OAK RIDGE National Laboratory

DOE's Plant Water Profiler Tool for Water Assessment of Manufacturing Facilities

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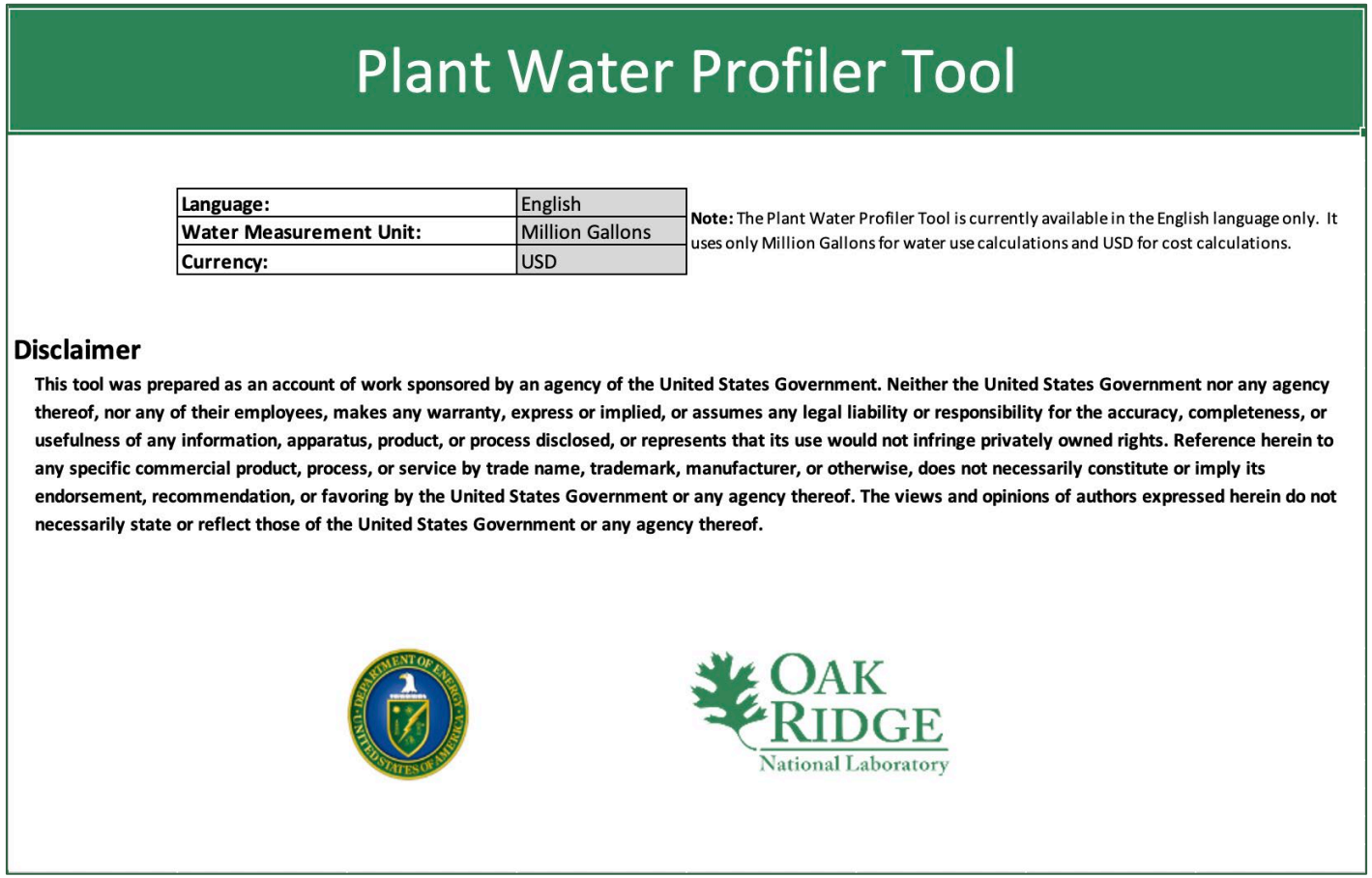
U.S. DEPARTMENT OF ENERGY

Striving for Energy Efficient, Resilient, and Competitive Manufacturing Sector

Plant Water Profiler (PWP) Tool

The Plant Water Profiler (PWP) tool is a comprehensive excel-based tool designed for use by manufacturing plants to help perform a facility level water assessment

https://www.energy.gov/eere/amo/plant-water-profiler-tool-excel-beta-version-pwpex-v01



Plant Water Profiler Tool

Language:	English
Water Measurement Unit:	Million Gallons
Currency:	USD

Note: The Plant Water Profiler Tool is currently available in the English language only. It uses only Million Gallons for water use calculations and USD for cost calculations.

Disclaimer

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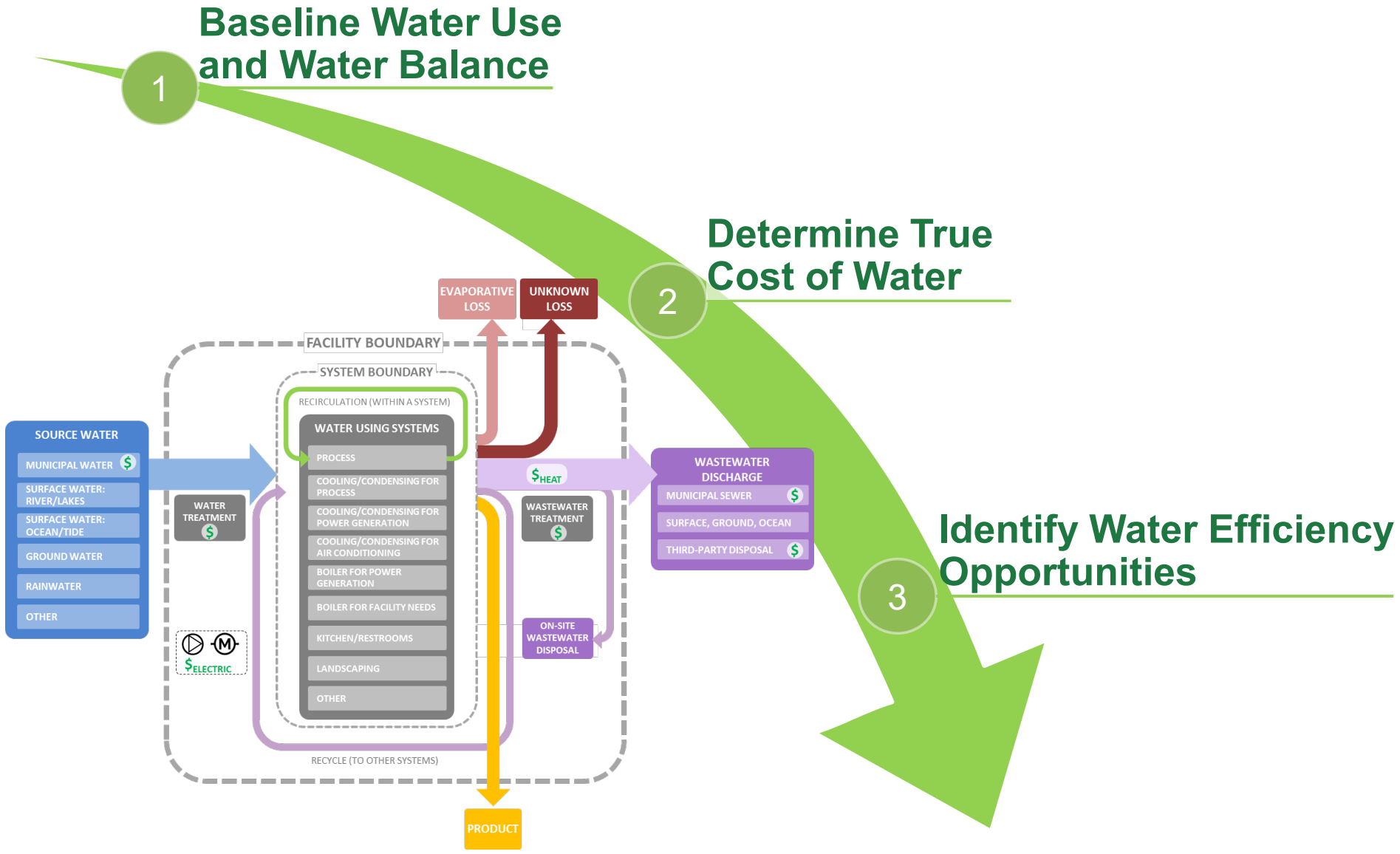
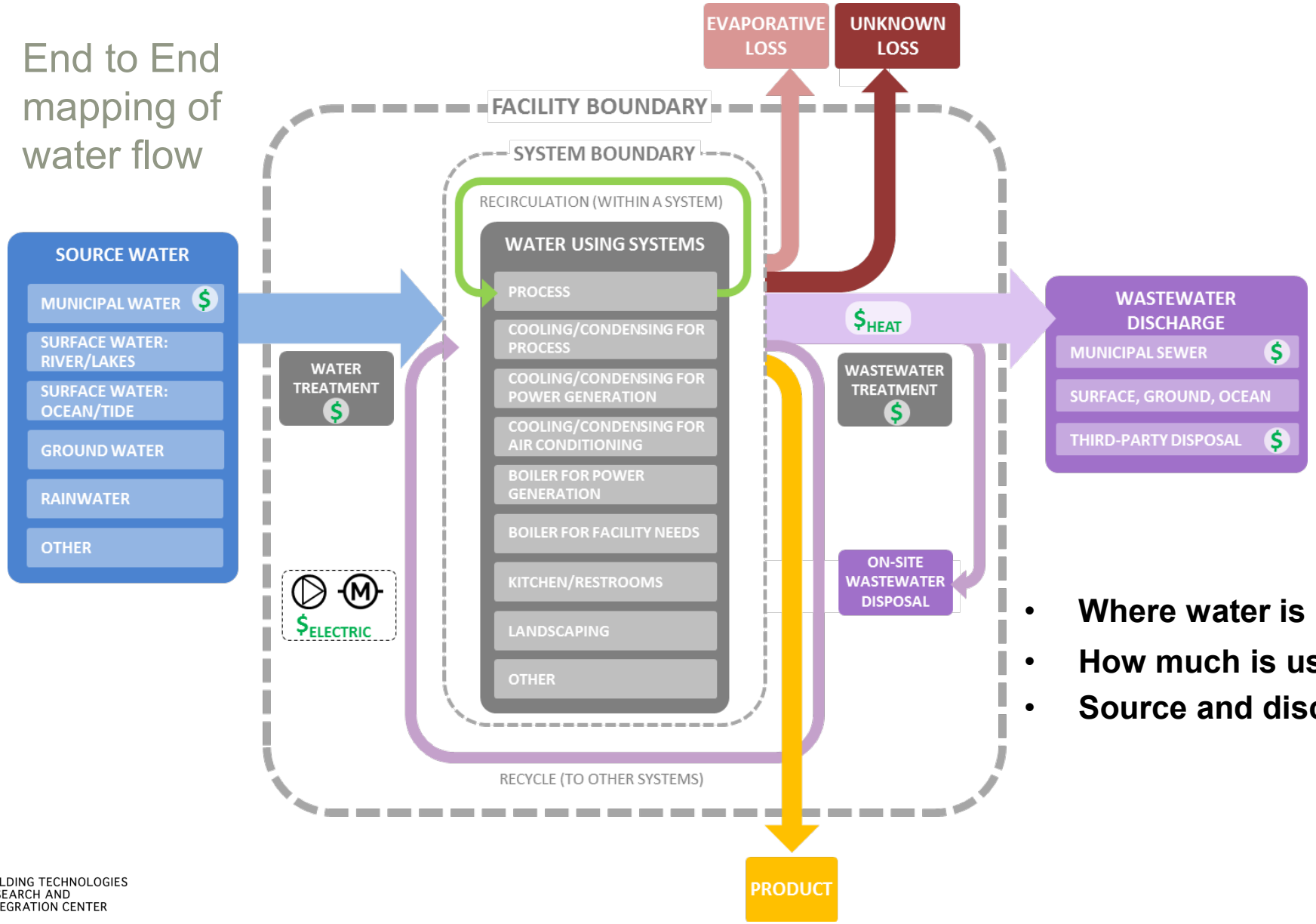
PWP Tool Concept



Baselining water use

End to End mapping of water flow

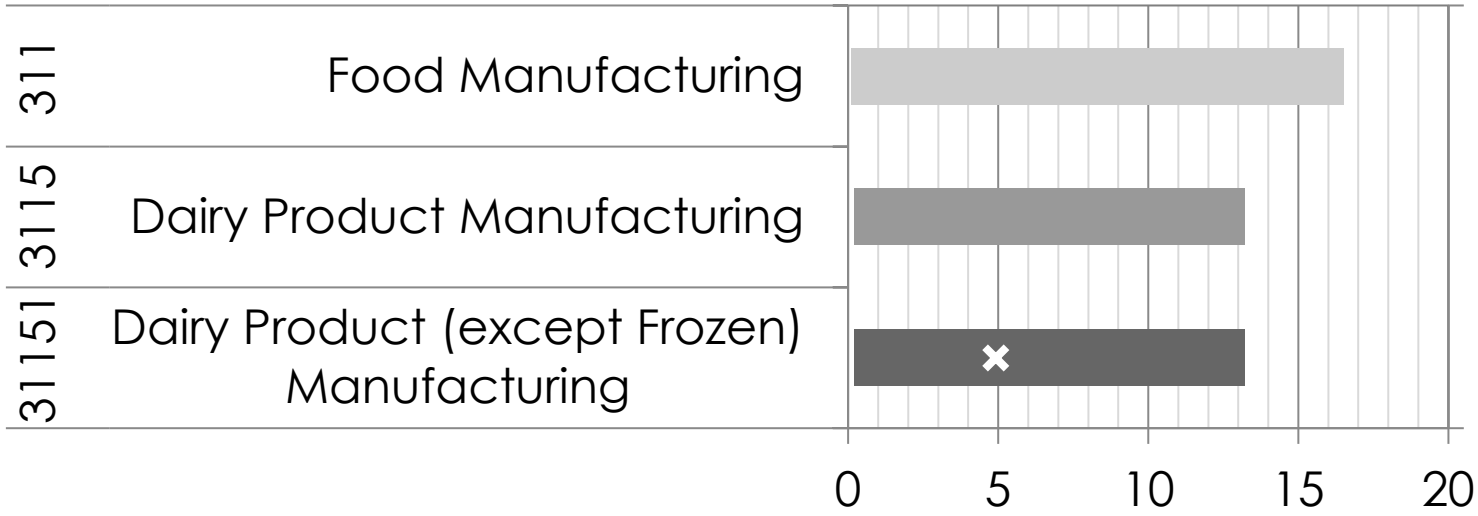


- **Where water is used**
- **How much is used**
- **Source and discharge**

Baselining water use

Significance to the facility

- Establishes baseline to track water use over time
- Allows comparison with other industries (motivation)



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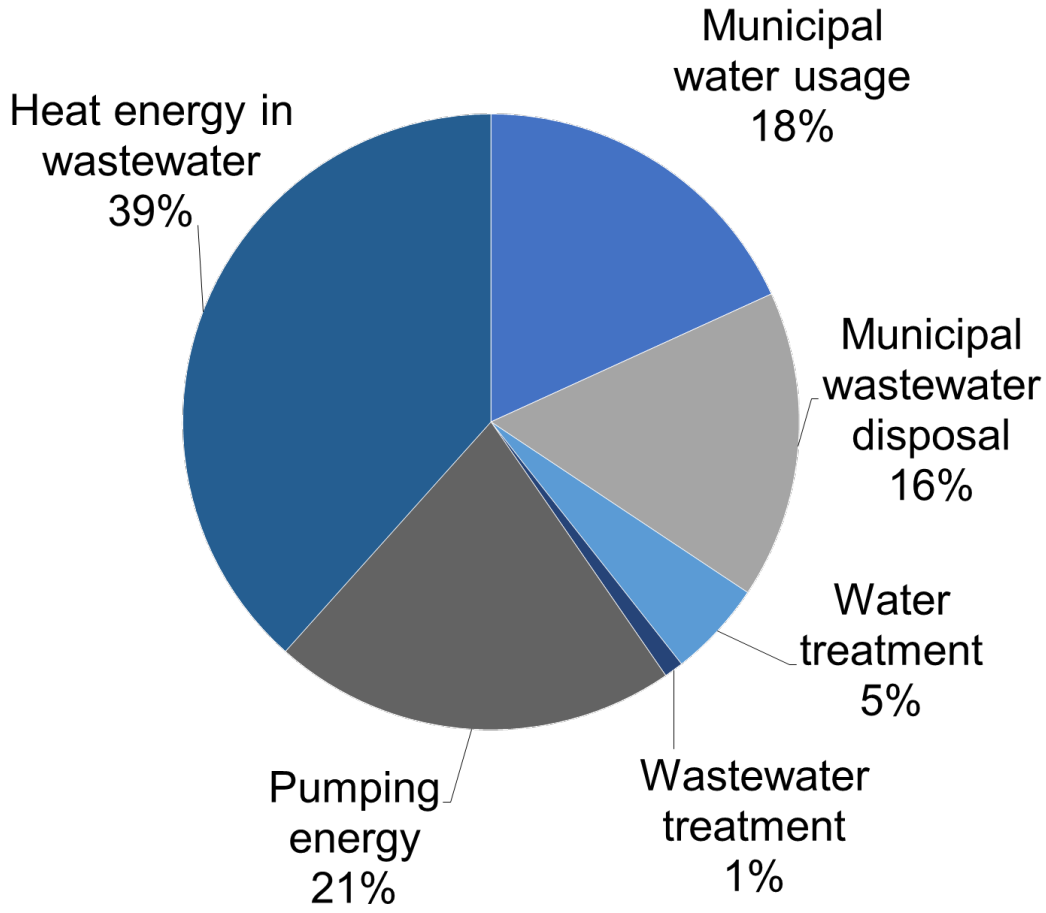
True Cost of Water

- Water costs beyond utility
  - Incoming water treatment
  - Fuel: Heating
  - Electricity: cooling, blowers, pumping
  - Discharge water treatment
- Reducing water use can reduce energy and other costs



True Cost of water is unique for each facility

Direct Cost

- Cost of purchased water
- Cost for municipal and industrial sewer

Indirect Cost

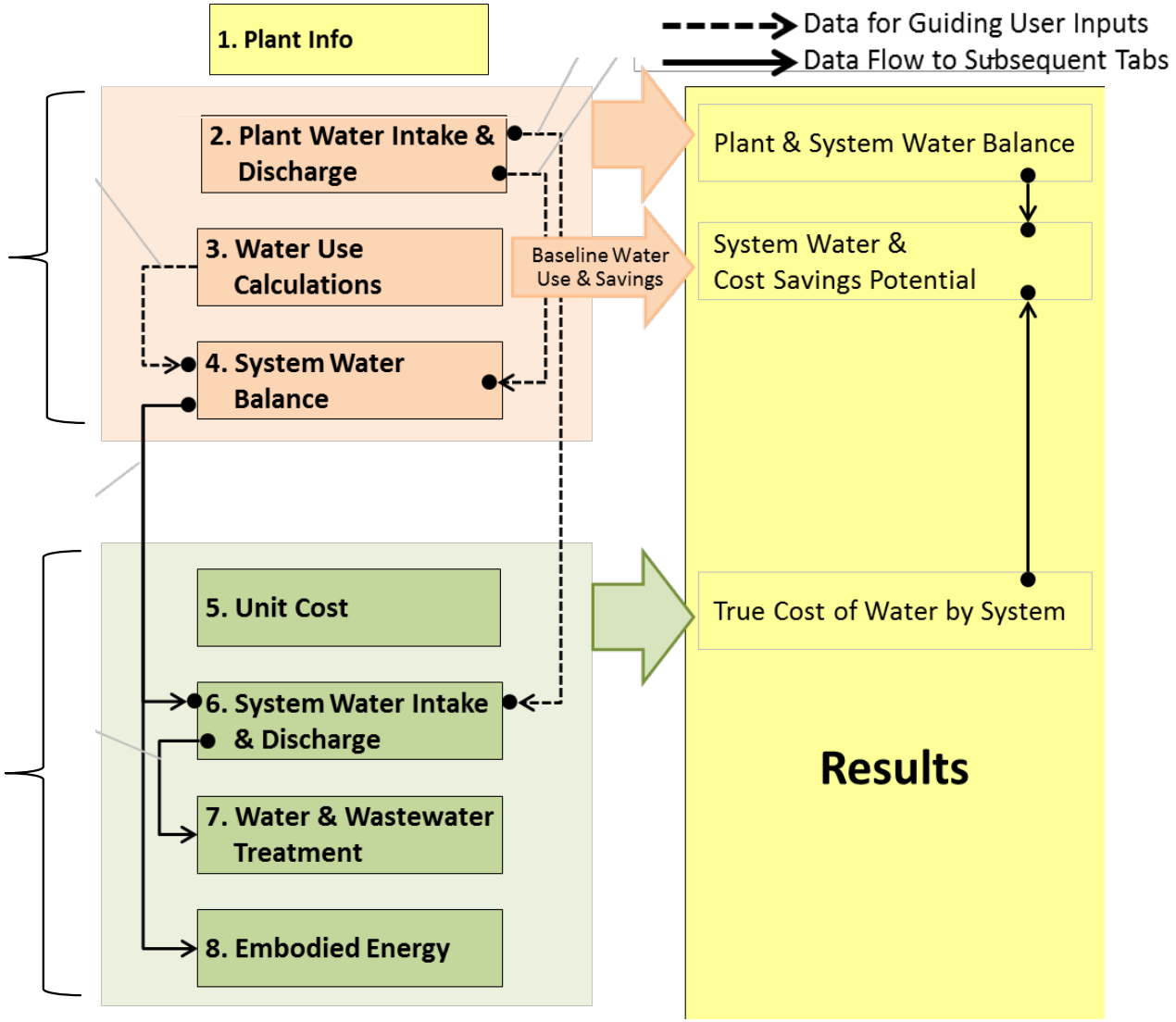
- Cost of water and wastewater treatment
- Cost to pump water to point of use
- Cost to heat/cool water
- Cost of chemicals in outflows
- Third Party Disposal…

True Cost of Water

PWP Tool – Map

Baseline Water Use

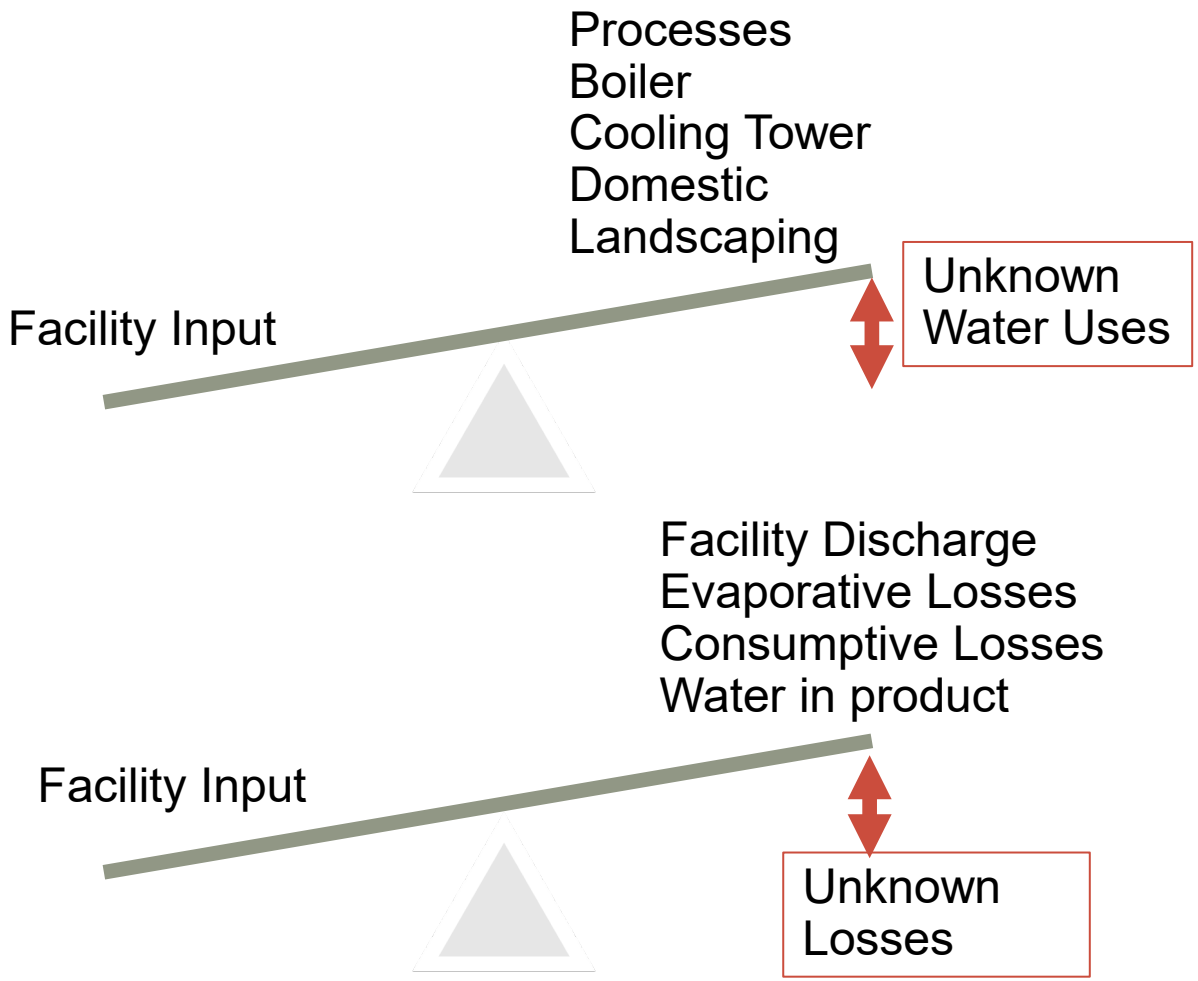
True Cost of Water



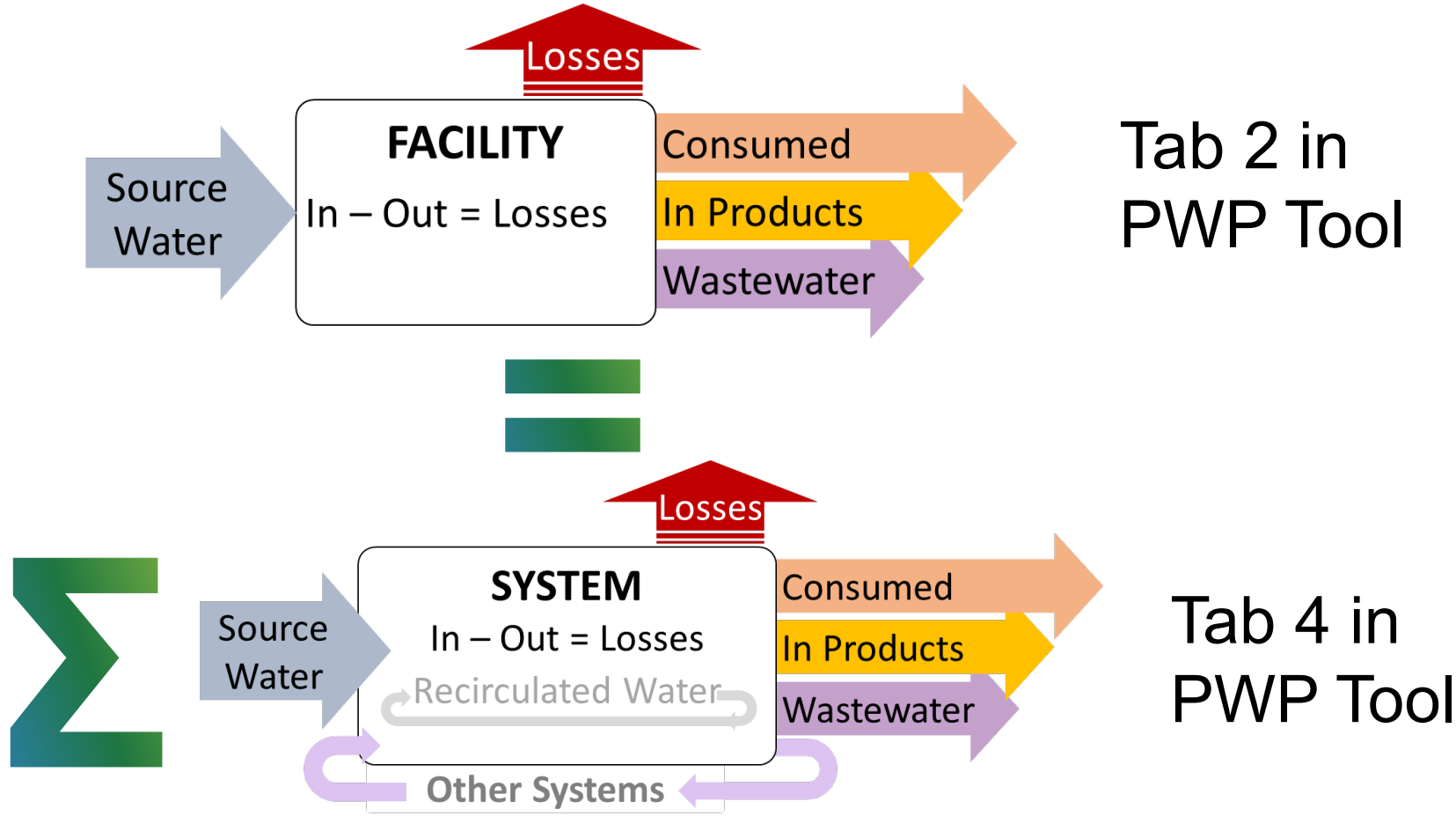
Step 1. Baselining water use (water balance)

- Total of all water used by individual **Systems** should equal **Plant Water Intake**

- **Plant Water Intake** should equal **Plant Water outflows**



Step 1 - Baseline Water Use and Water Balance



Tab 2 in PWP Tool

Tab 4 in PWP Tool

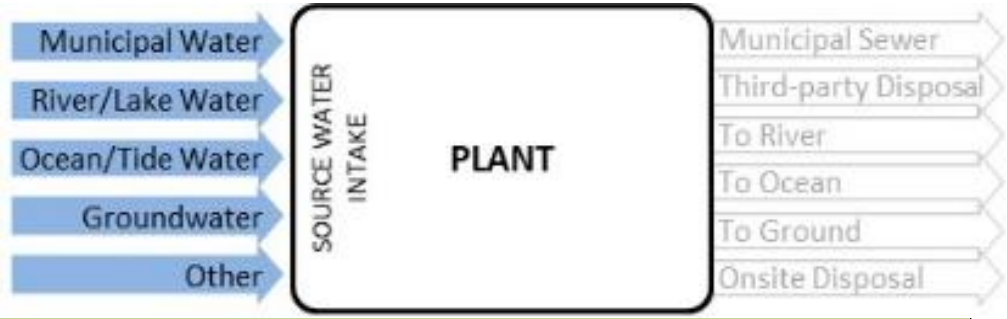
Tab 3 provides calculators to estimate system water consumption

Tab 2 – Plant Water Intake Table

Part 2.1 - Plant's Source Water Intake

Please select the data interval (i.e., monthly or annual) and provide an estimate of water intake in your plant from applicable water sources. You may also select a water source that is not listed in the table, such as rainwater, desalinated water, or other. Select the quality of water from the drop-down list.

Year	2018
Data Interval	Monthly



Month	Plant's Source Water Intake (Million Gallon)							
	Municipal Water Potable	Municipal Water Nonpotable	Municipal Water	River or Lake Nonpotable	Ocean or Tide	Groundwater	Other	Total
January	0.95			0.15				1.1
February	0.95			0.15				1.1
March	0.95			0.15				1.1
April	0.95			0.15				1.1
May	0.95			0.15				1.1
June	0.95			0.15				1.1
July	0.95			0.15				1.1
August	0.95			0.15				1.1
September	0.95			0.15				1.1
October	0.95			0.15				1.1
November	0.95			0.15				1.1
December	0.95			0.15				1.1
Annual								-
ANNUAL TOTAL	**11.4**	**-**	**-**	**1.8**	**-**	**-**	**-**	**13.2**

Note: *If the plant boundary encompasses the entire facility, ANNUAL TOTAL should match with Facility-Wide Annual Source Water Intake you have entered in Part 1.3, also shown here in the purple cell.* 13.2

Tab 3 – Example System Level Calculator

Yellow	Please input data ONLY in the yellow cells.
Orange	Please select from the drop-down menu in the orange cells.
Tan	Please DO NOT enter any data or delete values in the tan cells. They contain formulae.
Purple	Please DO NOT enter any data in the purple cells. They show values calculated elsewhere for guiding user input and cross-checking results.
Gray	Please DO NOT enter any data in the gray cells. They are not applicable to your plant.

Part 3.2 - Cooling Tower Water Use

This table calculates cooling tower water use in the plant. Please select the applicable cooling/condensing system and enter required data in the highlighted cells.
For "Load (Fraction of Chiller Tonnage)," the typical range is 0.5-0.8. For "Evaporation Rate per 10°F Temp. Drop," 0.85% is a typical value, and the typical range is 0.65% for moist climate to 1.0-1.2% for dry climate. For "Temp. Drop Across Cooling Tower," typical range is 10-15°F. For conductivity, first select "Conductivity Unit" from the drop-down list on the right and then enter data below.

Conductivity Unit:	µS/cm

Cooling Tower	Hours of Operation per Year	Cooling Tower Tonnage	Load Factor (Fraction of Tonnage)	Evaporation Rate per 10°F Temp. Drop (%)	Temp. Drop Across Cooling Tower (°F)	Makeup Water Conductivity	Blowdown Conductivity	Million Gallon per Year (% of Gross Water Use)				
								Gross Water Use	Incoming	Outgoing		Recirculated Water
						µS/cm	µS/cm		Makeup Water	Blowdown	Evaporation	
Cooling Tower for: Process 1	2,912	250	0.8	0.85%	10	600	1,800	105 (100%)	1.34 (1.28%)	0.446 (0.425%)	0.891 (0.85%)	103 (98.7%)
Cooling Tower for: Air Conditioning	2,000	75	0.78	0.85%	10	600	1,800	21.1 (100%)	0.269 (1.28%)	0.0895 (0.425%)	0.179 (0.85%)	20.8 (98.7%)

Tab 4 – System Water Balance

Part 4.1 - System Gross Water Use

For EACH water-using system, please provide an estimate of water use originating from different paths. ***Note:*** *You may use values in the purple cells, which were calculated in previous tabs, as a guide for your estimates in yellow cells, as shown below:*

** Use calculated Incoming Water (Source Water + Water From Other Systems) for user estimate for Source Water and Water From Other Systems.*

** Use calculated Recirculated Water for user estimate for Recirculated Water.*

** Use calculated Gross Water Use to cross-check TOTAL of User Estimate of Water Use.*

Water-Using System	Water Flows Calculated on Tab 3 (Million Gallon per Year)			Water Use (Measured or Estimated) (Million Gallon per Year)			
	Incoming Water (Source Water + Recycled From Other Systems)	Recirculated Water	Gross Water Use	Incoming Water		Recirculated Water	**Total (Gross Water Use)**
				Source Water	Recycled Water From Other Systems		
Process: Product Cooling	-	-	**-**	6.8			**6.8**
-	-	-	**-**				**-**
-	-	-	**-**				**-**
Cooling Tower for: Process 1	1.337	103.495	**104.832**	1.3		100.0	**101.3**
Cooling Tower for: Air Conditioning	0.269	20.791	**21.06**	0.3		20.79	**21.09**
-	-	-	**-**				**-**
Boiler for: Facility Needs	3.841	1.28	**5.121**	3.85		1.28	**5.13**
-	-	-	**-**				**-**
Kitchen and Restrooms	1.399	-	**1.399**	1.4			**1.4**
Landscaping and Irrigation	1.849	-	**1.849**		1.85		**1.85**
-							**-**
TOTAL	**8.693**	**125.567**	**134.26**	**13.65**	**1.85**	**122.07**	**137.57**

Note: *System-level TOTAL for Source Water should closely match with plant-level ANNUAL TOTAL calculated in Part 2.1, also shown here in the purple cell.* 13.2

Data Required

Process	Cooling System	Boiler System	Domestic	Landscaping
Number of Units Processed per Year	Annual Hours of Operation	Annual Hours of Operation	Number of Employees	Area of Land Irrigated
Water Required for Processing	Chiller Tonnage	Boiler Horsepower	Workdays per Year	Inches of Irrigation Water
Fraction of Water Recirculated	Load Factor	Load Factor	Water Use/ Employee	
Water Used in Products (consumed)	Evaporation Rate	Steam Generation Rate		
	Temp. Drop Across Cooling Tower	Feedwater Conductivity		
	Makeup Water Conductivity	Makeup Water Conductivity		
	Blowdown Conductivity	Blowdown Conductivity		

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Step 2. Determine True Cost of Water

Tab 5 - Define Unit Cost of all components – Typical Values are Provided

Tab 6 & 7 - Match unit cost with water flow volumes identified through water baselining

Tab 8 - Define the embodied energy components – Pumps, Fans and Heating

Tab 7 – Cost of Water and Wastewater Treatment

Part 7.1 - Onsite Water Treatment

Please select water treatment processes from the drop-down list for your plant. Enter a percent estimate of water that is treated for applicable incoming water categories. For example, if "Process A" receives water from "River," all of which undergoes "Water Treatment Process 1" and "Water Treatment Process 2," enter 100% in both cells of that row.

Water-Using System	Water from:	Quantity (Million Gallon per Year)	% of Water Use Undergoing Water Treatment	
			Water Treatment Process	
			Reverse Osmosis	Lime Softening
Process: Product Cooling	Municipal Water: Potable	6.8	100%	
	River or Lake: Nonpotable	-		
	Water from Other Systems	-		
	Recirc. within System	-	100%	
Cooling Tower for: Process 1	Municipal Water: Potable	-		
	River or Lake: Nonpotable	1.3		100%
	Water from Other Systems	-		
	Recirc. within System	100.0		

Step 3. Identify water opportunities – Tab 9 & 10

Checklist of plant and system level measures

User answers questions to evaluate water efficiency status on system-level and to identify potential opportunities.

System Water Efficiency Status	Response
Process	
Cooling/condensing for process	
Has once-through cooling water been eliminated with the use of chillers, cooling towers, or air-cooled equipment?	No
Has blow-down/bleed-off control on cooling towers been optimized?	No
Is treated wastewater (or other sources of water for cooling tower make-up) reused where possible?	No
Are cycles of concentration for cooling towers maximized through efficient water treatment?	No
Cooling/condensing for air conditioning	
Boiler for Facility	
Kitchen and Restrooms	
Landscaping	

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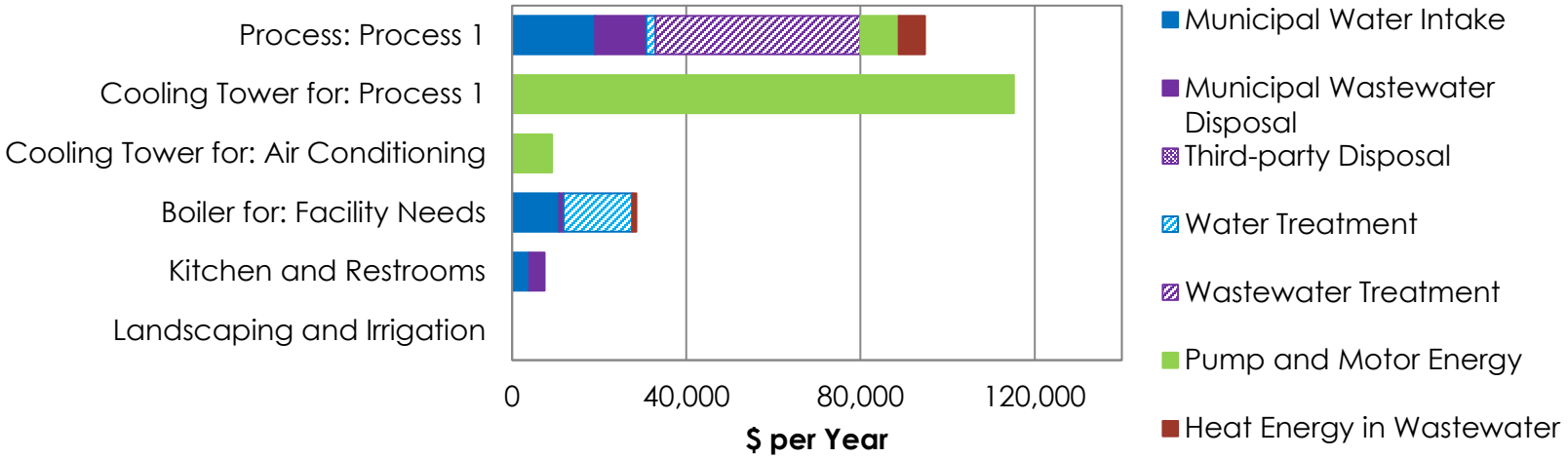
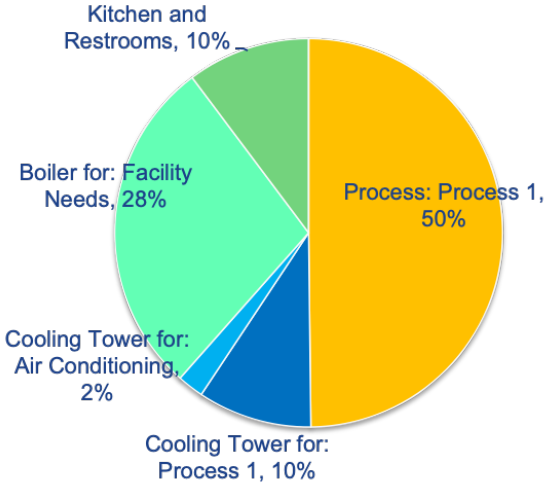
PWP results

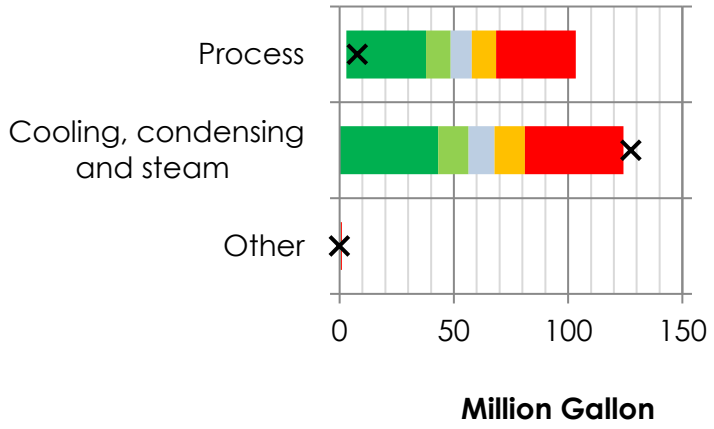
True Cost of Water



Water Intake by System



Comparison with Industry Average



Water Imbalance by System

Water-Using System	Incoming Water	Outgoing Water	Water Imbalance		
	Million Gallon per Year		Million Gallon Per Year	% of Incoming Water	% of Total Loss
Process: Process 1	6.8	6.405	0.395	5.8%	87.2%
Cooling Tower for: Process 1	1.3	1.3	-	-	-
Cooling Tower for: Air Conditioning	0.3	0.27	0.03	10.0%	6.6%
....					
PLANT TOTAL	**15.5**	**15.047**	**0.453**	**16.5%**	**100.0%**

Questions?

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PWP Tool Download Link:
https://www.energy.gov/eere/amo/plant-water-profiler-tool-excel-version-10-pwpex-v10

Acknowledgement

Industry Partners

- Saint-Gobain North America #, ⊗
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- Owens Corning ⊗
- ALCOA
- Arconic
- General Motors

* Provided beta testing feedback
# Provided case study
⊗ Hosted Water INPLT Pilot Training

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