ELEVATE
Equity through climate action

Step-by-Step Guide: How to Fully Account for the Energy Savings that Occur When Water Saving Devices are Installed

The purpose of this guide is to provide a step-by-step overview of how to add calculations into your state's Technical Reference Manual (TRM) to fully account for the energy savings that occur when water saving devices are installed in homes and businesses. A TRM is a guide for calculating and evaluating energy savings for certain measures or devices.

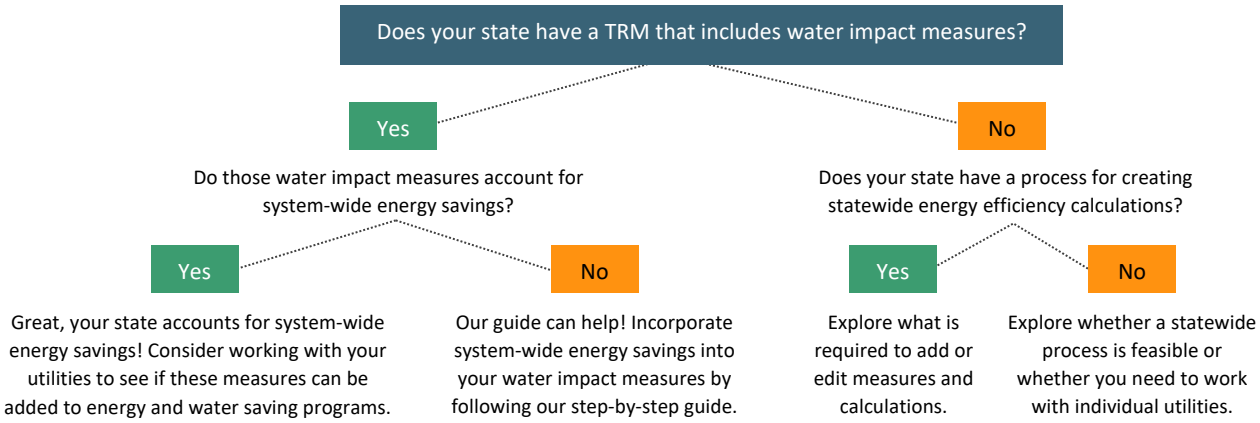
Why is it important to fully account for the energy savings from water saving devices?

Few states' TRMs currently account for the system-wide energy savings associated with water saving devices. Water saving devices such as low-flow showerheads, faucet aerators, and ENERGY STAR® dishwashers and appliances produce both end-user energy savings (reduction in the amount of energy needed to heat, cool, and pressurize water in homes and businesses) and system-wide energy savings (reduction in energy used to collect, treat, and deliver water and collect and treat wastewater). While some state TRMs include calculations to account for the end-user energy savings that occur when a water saving device is installed, few TRMs include calculations to account for the system-wide energy savings that occur. It is important to fully account for both end-user and system-wide energy savings to better understand the impact these devices have on reducing energy usage and to encourage future investment in water saving devices for homes and businesses.

Who should use this guide?

This step-by-step guide is intended for states that already have a TRM in place that includes water impact measures (measures that primarily reduce the energy used for heating or cooling water, but that may also include water saving devices that reduce the amount of water used) but doesn't yet account for the system-wide energy savings associated with these water saving devices. If you are a policymaker, advocate, or utility provider in one of these states, this guide is for you!

The outline below can help determine if your state is a good fit to add calculations into your TRM to account for the system-wide energy savings that result from water saving devices.



Step-by-Step Guide

1. **BACKGROUND INFORMATION**
    a. Want to learn how other states fully account for the energy savings associated with water saving devices? Learn more about Illinois' process by reading Elevate's "Energy Per Gallon" whitepaper.
    b. Not sure if your state has a TRM with water impact measures? Appendix 1 on page 80 of this report from the Department of Energy's State and Local Energy Efficiency Action Network is a good starting point.
2. **GET TO KNOW YOUR TRM**
    a. Before you can suggest updates to fully account for the energy savings associated with water saving devices, it's important to familiarize yourself with your state's TRM. Start by learning the timeline and process for submitting an update or new measure. You may need to reach out well before the timeline. There's no time like the present!
    b. Confirm what supporting documents are required.
    c. Other questions to consider:
        i. Who can participate in making changes? Anyone?
        ii. What technical expertise is needed? Who can help me if I don't have that expertise?
        iii. Are the technical calculations public so experts can view them? If not, how can you access them?
        iv. Once the TRM is updated or revised, how do the findings get incorporated in a utility's energy efficiency plans or portfolio?
3. **IDENTIFY STAKEHOLDERS AND GAIN SUPPORT**
    a. Stakeholders are vital for answering the questions above and accessing information that you may not have. Stakeholders in the TRM process likely include energy and water utility providers, advocates, regulators, and consultants. They can help support the idea of adding water impact measures and help you navigate the process of updating the TRM. The more TRM stakeholders that are on board, the better.
    b. As you're starting to gather information, you'll want to consult your state's water and electric utilities. They may have the data needed for creating calculations to include in your TRM. Electric utilities may also be a helpful champion because they will be claiming the kWh savings.
    c. Don't forget about gaining support from and collaborating with any third-party energy or water efficiency stakeholders. This collaboration could be mutually beneficial since the updated water impact measures could facilitate their efficiency work. The increased energy savings benefit of water conservation could lead to new efficiency programs and/or offerings.

4. **CREATE CALCULATIONS TO ACCOUNT FOR THE SYSTEM-WIDE ENERGY SAVINGS**
    a. Once you are familiar with your state's TRM process, it's time to develop the calculations to fully account for the energy savings associated with water saving devices. To create your calculations, start by collecting statewide data on the energy used to collect, treat, and distribute water, and collect and treat wastewater in your state. The energy per gallon used to produce water and treat wastewater (aka energy use intensities) will both be needed in

your calculations. Be sure to ask your water and electric utilities if they have any of this data on-hand.

i. As you collect this data, consider the ratio of groundwater to surface water in your state and the ratio of water utilities that rely on each as their drinking water source.
ii. If statewide data does not exist, national averages may be used (i.e., data from the Electric Power Research Institute, Water Research Foundation, US EPA, USGS, etc.).

b. From these datapoints, create a calculation (also referred to as an energy per gallon factor) to account for how much energy is used to produce and treat a gallon of water (kWh per gallon). You'll want to create one energy per gallon factor for water supply and one for wastewater to add to your TRM's water saving device measures. They may be combined for an energy per gallon factor if water is supplied to and wastewater is sent from a water saving device or used individually as appropriate.
c. The figure below shows sample energy per gallon factors. For additional resources and support in creating these factors, see the Appendix.

Figure 1. Sample calculation (kilowatt-hours per million gallons)

Water Source	kWh/MG	% of Total State Water Supplied	Weighted kWh/MG
Groundwater	2,844	67%	1,905
Surface Water	2,019	33%	666
		Water Supply kWh/MG	2,571
Wastewater SystemType	kWh/MG	% of Total State 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 System kWh/MG	2,439

Water Supply Factor		Wastewater System Factor		State Energy per Gallon Factor
2.571 (kWh/MG)	+	2.439 (kWh/MG)	=	5.010 (kWh/MG

5. **INCORPORATE THE ENERGY PER GALLON FACTORS INTO THE TRM**
   a. Now it's time to outline the value of incorporating your energy per gallon factors into your state TRM by drafting a whitepaper. This may not be required in your state, but it provides valuable background and reference information that can streamline supporting materials.
   b. Next, incorporate the energy per gallon factors into existing TRM water impact measure calculations.
      i. Start by applying the energy per gallon factors to the water saved for the water saving device measures listed in your TRM.
      ii. Then adjust calculations throughout the TRM.
6. **WHAT NOW?**
   a. You should now understand the following, which will help you determine next steps:
      i. How the TRM or equivalent in your state is revised or updated

ii. How updated efficiency measures from the TRM are added to a utility's energy efficiency plans or portfolio
iii. Possible water impact measures that can or should have a system-wide energy per gallon factor included
iv. Why and how to include system-wide energy savings from water impact measures into those plans or portfolio
v. Potential partners and avenues for reaching the utility and Public Utilities Commission staff with your findings
vi. Energy use intensity of water and wastewater operations, which can inform the true value of energy savings from water saving devices

b. You should also be well positioned to advocate for changes and improvements to energy and water savings opportunities in your state, such as:
    i. Adding rebates and incentives for water saving devices not currently included in your state's TRM
    ii. Increasing rebates and incentives for existing water saving devices, based on the increased energy savings that you have demonstrated
    iii. Maximizing the effectiveness and societal benefits from existing multi-measure programs
        a. For example, utility programs that direct-install LED lightbulbs, weather stripping, faucet aerators, and low-flow showerheads in apartments may now also offer to replace outdated toilets with low water use models
    iv. Adding water conservation measures into custom programs where commercial or industrial customers propose their own site-specific efficiency measures and receive incentives for the total energy saved
    v. Increase utility savings goals by illustrating new sources of savings
    vi. Advocate for better, well organized, and continuous coordination between water utilities and electric utilities – this could include a memorandum of understanding between the two organizations, and public official or regulator involvement

Glossary of Terms

End-user energy savings: Reduction in the amount of energy needed to heat, cool, and pressurize water in homes and businesses.

System-wide energy savings: Reduction in the energy needed to collect, treat, and distribute potable water, as well as the energy needed to collect and treat wastewater.

Water saving devices: Devices that reduce the amount of water used.

Water impact measures: Measures that primarily reduce the energy used for heating or cooling water, but that may also reduce the amount of water used.

Energy per gallon factor: The amount of energy that is used to produce and treat a gallon of water (kilowatt hour per gallon).

Appendix

Figure 1. Sample calculation (kilowatt-hours per million gallons)

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Water Supply Factor		Wastewater System Factor		State Energy per Gallon Factor
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The line items in Figure 1 (kWh/MG or %'s) can be modified as needed to account for any differences in your state data, i.e., additional, fewer or different water sources or wastewater system types.

If more current data from/for your state is not available, the data in the below tables could be used to fill in the raw kWh/MG in the table above.

- Tables 1 and 2 below show the kWh/MG needed (energy use intensity data) to produce water and treat wastewater in some specific states and regions.
- Tables 3 and 4 show national averages/estimates to produce water and treat wastewater. Table 4 has two groups of wastewater treatment types. The first group is based on specific technologies, trickling filter, activated sludge, advanced without nitrification, and advanced with nitrification. The second group is based on general type, less than secondary, secondary, greater than secondary or no discharge. You would need to select one group or the other.

The percentages used for weighting the individual technologies or types in your state mix, would need to be estimated based on your knowledge of your specific state's water supply and/or water treatment technology. Or you could use average percentages derived from data in the EPRI report (see footnote 2), for which water supply averages are based on a 2005 report from the US Geological Survey and wastewater averages are based on a 2008 EPA report.

- For water source these percentages are: groundwater 33%, surface water 67%.
- For wastewater type these percentages are: secondary 41%, less than secondary 1%, greater than secondary 52%, no discharge 6%.

Table 1. Energy Use Intensity to Provide Potable Water — Select States and Regions [1]

State/Region	Source of Potable Water	Energy Use Intensity (kWh/MG)	Data Vintage
Northern California	All	3,500	2006
Southern California	All	11,110	2006
Iowa	Groundwater	2,740	2002
Illinois	Lake Michigan	866	2012
Illinois	Surface	2,019	2012
Illinois	Groundwater	2,844	2012
Massachusetts	All	1,500	2007
New York	Surface	470-2,380	2008
New York	Groundwater	820-1,060	2008
Wisconsin	Surface	2,160	2016
Wisconsin	Groundwater	2,010	2016

[1] *IL TRM: Energy per Gallon Factor* (Chicago: Elevate Energy, 2018)

Table 2. Energy Use Intensity to Treat Wastewater — Select States and Regions [1]

State/Region	Type of Wastewater Treatment	EUI (kWh/MG)	Data Vintage
Northern California	All	1,911	2006
Southern California	All	1,911	2006
Iowa	All	1,570	2002
Massachusetts	All	1,750	2007
New York	All	1,480	2008
Wisconsin	Activated Sludge	3,954	2016
Wisconsin	Aerated Lagoon	7,288	2016
Wisconsin	Oxidation Ditch	3,895	2016

[1] *IL TRM: Energy per Gallon Factor* (Chicago: Elevate Energy, 2018)

Table 3. Energy Use Intensity to Provide Potable Water – National Estimates [2]

	Source	EUI (kWh/MG)	Data Vintage
National estimate	Groundwater	1,600	2013
National estimate	Surface	2,100	2013
National estimate	Desalination	12,000	2013

[2] Electric Power Research Institute and Water Research Foundation. *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries* (Palo Alto: EPRI, 2013).

Table 4. Energy Use Intensity to Treat Wastewater – National [2]

	Type of Treatment	EUI (kWh/MG)	Data Vintage
Average for Various Wastewater Plants	Trickling Filter	673-1,811	2009
Average for Various Wastewater Plants	Activated Sludge	1,028-2,236	2009
Average for Various Wastewater Plants	Advanced without Nitrification	1,188-2,596	2009
Average for Various Wastewater Plants	Advanced with Nitrification	1,588-2,951	2009
National Estimate for Municipal Wastewater Industry	Less than secondary	750	2013
National Estimate for Municipal Wastewater Industry	Secondary	2,080	2013
National Estimate for Municipal Wastewater Industry	Greater than secondary	2,690	2013
National Estimate for Municipal Wastewater Industry	No discharge	2,960	2013

[2] Electric Power Research Institute and Water Research Foundation. *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries* (Palo Alto: EPRI, 2013).

We thank our colleagues at the Network for Energy, Water, and Health in Affordable Buildings (NEWHAB) Energy/Water Nexus Challenge Group who collaborated on this document. Learn more about NEWHAB and their goals here.