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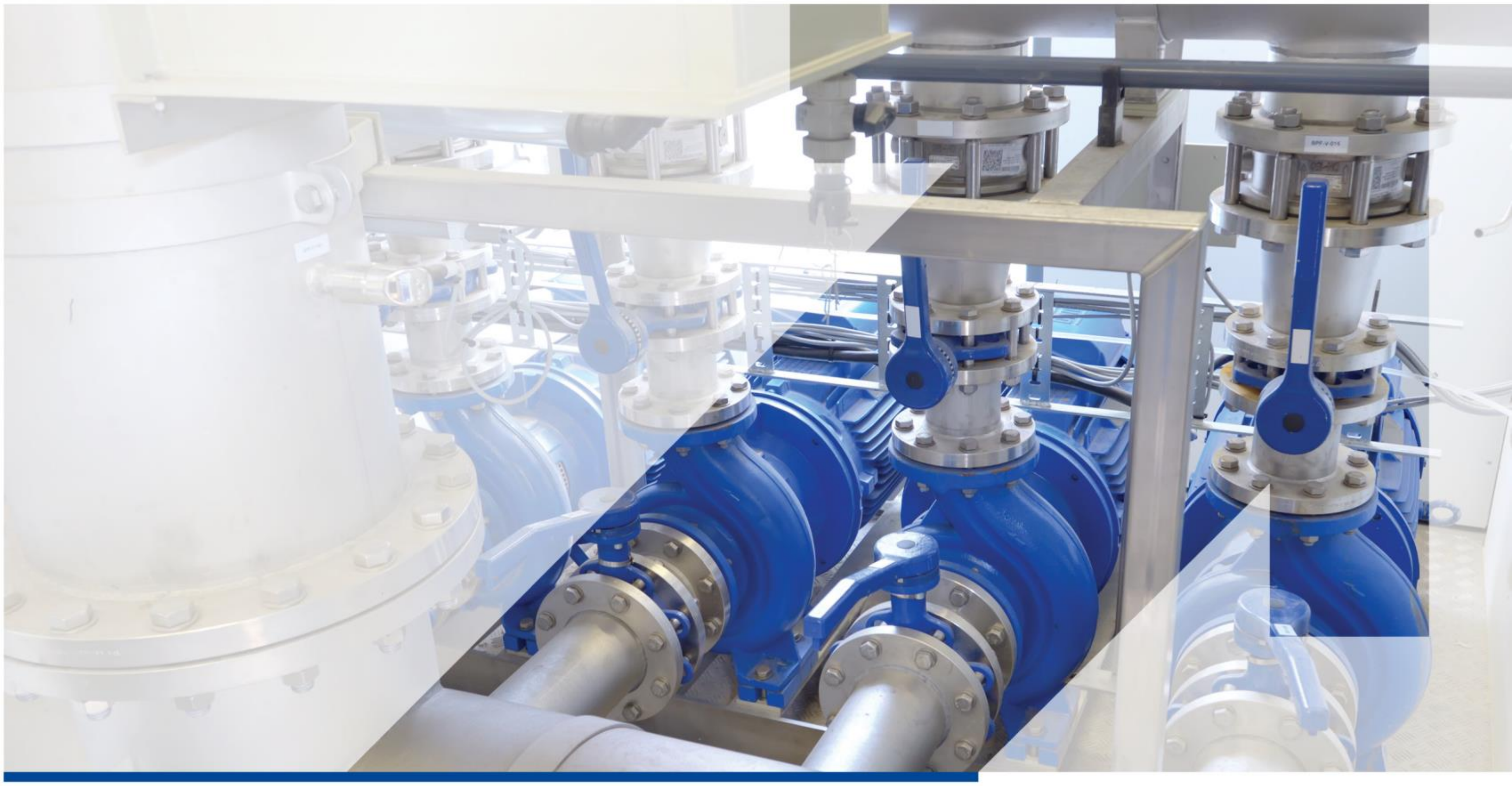
U.S. DEPARTMENT OF ENERGY

Developing a Corporate Water Management Strategy for Manufacturers

Lessons Learned from the DOE Better Buildings Challenge Water Savings Pilot



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By Prakash Rao, Phd
Lawrence Berkeley National Laboratory

Contents

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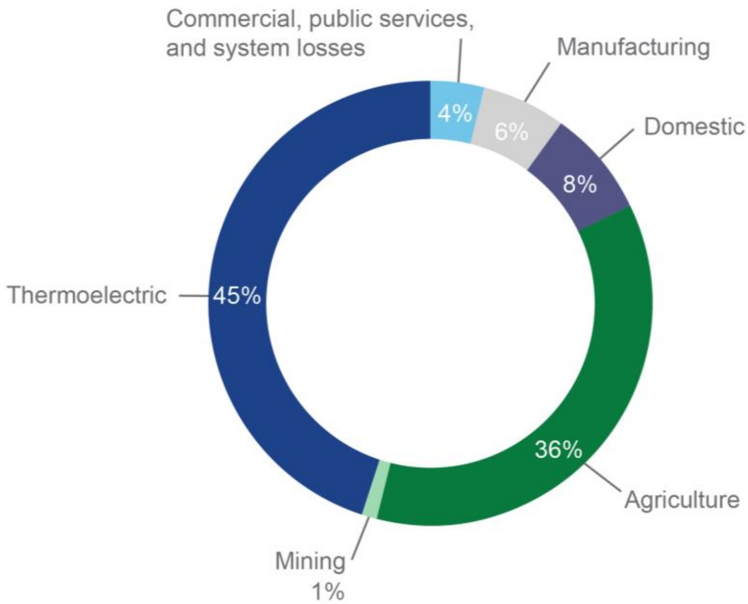
Introduction

Better management of water resources is a growing interest for many manufacturers as they seek to cut costs, mitigate risks, and reduce their environmental impact. Over the last couple of years, through the Better Buildings Challenge, the U.S. Department of Energy (DOE) has worked closely with a select group of manufacturers with well-developed water management programs to better understand key details of their successful water management efforts, including the motivating factors behind their strategies, metrics used to track progress, and specific projects and activities implemented to achieve water savings. By summarizing insights gained from working with these partners, this paper aims to serve as a resource to other manufacturers developing new, or seeking to improve existing, water management programs.

Companies are developing water management programs for multiple reasons. More efficient use of water resources results in lower operating costs, a more reliable water supply, and improved water quality. Additionally, factors such as drought, population growth, and changing watersheds due to climate change are putting pressure on available water sources. This can lead to higher costs and increases the risk that limits could be placed on water supplies in highly stressed regions.

Total U.S. manufacturing water use from both public and self-supplied sources in 2010 was approximately 21,000 million gallons per day, or 6% of total U.S. water use (see Figure 1). That share rises to 31% if water used for agricultural and thermoelectric power is excluded from the total, which is consistent with how some regulatory actions have been designed in the U.S. For example, 2015 water curtailments mandated in California targeted any water user served by a water supplier, essentially exempting agricultural and thermoelectric water users.

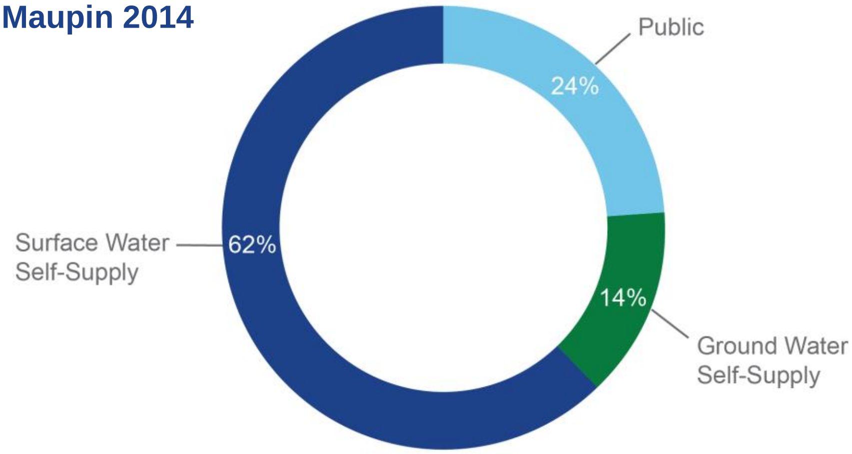
Figure 1: Estimated 2010 water use (fresh and saline) by end use sector. Figure adapted from Maupin 2014.[1]



[1] Agriculture includes irrigation, livestock, and aquaculture. Commercial, public services, and system losses are the remainder from Public Supply, as reported by the USGS, after discounting the share attributable to the industrial and domestic sectors. Share of Public Supply for industrial sector estimated using 1998 USGS estimates.

Over half of manufacturing water use was derived from surface water sources and three-quarters is self-supplied (see Figure 2). Facilities often do not pay monthly charges for the volume of water drawn from self-supplied sources, leading to a perception that this water is “free.” However, there are costs associated with self-supplied water such as energy costs to pump and treat the water and chemicals to maintain quality. Further, competing uses of local surface or ground water can lead to tension with communities that share the same resource. This represents a risk to production that companies are increasingly looking to mitigate.

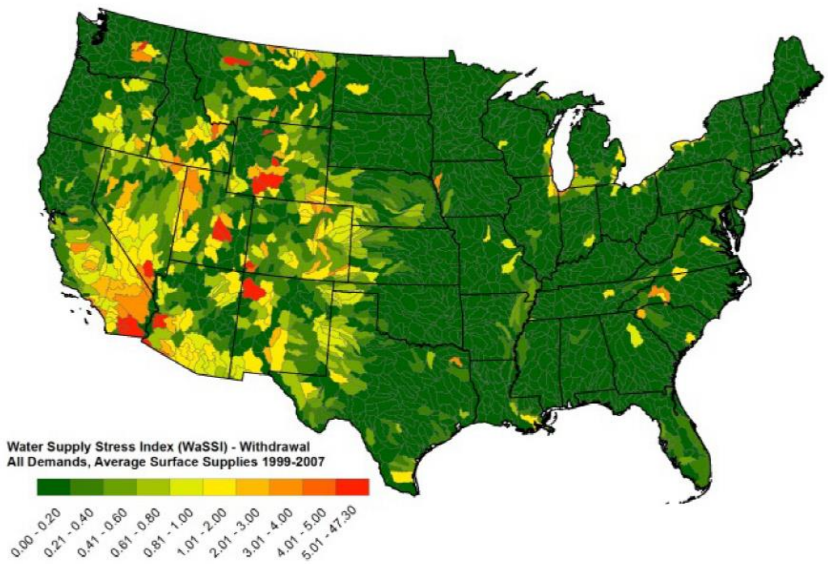
Figure 2: Estimated sources of manufacturing water use (fresh and saline). Adapted from Maupin 2014



Concerns over water scarcity are present in a number of regions in the United States. Figure 3 shows the regions of the U.S. where annual water withdrawals outpaced water supply between 1999 and 2007. As shown, water stressed regions can be found throughout the West, especially in the Southwest, the Great Lakes, and areas in the Southeast. Seven of the top eight states in terms of industrial energy end-use[2] consumption have water stressed regions: Texas, Louisiana, California, Indiana, Illinois, and Ohio [U.S. EIA 2013]. Further, six of the top eight states in terms of number of manufacturing establishments have water stressed regions: California, Michigan, Illinois, Ohio, New York, and Texas [U.S. Census 2012]. As droughts and population growth continue in the United States, manufacturers can expect increased competition for water resources.

[2] Includes agriculture, construction, and mining.

Figure 3: Water supply stress in the contiguous U.S. as measured by the annual water demand/annual water supply in each shed (WaSSI) 1999-2007. Indices greater than 1 indicate more water was withdrawn than supplied [Averyt 2013]



For many manufacturers, water management is still new or in early stages of development. Most companies lack a dedicated employee responsible for water management; in many instances energy managers are being asked to take on the additional duties of establishing and implementing a water management program. In other cases, the company's environmental, health, and safety function will be responsible for water conservation programs. Regardless of where the water program is housed, elements of a successful continual improvement based energy management system are transferable to a water management program, including gaining senior management support, setting goals, and establishing metrics to track progress towards the goals. However, water management also presents its own challenges that require water-specific solutions rather than transplanted solutions from energy management.

In 2014, DOE launched a Water Savings Pilot as part of the Better Buildings Challenge to help partners demonstrate and share successful approaches to reducing water use. Seven industrial companies stepped up to the challenge and partnered with DOE to expand their resource management strategies to include water in addition to energy, set water savings goals, track progress and showcase solutions. The seven industrial pilot partners are Cummins, Ford Motor Company (Ford), General Motors (GM), HARBEC, Nissan North America (Nissan), Saint-Gobain, and United Technologies Corporation (UTC). Most set water-savings targets that range from 2 to 5% per year. Some have already met their initial targets and have either set or are working towards setting a new round of water-saving goals. HARBEC is pushing the envelope by seeking to become largely water neutral in its manufacturing operations. Nissan, Saint-Gobain, and GM have all implemented water savings projects that are leading to significant savings. All of these companies had to develop strategies to overcome a variety of barriers in order to incorporate effective water management programs into their sustainability efforts.

Based on progress made working with its pilot partners, DOE expanded its efforts in this area, and is inviting all interested Better Buildings Challenge partners to make a water savings commitment. DOE will work with these partners to advance data collection and analysis practices and share more solutions to common water-saving barriers.

The purpose of this document is to share some of the water management strategies employed by the industrial Water Savings Pilot partners. This document is not intended to be an exhaustive guide to establishing an effective water management strategy, but shares with the broader manufacturing community some of the lessons learned during the development of the Water Savings Pilot.

This document considers the following four questions:

1. How do manufacturers make the business case for water saving projects?
2. What facilities and water sources should initial efforts focus on?
3. How do manufacturers establish water use baselines and strong water metrics?
4. What water management strategies and water reduction actions are other manufacturing companies and facilities implementing?

How do manufacturers make the business case for water saving projects?

The challenge of making a business case for water saving projects

For most companies, a business case will be required before implementing a water saving action. This presents a challenge for many manufacturers as the low cost of water causes many water saving projects to fall outside of a company's typical allowable payback period. As a consequence, projects to save water are often not implemented, suggesting the presence of significant, relatively low-cost water saving opportunities.

Water Saving Pilot partners were asked to identify the required payback threshold for water saving projects. The responses generally cited a 1-2 year payback period, with GM allowing a 3-year period for projects implemented at new facilities. Given the typical required payback period, partners reported that projects whose prime benefit is to reduce water use are often difficult to justify financially. None of the companies reported having dedicated funds for implementing water saving projects and financing was mostly done through the same corporate channels used for other capital projects.

Strategies for making the business case for water saving projects

Water Savings Pilot partners realized large water savings through various strategies and often through implementing low or no cost actions. Partners also reported that water savings were often achieved as an ancillary benefit of other projects. As such, partners look for opportunities to build water efficiency into other capital projects. As an example, Ford implemented a new paint process known as "3-Wet Paint" that allowed coats of paint to be applied while the previous coat was still wet. In addition to reducing CO_2 emissions by 15-20% and volatile organic compound emissions by 10% compared to conventional paint systems, the 3-Wet process also realized significant water savings due to physically smaller paint booths.

Additionally, Cummins and Saint-Gobain indicated that avoided risk can be a consideration when justifying water saving projects. Ford indicated that costs are not always a driver for larger water savings projects;

many of these are strategically installed as part of a new operation/process or to address local regulations or water availability concerns.

Evaluating the true cost of water

For many facilities, water is not a significant cost-contributor to overall production costs. Five partners indicated that water costs range from “negligible” to less than 1% of overall production costs (two partners did not provide responses). This is attributable to both the low costs of water and relatively low water usage. Partners indicated their average combined intake and sewer costs were $5.78 / 1000 gallons, with a range between $4 - $6.71 / 1000 gallons. To provide a broader context for industrial water rates, water and sewer volume charges for metropolitan regions across the U.S. were taken from the water and/or sewer authority websites and reproduced in Table 1. The rates are not intended to be comprehensive, but to illustrate variability in water rates throughout the country. Water and sewer rates will vary depending on location within the district. Many districts apply a tiered rate structure to the water supply charge. Generally the volumetric charge declines with increasing usage. However, for Los Angeles and San Antonio, the volumetric charge increases with increasing usage. Both of these cities are in water stressed areas (see Figure 3) and the rate structure incentivizes water savings.

Table 1: Sample water and sewer rates across US metropolitan areas

	Water Supply		Sewer	
City, State	**Water Authority**	**Range of water supply volume rate per 1000 gallons+**	**Sewer Authority**	**Example++ sewer volume rate per 1000 gallons**
Asheville, NC	City of Asheville	$2.42 - $4.44	Metropolitan Sewerage District	$4.94
Hartford, CT	Metropolitan District Hartford, CT	$3.56	Metropolitan District Hartford CT	$3.82
Kansas City, MO	Kansas City Water Services	$3.68 - $6.35	Kansas City Water Services	$9.49
Los Angeles, CA	LA Department of Water and Power	$6.36 - $8.58	LA Sanitation	$5.66
Milwaukee, WI	Milwaukee Water Works	$1.54 - $2.66	Local Charge + Milwaukee Metro Sewerage District	$2.73+++
San Antonio, TX	San Antonio Water System	$1.97 - $3.45	San Antonio Water System	-
Virginia Beach, VA	City of Virginia Beach	$4.41	Hampton Regional Sewerage District	$5.52

Sources: City of Asheville, MDC, MSD, Kansas City Water Services, LADWP, LADS, MWS, Cudahy Wisconsin, MMSD, San Antonio Water System, City of Virginia Beach, HRSD

+Actual rate depends on usage volume. Additional base charges and seasonal charges not included

++Does not include charges for higher concentration discharges and connection charges

+++Cudahy district local charged used in example charge

Often the actual cost to purchase and discharge a volume of water does not provide the complete costs associated with water use at a facility. For example, energy is required for the pumping systems to move the water, and chemicals may be required to treat the water (as is the case with water used in cooling towers). In a case study at a Campbell's Soup tomato processing facility in California, the energy intensities of two well water pumping systems were measured to be 2.4 kWh/1000 gallons of water and 1.7 kWh/1000 gallons of water, while a wastewater pumping system had an energy intensity of 0.42 kWh/1000 gallons of water [Amon 2013]. The higher intensity of the well water pumping systems compared to the wastewater pumping system was attributed to overcoming the pressure head associated with pumping water from a well. The electricity unit cost for the facility was estimated to be $0.15/kWh. Based on the reported costs, it is estimated that the energy costs to operate any one of the three pumping systems added an additional $0.06 - $0.36/1000 gallons of water to the volumetric water charge for this facility.

The "true cost of water" captures all costs associated with water use such as energy costs to operate pumps, treatment costs, and water discharge costs. Cummins has developed a tool to calculate the true cost of water, which it plans to use when evaluating projects. Cummins has found that the true cost of water is 3-5 times the water intake and sewer charge and sometimes as high as 10-12 times for high energy and water-intensive operations. Cummins' true cost of water tool factors in the cost of energy, chemicals, and other costs associated with water use and also provides methods for estimating costs (e.g. ratios for pumping system energy costs). Considering the true cost of water rather than the volumetric charge alone may strengthen the business case for water saving projects.

What facilities and water sources should initial efforts focus on?

An early step in establishing a water management program is to prioritize the facilities and water sources included in the program. Companies generally want to prioritize the facilities and sources by their impact on their business and the watershed. However, determining impact can be complex and the level of rigor towards understanding these complexities must be balanced with practical considerations, such as the availability of facility and watershed data. The partners from the Water Savings Pilot have demonstrated a variety of approaches for prioritizing facilities and water sources on which to focus initial efforts.

Prioritizing facilities on which to focus

The business risks associated with water use are often driven by supply and environmental constraints, which will vary by location. Compared to energy, which is relatively plentiful across the country, though with variations in price, water availability will vary dramatically by region. Similarly, the environmental impacts of water use and discharge will generally be concentrated at the nearby watershed, whereas the environmental impacts associated with electricity use may be greatest at a power plant several miles away, or more of a global problem in the case of greenhouse gas emissions. As such, regional considerations will dictate the business risk attributable to water issues. These regional considerations tend to drive the development of water management strategies to a greater extent than they do for energy management. Corporations will commonly focus their water-saving efforts on facilities located in communities with water scarcity, quality, or other concerns. However, in order to gain a comprehensive understanding of their water use, DOE recommends that companies set water saving targets across all their facilities regardless of local water concerns. The benefits of a comprehensive understanding include enabling the consideration of water use in strategic planning, sharing of best practices across all facilities, and insurance against unseen water-related issues. To this end, partners in the Water Savings Pilot were asked to enroll all of their U.S. manufacturing operations in their water management program.

While some companies apply expected water reduction efforts uniformly across all their facilities, others determine the appropriate level of effort on a facility-by-facility basis with local water concerns factoring into the decision. Some criteria observed by DOE for establishing facility-specific water reduction efforts include:

- **Water scarcity:**

  UTC uses the World Business Council for Sustainable Development's Global Water Tool in conjunction with an internally developed guidance document to determine the required water reduction effort for each facility (see *Appendix B: Related tools, guidebooks, and organizations* for more information on the Global Water Tool). The guidance document contains ten water management actions. The number of actions each facility is required to implement depends on a water scarcity assessment for the facility as determined by the Global Water Tool. Facilities in extremely scarce areas are expected to implement most of the actions while facilities with abundant water supplies have to implement fewer actions. See the UTC Implementation Model on the DOE Better Buildings Solution Center for more information.

- **Use of a water performance index:**

  Cummins applies regression analysis to develop a water performance index at each facility. Cummins develops a model relating water use to the variables most responsible for driving water use, such as labor hours, production, and energy consumption (for sites conducting product testing). The model is used to predict future water use at each facility and develop a water performance index for that facility. This index is the ratio of the predicted to actual usage for the current year. If the facility uses less water in the current year than predicted by the model (water performance index < 1), then the facility's water performance improved. If the facility used more water in the current year than predicted (water performance index > 1), the facility's water performance worsened. Cummins prioritizes efforts and resources based on the facility's water performance index. Facilities with a water performance index > 1 have the greatest opportunity for water reductions while facilities with an index < 1 are asked to share their water saving best practices.

Selecting sources on which to focus

In addition to selecting facilities on which to prioritize actions, companies must also evaluate the water sources to include in their efforts. In general, DOE has observed that most companies include any water source that is billed (i.e. from a public or private water utility) or regulated within their water management program. However, DOE guidance is to include all water sources within a water management program. A more holistic approach will allow for better monitoring of water use and create a stronger connection between the water management program and business operations, including other sustainability efforts. For example, unbilled water sources still require energy to pump and treat. Excluding these water sources may cause many energy saving opportunities associated with unbilled water use to go unnoticed. Other water sources to consider include self-supplied surface (fresh or saline), self-supplied ground (fresh or saline), rainwater, and purchased recycled water.

When selecting which sources to focus on, facilities should consider the environmental impact of the water use. Not all water uses result in the same environmental impact. Some manufacturing water uses result in water being returned to the source or local watershed at a quality suitable for reuse after treatment. Others result in water being removed from the local watershed and no longer available for use within the watershed. The latter is referred to as "consumptive water use" and accounts for an estimated 15% of all manufacturing water use [Solley 1998]. The United States Geological Survey defines consumptive water use as "that part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment" [Solley 1998]. Examples of consumptive water use include water loss through evaporative cooling (e.g., a cooling tower) and in-product use (e.g., beverages or food). Examples of sectors with consumptive water use are food, beverage, paper, petroleum refining, iron and steel. Examples of water uses that are not consumptive include non-contact cooling with minimal temperature gain and water that can be returned to the source or local watershed after treatment. An example of the latter is water used for rinsing vessels. Focusing water reduction efforts on consumptive water uses can optimize water management efforts driven by concerns for the local watershed. Third party tools are available to assist facilities and companies understand their water use in terms of consumptive uses (see Water Footprint Network, the Global Environmental Management Index Local Water Tool and others in *Appendix B: Related tools, guidebooks, and organizations*).

Similar to consumptive water use, facilities may also want to consider impacts of their water discharge on their watershed(s). For example, certain wastewater discharges can contaminate the watershed by adding too much nitrogen, depleting the oxygen levels or raising its temperature. Others may add pollutants that ultimately harm the local watershed, require energy consumption to treat, or both. As an example of a company incorporating water discharge quality into their water management efforts, the paper manufacturer Weyerhaeuser[3] has set a goal to improve water quality by reducing the biological oxygen demand discharged (as measured in pounds per unit of production) by 10% from a 2010 baseline [Weyerhaeuser 2015]. In a review of 121 companies, the Pacific Institute found that 33 set goals or targets for wastewater discharge volume or quality [Morikawa et al 2007].

How do manufacturers establish water use baselines and strong water metrics?

A water use baseline is a critical element of any water management program, particularly one that accompanies a quantitative target for water use reduction. From DOE's experience with the Water Savings Pilot, complications can arise when developing a water use baseline stemming from a lack of metering, or estimation techniques in lieu of metered data, and uncertainty regarding which sources to include in the baseline. Further, the data gathering capabilities and the quantitative reduction target should align such that the water use and/or intensity metric can be measured in the baseline year. For example, if calculation of the metric requires a specific set of production and/or water use data, this data should be available in the baseline year, and all subsequent years. As such, selection of the baseline year may depend on the availability of data to calculate the metric. This section highlights strategies employed by the Water Savings Pilot partners to tackle some of the challenges faced when developing water baselines including data collection, developing metrics, and making adjustments to the water use baseline.

[3] Weyerhaeuser is a Better Plants Program partner, but not a partner in the Water Savings Initiative

Data collection

All partners in the Water Savings Pilot collected data at the facility-level to establish water use baselines. For metered water sources, data was collected from records, such as utility bills. For water sources that are not metered, partners employed estimation techniques to determine their water use. These techniques included basing estimates on predicted use at the process level, using weather data to estimate rainwater use, and extrapolation of observed flow rates using operating hours. In describing their estimation techniques, one partner characterized the resulting values as less reliable and based on data that was collected less frequently than metered data. However, another partner noted that estimation techniques have led to identifying several water savings opportunities. Table 2 summarizes the water sources included and data collection techniques used by the seven partners in the Water Savings Pilot:

Table 2: Summary of water sources included by the seven partners in the Water Savings Pilot and the methods for collecting data for each source

Water source	Applicable source (# of partners)	Metered (# of partners)	Estimated (# of partners)	Mix (# of Partners)
Public water supply	7	5	0	2
Ground water	3	0	1	2
Surface water	3	0	1	2
Rain water	2	0	1	1
Recycled/reuse water	0	-	-	-
Non-fresh water intake	1	0	1	0

Table 2 shows that all partners receive water from public supply. Additional water sources included surface, ground, rain, and non-freshwater sources. Quantification of usage from these additional sources relied on estimation techniques.

Where deployed, partners reported that the majority of metering was at the facility level. In addition to quantifying unbilled water sources, metering end-uses can provide insights such as understanding where water is being used, developing baselines for equipment or processes, identifying water saving actions, or establishing operating parameters for equipment or processes. The partners in the Water Savings Pilot were asked about the extent of metering on water end-uses. Table 3 summarizes their responses (note that DOE received responses from six of the seven partners). Partners are aware of which end uses use water, but often do not have a means for tracking the volume of usage either through meters or estimation techniques.

Table 3: Water tracking capabilities by water end use for six of the partners in the Water Savings Pilot

Water use Category	Applicable to company (# of partners)	Able to track or estimate usage volume (# of partners)
Production and in-product use	5	3
Auxiliary processes (e.g., pollution control)	3	0
Cooling and heating (e.g., cooling towers and boilers)	6	2
Indoor domestic use (e.g., restrooms, kitchens, laundry)	6	1
Outdoor (e.g., landscape irrigation)	4	1

Developing metrics to track against a baseline

Targets tied to water use metrics, such as water used/ton of product, can be an effective method to measure, track, communicate, and motivate water reduction efforts. The development of water use metrics is dependent upon the ability to construct a water use baseline. When developing metrics, the company will need to consider data availability in the baseline year and all subsequent years of interest. Additionally, the level (corporate or facility) at which the metric will be calculated will dictate the level at which baselines need to be developed. For companies calculating metrics at the facility-level, such as GM, the metric or percent improvement is calculated for each of the individual facilities and rolled up to develop a corporate level metric. Companies using this approach will need to be able to collect the required baseline data at each facility. For companies calculating metrics at the corporate level, the water use across a portfolio of facilities is divided by the total production across those same facilities.

Five of the seven partners use metrics that are intensity based when reporting to DOE (see Table 5 for a breakdown of the types of targets set by partners in the Water Savings Pilot). This type of metric can be a better indicator of water use efficiency than an absolute metric, but can also present challenges for companies manufacturing a diverse range of products. Of the five Partners reporting using an intensity metric, three (Cummins, GM, and Saint-Gobain) calculated the intensity at the facility level, before rolling those metrics up at the corporate level, and two (Nissan and Ford) sum water use and production across all plants to create their water-intensity metrics. For internal purposes, Ford also tracks water intensity at the facility level, with specific goals for each facility.

For facilities located in communities with restricted access to water supplies, absolute metrics can be more reflective of a company's water risks than intensity metrics. Facilities in water scarce regions may be subject to water allotments (either presently or imminently) and face real physical supply constraints. In anticipation of such risks, one company not participating in the water savings initiative operates a facility in Southern California that can operate for one week without access to freshwater. A reduction in absolute volume of usage may be required to operate within an allotment and mitigate the risk of water shortages. In addition to the risk management benefits, baselines when using absolute metrics are simpler to develop compared to baselines when using intensity metrics since they do not require any data beyond water use. Similarly, an absolute metric is simpler to track and calculate improvements against. However, absolute metrics will be sensitive to changes in production or other variables impacting water use and percent improvements measured using absolute metrics may not be reflective of water saving efforts. DOE generally recommends that companies participating in the water savings initiative use a water intensity metric, but also allows the use of absolute metrics.

Still others may adopt additional metrics that best measure and track their water reduction efforts. HARBEC has adopted a target to achieve “water neutrality,” which the company has defined as using rainwater for all water uses except hand washing and drinking. To develop a baseline in support of this target, HARBEC (which has just one manufacturing facility) will need to be able to track rainwater use and water purchased from the local water utility. In order to determine if its goal is met, HARBEC will need to meter or estimate the amount of water used for hand washing and drinking. If metering these uses is not possible, estimation techniques can be developed and applied. For example, the EPA analyzed the water use data reported through Portfolio Manager and found that the median indoor domestic water use for office buildings is 13 gallons/employee/day [EPA 2012]. This metric can be used to estimate employee/office use at an industrial complex.

Facilities that publicly report using one type of metric (absolute or intensity), will sometimes use both internally to enable their efforts. For example, Cummins, Ford, and Nissan report using intensity metrics but also track absolute water for internal purposes. For companies using absolute metrics, intensity metrics may still need to be developed to help identify water-intense operations and opportunities for water savings.

Setting targets against a baseline

The practice of setting and tracking targets against a baseline can serve as an effective element of a water management strategy by motivating facilities and providing them with a measure and milestone of success. Nissan reported having never implemented a measure for the sole purpose of saving water until they adopted a water reduction target. Motivated by the target, Nissan reported that they were in the process of implementing two water saving projects that would save close to 50 million gallons of water annually.

The partners were asked to indicate the drivers for establishing water reduction targets (they were allowed to select multiple drivers). A summary of the responses is provided in Table 4. The “other” responses included costs and risks associated with wastewater treatment and business continuity.

Table 4: Summary of drivers for establishing water reduction targets

Driver	# of partners applicable to (out of 7)
Regulation of water consumption and use	2
Overall cost of water	3
Energy benefits from water reduction	5
Availability of suitable water supplies	4
Risk associated with lack of access to water	4
Environmental stewardship/corporate sustainability	7
Other	3

All the partners in the Water Savings Pilot were asked to set a target against a baseline year. The targets and baseline years pledged by the Water Savings Pilot partners are provided in Table 5. All partners set intensity-based targets, with the exception of HARBEC and UTC, which set absolute targets.

Table 5: Pledged targets and baseline years for Water Savings Pilot partners

Partner	Water Intensity % Reduction	Metric	Achievement Year	Baseline Year
Cummins	40%	Gallons of water/labor hour	2020	2010
Ford	30%	Cubic meters of water/vehicle	2015	2009
GM	20%	Gallons of water/vehicle	2020	2010
HARBEC	Water neutral	N/A	2015	2013
Nissan	2%	Gallons of water/unit	2016	2013
Saint-Gobain	6%	Gallons of water/ton produced	2016	2012
UTC	25%	Volume of water	2020	2015

The targets and baselines adopted by the partners were often driven by the corporate office. However, partners with corporate water reduction targets sometimes established different regional or local targets. For Cummins, the U.S. target represents the required reductions from U.S. facilities in order to meet its global target. Similarly Nissan reported that the U.S. targets were set by the corporate headquarters in support of a global target, with facilities in water stressed areas given more ambitious targets. These targets represented a minimum and Nissan North America has elected to set a more stringent target than the one set by the corporate headquarters. Both these partners established domestic targets that supported but differed from the global target. This was not the case for all partners. UTC reported adopting the global target as its domestic target per corporate guidance. While facilities in water stressed areas did not receive more stringent targets, they were required to implement more water management actions from their internal guidebook (see page 7).

Adjusting water baseline for improved performance tracking

Capturing water efficiency improvements from one period to the next can be made difficult by external factors that impact water use but are unrelated to water management efforts. For example, a facility may implement several water efficiency measures but experience unusually high production demands or ambient temperatures well out of typical ranges. Quantifying the impact of the water efficiency measures will be complicated by increased water use to meet the high production demand and/or cooling/heating needs. Using regression analysis to adjust water use baselines to account for factors effecting water use but not related to water efficiency measures, such as changes in production or weather, is one option to more accurately track water management efforts. In the example case above, regression analysis could be performed to adjust water use to account for differences in production and weather between the two periods. Regression analysis is the recommended approach for partners participating in DOE's Better Buildings, Better Plants Challenge and Program when reporting their improvements in energy intensity.

Results from the Water Savings Pilot indicate that applying regression analysis to water use is not common. None of the seven partners employed regression analysis when publicly reporting their water data (including reporting to DOE). While more case studies and data are required to better understand the potential benefits of applying regression analysis to water use, there are some early indicators of its potential. Cummins' use of regression analysis (highlighted on page 7) provides an example of one application with actionable results. Further, both Ford and GM see enough benefit in exploring the tracking and measuring of water use using regression that they are continuing to work through the process. The use of regression analysis by partners in the Better Plants Challenge and Program has provided partners with greater insights into energy efficiency improvements. For example, regression analysis can show energy efficiency improvements that would have otherwise been masked by unusually cold winter weather; conversely, it can control for the impacts of increased production, which generally inflate energy intensity improvement numbers. While DOE has worked with partners to apply regression analysis to water reduction tracking on a limited basis, the expectation is that similar insights can be gleaned from applying regression analysis to water use.

The steps for performing regression analysis on energy consumption have been outlined in DOE's Energy Intensity Baselining and Tracking Guidance for the Better Buildings, Better Plants Program. While the document outlines the steps for calculating and reporting energy intensity improvements for the Better Plants Program, the themes of each step for performing regression analysis as outlined in the document could be applied to water use.

Example baseline reporting form

Tools to assist in the development of water baselines include the Water Footprint Network's Water Footprint Assessment Tool and GEMI's Collecting the Drops. See *Appendix B: Related tools, guidebooks, and organizations* for more information.

For the Water Savings Pilot, DOE developed a water use baseline reporting form that partners use to report water use baseline data and annual improvement metrics. Each of the seven partners in the Water Savings Pilot reviewed and provided input into the form. The form has been reprinted in *Appendix A: Water Savings Pilot - Baseline Reporting Form and Instructions* along with the accompanying instructions that define the terms used in the form.

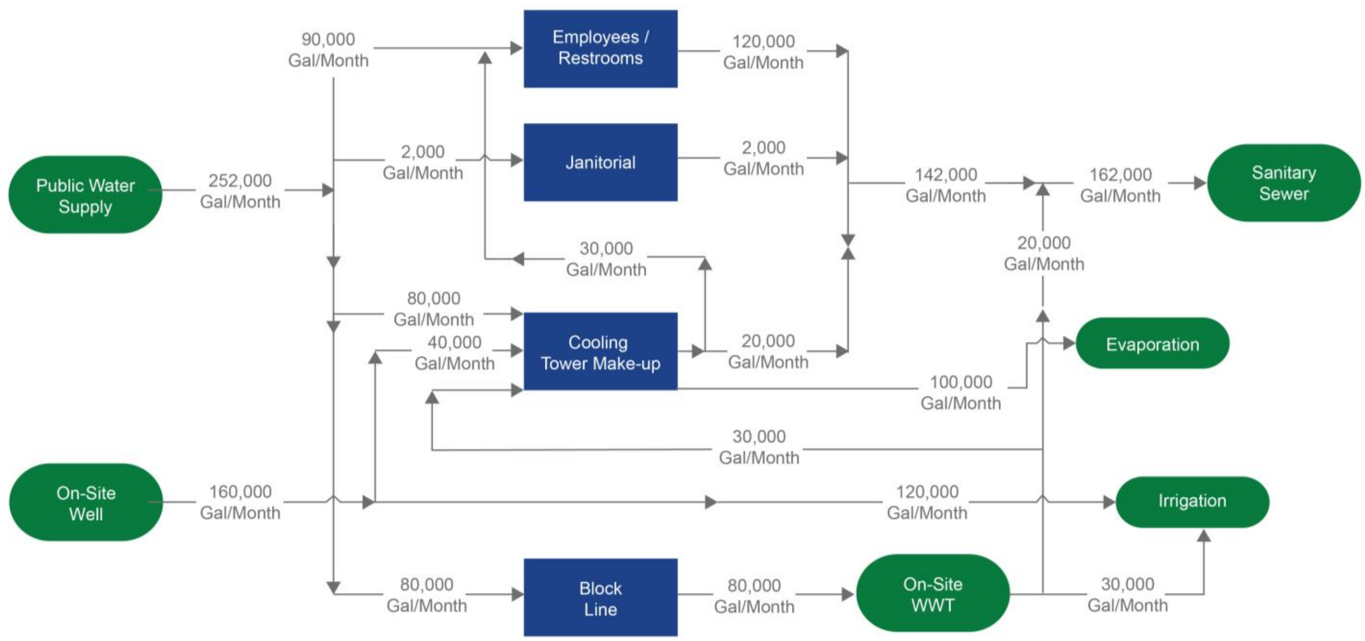
What water management strategies and water reduction efforts are other manufacturing companies and facilities implementing?

A primary goal of the Water Savings Pilot is to share successful strategies employed by partners for managing and reducing their water consumption. Sharing water management strategies can help manufacturers identify and evaluate strategies at their own facilities and generate ideas for overcoming potential barriers and obstacles. This section highlights successful water management strategies and reduction efforts employed by the partners including identifying water saving projects and types of projects implemented.

Identifying water saving projects

Cummins, Saint-Gobain, and UTC reported that performing a water balance at their facilities led to the identification of a number of water reduction actions, including many low cost actions such as repairing leaks. A water balance maps the water flow into, stored in, and out of a facility. If there are unaccounted water flows, the facility will not be able to reconcile its water balance. Unaccounted water flows can indicate that there is an unknown water use (perhaps a leak) within the facility. An example of a water balance was provided by Cummins and is shown in Figure 4. The facility has identified its sources of water intake, the water end uses within the facility, and the means by which the water exits the facility. For each, the facility has metered or estimated the amount of water use. The facility is able to balance its water use since the volume of water entering the facility (via public water supply and on-site well) is equivalent to the amount of water exiting the facility (via sanitary sewer, evaporation, and irrigation).

Figure 4: Example water balance from Cummins



Several resources are available for companies seeking to conduct a water balance at their facilities. Two are UTC's Global Water Conservation Guidance Document (featured as UTC's Implementation Model for the Water Savings Pilot) and the Global Environmental Management Initiative's *Collecting the Drops: A Water Sustainability Planner* (see *Appendix B: Related tools, guidebooks, and organizations*). The UTC document includes developing a water balance as one of its recommended steps to achieving water savings. The GEMI document (and supporting Water Balance Program tool) details how to develop a water balance including typical water uses, "rules of thumb" and calculations for estimating water use. The planner also includes examples and a Water Balance Program (an online and downloadable tool) that facilities can use to develop their water balance.

Types of projects implemented

The partners' experiences highlighted that water savings can be achieved without dedicated capital. Partners reported substantial savings through operational and/or behavioral projects and low cost changes. For example, Cummins, Nissan, and UTC incorporate leak remediation as part of their water savings strategies. As Cummins explained, a small leak on the order of 1 gallon per minute equates to more than 500,000 gallons of water use per year. Ford tackles this by tracking water use during a 24-hour period with no production or other operations occurring and evaluating the data for excessive water use. GM reported that operating equipment closer to its original water use specification is a common water saving measure at its facilities. Partners also reported reducing water usage by meeting standard limits on cycle of concentration for cooling towers and eliminating excessive blowdown.

When reporting to DOE, partners were asked to describe some of the measures implemented at their facilities to realize water savings. The measures relayed to DOE are listed in Table 6. The measures have been categorized into six general classifications: leak management, improved controls, increased recycling or reuse of water, finding substitutes for water for certain water uses, training facility personnel, and water storage measures.

"Install rain water harvesting system" is one of the measures listed in Table 6 (under "water storage"). In most cases, this will be a capital project. However, HARBEC was able to re-purpose an existing rainwater collection pond to serve its water needs. The company was required to implement a sprinkler system per a fire insurance requirement. When the municipal water authority was reluctant to build a larger water supply line to the facility, HARBEC installed an 800,000 gallon rain water collection pond to provide the water for the sprinkler system. HARBEC is now using the pond to also meet space and process cooling needs. The pond has replaced the cooling towers and offsets 900,000 gallons of cooling tower make-up water annually while still serving its original purpose of supporting the fire sprinkler system. Utilizing the rainwater pond is HARBEC's central strategy for meeting its goal of becoming water neutral. The innovative approach demonstrated by HARBEC highlights the use of existing assets to meet water reduction goals, particularly when capital may not be available.

Table 6: Actions resulting in water savings as reported to DOE by the Water Savings Pilot partners

Type of Measure	Examples of Type of Measure
Leaks	▶ Leak detection and correction
Monitoring and controls	▶ Adjustment on control valves to improve water efficiency ▶ Automate controls on continuous flow streams ▶ Change faucets to auto type faucets ▶ Install low flow fixtures ▶ Install thermal proportioning valves ▶ Install automatic shutoff valves ▶ Implement procedures to monitor and adjust the flow on water cooled equipment ▶ Monitor water quantity and quality ▶ Monitor cooling tower cycle of concentration
Recycle/reuse	▶ Eliminate once through cooling, including installing closed loop chillers ▶ Recycle non-contact cooling water ▶ Modify existing equipment to eliminate non-contact water cooling ▶ Clean and recirculate treated contact water ▶ Install semi-closed loop water system ▶ Use recycled water for process water ▶ Reuse process water, including capturing formerly discharged cooling tower wastewater for use in a recirculating chilled process water loop system.
Substitute water	▶ Replace water with other coolants (i.e. air and antifreeze in a closed loop circuit) ▶ Replace water cooled compressors with air cooled compressors ▶ Replace water cooled chilled water system with air cooled system ▶ Install air cooled systems in place of non-contact cooling water ▶ Replace water cooled vacuum pumps with air cooled units ▶ Install waterless urinals throughout the facility
Training	▶ Increase water usage awareness throughout the facility ▶ Train operators in the most water efficient procedures
Water storage	▶ Design of rinse tank overflow systems ▶ Install rain water harvesting system ▶ Capture and store water during facility shutdowns for future use, instead of discharging to sewers

Conclusion

The seven industrial companies that partnered with DOE in the Water Savings Pilot—Cummins, Ford, GM, HARBEC, Nissan, Saint-Gobain, and UTC—demonstrated the importance and complexity of developing robust and effective water management strategies. The benefits of water conservation are numerous and include financial, environmental, reputational, and resiliency benefits. However, developing water management strategies is not simple. With less historical focus on water efficiency compared to energy efficiency, manufacturers are left with few resources and little information on which to draw upon when developing their water management efforts.

This document addresses a few of the challenges encountered when establishing a water management program and shares some of the best practices and strategies demonstrated by the partners. There are many other challenges in addition to those addressed here including: lack of metering and data regarding water use, determining the desired outcome of the water management strategy (e.g. reduce costs, mitigate business risk, limit environmental impact), insufficient insight into water flows within a facility, difficulty promoting water conservation in non-water stressed regions, capturing the potential for recycling and reusing water, determining the level of effort and resources to dedicate to water management, and others. In addition to this document, the Showcase Projects and Implementation Models developed by the partners as part of their participation in the Water Savings Initiative will provide manufacturers with additional opportunities and platforms for knowledge sharing.

The impacts of climate change and global population growth will only increase the pressures on freshwater supplies. Increased demand will lead to higher water costs, public scrutiny of water stewardship, and greater business risk associated with water supply. Ultimately, all of these will impact competitiveness and the bottom line for U.S. manufacturers. Companies that begin actively managing and reducing their water use now will be better prepared to face these growing challenges in the future.

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Appendix A: Water Savings Pilot - Baseline Reporting Form and Instructions

Better Plants CHALLENGE
U.S. DEPARTMENT OF ENERGY

Water Savings Pilot Baseline Reporting Form

BETTER BUILDINGS, BETTER PLANTS CHALLENGE

Company Name:
Company Contact Name:
Company Contact Title:
Address:
Phone:
E-mail Address:
NAICs of Partipating Facilities (max 3):
Year of reported data:
Baseline Year:

	Baseline year	Current year
Number of participating facilities*:		
Number of participating facilities that are manufacturing plants		

Water intake (thousand gallons):

	Baseline year	Metered or estimated?	Reporting year	Metered or estimated?	Included in water intensity metric for tracking (y/n)?
Water utility (public or private)					
Surface freshwater, including self-supplied					
Ground freshwater, including self-supplied					
Other freshwater					
Total saline water intake (e.g., ocean water)					
Rainwater					
Externally supplied recycled (i.e., grey water)					
Total water intake					
Total water intake included in target (thousand gallons)					

Baseline adjustment due to increase/decrease in the number of facilities reporting relative to baseline year or other operational changes, (+/- thousand gallons):

If a baseline adjustment was made, please indicate the reason for making the adjustment

Adjusted baseline for total water intake (thousand gallons):

Unit(s) for water intensity metric

	Baseline year	Current year
For partners using a single water intensity metric across all plants, water intensity or other metric used for tracking Water Savings Pilot goal (numeric value)		

Annual improvement (%) in water intensity for current year

Total improvement (%) in water intensity

Please describe the methdology used for calculating water intensity improvements:

Please briefly describe major technologies, strategies, and practices employed during the previous year to decrease water intensity. Please identify: systems/processes impacted, approximate water savings from projects, and implementation cost

Reporting Form Field	Instructions
Company Name:	Provide the name of the organization that has committed to the Water Savings Pilot
Company Contact Name:	Provide the name of the person at the organization who is responsible and knowledgeable for the information reported on this form.
Company Contact Title:	Provide the title of the person named as the Company Contact
Address:	Provide the address for the organizational contact.
Phone:	Provide the phone number for the organizational contact.
E-mail Address:	Provide the email address for the organizational contact.
NAICs of Participating Plants:	Provide the 6-digit North American Industry Classification Codes (NAICs) for the facilities that are under the scope of the pledge effort. If more than 1 NAICS code describes the facilities, please provide up to 3. To find your NAICs code, please visit: http://www.naics.com/search.htm
Year of Reported Data:	Identify the current reporting year, in YYYY format.
Baseline Year:	Identify the start and end month/yr of the baseline year for your pledge agreement. Please use MM/YYYY format. For the Baseline Reporting Form, the baseline year identified here should correspond to the Year of Reported Data.
Number of Participating Facilities:	Identify the number of facilities that are represented in the organization's baseline year and current pledge year.
Number of participating facilities that are manufacturing plants	Of the Number of Participating Facilities, indicate the number that are manufacturing plants.
Water intake (thousand gallons):	Provide the water intake in thousands of gallons by water source for the baseline year. Indicate if the intake for each source is determined through metering or estimatation techniques. Also indicate if reduction in the water intake from this source is included in the organization's water reduction target for the Water Savings Pilot. Definitions of each category are (*note: Per EPA secondary drinking water standard, 'freshwater' is water containing less than 500 milligrams per liter of total dissolved solids)* : **Water utility (public or private):** Freshwater purchased from a local water department **Surface freshwater, including self-supplied:** Freshwater that collects on the surface of the ground. Surface freshwater sources include water in rivers, streams, creeks, lakes, and reservoirs **Ground freshwater, including self-supplied:** Freshwater beneath the earth's surface **Other freshwater:** Freshwater sources not listed **Total saline water intake (e.g., ocean water):** Total all water intake from sources located outside of the facility with greater than 500 milligrams/liter of dissolved solids. Salt water, such as sea/ocean water, intake would be included here. **Rainwater:** Rainfall water captured and used onsite **Externally supplied recycled:** Also referred to as reclaimed water, water from an external source that has been used for elsewhere, treated as required, and supplied to the facility for use. This excludes water recycled on-site and re-used at the facility. Examples include purchased municipality grey water or water used by an adjacent business. **Total water intake**: Total all the water intake for the facilities included in the Water Pilot. This should be the sum of the preceeding rows
Total water intake included in target (thousand gallons):	Sum the water sources covered under the scope of your water savings commitment. This will serve as your baseline water consumption for the purposes of the program (DOE does not require rainwater or on-site recycled water to be included in this total)
Baseline adjustment due to increase/decrease in the number of facilities reporting relative to baseline year or other operational changes, (+/- thousand gallons):	Identify the baseline adjustment due to **Increase/Decrease in the Number of Facilities Reporting** Relative to Baseline Year or other operational changes, if applicable. This is only required for current year reporting and not required for baseline year reporting.
If a baseline adjustment was made, please indicate the reason for making the adjustment	Reasons can include changes to the plant portfolio (e.g., acquisitions or closures), significant process changes that impact water consumption (e.g., new product line), or other operational changes since the baseline year that impact water consumption
Unit(s) for water intensity metric	Indicate the unit(s) for the water intensity metric(s) used for tracking water reduction for the Water Savings Pilot. Examples include thousand gallons/ton of product, thousand gallons/labor hours. If using an absolute metric, please indicate the unit of intake being used (e.g., thousand gallons). If using a regression-based approach, leave this field blank.
For partners using a single water intensity metric across all plants, water intensity or other metric used for tracking Water Savings Pilot goal (numeric value)	Indicate the water intensity at the organization level (if one exists) for the baseline year. This is the water intensity against which progress towards target achievement is calculated. If water intensity improvements are calculated at the plant level and rolled up to the organization level, leave this field blank.
Annual improvement in water intensity for current year (%):	Provide the change in water intensity experienced in current year. A simple way of calculating this value is to subtract last year's Total Change in Water Intensity from the current year's Total Change in Water Intensity.
Total change In water intensity (%):	Provide the total change in water intensity since the baseline year. This value can be calculated with the following equation: Total Improvement in Water Intensity (%) = (Water Intensity$_{\text{Baseline Year}}$ -- Water Intensity$_{\text{Current Year}}$) / Water Intensity$_{\text{Baseline Year}}$
Please describe the methdology used for calculating water intensity improvements:	Briefly describe the data and calculations to determine the reported water intensity improvement, especially the process through which facility-level metrics are rolled up to the corporate level
Please briefly describe the technologies, strategies, and practices employed during the previous year to decrease water intensity. Please identify: systems/processes impacted, approximate water savings from projects, and implementation cost	Briefly describe, in general, the range of technologies, strategies and practices employed since the baseline year that resulted in a reduction in water intensity. If possible, identify systems and/or facilities that were impacted, approximate water savings, and implementation cost . Optional details: geographic location, industry, and additional descriptive details about the projects.
Facility-Level Water Performance (Applies to Companies with Multiple Plants)	Please mark down the number of facilities that have achieved the level of "Water Intensity Performance Level" indicated in the left hand column of the table. Facility-level water intensity should be measured on a cumulative basis against the organization's baseline year.

Appendix B: Related tools, guidebooks, and organizations

There are a number of resources available to companies seeking to establish a water management program. Below is a list of tools, guidebooks, and organizations along with a brief description of how they may assist in establishing a water management program. The list is not meant to be exhaustive, but it summarizes resources DOE has identified through its efforts with the Water Savings Initiative. Where relevant, partners' use of the resources is highlighted. All the resources listed are publicly available. The listing of tools, guidebooks, and organizations below does not represent any endorsement by DOE.

Tools

The software tools below can help manufacturers develop elements of their water management program including developing a water footprint, identifying facilities throughout the supply chain in water scarce areas and evaluating their water risk, and identifying water efficiency measures.

EDF-GEMI Water Management Application (WaterMAPP)

Developed by the Environmental Defense Fund (EDF) and the Global Environmental Management Initiative (GEMI) and based on a collaboration between AT&T and EDF, WaterMAPP is a set of tools and resources intended to help facility managers evaluate water usage and identify opportunities for improvement.

A presentation (beginning on slide 40) from EDF given at the DOE 2015 Better Buildings Summit provides more details on the tool.

The EDF-GEMI WaterMAPP can be downloaded (Excel based) through the EDF or GEMI at: http://business.edf.org/projects/featured/water-efficiency-and-att/water-efficiency-toolkit-2/ or http://www.gemi.org/EDFGEMIwaterMAPP/

GEMI Collecting the Drops: A Water Sustainability Planner Tool

This web-based tool (also available as a guidebook) has been developed by GEMI's Water Sustainability Group. The tool guides a facility through assessing and evaluating the impact of its water uses and needs with respect to the local water availability and identifying operational risk factors related to water use. The tool includes 47 industry case studies highlighting how GEMI members have identified water management opportunities.

The Collecting the Drops: A Water Sustainability Planner Tool and accompanying guidebook can be accessed through GEMI at: http://waterplanner.gemi.org/index.htm

GEMI Connecting the Drops: Toward Creative Water Strategies

This web-based tool (also available as a downloadable guidebook) developed by GEMI is designed to help companies understand emerging water issues within the context of their operations, needs, and circumstances and build a responsive business water strategy.

The Collecting the Drops: A Water Sustainability Planner Tool and guidebook can be accessed through GEMI at: http://www.gemi.org/water/index.htm

GEMI Local Water Tool

The GEMI Local Water Tool helps companies identify external impacts, business risks, and mitigation opportunities at specific sites. Developed in partnership with the World Business Council for Sustainable Development (WBSCD), the Local Water Tool links with the WBCSD Global Water Tool (see below) allowing local and corporate risk assessments to be conducted using a uniform approach. A company can use the Global Water Tool to identify high risk sites and the Local Water Tool to conduct a more detailed evaluation of the risks and develop risk management strategies at these sites.

The Local Water Tool can be downloaded (Excel based) at: http://gemi.org/localwatertool/

Water Footprint Assessment Tool

This web-based tool helps companies map their water footprints including their supply chains, and improve the sustainability and efficiency of their water use. The user has the option to evaluate a company's water footprint, assess its sustainability, and identify reduction actions either through a Geographic Assessment based on the water basin or a Production Assessment based on a product. The tool has been developed by the Water Footprint Network and the University of Twente in the Netherlands. The tool also gathers data for assessing global water footprint from WaterStat—a comprehensive global water footprint database.

The Water Footprint Assessment Tool can be accessed through the Water Footprint Network at: http://waterfootprint.org/en/resources/interactive-tools/water-footprint-assessment-tool/

Water Risk Filter

Developed by the World Wide Fund for Nature (WWF) in collaboration with the German financial institution KfW DEG, this web-based tool assists companies in assessing water-related risks for their own operations, suppliers, or growth plans and provides guidance on potential responses. The tool can be used to conduct a high-level risk assessment, where only industry, facility name and location are required or at a facility-specific level where the assessment is based on a more detailed questionnaire.

The Water Risk Filter can be accessed at: http://waterriskfilter.panda.org/

Water Risk Monetizer

The Water Risk Monetizer can help companies value the financial costs associated with water risk based on current water use, water prices, and production projections at a single or multiple facilities. The tool calculates risk adjusted water cost and potential revenue at risk due to the impact of water scarcity. The tool was developed by Ecolab.

The Water Risk Monetizer can be accessed at: http://ecolab.com/sustainability/water-risk-monetizer/

WBCSD Global Water Tool

The World Business Council for Sustainable Development (WBCSD) Global Water Tool allows facilities to assess their own water use information relative to country and watershed information such as water sanitation, population, and biodiversity. It also establishes water risks relative to the company's portfolio and enables communication of these risks. The tool addresses the following:

- Number of sites in extremely water-scarce areas including those at present and future risk
- Production volume from sites at greatest risk
- Number of employees globally without access to clean water
- Implications of water-risk on the supply chain

While the tool does not provide a detailed watershed analysis, it facilitates the consideration of the local watershed when establishing a corporate water management strategy. The tool has been used by Cummins, Saint-Gobain, and UTC.

The Global Water Tool can be downloaded (for use in Excel) through the WBCSD at: http://www.wbcsd.org/work-program/sector-projects/water/global-water-tool.aspx

WRI Aqueduct Tool

Developed by the World Resources Institute (WRI), Aqueduct helps companies, investors, governments, and communities understand current and emerging water risks throughout the world. At its center is the Water Risk Atlas which uses a peer reviewed methodology and best available data to create global maps of water risks. In developing the tool, WRI partnered with several industrial companies to provide expertise and perspective on the project. The tool has been used by Cummins, GM, and UTC.

Aqueduct is a web-based tool and can be accessed at: http://www.wri.org/our-work/project/aqueduct

Guidebooks

The guidebooks listed below have been developed by various organizations, including non-profits, state agencies, companies, and the EPA. These guidebooks are publicly available. Bibliographical information follows the description of each guidebook. Descriptions of guidebooks are adapted from their own documentation.

"Industrial Water Management: A Systems Approach" by W. Bryers, G. Lindgren, and C. Noling

Developed by the Center for Water Reduction Technologies of the American Institute of Chemical Engineers and written by CH2M Hill, this guidebook outlines a systematic approach to water reuse. Topics covered include: a six step framework for water management, water reclamation strategies and technologies, case studies from various sectors, and descriptions of water use in several industries including aluminum, chemical, forest products, and steel sectors.

Byers, W., Lindgren, G., Noling, C., Dennis Peters. July 2003. "Industrial Water Management: A Systems Approach", CH2M Hill, 2nd Ed.

"Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature Volume II" by the California Department of Water Resources

As part of an effort to address the increasing demand on the state's water supply, the California Department of Water Resources and the California Urban Water Conservation Council convened a Commercial, Industrial, and Institutional (CII) Task Force to develop best practices for water management for the CII sector. This report identifies those practices. Although written for the California CII sector, the best management practices presented are relevant to the CII sector more generally. The audience for the report includes policymakers and end-users. Section 5 (Water Use Metrics and Data Collection) and Section 7.2 (Commercial, Industrial, and Institutional Sectors and Best Management Practice – Industrial Sectors) are of particular relevance to establishing a water management program at industrial facilities. The report is divided into two volumes with Volume II providing the same information as Volume I but in greater detail.

CII Task Force. October 2013. “Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature Volume II,” California Department of Water Resources.

“Cooling Tower Efficiency Guide Property Managers: Improving Cooling Tower Operations” by Environmental Defense Fund

This two part guide assists facility managers to better understand and optimize cooling tower operations, including energy, water, and chemical use. The guide benefits from a collaboration between AT&T and Environmental Defense Fund to examine water use in cooling towers. It incorporates lessons learned from the collaboration and AT&T’s existing approach to cooling tower water management.

Environmental Defense Fund, “Cooling Tower Efficiency Guide Property Managers: Improving Cooling Tower Operations”, March 2013.

“Lean & Water Toolkit: Achieving Process Excellence Through Water Efficiency” by the Environmental Protection Agency

Developed by the EPA, the toolkit addresses opportunities to improve water use efficiency as identified through the combined experiences and best practices of multiple industry and government partners including: PepsiCo, Levi Strauss and Co., Del Monte Foods, Coca-Cola, and Johnson & Johnson. Topics addressed include: evaluating water costs, measuring water use, developing a water balance, water losses and leaks, non-value added or inefficient use of water, missed opportunities to reuse water, wastewater discharges, unnecessary water use and risks throughout the supply chain, and missed opportunities to address customers’ water-efficiency goals. The toolkit assumes the reader has some familiarity with Lean methods and provides strategies and techniques for improving common Lean results.

Environmental Protection Agency, “Lean & Water Toolkit: Achieving Process Excellence Through Water Efficiency”, October 2011.

“Water Efficiency Manual for Commercial, Industrial, and Institutional Facilities” by North Carolina Department of Environment and Natural Resources

Developed jointly by the Division of Pollution Prevention and Environmental Assistance and Division of Water Resources of the North Carolina Department of Environment and Natural Resources, this document assists facilities “reduce water use, improve efficiency, and save money.” Specific guides for textiles, food and beverage, and metal finishing industries are provided in Chapter 5. Other topics include: steps for establishing a water efficiency program, conducting water audits, drought planning, and specific water efficiency measures.

Organizations

In addition to the DOE and EPA, the following organizations have dedicated efforts and resources for assisting manufacturers with the development of their water management programs.

Carbon Disclosure Project (CDP) Water Program

In 2014, more than 2,200 companies were asked to report information on their global water use through the CDP's water program. By reporting water use through the program, companies disclose their water risks and mitigation strategies to investors and companies with large supply chains. Most of the partners in the Water Savings Pilot reported through the program, including Cummins, Ford, GM, Nissan, Saint-Gobain, and UTC.

For more information on the CDP Water Program visit: https://www.cdp.net/water

Ceres

Ceres is a non-profit organization focused on increasing the adoption of sustainable business practices and solutions to build a stronger global economy. One of Ceres' focus areas is water. Ceres' work in the field focuses on changing the way investors consider water risk in investment decisions. To this end, Ceres has developed the Aqua Gauge Tool to help companies assess, improve, and communicate their water risk management strategy and for investors to evaluate the strategy. Cummins is working with Ceres to analyze its water goals.

For more information on Ceres visit: http://www.ceres.org/

United Nations (UN) CEO Water Mandate

The CEO Water Mandate gathers commitments from CEO's of companies to implement the six elements of the mandate. These elements pertain to: direct operations, supply chain and watershed management, collective action, public policy, community engagement, and transparency. The initiative was launched in 2007 by the UN Secretary-General and is a mechanism for companies to help realize the vision of the UN Global Compact and the Millennium Development Goals. Ford and Saint-Gobain are signatories to the CEO Water Mandate.

For more information on the UN CEO Water Mandate visit: http://ceowatermandate.org/

World Business Council for Sustainable Development (WBCSD)

The WBCSD is a CEO-led organization focusing on business sustainability issues. WBCSD consists of 200 member companies representing all business sectors and continents. Member companies share best practices on sustainable development issues and develop tools to support corporate sustainability initiatives.

The WBCSD water-related efforts have focused on raising awareness (e.g. Water Facts & Trends), collaborative processes (e.g. Water Scenarios to 2025), the development of tools (e.g. Global Water Tool), and advocacy efforts (Stockholm World Water Week, World Water Forum, UN World Water Development Reports). UTC has been active in the WBCSD.

For more information on WBCSD's water-related efforts visit: http://www.wbcsd.org/work-program/sector-projects/water.aspx

World Resources Institute

WRI is a global research organization focusing on climate, energy, food, forests, water, and cities and transport. With respect to water, WRI has conducted analysis, and developed tools (such as Aqueduct) and resources to help companies map, measure, and mitigate global water risks with respect to both water quantity and quality. UTC has been engaged with WRI on their water efforts.

For more information on WRI's water related efforts visit: http://www.wri.org/our-work/topics/water

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