Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

Supporting Information for

Cost and Energy Intensity of U.S. Potable Water Reuse Systems

Alison Sim[a] and Meagan S. Mauter[a,*]

[a] *Department of Civil and Environmental Engineering, Stanford University, CA 94305, USA.*

*Corresponding author: E-mail: mauter@stanford.edu

Supporting Information Summary:
This supporting information contains 1) dataset of general features and costs of potable reuse systems; 2) method of matching PWS IDs in SDWIS to potable reuse facilities; 3) water AHEAD model input, outputs, and assumptions; 4) additional details of potable reuse systems, such as cumulative history and locations.

1.0 Datasets and Sources

Table S1. Dataset of general potable reuse system information. The semicolon indicates parallel treatment trains tested in pilot study. Treatment trains listed are reported to the detail that the source provides. Type of chemical post-treatment or chlorination is often not specified. As facilities undergo expansions or upgrades, treatment trains and capacities are subject to change.

project.name	state	reuse type	year installed	augmentation type	augmentation method	capacity (mgd)	capacity (m3d)	status	treatment	sourcewater
Montebello Forebay County Sanitation Districts of Los Angeles County	CA	IPR	1962	GW	spreading basins	44	166540	Operational	Soil-aquifer Treatment	tertiary effluent
Upper Occoquan Service Authority	VA	IPR	1978	SW		54	204390	Operational	Rapid Mix - Flocculation - Sedimentation - Recarbonation - Media Filtration - GAC - Chlorination	secondary effluent
Denver Potable Reuse Demonstration	CO	DPR	1980			1	3785	Demonstration Project	Rapid Mix - Flocculation - Recarbonation - Ballast Pond - Media Filtration - IEX - GAC - Ozone - UV - GAC - RO - Air Stripping - Chlorination	secondary effluent
Hueco Bolson Recharge Project, El Paso Water Utilities	TX	IPR	1985	GW	direct injection, spreading basins	12	45420	Operational	Primary Treatment - Secondary Treatment - PACT Filter - pH Adjustment - Media Filtration - Ozone - GAC - Chlorination - Storage	secondary effluent
Clayton County Water Authority	GA	IPR	1985	SW		12	45420	Operational	Constructed Wetlands	secondary effluent
City of Tampa Water Resource Recovery Project	FL	IPR	1987	GW	direct injection	0.072	273	Pilot study	Preaeration - Lime Addition - Recarbonation - Media Filtration - GAC - Ozone	secondary effluent
City of West Palm Beach Constructed Wetlands Demonstration Project	FL	IPR	1996	SW	wetlands	0.15	568	Demonstration Project	Coagulation - Niftrying Filters - Chlorination - Constructed Wetlands	secondary effluent
Gwinnett County	GA	IPR	1999	SW		60	227100	Operational	Chemical Clarification - Sedimentation - UF - Media Filtration - Ozone - BAF - Ozone	secondary effluent
Yelm Cochrane Memorial Park	WA	IPR	1999	SW	wetlands	0.05	189	Operational	Constructed Wetlands	tertiary effluent
City of Ephrata	WA	IPR	2000	GW	spreading basins	0.6	2271	Operational	Secondary Treatment - Coagulation - Media Filtration - UV	raw wastewater
Grant County Royal City	WA	IPR	2000	GW	spreading basins	0.25	946	Operational	Secondary Treatment - Coagulation - Rapid Mix - Cloth Disk Filter - UV	raw wastewater
Grant County Quincy City	WA	IPR	2002	GW	spreading basins	1.5	5678	Operational	SBR - Coagulation - Media Filtration - UV	raw wastewater
Los Alamitos Barrier Water Replenishment (Leo J Vander Lans Water Treatment Facility)	CA	IPR	2005	GW	direct injection	8	30280	Operational	MF - RO - UV/AOP (H2O2) - Decarbonation - Chlorination	tertiary effluent
LOTT Cleanwater Alliance Hawk's Prairie Ponds	WA	IPR	2006	SW	wetlands, spreading basins	1.5	5678	Operational	Constructed Wetlands	tertiary effluent
City of Sunrise Advanced Water Treatment and Reuse Pilot	FL	IPR	2007	GW		0.014	55	Pilot study	BNR - MBR - RO - UV/AOP (Ozone); BNR - MBR - UV/AOP (Ozone); BNR - MBR - Coagulation - Media Filtration - UV/AOP (Ozone)	secondary effluent
City of Plantation Advanced Wastewater Treatment Pilot	FL	IPR	2007	SW		0.014	55	Pilot study	MBR - BNR - RO - UV; Denitrifying Filters - UF - RO - UV	surface water
Chino Basin Groundwater Recharge Project Inland Empire Utility Agency	CA	IPR	2007	GW	spreading basins	18	68130	Operational	Soil-aquifer Treatment	tertiary effluent
Miami-Dade County Coastal Wetlands Rehydration Demonstration Pilot	FL	IPR	2009	GW	direct injection	0.173	654	Pilot study	Media Filtration - Chlorination - MF - RO - IEX - UV/AOP (H2O2)	secondary effluent
North Texas Municial Water District East Fork Water Reuse Project	TX	IPR	2009	SW		90	340650	Operational	Constructed Wetlands	surface water
Arapahoe County Cottonwood	CO	IPR	2009	GW		6	22710	Operational	Riverbank Filtration - RO - UV/AOP (H2O2) - Air Stripping - Chlorination	tertiary effluent
Town of Davie Advanced Water Treatment for Aquifer Recharge and Indirect Potable Reuse Pilot	FL	IPR	2010	GW	direct injection	0.022	82	Pilot study	UF - RO - UV	secondary effluent
Prairie Water Project Aurora	CO	IPR	2010	GW		50	189250	Operational	Riverbank Filtration - Aquifer Recharge - Chemical Softening - UV/AOP (H2O2) - Media Filtration - GAC - Chlorination	surface water
City of Tenino Class A Reclaimed Water Facility	WA	IPR	2011	GW	spreading basins	0.375	1419	Operational	MBR - Chlorination	raw wastewater
Airway Heights	WA	IPR	2012	GW	spreading basins	1.5	5678	Operational	Preliminary Treatment - Secondary Treatment - Tertiary Treatment - UV - Post Treatment	raw wastewater
Western Reverse Land Conservancy Tangent WaterCycle	OH	DPR	2013	DD		0.360	1363	Demonstration Project	MBR - RO - UV/AOP (H2O2) - Post Treatment - Chlorination	raw wastewater
City of Hollywood Effluent Recharge Treatment Pilot	FL	IPR	2013	GW	direct injection	0.014	55	Pilot study	Media Filtration - IEX - UV/AOP (H2O2) - BAC; Media Filtration - IEX - Ozone - BAC - UV	secondary effluent
Tarrant Regional Water District	TX	IPR	2013	SW		90	340650	Operational	Constructed Wetlands	surface water
Big Spring Colorado River Municipal Water District	TX	DPR	2013	SW	blending	1.8	6813	Operational	MF - RO - UV/AOP (H2O2) - Blending - Coagulation - Flocculation - Sedimentation - Chlorination	tertiary effluent

Wichita Falls Cypress Water Treatment Plant (DPR)	TX	DPR	2014	SW		5	18925	Decommisioned	MF - RO - UV - 50/50 SW Blend - Drinking Water Treatment	secondary effluent
Orange County Groundwater Replenishment System	CA	IPR	2014	GW	direct injection	100	378500	Operational	MF - RO - UV/AOP (H2O2) - Decarbonation - Lime Addition	secondary effluent
West Basin Recycling Plant Groundwater Replenishment and Seawater Barrier	CA	IPR	2014	GW	direct injection	12.5	47313	Operational	MF - RO - UV/AOP (H2O2) - Decarbonation - pH Adjustment	secondary effluent
City of Tucson Potable Reuse Pilot	AZ	IPR	2014	SW		0.014	55	Pilot study	Soil-aquifer Treatment - NF - Ozone - BAF	secondary effluent
Cambria Emergency Water Supply	CA	IPR	2014	GW	direct injection	0.65	2460	Operational	MF - RO - UV/AOP (H2O2) - Post Treatment - Chlorination	surface water
Dominguez Gap Barrier Terminal Island, City of	CA	IPR	2014	GW	direct injection	12	45420	Operational	MF - RO - UV/AOP (H2O2) - Chlorination	tertiary effluent
Silicon Valley Advanced Purification Center	CA	IPR	2014	GW	direct injection	8	30280	Operational	MF - RO - UV/AOP (H2O2)	tertiary effluent
Scottsdale Water Campus	AZ	IPR	2014	GW	direct injection	20	75700	Operational	Ozone - UF - RO - UV - Lime Addition - Decarbonation	tertiary effluent
City of Abilene Hamby Water Reclamation Facility and Indirect Reuse Project	TX	IPR	2015	SW		22	83270	Operational	MBR - RO - Ozone - BAF - Chlorination	raw wastewater
Ventura Pure Water	CA	DPR	2015	GW	direct injection	0.043	164	Demonstration Project	Pasteurization - UF - RO - UV/AOP (H2O2)	tertiary effluent
City of Oxnard Advanced Water Treatment Facility	CA	IPR	2016	GW	direct injection	6	22710	Operational	MF - RO - UV/AOP (H2O2) - Decarbonation - Lime Addition	secondary effluent
Gwinett County Pilot Study	GA	DPR	2016	SW		0.0086	33	Pilot study	Ozone - Rapid Mix - Flocculation - BAF - BAC - Chlorination	surface water
San Francisco Public Utilities Commission PureWat	CA		2016			0.001	5	Pilot study	UF - RO - UV - Chlorination	surface water
Hillsborough County Direct Potable Reuse Demonstration	FL	DPR	2016	SW		0.029	109	Demonstration Project	UF - RO - UV/AOP (H2O2)	tertiary effluent
Village of Cloudcroft DPR Project	NM	DPR	2017	DD	blending	0.18	681	Demonstration Project	MBR - Chlorination - Storage - RO - UV/AOP (H2O2) -	raw wastewater
City of Altamonte Springs pureALTA	FL	IPR	2017			0.28	1060	Pilot study	Ozone - BAC - UF - GAC - UV/AOP (H2O2)	tertiary effluent
Wichita Falls Resource Recovery Facility	TX	IPR	2018	SW		16	60560	Operational	Cloth Disk Filter - Advanced Tertiary Treatment	secondary effluent
Texas A&M University Direct Potable Reuse Research & Demo	TX	DPR	2018			0.0005	2	Demonstration Project	GAC - Ozone - Chlorination - RO - UV	secondary effluent
Portland Clean Water Services Pure Water Brew	OR	DPR	2018	SW				Operational	UF - RO - UV/AOP (H2O2)	tertiary effluent
Big Bear Area Regional Wastewater Agency Replenish Big Bear	CA	IPR	2019	SW		1.6	6056	Not Built	Not yet determined	secondary effluent
Pure Water Oceanside	CA	IPR	2019	SW		4	15140	Not Built	MF - RO - UV/AOP (Cl) - Post Treatment	secondary effluent
City of Pismo Beach Central Coast Blue	CA	IPR	2019	GW	direct injection	3.1	11734	Not Built	MF - UF - RO - UV/AOP (H2O2)	secondary effluent
Metropolitan Water District of Southern California	CA	IPR	2019	GW	spreading basins	0.5	1893	Demonstration Project	MBR - RO - UV/AOP (H2O2) - Post Treatment	secondary effluent
City of Daytona Beach Direct Potable Reuse Demo Test System	FL	DPR	2019	SW		0.2	757	Demonstration Project	UF - RO - UV/AOP (H2O2)	tertiary effluent
Las Virgenes-Triunfo Join Powers Authority Pure Water Project	CA	IPR	2019	SW				Demonstration Project	UF - RO - UV/AOP (H2O2)	tertiary effluent
Carpinteria Valley Water District Advanced Purification Project	CA	IPR	2020	GW	direct injection	1	3785	Not Built	MF - UF - RO - UV/AOP (Cl)	secondary effluent
Soquel Creek Water District Pure Water Soquel	WA	IPR	2020	GW	direct injection	1.3	4921	Not Built	MF - RO - UV/AOP (H2O2)	tertiary effluent
Jacksonville Electric Authority Water Purification Treatment Demonstration Facility	FL	DPR	Future	GW	direct injection	1	3785	Demonstration Project	UF - LPRO - pH Adjustment - UV/AOP	secondary effluent
Hampton Road Sanitation District SWIFT Project	TX	IPR	Future	GW	direct injection	1	3785	Demonstration Project	Flocculation - Sedimentation - Ozone - BAF - GAC - UV - Chlorination - Post-Treatment	secondary effluent
Pure Water Monterey	CA	IPR	Future	GW	direct injection	7	26495	Not Built	Ozone - (BAF) - MF - RO - UV/AOP (H2O2) - Post Treatment	secondary effluent
El Paso Advanced Water Purification Facility	TX	DPR	Future	DD		10	37850	Not Built	MF - UF - RO - UV/AOP (H2O2) - GAC - Chlorination - Storage	secondary effluent
Laguna Madre Water District	TX	DPR	Future	SW		1	3785	Not Built	Not yet determined	secondary effluent
East County Advanced Water Purification Program	CA	IPR	Future	GW	direct injection	11.5	43528	Not Built	MF - RO - UV/AOP (H2O2) - Chlorination	secondary effluent
Scottsdale Water Campus DPR Permit	AZ	DPR	Future	SW				Not Built	UF - RO - UV - UV - GAC	surface water
Palmdale Water District Groundwater Recharge and Recovery Project	CA	IPR	Future	GW	spreading basins	46	174110	Not Built	Soil-aquifer Treatment	surface water
City of Clearwater and the Southwest Florida Water Management District	FL	IPR	Future	GW	direct injection	3	11355	Not Built	UF - RO - UV/AOP (H2O2) - Microcontactor - Recarbonation - Lime Addition	tertiary effluent
Groundwater Reliabiltiy Improvement Project (GRIP)	CA	IPR	Future	GW		15	56775	Not Built	MF - UF - RO - UV/AOP (Cl) - Post Treatment	tertiary effluent
North City Pure Water Purification Facility (Phase 1)	CA	IPR	Future	SW		30	113550	Not Built	Ozone - BAF - MF - UF - RO - UV/AOP (H2O2) - Post Treatment - Chlorination	tertiary effluent
Donald C Tillman Water Reclamation Plant	CA	IPR	Future	GW	spreading basins	25	94625	Not Built	Ozone - BAC - UV/AOP (H2O2)	tertiary effluent
City of Brownwood	TX	DPR	Future	SW		1.25	4731	Not Built	Chlorination - UF - UV - Chlorination - Dechlorination - RO - GAC - UV - Chlorination	tertiary effluent
Kitsap County Kingston Recycled Water Project	WA	IPR	Future	GW	spreading basins	0.5	1893	Not Built	Soil-aquifer Treatment	tertiary effluent
Eastern Municipal Water District	CA	IPR	Future	GW	spreading basins	11	41635	Not Built	MF - RO - Ponds	tertiary effluent

Table S2. Dataset of costs for selected potable reuse systems.

Project Name	Status	Multistate Project	Plant Cost ($MM 2020)	O&M Cost ($MM/yr 2020)	Total Capital Costs ($MM 2020)	Available Breakdown (Bolded year used for inflation adjustment)	Numeric label for systems in Figure 6.	Notes
Upper Occoquan Service Authority	Operational	Y	n/a	n/a	**907**	$78 million (**1973**-1978) for 15 mgd; $21 million (**1985**-1987) for expansion to 27 mgd; $38 million (**1993**-1996) for interim-expansion to 32 mgd; $200 million (**1996**) to 54 mgd		Not including CIP capital costs since 2011.
Denver Potable Reuse Demonstration	Demonstration Project	N	**71**	**2.1**	n/a	Total project cost (**1979**-1993): $34.3 million, Design & Construction: $19.8 million O&M: $8.4 million		Outlier in costs.
Hueco Bolson Recharge Project (Fred Hervey Water Reclamation Plant)	Operational	N	n/a	n/a	**80**	Capital cost: $33 million (**1985**); treatment cost: $1.54/kgal (2015)		
Gwinnett County (F. Wayne Hill)	Operational	Y	**763**	n/a	**849**	$200 million initial plan construction (**1999**); $350 million facility expansion (**2006**); $72 million pipeline (2010)	1	
Prairie Water Project	Operational	N	**786**	n/a	**976**	Total plant cost: $659 million (**2010**); $160 million pipeline (2010)	3	Constructed $100 million below budget.
Los Alamitos Barrier Water Replenishment (Leo J Vander Lans Water Treatment Facility)	Operational	Y	**64**	**5.3**	n/a	Initial phase construction: $17 million (2001-2005); total construction cost: $52.2 million (**2014**); planning and design $5.96 million (2014); O&M: $4.8 million/yr (2014)	2	At time of publication, O&M and total construction costs were estimates. Only initial phase had been constructed.
City of Tenino Class A Reclaimed Water Facility	Operational	N	n/a	n/a	**7.5**	Total project cost: $6.2 million (**2009**)		
Big Spring Colorado River Municipal Water District	Operational	N	**15.6**	**0.84**	n/a	Treatment facility cost: $14 million (**2013**)	4	Note the operating costs were from design report.
Dominguez Gap Barrier (Terminal Island Water Reclamation Plant)	Operational	N	**87**	n/a	n/a	Treatment facility cost: $23 million (**2002**). Expansion from 5 mgd to 12 mgd: $50 million (**2016**)	5	
Silicon Valley Advanced Purification Center	Operational	N	**79**	n/a	n/a	Treatment facility cost: $72 million (2014)	9	
Orange County Groundwater Replenishment System	Operational	Y	n/a	**40**	**823**	Initial phase of 70 mgd: $481 million (**2008**); Expansion to 100 mgd: $142.7 million (**2012**)		Expansion cost to 130 mgd not included. O&M cost estimate (see GWRS FAQs).
City of Abilene Hamby Water Reclamation Facility and Indirect Reuse Project	Operational	N	n/a	n/a	**90**	Planning/design,construction permitting cost: $82 million (**2015**)		
Hillsborough County Direct Potable Reuse Demonstration	Demonstration Project	N	n/a	n/a	**0.22**	Demonstration cost: $0.2 million (**2016**)		Estimated cost.
City of Plantation Advanced Wastewater Treatment Pilot	Pilot Study	N	n/a	n/a	**0.38**	Pilot program cost: $0.3 million (**2007**)		
Miami-Dade County Coastal Wetlands Rehydration Demonstration Pilot Project	Pilot Study	N	n/a	n/a	**2.0**	Pilot program cost: $1.7 million (**2009**)		
City of Oxnard Advanced Water Treatment Facility	Unbuilt	N	n/a	n/a	**91**	Total project cost: $80 million (**2012**)		
City of Altamonte Springs pureALTA	Unbuilt	N	n/a	n/a	**1.1**	Total project cost: $1 mill (**2016**)		
City of Daytona Beach Direct Potable Reuse Demo Test System	Demonstration Project	N	n/a	n/a	**3.9**	Total program cost: $3.7 million (**2017**)		Operated from 2018 to 2020.
Village of Cloudcroft DPR Project	Demonstration Project	N	n/a	**0.38**	**5.5**	Total capital costs (**2015**): $5 million; including $1.4 million upgrade to WWTP; O&M costs: $350,000/year		
Big Bear Area Regional Wastewater Agency Replenish Big Bear	Unbuilt	N	n/a	n/a	**44**	Total project cost: $43.7 million (**2019**)		Feasibility cost estimate.
Carpinteria Valley Water District Advanced Purification Project	Unbuilt	N	n/a	n/a	**24**	Total project cost: $23.2 million (**2019**)		Feasibility cost estimate. Estimate includes pump and conveyance (pipeline) costs.
Pure Water Oceanside	Unbuilt	N	**49**	n/a	**84.2**	Facility cost: $48 million (**2019**), Total project cost: $84.2 million (**2020**)	7	Engineer estimated cost.
City of Pismo Beach Central Coast Blue	Unbuilt	N	**31.5**	**2.3**	**51**	Treatment facility cost estimates: $17-31 million (**2019**); distribution infrastructure: $11-19 million (2019); Annual O&M: $1.8-2.3 million (2019)	8	
Pure Water Monterey	Unbuilt	Y	**49.8**	**2.7**	n/a	Advanced Water Purification Facilty cost (**2016**): $46 million; O&M cost: $2.5 milion; Expansion from 5 mgd to 7 mgd cost: $32.5 million (**2018**)	6	Cost of expansion is cost opinion, not included.
El Paso Advanced Water Purification Facility	Unbuilt	N	n/a	n/a	**153**	Estimated total project cost range is between $110 and $150 million (**2019**).		Took higher end cost estimate.
Groundwater Reliabiltiy Improvement Project (Albert Robles Center)	Unbuilt	N	**119**	n/a	n/a	Facility project cost: $110 million (**2016**)	10	

A complete list of Table S1 and Table S2 references are publicly available on the NAWI Water Data Analysis and Management System (DAMS) database at https://dx.doi.org/10.15473/1700651 and https://dx.doi.org/10.15473/1700652.

2.0 Matching potable reuse projects to SDWIS public water system identification (IDs)

We first extract SDWIS quarterly reports from 2018, matching operational potable reuse systems from the NRC (2012) report, EPA (2017) compendium, and our aggregated data from plant technical documentation to public water systems (PWSs) by name or city. From our dataset, no new potable reuse systems were reported as operational in 2019 or 2020. For cities that contain multiple PWSs, we refined our matching process using system capacity in million gallons per day (MGD). We multiply the county-wide gallons per capita per day (gpcd) calculated in prior work[1] by the PWS population served to approximate the facility's capacity, choosing the PWS with the closest system capacity. If there is no initial match by name, city, or capacity, the PWS is identified through manual inspection.

3.0 Water AHEAD Model Inputs and Limitations

The Water Associated Health and Environmental Air Damages (AHEAD) tool is a model that predicts embedded greenhouse gas (GHG) emissions and related climate and health damages for unit processes used in drinking water, municipal wastewater, and industrial wastewater plants.[2] In the model graphical user interface (GUI), the user can specify the plant's capacity in m^3/day, the geography (i.e., state) of the electricity grid and chemical manufacturing sources, the treatment train unit processes and corresponding recoveries. The model outputs annual air emission damages ($K/year) in 2015$ with a value of a statistical life (VSL) of $8.6 million and a social cost of carbon (scc) of $40 per short ton of CO_2. The user can also specify the VSL and scc in the model.

The following equations are embedded in the Water AHEAD program to calculate health and climate damages due to electrical energy consumption. Unit GHG electricity emissions per m^3 of water are multiplied by a conversion factor from short tons to grams and $/short ton of GHG from AP2 and EASIUR to obtain unit GHG damages in $/$m^3$. The total health damages comprise of the sum of unit NO_x, SO_2, and $PM_{2.5}$ damages.

$$Unit\ NOx\ Damages\ \left[\frac{\$}{m^3}\right] = \frac{g_{NOx}}{m^3} * \frac{ton_{NOx}}{907184\ g} * \frac{\$}{ton_{NOx}}$$

$$Unit\ SO2\ Damages\ \left[\frac{\$}{m^3}\right] = \frac{g_{SO2}}{m^3} * \frac{ton_{SO2}}{907184\ g} * \frac{\$}{ton_{SO2}}$$

$$Unit\ PM2.5\ Damages\ \left[\frac{\$}{m^3}\right] = \frac{g_{PM2.5}}{m^3} * \frac{ton_{PM2.5}}{907184\ g} * \frac{\$}{ton_{PM2.5}}$$

$$Total\ health\ damages\left[\frac{\$}{m^3}\right] = NO_x\ Damages + SO_2\ Damages + PM_{2.5}\ Damages$$

The total climate damages from electricity consumption comprise of damages from CO_2 emissions, calculated from unit CO_2 emissions and the scc ($/ton).

$$Total\ climate\ damages\left[\frac{\$}{m^3}\right] = Unit\ CO_2\ Damages\ \left[\frac{\$}{m^3}\right] = \frac{g_{CO2}}{m^3} * \frac{ton_{CO2}}{907184\ g} * scc\left(\frac{\$}{ton}\right)$$

The results are then converted to $2020. Chemical damages are calculated with the same equations embedded in the Water AHEAD model, but with unit chemical emissions.

There were a few limitations with the Water AHEAD model. Since our data source consistency varied, we did not specify the number of units installed for each treatment process, which is an option in the Water AHEAD GUI. Therefore, we build our treatment trains assuming one unit per treatment process. Additionally, not all possible treatment processes in a water reuse treatment train are listed as an option in the drinking water system tab of the GUI. As a result, we add them as a "new treatment process," where the user specifies the minimum and maximum electricity consumption and chemicals used for this process. We did not include thermal energy consumption for the processes. For UV AOP processes, we used the 25th percentile to 75th percentile of electricity consumption surveyed from full-scale facilities with an average dose of 3 mg/L of H_2O_2.[3]

Electricity intensity, treatment objective, and chemical inputs for drinking water unit processes used in potable water reuse advanced treatment are detailed in Supporting Information of Gingerich and Mauter (2017).[4] For conventional drinking water processes, with exception to MF, UF and RO, we assumed water recovery of 99%. Recoveries for MF/ UF were set at 95%, while recovery for RO was set at 85%. The unit process BAF was modeled using generic filtration media. The minimums and maximum electricity consumption and recovery values for unit processes not specified in Gingerich and Mauter (2017) are in Table S3.

Treatment Processes	EI Min	EI Max	Recovery
MBR	0.5	0.7	0.95
UVAOP	0.3	1	0.99

Table S3. Unit process electricity consumption for unit processes in Water AHEAD.

4.0 Historical trends and location map of U.S. potable reuse systems as of 2020

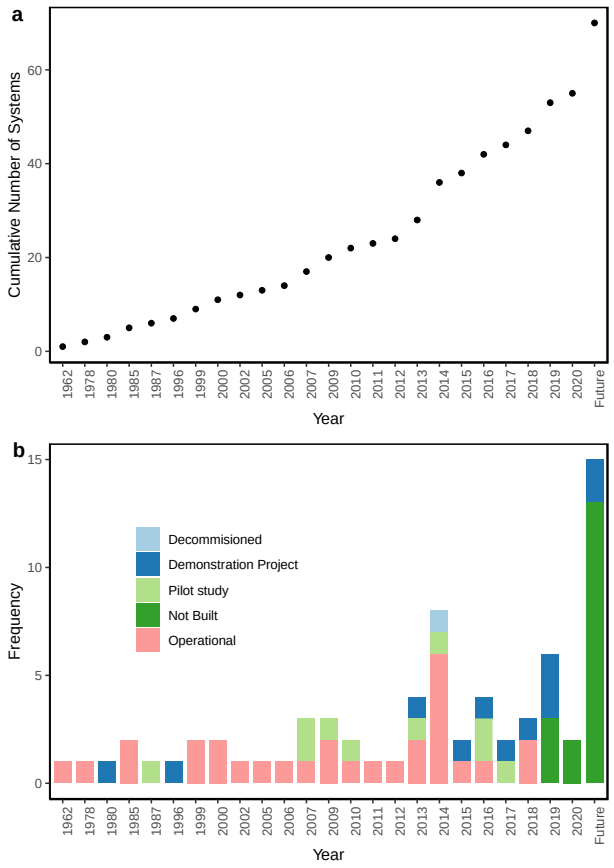

Figure S1. (a) Histogram of cumulative number of potable reuse systems built and classified by status over the past six decades. (b) Histogram of potable reuse systems by year of construction completion or development of pilot study and demonstration.

Figure S2. Map of U.S. Potable Reuse Systems as of 2020. Data points are not scaled to size of facility.

References

1 Y. Liu and M. S. Mauter, Assessing the demand response capacity of U.S. drinking water treatment plants, *Appl. Energy*, 2020, **267**, 114899.

2 D. B. Gingerich and M. S. Mauter, *Water Associated Health and Environmnetal Air Damages (AHEAD) model*, OSF.

3 D. B. Miklos, C. Remy, M. Jekel, K. G. Linden, J. E. Drewes and U. Hübner, Evaluation of advanced oxidation processes for water and wastewater treatment – A critical review, *Water Res.*, 2018, **139**, 118–131.

4 D. B. Gingerich and M. S. Mauter, Air Emissions Damages from Municipal Drinking Water Treatment Under Current and Proposed Regulatory Standards, *Environ. Sci. Technol.*, 2017, **51**, 10299–10306.