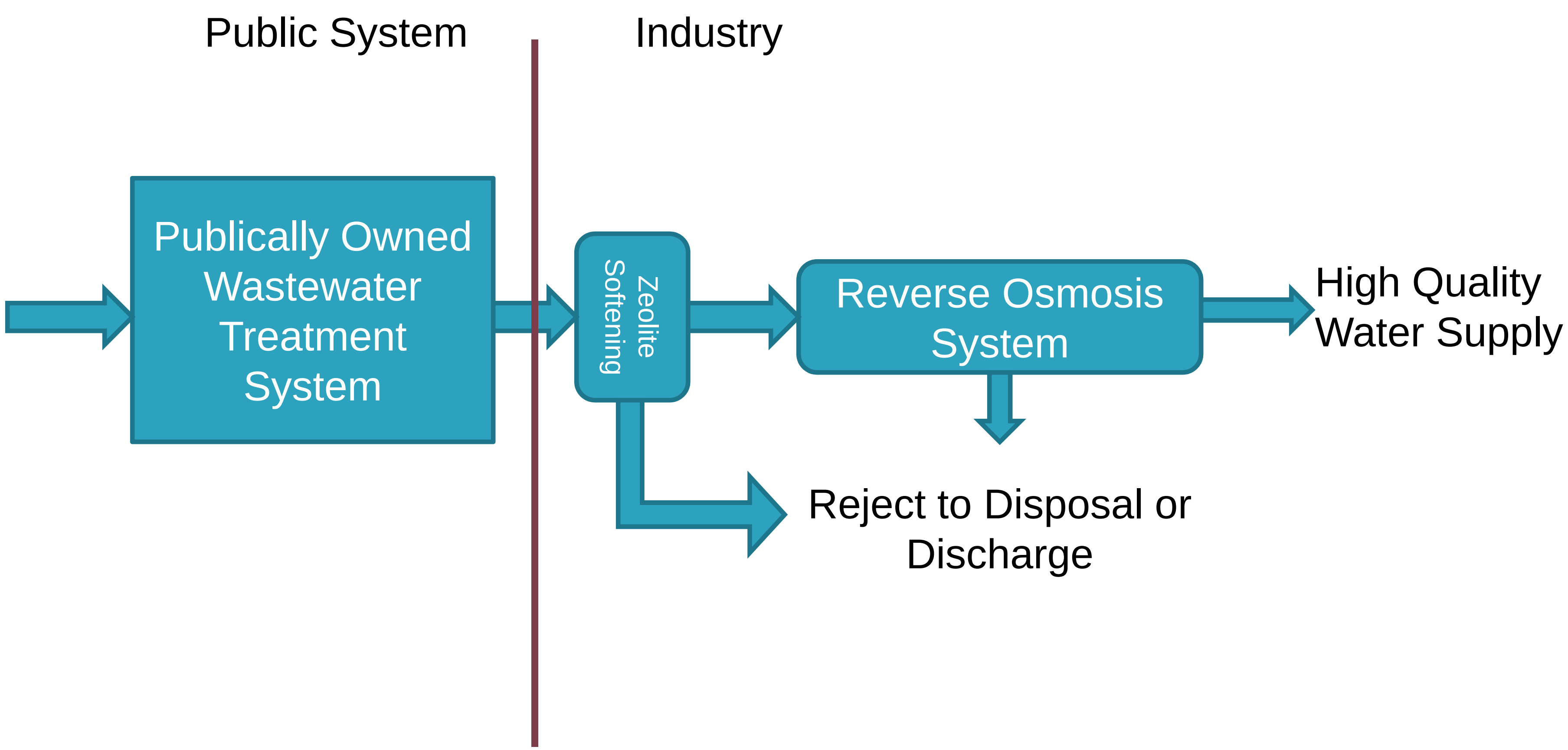


By switching to a readily available water source with lower silica concentrations (5 ppm vs. 50 ppm), water demand was reduced by over 600 gpm.

Reuse of Treated Municipal Effluent

- In some areas, municipal effluent is being provided to industry as a substitute for fresh water.
- California's East Bay Municipal Utility District has successfully implemented one project, and is planning others.
- Los Angeles and Anglian Water (U.K.) are also planning projects.

Typical Reuse Process



Benefits

- Proven technologies.
- Recovers up to 70% of municipal wastewater.
- Provides a very high quality water supply—supports low usage.

Concerns

- So far, economically feasible only with subsidies (California and the U.K.).
- Produces waste stream with high dissolved solids—disposal issues.

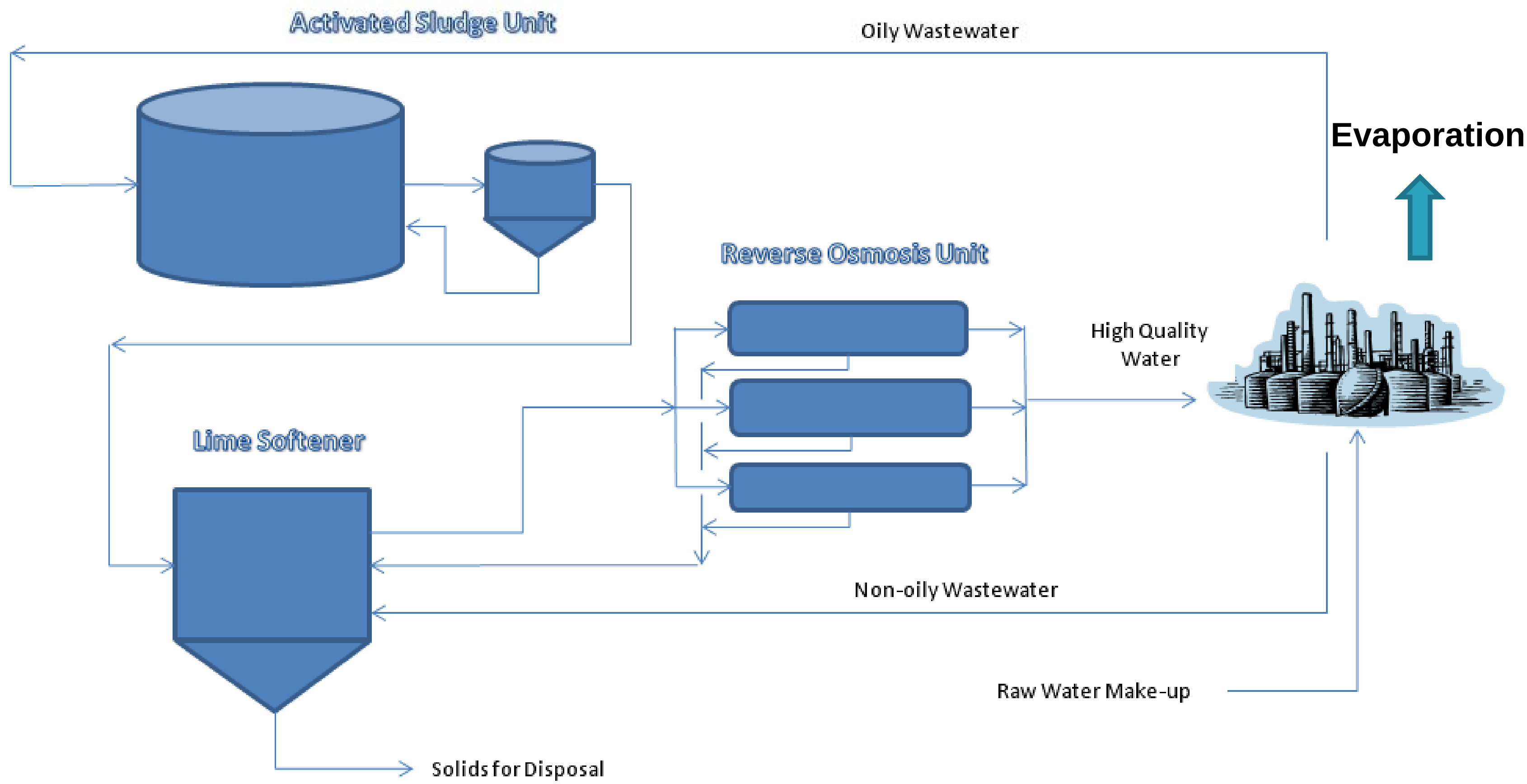
Zero Discharge Concepts

- The “zero discharge” concept has been around for many years.
- Serious planning to achieve zero discharge is just now starting to take place.
- Existing infrastructure, coupled with new technologies can bring facilities close to the zero discharge goal.

Zero Discharge Challenges

- Salts and impurities must be removed from the system.
- Make up is still required to replace large evaporation rates.

Zero Discharge Process



Summary

- Petroleum refining is a water intensive industry.
- Increasing water costs, availability, and conservation initiatives are driving the need to re-evaluate usage and supply alternatives.
- Improved water use strategies, old technologies, and newer technologies are providing opportunities.