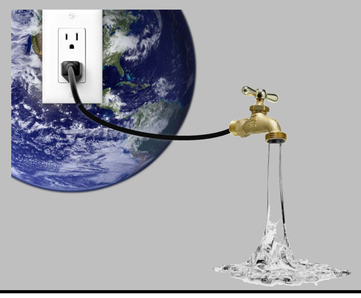

Public Water Supply: How Much Energy Does It Take?

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ABSTRACT

The delivery of reliable, high-quality water to modern cities requires energy. But how much?

As one facet of the water–energy nexus, the energy requirements of water supply have received little attention, though they carry significant implications for sustainability.

In this study we collected annual water use and energy use data from 109 water utilities in the United States. The effort is the first to compile a consistent dataset of city-scale water and energy observations that describes, with considerations for geographic and interannual variation, the electric loads associated with public water services. We found relationships to a water system's location, water source, and size.

The data contribute to several research needs in the water–energy nexus and will help advance sustainable water planning, design, and operation from an energy perspective.

INTRODUCTION

Though water on Earth is abundant, most of it is salty, frozen, underground, remote, or otherwise unsuitable for human consumption. We overcome these challenges with energy.

To date there has been little research on these important energy demands, limiting efforts to sustainably manage both water and energy resources. Our study extends previous work by contributing a national dataset of annual, city-scale water and energy observations.

METHODS

Energy intensity is the ratio of energy use to water volume—a sort of footprint—often expressed in kilowatt-hours per million gallons (kWh/MG). It is the energy required, on a whole-system basis, to produce, treat, and deliver one unit of water.

Our research collected and analyzed energy intensity observations obtained through a primary survey of U.S. water utilities.

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RESULTS

- Average energy intensity 2,500 kWh/MG, but varies significantly (Figs. 1, 4)
- Variability not considered in previous work
- Energy intensity related to:
  - Location: West more intensive than East (Figs. 1, 2)
  - Water source: Surface water least intensive (Fig. 3)
  - Size: Large systems less intensive (Fig. 5)
- Approximate log-normal distribution (Fig. 4)
- Mixed interannual variations, but net change near zero
- Poor reporting of energy data associated with water use
- Applications to government, research, policy, and water system operation

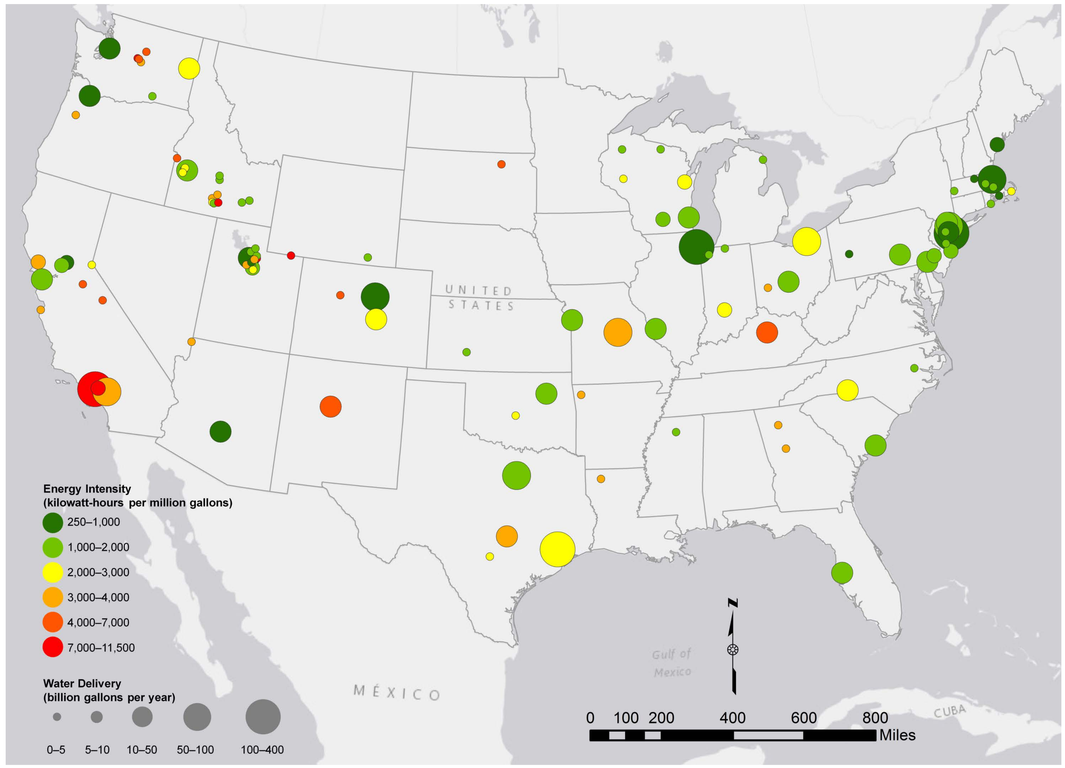

Figure 1: Geographic distribution of energy intensities for public water supply

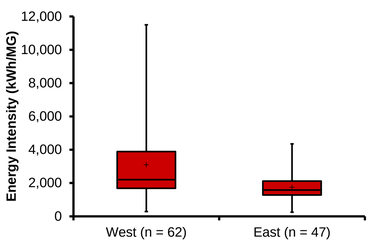

Figure 2: Energy intensity by geographic region

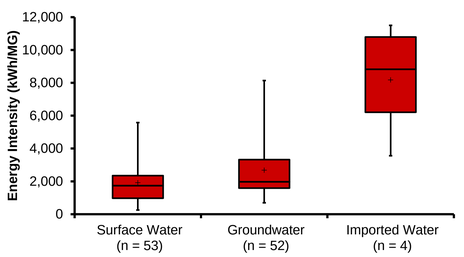

Figure 3: Energy intensity by primary water source type

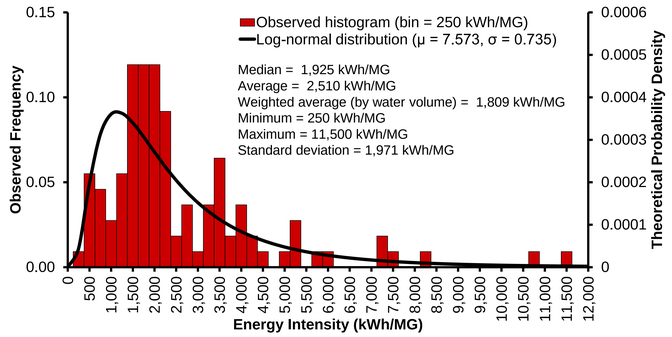

Figure 4: Histogram of energy intensities for public water supply

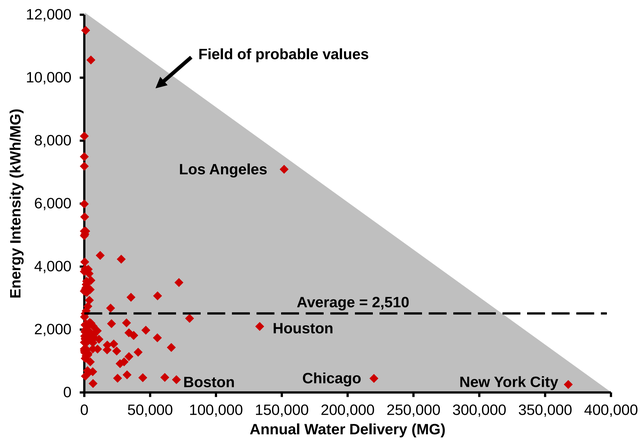

Figure 5: Energy intensity vs. water system size

RECOMMENDATIONS

- Future work should consider the geographic and temporal variability of energy intensity.
- Relationships to geography, climate, and system characteristics should be investigated.
- Water utilities should collect, at a minimum, annual water and energy data to compute energy intensities and measure improvements.

ACKNOWLEDGEMENTS

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CITATION

Sowby, Robert B., and Burian, Steven J. 2017. "Survey of Energy Requirements for Public Water Supply in the United States." *Journal – American Water Works Association* 109 (7): E320–E330.