IL TRM: Energy per Gallon Factor

Background Information to Inform Elevate Energy's Request to Include an Energy per Gallon Factor in the Illinois TRM

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ELEVATE ENERGY
Smarter energy use for all

Overview

Water conservation measures such as low flow showerheads, faucet aerators, and ENERGY STAR® dishwashers and appliances reduce the amount of energy that is needed to heat, cool, and pressurize water in homes and businesses (end-user energy savings). These measures also reduce the energy needed to collect, treat, and distribute potable water as well as the energy needed to collect and treat wastewater (system-wide energy savings).

While the Illinois Technical Reference Manual (IL TRM) currently includes calculations to account for the energy savings that occur at the end-user level from water conservation measures, it does not include calculations to account for the system-wide energy savings that occur when less water comes to and from a customer's premises because a natural gas or electric utility has installed a water-saving measure there. Elevate Energy proposes adding an energy per gallon factor to the IL TRM that allows utilities to capture and claim system-wide energy savings from existing TRM measures that conserve water. This factor could be applied to any measure that has a "water impact calculation" in the IL TRM and would more accurately reflect the energy savings from water conservation measures installed by both electric and natural gas utilities.

This paper outlines a recommended approach for adding an energy per gallon factor to the IL TRM to capture the system-wide energy savings from end-user water conservation measures. It also provides background information on the water-energy nexus, studies that quantify the energy embedded in water and wastewater services, and other state approaches that account for the system-wide energy savings from end-user water conservation measures.

Water-Energy Nexus

The water-energy nexus is a way to describe the interdependence between water and energy. For example, to provide a gallon of potable water to a household, energy is required to collect, treat, and deliver that gallon of water. Once the water arrives at a home or business, energy is typically needed again to heat, cool, or pressurize the water. Finally, energy is used at the end of the lifecycle when collecting, treating, and discharging wastewater back into the environment. On the flip side, water is often used in the production of energy, such as mining for fuels or using dams for electricity.[i] This paper will focus on the system-wide energy involved in providing water to and receiving wastewater from an end-user. It will also rely on the general concept that saving a gallon of water also saves energy.

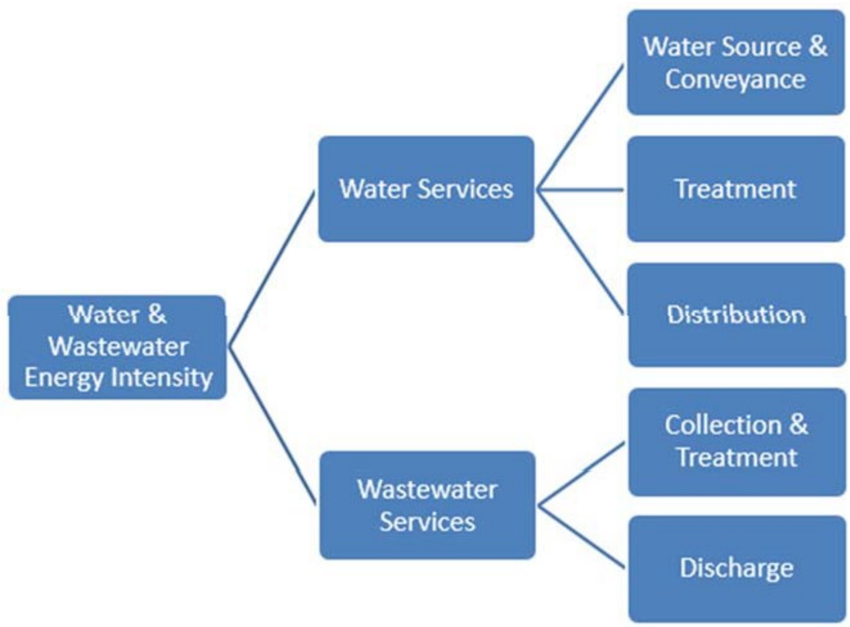
Energy Intensity Studies

Municipal water and wastewater systems use approximately 70 billion kWh of electricity annually, representing nearly 2 percent of all electricity used in the United States.[ii] Since 1996, the electricity used to provide water services has grown by 39 percent for public water systems and by 74 percent for municipal wastewater systems.[ii] Energy usage from water and wastewater treatment plants can also account for between 30 and 40 percent of a municipal government's overall energy consumption.[iii] These estimates provide important insight into the magnitude of energy that is required to provide these services and the potential energy savings that can be achieved through water conservation measures.

In the water-energy nexus literature, the term energy intensity is often defined as the "amount of energy required to treat or transport a unit of water."[iv] Energy intensity can also be thought of as the amount of energy that is embedded in a gallon of water. Some states, utilities, and communities have started to analyze the energy intensity of their water and wastewater systems as a way to better understand their consumption and to identify ways to reduce costs, achieve energy savings, and meet environmental goals.[iv] While understanding the energy involved in providing water and wastewater services is important everywhere, it can be particularly important in places with high operating costs, a growing population, energy intensive treatment technologies, and limited freshwater resources.

The image to the right displays the various ways in which energy is used to provide water and wastewater services for an end-user.[v] The energy intensity of water and wastewater services can be analyzed for a single piece of a utility system, such as for potable water treatment or distribution, or it can be analyzed for the system as a whole.[iv] Most studies report energy intensity numbers in kWh/MG or kWh/Gal,[vi] likely because electricity is the primary source of energy consumed by water and wastewater treatment facilities.[vii]

How Energy is Used to Provide Water and Wastewater Services



A full listing of the ways in which energy is used in the lifecycle of water is available in Figure 1 of the GAO's March 2011 Energy-Water Nexus Report.[v]

In 2010, the River Network published a Water-Energy Toolkit which provides an overview of how to conduct a simple energy intensity assessment of a community's water system. The toolkit shows that at its most basic level, the energy intensity of water or wastewater services can be calculated by collecting data on the total amount of energy consumed by each facility in the system (in kWh), as well as data on the total volume of water treated or delivered by each facility (in MG).[viii] If possible, energy used for lighting and other operational uses should be removed from the annual kWh total since it is not typically tied to providing or treating water and wastewater. If renewable energy such as biogas is generated onsite and used at a facility, this should also be removed (if possible) from the annual kWh use. The energy consumed by each facility should then be added together and divided by the sum of the volume of water treated and/or delivered by each facility. The resulting number will show the energy intensity of the water or wastewater system in kWh/MG.

Basic Approach to Calculating Energy Intensity

TOTAL Annual Energy Consumed by Each Water or Wastewater Facility (kWh)	/	TOTAL Volume of Water or Wastewater Provided or Treated (MG)	=	Water or Wastewater System Energy Intensity (kWh/MG)

There are a number of different factors that can impact the energy intensity of a water or wastewater system.

The energy required to source, convey, and distribute water is affected by distribution length, pipe material and age, topography, system pressure, and pumping volumes.[iv] For example, the distribution of water can become more energy intensive when a system must move water over long distances, up high elevations, or through pipes that are old and leaky. It is also more energy intensive to pump water out of the ground as opposed to sourcing it from a gravity-fed surface water source.[vi]

When looking specifically at the treatment of water and wastewater, the quality of the source of water and discharge requirements can impact the level of treatment and energy required.[vii] In general, more advanced treatment methods are the most energy intensive. For drinking water treatment, desalination and distillation are the most energy intensive processes, while surface water and groundwater treatment require the least amount of energy per unit treated. Surface water treatment is typically more energy intensive than groundwater treatment because solids and organics must be removed prior to distribution. At wastewater treatment plants, advanced wastewater treatment with nitrification is the most energy intensive process, while trickling filter is the least intensive.[vi]

Beyond a system's distribution characteristics and the type of water treatment technology being used, the size of a wastewater treatment facility is also important when looking at a facility's energy intensity. Due to economies of scale, larger wastewater treatment plants use less energy than smaller facilities. In fact, a 10 million gallon per day (MGD) wastewater treatment facility "requires 50–60% less energy [per unit of water] than a 1 MGD facility."[vi] In terms of drinking water utilities, a 2012 pilot study conducted by the Illinois Section American Water Works Association (ISAWWA) found that large and medium utilities use less electricity per unit than smaller drinking water utilities in Illinois.[ix] Data published in Wisconsin's 2016 Water & Wastewater Industry Energy Best Practices Guidebook[x] also show that larger water utilities (those serving 4,000 or more customers), use less energy per unit of water than smaller water utilities (those serving 4,000 or less customers).

Since the early 2000s, a limited number of states (California, Iowa, Illinois, Massachusetts, New York, and Wisconsin) and national studies have assessed the energy intensity of water and wastewater services. The tables below summarize the findings from these studies and provide a glimpse into some of the differences in intensity values across geographic location, treatment type, and source water type.

Table 1: Energy Intensity for Water Supply and Distribution

State/Region	*Intensity (kWh/MG)*	*Report Year*	*Data Description*
California (Northern)[xi]	3,500	2006	Water Supply and Conveyance, Water Treatment, and Water Distribution
California (Southern)[xi]	11,110	2006	Water Supply and Conveyance, Water Treatment, and Water Distribution
Iowa[xii]	2,740 (primarily groundwater facilities)	2002	Energy Intensity of Plants and Distribution in Iowa
Illinois[ix]	866 (Lake Michigan) 2,019 (surface) 2,844 (groundwater)	2012	Energy Intensity of Water Production

Massachusetts[xiii]	1,500	2007	Water Treatment and Distribution
New York[xiv]	470 – 1,380 (surface) 820 – 1,060 (groundwater)	2008	Raw Water Pumping, Treatment, and Finished Water Distribution
Wisconsin[x]	2,160 (surface) 2,010 (groundwater)	2016	Energy Use Rates at Drinking Water Utilities in Wisconsin
National Estimate for U.S. Public Water Supply Industry[ii]	1,600 (surface) 2,100 (groundwater) 12,000 (desalination)	2013	Estimated Electric Energy Use by System Type and Source Water

Table 2: Energy Intensity for Wastewater Treatment

State/Region	***Intensity (kWh/MG)***	***Report Year***	***Data Description***
California (Northern)[xi]	1,911	2006	Wastewater Treatment
California (Southern)[xi]	1,911	2006	Wastewater Treatment
Iowa[xii]	1,570	2002	Energy Intensity of Plant and Distribution in Iowa
Massachusetts[xiii]	1,750	2007	Wastewater Treatment (does not include distribution)
New York[xiv]	1,480	2008	Collection, Conveyance, Treatment, and Satellite System Energy Use
Wisconsin[x]	3,954 (activated sludge) 7,288 (aerated lagoon) 3,895 (oxidation ditch)	2016	Energy Use at Wisconsin Wastewater Facilities
Average Intensities for Various Wastewater Treatment Plant Types[ii]	673 – 1,811 (trickling filter) 1,028 – 2,236 (activated sludge) 1,188 – 2,596 (advanced without nitrification) 1,588 – 2,951 (advanced with nitrification)	2009	Intensity Values Vary by Average Flow (MGD) (energy intensity decreases the larger the average flow rate)
National Estimate for Municipal Wastewater Industry[ii]	750 (less than secondary) 2,080 (secondary) 2,690 (greater than secondary) 2,960 (no discharge)	2013	Electrical Energy Intensity by Treatment Type

Water and Wastewater Services in Illinois

The energy intensity literature highlights how the energy required to provide water and wastewater services is impacted by the size of population served, daily flow rates, treatment types employed, and the source of water being treated. Given the importance of these factors, this section describes the water and wastewater sector in

Illinois using publicly available reports and datasets. It also highlights in detail previously conducted energy intensity research for water and wastewater systems in Illinois.

Water Supply

In Illinois, approximately 12 million people receive drinking water from a community water supply.[xv] Of the state's community water supply systems, 36% serve a population between 0 and 500, 38% between 501 and 3,300, 13% between 3,301 and 10,000, and 13% greater than 10,000.[xvi] When looking at drinking water statistics by water source, 67% of community water suppliers are either groundwater-dependent or purchase groundwater, while 33% are surface water-dependent or purchase surface water.[xv]

While community water suppliers in Illinois do not publicly report their energy usage on an annual basis, a 2012 pilot study conducted by the ISAWWA provides a useful overview of the energy intensity of Illinois's water supplies by water source and utility size.[ix] The ISAWWA study collected usable surveys from 44 water utilities of varying sizes in Illinois to learn about their annual energy consumption and costs, treatment type, water source, and operating budget. The study accounts for the energy intensity of water suppliers serving 42% of Illinois' population.[ix] Key findings from the study are included below.

Energy Intensity of Water Production (2012 ISAWWA Study)[ix]

Utility Type	*Utility Size*	*# Respondents*	*Mean Intensity (kWh/MG)*
Large	> 15,000 service connections	7	1,621
Medium	5,000 to 15,000 service connections	15	1,560
Small	< 5,000 service connections	17	2,912
Wholesaler		3	1,946

Note: Energy intensity values only include electricity.

Energy Intensity by Water Source (2012 ISAWWA Study)[ix]

Utility Water Source	*# Respondents*	*Mean Intensity (kWh/MG)*	*National Intensity Estimate (kWh/MG)[ii]*
Groundwater	17	2,844	2,100
Lake Michigan	17	866	--
Surface	7	2,019	1,600

Note: Energy intensity values only include electricity. Surface water value does not include Lake Michigan.

As shown above, the Illinois study found that larger water utilities (those with 5,000 connections or greater) and surface water utilities use the least amount of energy to provide water for their customers, while smaller utilities, wholesalers, and those using groundwater tend to be the most energy intensive.

In comparison to the 2013 national energy intensity averages for the U.S. Public Water Supply by source type, Illinois' surface water intensity (2,019 kWh/MG) is slightly higher than the national average (1,600 kWh/MG), while the Lake Michigan average (866 kWh/MG) is lower than the national surface water average (1,600 kWh/MG). The Illinois groundwater average (2,844 kWh/MG) is slightly higher than the national groundwater average (2,100 kWh/MG).

Wastewater Treatment

According to the EPA's 2012 Clean Watershed Needs Survey, more than 11 million people in Illinois are served by a publicly owned wastewater treatment plant.[xvii] There are 416 publicly owned wastewater treatment plants in Illinois, and more than half (56%) provide greater than secondary treatment, 41.6% provide secondary treatment, and 2.4% have no discharge. In terms of flow rates, 15.9% of all publicly owned wastewater treatment plants in Illinois have a flow of less than or equal to 0.1 MGD, 51.2% between 0.1 and 1.0 MGD, 27.2% between 1.001 MGD and 10.0 MGD, and 5.8% have a flow greater than 10.0 MGD. Finally, 30.8% of these facilities serve a population greater than 10,000 people, 22.4% between 3,500 and 9,999, 32% between 1,000 and 3,499, and 14.9% less than 1,000.[xvii]

While a state-wide energy intensity study for wastewater treatment plants in Illinois does not currently exist, the Metropolitan Water Reclamation District of Greater Chicago (MWRD) conducted an energy intensity analysis of its system using reclamation, collection, and water management energy use data from 2005-2009.[xviii] MWRD serves a geographic footprint of more than 5 million people in Illinois, including residents in Chicago and from 128 suburban communities. There are seven wastewater treatment plants in MWRD's footprint with a combined daily flow of 1.4 billion gallons. MWRD's Stickney Water Reclamation Plant (WRP) is the largest wastewater treatment facility in the world.[xix]

The table below summarizes the energy intensity findings from MWRD's 2005-2009 analysis. During the time of this study, MWRD had an average flow of 1,310 MGD at its seven treatment plants (four were secondary treatment plants and three had tertiary or advanced treatment in place). More than 92 percent of the energy used by the system during this period went toward reclamation activities, 7 percent toward collection, and 0.9 percent toward water management activities.[xviii] Note that all values provided in the table below (in kWh/MG) are based on flow treated at MWRD plants from 2005-2009. The waterway management average intensity includes electricity use; the collection average includes electricity and natural gas use; and the reclamation average includes electricity, natural gas, and biogas use. All numbers were provided by MWRD.

Energy Intensity of MWRD Collection, Reclamation, and Water Management Activities[xviii]

Activity	***Average Intensity kWh/MG***
Waterway Management	18
Collection	138
Reclamation	1,822
Combined Average	1,978

When comparing MWRD's overall energy intensity average (1,978 kWh/MG) to that of national estimates (see Table 2), it is within the 2009 average intensity range for wastewater treatment plants with advanced treatment with nitrification (1,588 – 2,951 kWh/MG) and those with advanced treatment without nitrification (1,188 – 2,596 kWh/MG). However, MWRD's average intensity is slightly lower than the 2013 national average for facilities with greater than secondary treatment (2,690 kWh/MG).

Accounting for System-Wide Energy Savings

The ISAWWA study and MWRD analysis show that a significant amount of energy is used to provide water and wastewater services to Illinois residents. As a result, water conservation measures represent a significant opportunity to reduce energy use in Illinois. In fact, a report by the California Energy Commission found that energy savings from water conservation measures could achieve "95 percent of the savings expected from [their] 2006-2008 energy efficiency programs, at 58 percent of the cost."[xx]

A number of national, state, and local studies have assessed the potential for system-wide energy savings and greenhouse gas emission reductions that can result from water conservation measures installed on the end-user side. A 2009 study for the Colorado Water Conservation Board found that if half of Denver's residents upgraded their washers, faucets, dishwashers, and showerheads with water-efficient devices, the water saved would result in system-wide energy savings of 201,700 MWh and in the reduction of 274,000 metric tons of CO_2.[xxi] A study conducted in Canada found that increases in water efficiency on the residential side could results in an overall reduction in municipal energy consumption by 330,000 MWh/year in the Province of Ontario.[xxii] At the national level, a River Network report estimates that water conservation upgrades in every American household (major fixtures and appliances) would result in 9.1 million MWh in indirect energy savings per year and in the reduction of 5.6 million metric tons of CO_2.[xxiii]

While the system-wide energy savings from water conservation measures can be significant, most states only provide guidance on how to calculate direct energy savings from water conservation measures. Few states provide a method by which utilities can claim more robust, system-wide energy savings from water conservation measures. According to a 2018 study conducted by the American Council for an Energy Efficient Economy (ACEEE), twelve states currently provide guidance on how to quantify the non-energy benefits achieved from the avoided cost of water.[xxiv] However, this guidance is typically only informed by average water and sewer rates and typically does not consider the embedded energy in providing or treating a gallon of water. ACEEE's research did find that the DC's Sustainable Energy Utility and Wisconsin's Focus on Energy Program are able to value system-wide energy savings (savings associated with water supplied and wastewater treated) from water conservation measures.[xxiv] The State of California, through its Public Utilities Commission (CPUC), has also been studying the water-energy nexus for more than a decade, including how to value system-wide energy savings. Although the CPUC has not finalized guidance for how "cost effectiveness should be analyzed for water/energy nexus programs," it has developed a water energy calculator and model for valuing avoided water capacity cost.[xxv]

The Wisconsin Approach

In 2015, Wisconsin's Public Service Commission (PSC) provided guidance to Focus on Energy and other voluntary utility programs for estimating system-wide energy savings from water conservation measures installed on the end-user side, e.g., low flow showerheads and aerators.[xxvi] It is useful to understand Wisconsin's approach when developing guidelines in Illinois since Wisconsin also relies on surface and groundwater sources at its water supply utilities, has a mix of urban and rural water and wastewater systems, and is one of the few places where system-wide energy savings from water conservation measures can be claimed.

To develop its guidance, Wisconsin analyzed energy use data for water and wastewater facilities in Wisconsin and averages available at the national level. The PSC ultimately decided to use annual energy use averages from Wisconsin's water supply facilities in 2013 and a survey of energy usage at Wisconsin wastewater treatment plants to develop an “energy use per gallon of water processed” ratio for calculating system-wide savings. One ratio was created for water conservation measures that result in energy savings for water supplied and another for measures that achieve savings for wastewater processed. The ratios also account for the percent of water supply facilities in Wisconsin that rely on groundwater and surface water as well as the mixture of wastewater treatment facilities in the state.[xxvi] A description of both ratios is included below.

- **Water Supply Utilities**: To develop a ratio for measures impacting water supplied, PSC staff first created a kWh per 1,000 gallons of water supplied value for groundwater and surface water utilities in Wisconsin (2.05 kWh/1,000 gal and 1.98 kWh/1,000 gal, respectively). This ratio was developed based on annual energy use data that water utilities are required to submit to the PSC each year. Since 55 percent of the total water supplied in Wisconsin is from groundwater and 45 percent from surface water, a weighted kWh per 1,000 gallons value was then created for groundwater and surface water supplied. Below are Wisconsin’s initial ratios for groundwater and surface water supplied and the weighted ratios based on the percent of source water supplied in Wisconsin.

    - Groundwater: 2.05 kWh/1,000 gallons x 55 percent = 1.13 kWh per 1,000 gallons
    - Surface Water: 1.98 kWh/1,000 gallons x 45 percent = 0.89 kWh per 1,000 gallons

  From there, both the weighted groundwater and surface water values (1.13 kWh and 0.89 kWh) were added together to create a blended “water supply kWh per 1,000 gallons” ratio, although the non-weighted water supply values can be used for custom measures.

    - **WI Water Supply Ratio**: 2.02 kWh per 1,000 gallons[xxvi]

- **Wastewater Treatment Utilities**: To develop a ratio for measures impacting wastewater processed, PSC staff first created a kWh per 1,000 gallons of wastewater treated value for the wastewater treatment systems in Wisconsin. Although Wisconsin does not have access to annual wastewater energy data like it does for its water supply utilities, PSC staff was able to rely on a study which analyzed the energy usage at 85 wastewater facilities in Wisconsin. Since 2 percent of wastewater in Wisconsin is treated by activated sludge facilities (0-1 MGD), 73 percent by activated sludge (> 1 MGD), and 25 percent by aerated lagoon and oxidation ditch facilities, a weighted kWh per 1,000 gallons value was then created for the different type of wastewater systems and their flow rates.

    - Activated sludge (0 to 1 MGD): 5.44 kWh/1,000 gallons x 2 percent = 0.11 kWh per 1,000 gallons
    - Activated sludge (> 1 MGD): 2.40 kWh/1,000 gallons x 73 percent = 1.75 kWh per 1,000 gallons
    - Aerated lagoon and oxidation ditch: 7.09 kWh/1,000 gallon x 25 percent = 1.77 kWh per 1,000 gallons

  From there, both the weighted activated sludge values, along with the aerated lagoon and oxidation ditch values, were added together to create a blended “wastewater kWh per 1,000 gallons” value, although the non-weighted wastewater system values can be used for custom measures.

    - **WI Wastewater Ratio**: 3.63 kWh per 1,000 gallons[xxvi]

After creating both the blended ratios for measures impacting water and wastewater utilities (2.02kWh per 1,000 gallons and 3.63 kWh per 1,000 gallons, respectively), Wisconsin PSC staff added the values together to create one blended ratio:

- **WI Blended Ratio:** 5.65 kWh per 1,000 gallons[xxvi]

This ratio (5.65 kWh per 1,000 gallons) can be applied to projects where utilities install prescriptive measures such as low flow showerheads and aerators.[xxvi]

Recommended Approach for Illinois

The existing TRM does not include any mechanism by which to count the reductions in energy use when the local water and wastewater utilities pump less water coming to and from the customer's premises because a natural gas or electric utility has installed a water-saving measure there. These savings are a natural result of the installation of these measures and natural gas and electric utilities in Illinois should be able to count these savings toward their statutory efficiency goals when they install water-saving measures.

The TRM includes a Water Impact Calculation in the TRM measure characterizations for water-saving measures, which calculates the gallons of water saved by the measure (TRM v. 6.0, Vol. 1, Sec. 2.2. at Pg. 24 (general template); ex. TRM v. 6.0, Vol. 3, Sec. 5.4.4. at Pg. 185-85 (Aerators)). The gallons of water saved can be used in the TRC calculations to assist in valuing the water saved. However, there is no subsequent energy per gallon ratio to calculate the amount of energy saved.

An energy per gallon ratio can be created for the TRM using available guidance from the State of Wisconsin for valuing system-wide (indirect) energy savings from water conservation measures. The Illinois energy per gallon ratios are listed below, along with a description of how to apply these ratios to various Water Impact Measures listed in the TRM.

Illinois Energy per Gallon Factor for Water Supplied

Water Source	*kWh/MG*	*% of Total IL Water Supplied*	*Weighted kWh/MG*
Groundwater	2,844	67%	1,905
Surface Water	2,019	33%	666
		Water Supply kWh/MG	2,571

The Illinois Energy per Gallon Factor for Water Supplied was created using energy intensity use data from the ISAWWA study which analyzed energy intensity usage at 44 water utilities in Illinois, including by type of source water. The percent of total Illinois water supplied by source type was then applied to the energy intensity numbers from the ISAWWA study to create a weighted kWh/MG of water supplied ratio (2,571 kWh/MG).

Illinois Energy per Gallon Factor for Wastewater Processed

Wastewater System Type	*kWh/MG*	*% of Total IL Wastewater Treated*	*Weighted kWh/MG*
Secondary Treatment	2,080	42%	874
Greater than Secondary Treatment	2,690	56%	1,506
No Discharge	2,960	2%	59
		Wastewater kWh/MG	2,439

In the absence of a statewide survey of energy usage at wastewater treatment plants in Illinois, the Illinois Energy per Gallon Factor for Wastewater Processed was created using national energy intensity use estimates[ii] by treatment type. The percent of total Illinois wastewater treated by secondary, greater than secondary, and no discharge systems was then applied to the national energy use estimates to create a weighted kWh/MG of wastewater processed ratio (2,439 kWh/MG).

Illinois Energy per Gallon Factors for Calculating System-Wide Energy Savings from Water Impact Measures

Water Supply Factor	Wastewater Supply Factor	IL Energy per Gallon Factor
2,571 (kWh/MG)	2,439 (kWh/MG)	5,010 (kWh/MG)

The weighted water supply and wastewater factors were then added together to create a single, Illinois Energy per Gallon factor (5,010 kWh/MG) that can be used to calculate the system-wide (indirect) energy savings from Water Impact measures listed in the Illinois TRM. There are currently twelve existing measures that have a Water Impact calculation for which system-wide energy savings can be valued.

Illinois TRM Measures containing a Water Impact Calculation

Commercial and Industrial Measures	*Residential Measures*
4.2.3 Commercial Steam Cooker 4.2.6 ENERGY STAR® Dishwasher 4.2.11 High Efficiency Pre-Rinse Spray Valve 4.3.2 Low Flow Faucet Aerators 4.3.3 Low Flow Showerheads 4.3.4 Commercial Pool Covers 4.3.6 Ozone Laundry	5.1.2 ENERGY STAR® Most Efficient Clothes Washers 5.1.4 ENERGY STAR® Dishwasher 5.4.4 Low Flow Faucet Aerators 5.4.5 Low Flow Showerheads 5.4.8 Thermostatic Restrictor Shower Valve

The 5,010 kWh/MG Illinois Energy per Gallon Factor can be applied directly to the gallons of water saved calculated in the Water Impact Calculations for all measures except Commercial Steam Cookers and Commercial Pool Covers.

- Since the Commercial Steam Cooker does not discharge its water into the wastewater system, it should use only the 2,571 kWh/MG Water Supply Factor.
- Since the Commercial Pool Cover also does not discharge its water into the wastewater system, it should only use the 2,571 kWh/MG Water Supply Factor.

The Water Impact Calculations for Low Flow Faucet Aerators use a Drain Factor to account for the portion of the supplied water not entering the wastewater stream. In all other cases, all the water supplied is assumed to also enter the wastewater stream.

Future Updates to the Illinois Energy per Gallon Factor

In future years, the Illinois Energy per Gallon Factor can be updated by incorporating additional and current energy and flow data from water supply utilities in Illinois, and initial energy and flow data from wastewater utilities in Illinois with varying treatment types.

TRC Implications

The TRM includes parameter values for “water and other resources savings” to support cost-effectiveness calculations, which must include avoided costs associated with reduced water consumption (IL Energy Efficiency Policy Manual, Pg. 23; TRM v. 6.0, Vol. 1, sec. 1.4.0. at Pg. 20). The Water Impact Calculations, which determine how many gallons have been saved, help determine the TRC-test benefits of water-savings measures. Our understanding is that TRC calculations are a function of the Water Impact Calculation and a price of water and wastewater services, which may include the cost of energy used to collect, treat, and distribute water and wastewater. Consequently, we understand that there may be a double-counting issue relevant to the current TRC calculation and agree that this issue would be best addressed on a parallel path at the Stakeholder Advisory Group's Policy Committee.

The need for clarity in the TRC calculation should not prevent the addition of an energy-per-gallon factor to the TRM, because it is independent of the TRC calculation, is used for a different purpose, and is not in danger of improper double counting. The TRC calculation, while it may have some overlapping terms, does not determine the value of the TRM savings calculation. The TRC benefits calculation is used to determine if a measure is appropriate for inclusion in a program portfolio, while the TRM calculations determine how much savings can be counted toward the utilities' statutory goals. And, energy captured by the proposed factor is not currently included in the TRM manual's savings calculations. Consequently, including a factor to account for the energy used to collect, treat, and distribute water and wastewater would not result in artificially inflated, or double-counted, savings, but would instead make that calculation more accurate by ensuring that energy savings caused by the utilities' installation of a water-savings measure are counted toward the utilities' statutory goals.

Conclusion

While the Illinois TRM does not currently allow electric and natural gas utilities to claim system-wide energy savings from water conservation measures, an energy per gallon factor for Illinois can be created using available guidance from Wisconsin, along with state-wide energy usage data from water utilities in Illinois, and national estimates of energy usage by wastewater treatment type. Elevate Energy recommends using a single, Illinois Energy per Gallon factor of 5,010 kWh/MG to calculate the system-wide (indirect) energy savings from Water Impact measures listed in the TRM. This ratio can be used by electric and natural gas utilities installing measures in the TRM with a Water Impact Calculation. This ratio can also be updated in future years using current and additional energy usage data from Illinois water and wastewater treatment facilities.

Accounting for the system-wide energy savings from water conservation measures is important because it will allow electric and natural gas utilities to more fully account for the energy savings from the water-saving devices they install. It may also encourage utilities to implement more robust and wide-scale water conservation programs for Illinois residents and businesses. Additional reductions in energy usage through water conservation will ultimately reduce greenhouse gas emissions, the cost of providing water services, and the amount of money Illinois households and businesses spend on utility bills.

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[i] Moniz, Ernest. "Ensuring the Resiliency of Our Future Water and Energy Systems." Department of Energy, 18 June 2014, www.energy.gov/articles/ensuring-resiliency-our-future-water-and-energy-systems.
[ii] Electric Power Research Institute, and Water Research Foundation. *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries*. Palo Alto: EPRI, 2013. 3002001433.
[iii] United States Environmental Protection Agency. "Energy Efficiency for Water Utilities." *United States Environmental Protection Agency*, https://www.epa.gov/sustainable-water-infrastructure/energy-efficiency-water-utilities

[iv] Hallett, Kathleen. “ASME 2011 International Mechanical Engineering Congress and Exposition.” ASME, *Energy Intensity of Water: Literature Suggests Increasing Interest Despite Limited and Inconsistent Data*, vol. 1, 2011, pp. 409–419.
[v] United States, Congress, Government Accountability Office, et al. “Energy-Water Nexus - Amount of Energy Needed to Supply, Use, and Treat Water Is Location-Specific and Can Be Reduced by Certain Technologies and Approaches.” GAO, 2011.
[vi] Jones, Steven, and Robert Sowby. “Quantifying Energy Use in the U.S. Public Water Industry - A Summary.” *EWRI Currents*, vol. 16, no. 4, 2014.
[vii] Copeland, Claudia, and Nicole Carter. *Energy-Water Nexus: The Water Sector’s Energy Use*. Congressional Research Service, 2017.
[viii] Griffiths-Sattenspiel, Bevan. *Water Energy Toolkit: Understanding the Carbon Footprint of Your Water Use*. River Network, 2010.
[ix] *Water-Energy Nexus Survey Summary Report*. Illinois Section American Water Works Association Water Efficiency Committee, March 2012.
[x] *Energy Best Practices Guide: Water and Wastewater Industry*. Wisconsin Focus on Energy, 2016.
[xi] Navigant Consulting, Inc. *Refining Estimates of Water-Related Energy Use in California*. Sacramento: California Energy Commission, 2006. CEC-500-2006-118.
[xii] *Energy Consumption and Costs to Treat Water and Wastewater in Iowa, Part I: An Overview of Energy Consumption and Treatment Costs in Iowa*, Iowa Association of Municipal Utilities, 2002.
[xiii] *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*, United States Environmental Protection Agency, January 2008.
[xiv] Malcolm Pirne. *Statewide Assessment of Energy Use by the Municipal Water and Wastewater Sector*. New York State Energy Research and Development Authority, 2008. Final Report 08-17.
[xv] *Annual Groundwater and Drinking Water Program Review*, State of Illinois Environmental Protection Agency, June 2017.
[xvi] Information obtained from the US EPA’s SDWIS Fed Reporting Services system at https://ofmpub.epa.gov/apex/sfdw/f?p=108:200::::::
[xvii] United States, Congress, USEPA. “Clean Watersheds Needs Survey (CWNS) – 2012 Report and Data.” United States Environmental Protection Agency, Office of Water, 2012.
[xviii] Kozak, Joseph, and Mulvaney, Peter. “The Energy of the Urban Water Cycle in Greater Chicago.” Illinois Water Environment Association/Central States Water Environment Association Government Affairs Conference, 2012, Willowbrook, IL.
[xix] Metropolitan Water Reclamation District of Greater Chicago. “Water Reclamation Plants.” MWRDGC, www.mwrd.org/irj/portal/anonymous/waterreclamation.
[xx] Klein, Gary, et al. *California's Water – Energy Relationship*. Sacramento: California Energy Commission, 2005. CEC-700-2005-011-SF.
[xxi] Tellinghuisen, Stacy. *Water Conservation = Energy Conservation: A Report for the CWCB*. Western Resource Advocates, June 2009.
[xxii] Mass, Carol. *Greenhouse Gas and Energy Co-Benefits of Water Conservation*. POLIS Research Report, March 2009.
[xxiii] Griffiths-Sattenspiel, Bevan, and Wilson, Wendy. *The Carbon Footprint of Water*. River Network, May 2009.
[xxiv] Berg, Weston, and Ribeiro, David. *Saving Watts to Save Drops: Inclusion of Water Efficiency in Energy Efficiency Programs*. American Council for and Energy Efficient Economy, January 2018.
[xxv] California Public Utilities Commission. “Water/Energy Nexus.” Water/Energy Nexus Programs, www.cpuc.ca.gov/nexus_calculator/.
[xxvi] Wisconsin Public Service Commission. “*Guidelines to Estimate Water-Related Energy Savings*.” 8 Feb. 2015.