Water Saving Devices Save More Energy Than You Think

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I'm not really talking about *non-energy* benefits

I'm talking about *embedded energy* savings

What is Embedded Energy?

- Energy required in the lifecycle of a product or service
- Our focus → water supply and treatment

Collecting,
treating,
storing,
and transporting
water and wastewater

Each step requires energy

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The Project

- Research question
  - What is embedded energy in water saving measures?
- Team
  - Donney Dorton, OG&E
  - Ray Ehrhard, Washington University
  - Kelly Parmenter and others, AEG
- Length
  - 5 months

Approach

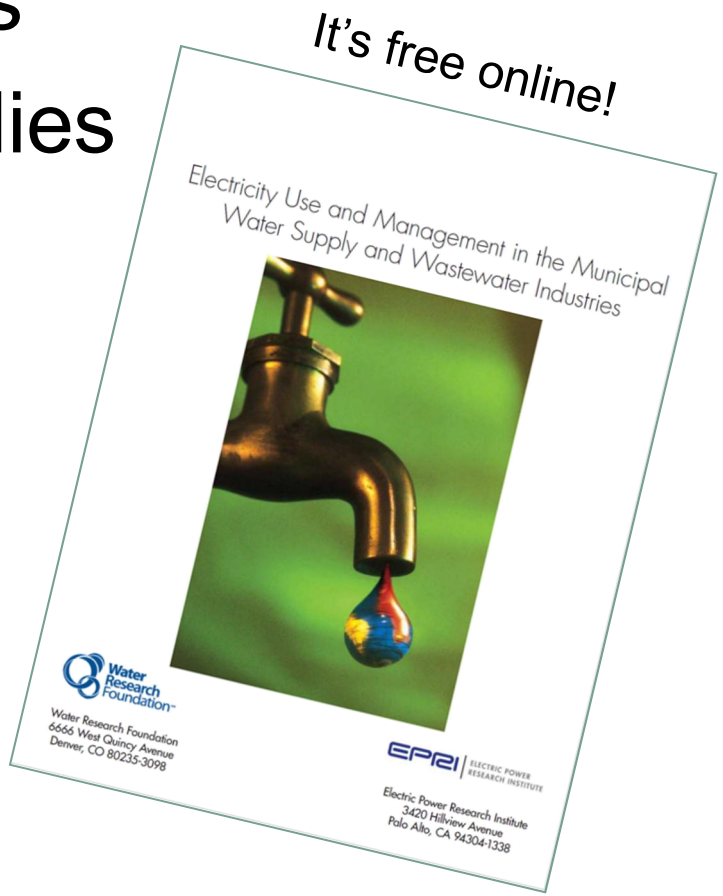
- Literature review
- Primary data collection
- Analysis of energy intensity, EI (kWh/MG)
- Recommendations

Literature Review

- Water-energy programs
- Embedded energy studies
- Industry-wide energy intensity (EI) estimates

  → Recent EPRI/WaterRF study we conducted

It's free online!



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Drinking Water EI Estimates

Estimated Average Energy Intensity by Source of Water in U.S. Public Water Supply

Source of Water	Energy Intensity (kWh/MG)
Surface	1,600
Groundwater	2,100
Desalination	12,000
Weighted U.S. Average	**2,070**

Source: *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries*, EPRI, Palo Alto, CA and WaterRF, Denver, CO: 2013.

Wastewater EI Estimates

Estimated Average Energy Intensity by Treatment Type in the U.S. Municipal Wastewater Industry

Type of Treatment	Energy Intensity (kWh/MG)
Less than secondary	750
Secondary	2,080
Greater than Secondary	2,690
No Discharge	2,960
Pumping Reuse Water	1,280
Partial	830
Weighted U.S. Average	**2,520**

Source: *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries*, EPRI, Palo Alto, CA and WaterRF, Denver, CO: 2013.

Data Collection

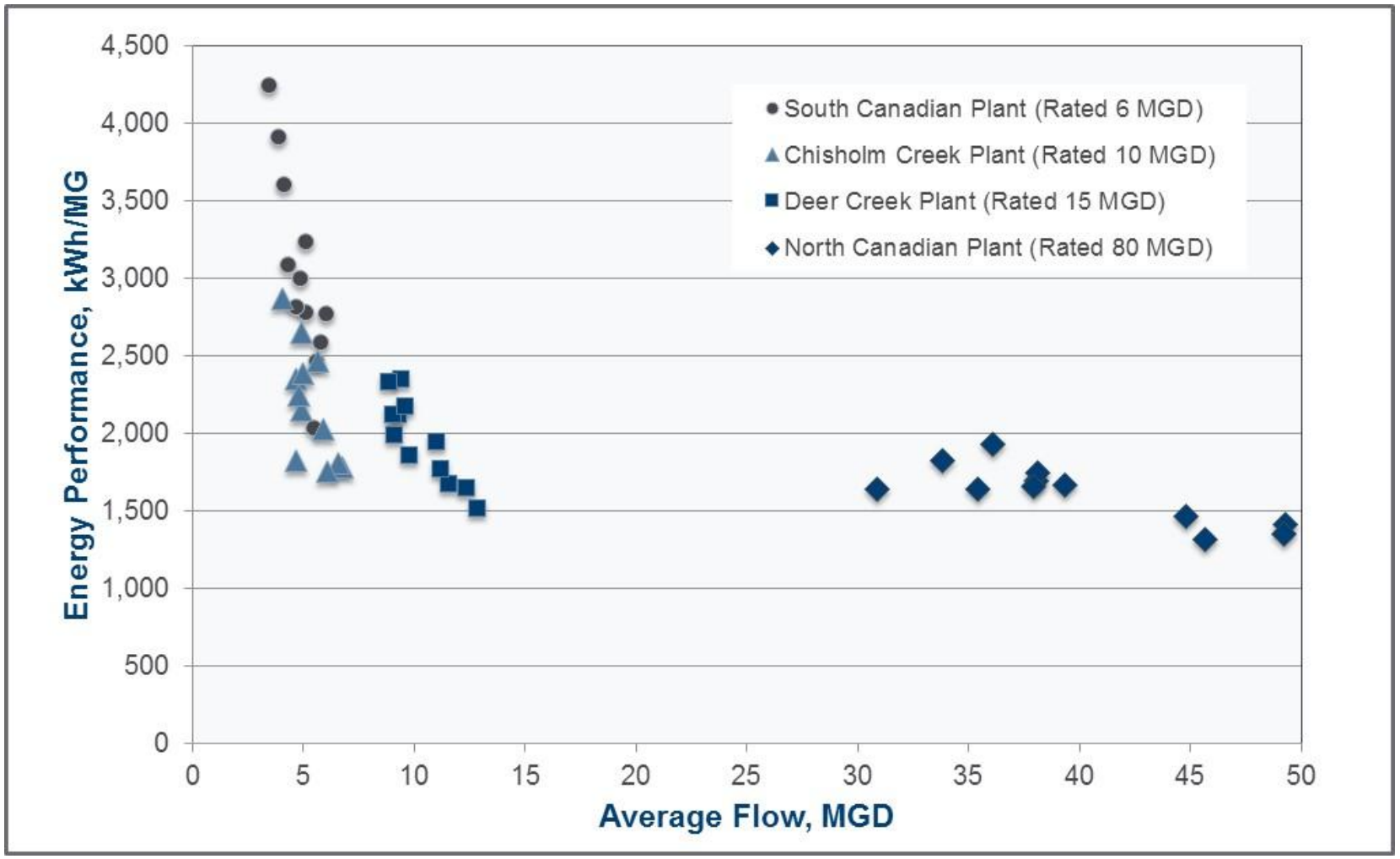
- Interviewed key W/WW agencies
  - Fort Smith, OKC, Ardmore, Muskogee
- Obtained system characteristics
  - Plant type, capacity, daily flow, number of pump stations, etc.
- Collected electricity data

Estimation of Energy Intensities

- EI values vary with
  - Treatment plant size
  - Treatment type
  - Water flow rates
  - Pumping requirements

→ *These aspects are reflected in regional variations*

Energy Intensity vs. Avg. Daily Flow, OKC's WW Treatment Plants



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Results

Location	Energy Intensity, kWh/MG		
	Drinking Water	Wastewater	Total
Oklahoma City, OK	2,996	1,806	4,802
Ardmore, OK	1,470	3,287	4,757
Muskogee, OK	1,389	2,274	3,663
Fort Smith, AR	480	1,917	2,397
Weighted Average	**2,401**	**1,914**	**4,316**

Also used the process in the EPRI/Water RF report as reality check for these findings

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Recommendation to OG&E

- For simplicity, use weighted average
  - Energy savings = 4.3 Watt-hr per gal avoided
  - Demand savings = 0.0005 W per gal avoided
- For greater accuracy, use regional values

Applied to PY 2013 and 2014 evaluation results

Figure Source: EPA

Example of Impact on Savings

Residential Faucet Aerator

Metric	Home with Electric Water Heater
Annual water savings	381 gal/yr
Embedded energy savings	(4.3 Watt-hr/gal) (381 gal/yr) = 1.6 kWh/yr
Direct energy savings	35 kWh/yr
Overall energy savings	36.6 kWh/yr
Increase in impact over direct savings alone	5%

In Closing…

- Most programs only claim direct savings
- EIs of W&WW not well known
- Embedded savings are real and quantifiable
- Approach extendable to other programs
- Deserves a place in policy discussion

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Thank you

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