

This presentation premiered at WaterSmart Innovations

watersmartinnovations.com



Point of Use Recycling and Reuse:

*Cut down on Purple Infrastructure
(and keep you customers)*



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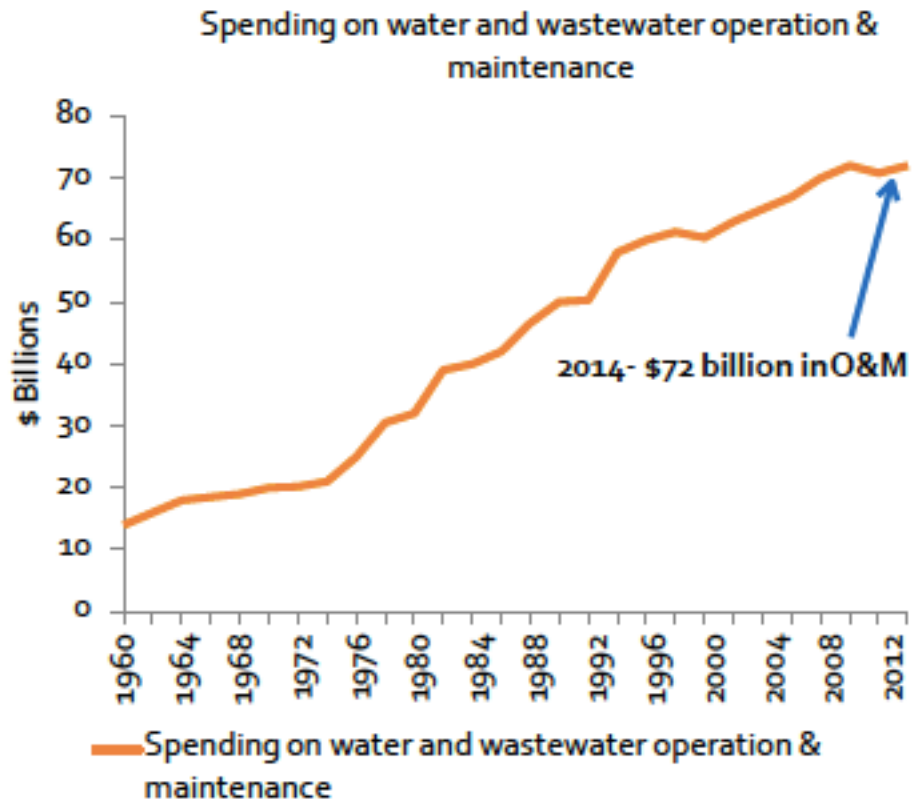
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Overall Drivers for Decentralized Treatment and Recycling

- Aging infrastructure is breaking the bank
- Centralized traditional treatment systems are outdated, obsolete and requires large investments to upkeep current and future demands
- Low sewer flows is causing many issues for local municipalities in managing the waste
- Treatment/recycling technologies can be more efficient and adaptive when used de-centrally or in point of use(POU) fashion
- Decentralized water and wastewater treatment/recycling allow for more rapid modifications and technology upgrade

Aging Infrastructure and investment gap on the Rise



Source: CBO – "Public Spending on Transportation and Water Infrastructure"

- A majority of the O&M spending is in repair and replacing old pipes and mains
- Investments of over \$100B is projected
- 60% of drinking water funding are related to pipe infrastructure – *U.S. EPA*

Source: Lux Research, 2016)

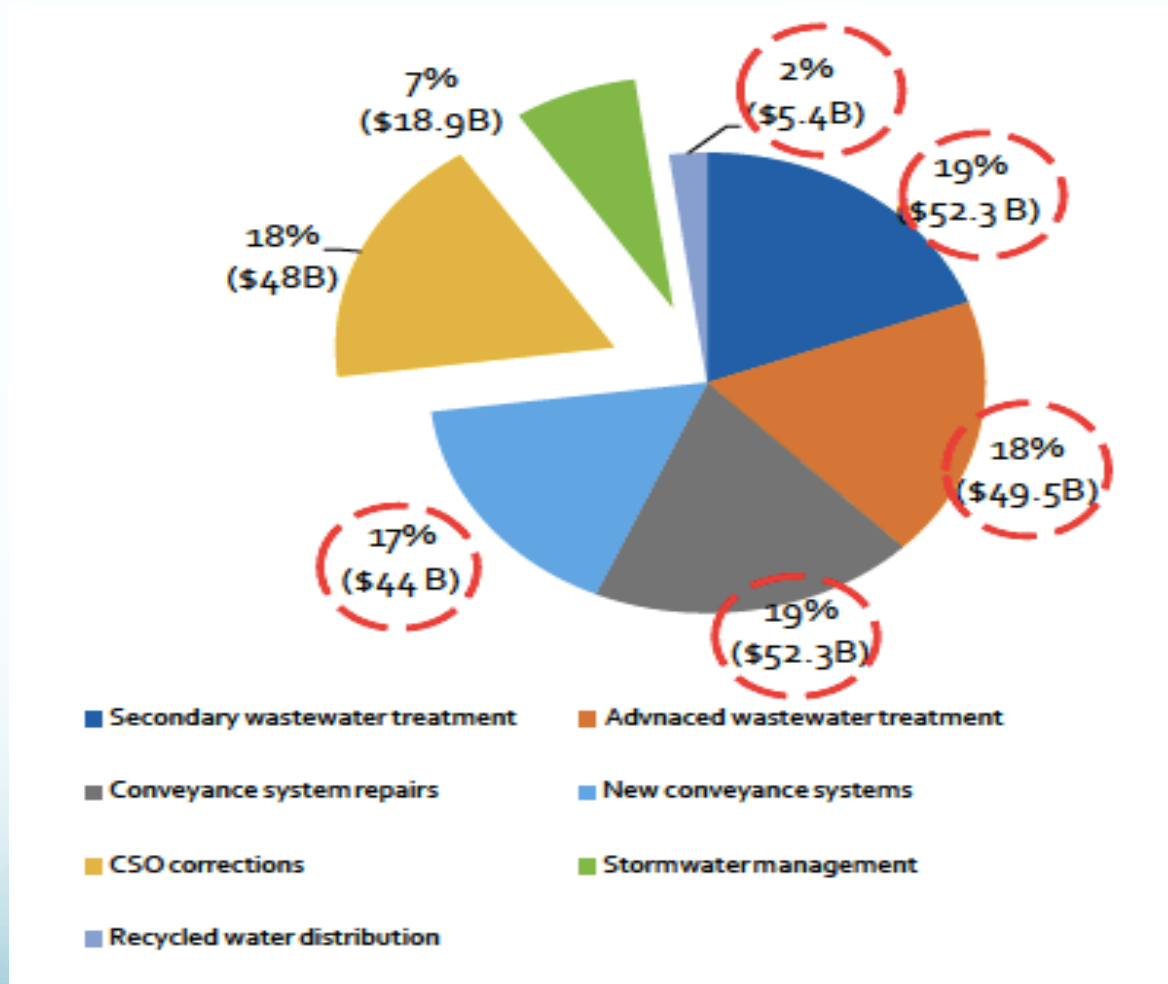
Wastewater infrastructure requires \$billions in capital investment

U.S. EPA survey - 15,000 plants require \$271 billion in capital spending over the next five years:

- ❖ 75% to modernize wastewater treatment
- ❖ 18% allocated to separate overflow from sewer lines
- ❖ 7% Plans for Stormwater conveyance

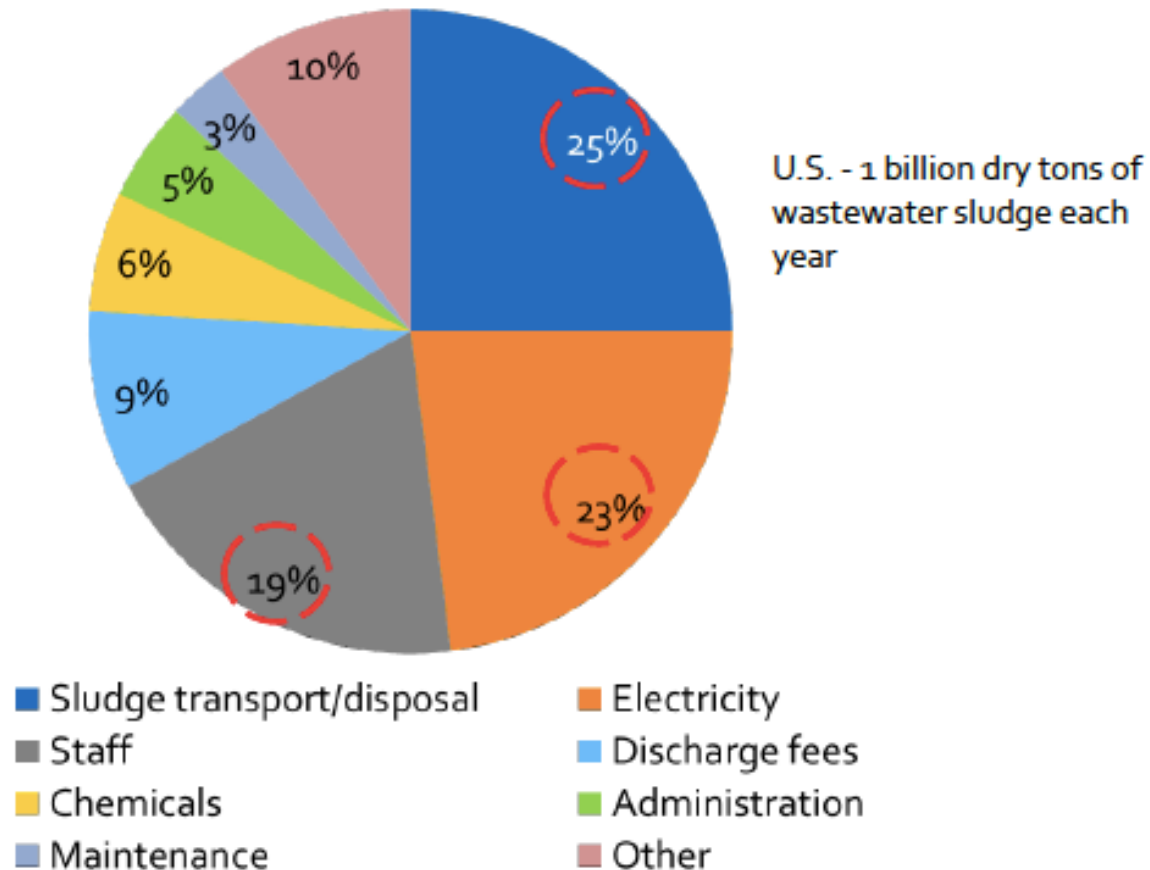
Source: Lux Research, 2016

Wastewater Infrastructure Requires \$B in Capital Investments



Source: Lux Research, 2016

High Cost of Central Municipal Wastewater Treatment

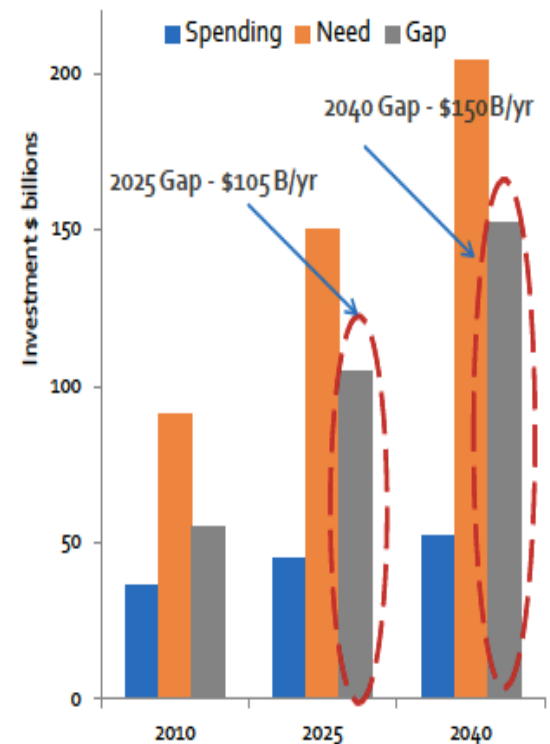


Source: Lux Research, 2016

Central WWT Capacity: is only getting worse as the conditions worsen

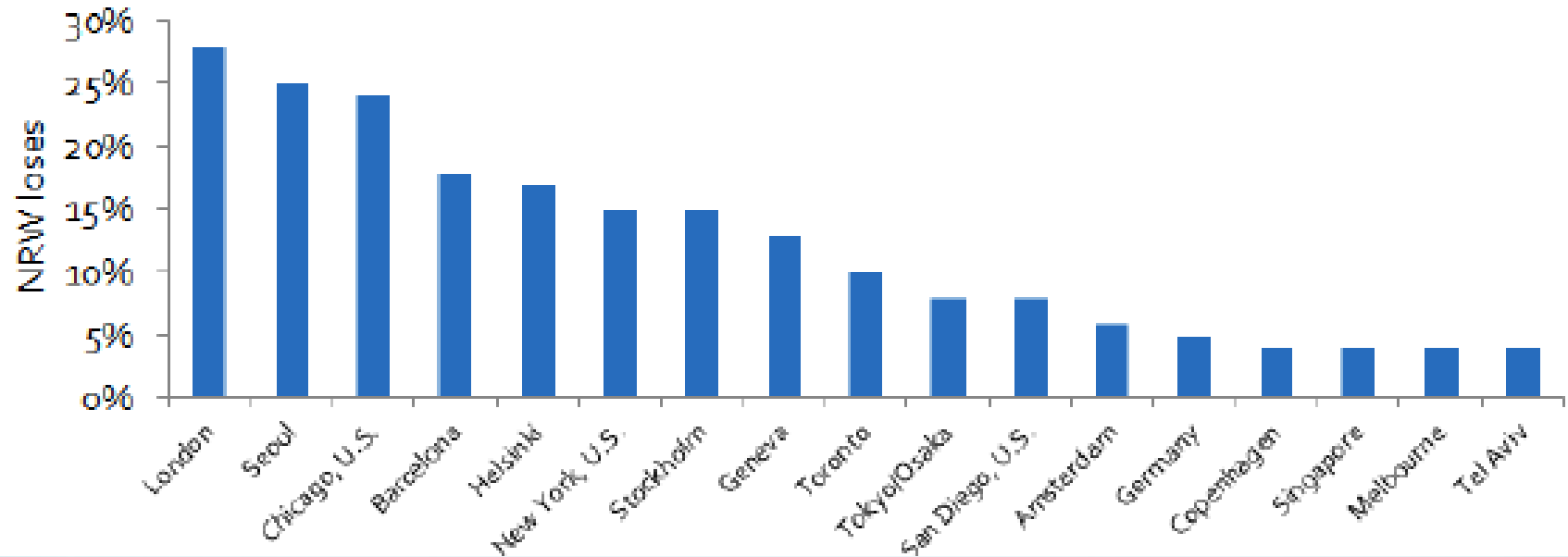
- If left unaddressed, investment gap to be \$105 billion per year over the next decade
- Cost of repairs and upgrades are not coming from government

"Access to centralized treatment systems is widespread, but the condition of many of these systems is also poor, with aging pipes and inadequate capacity" - ASCE



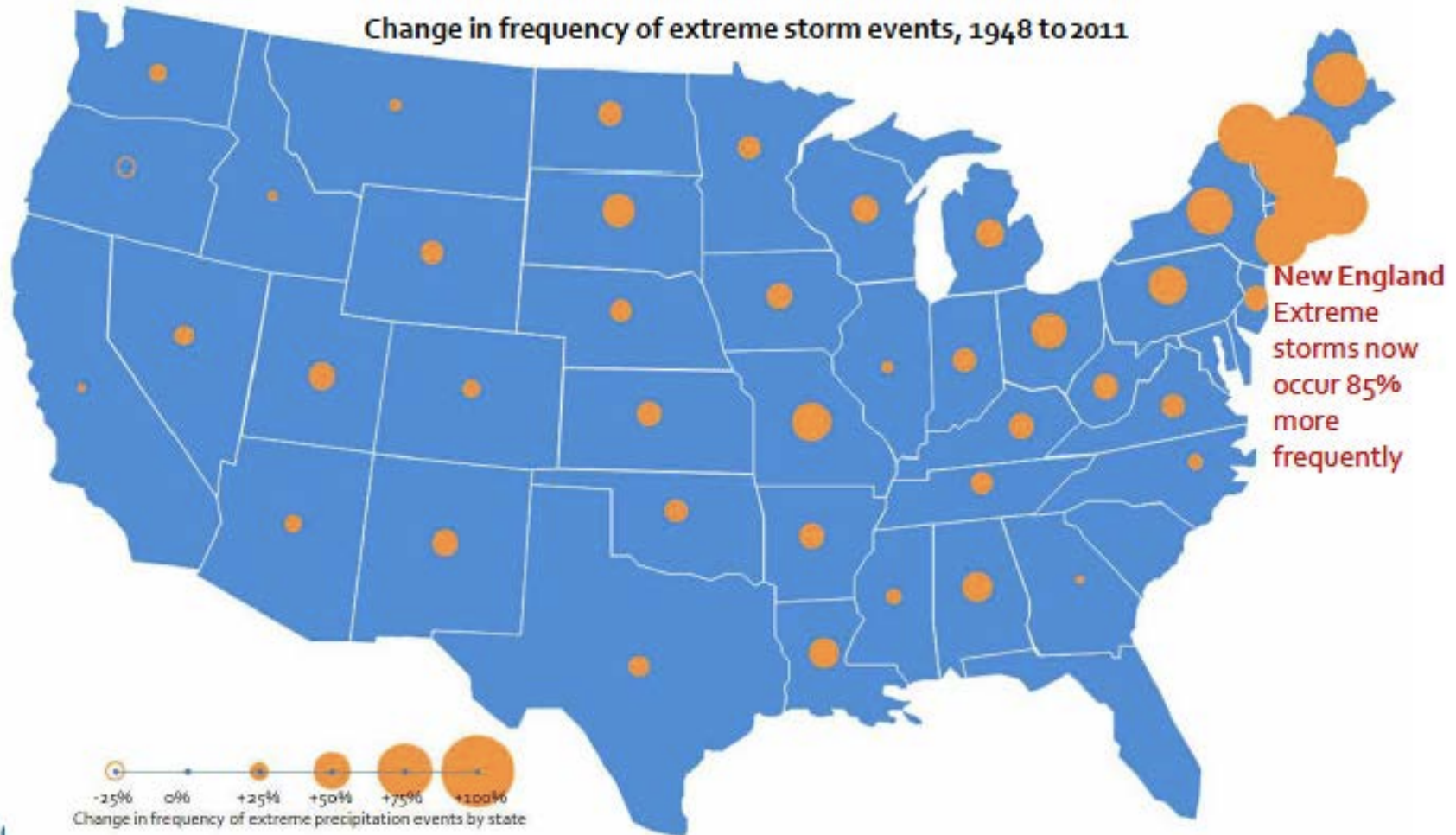
Source: Lux Research, 2016

Pipes in the ground offer no payback: Non Revenue Water loss is as much as 30%



Source: Lux Research, 2016

Many U.S. wastewater plants need to expand capacity due to population and climate pressures



Source: Lux Research, 2016

Why invest in central treatment when water usage is decreasing?

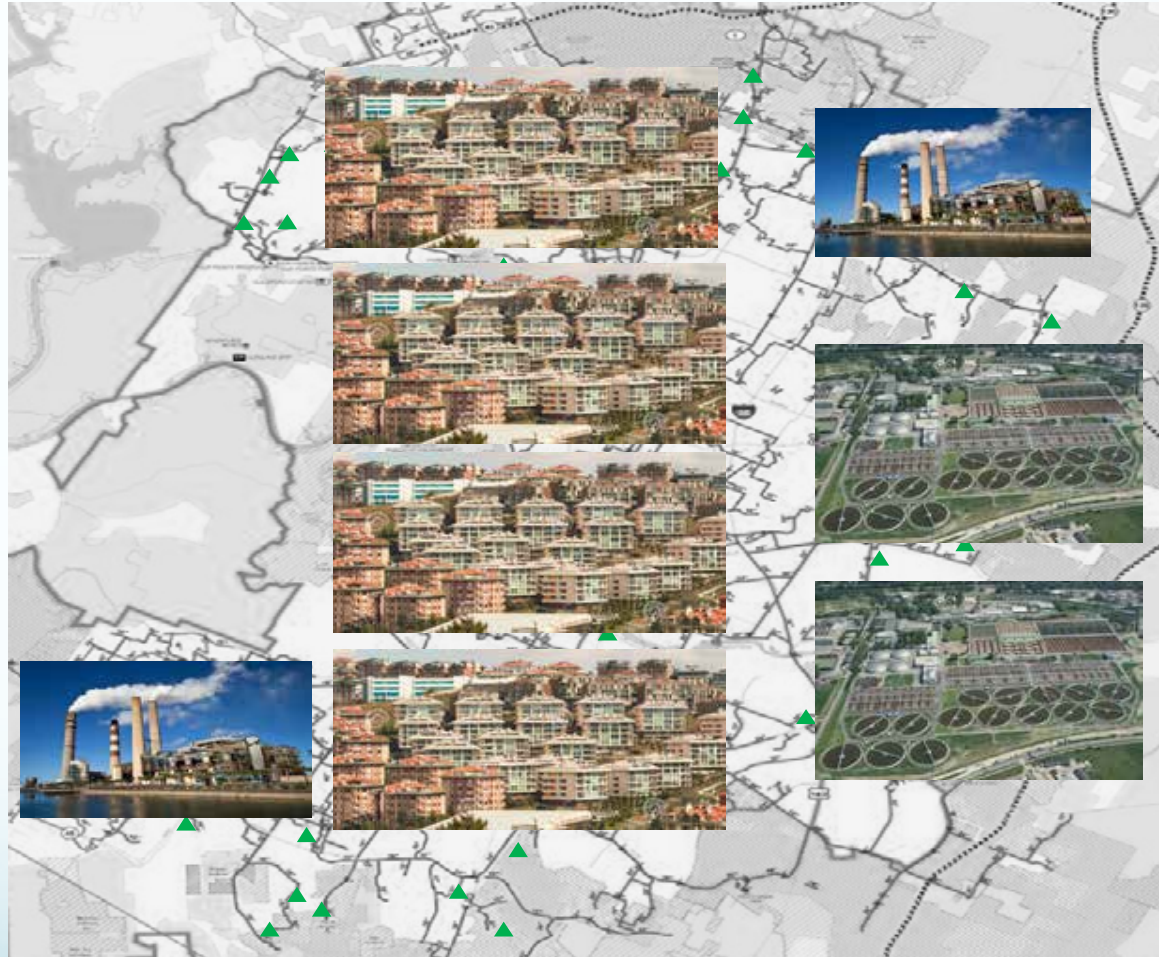
CURRENT AND PROJECTED PER CAPITA WATER USE IN THE UNITED STATES

Use	Flow, gal/capita•d					
	2013		2020		2030	
	Range	Typical	Range	Typical	Range	Typical
Domestic						
Indoor use	40 - 80	60	35 - 65	55	30 - 60	45
Outdoor use	16 - 50	35	16 - 50	35	16 - 50	35
Commercial	10 - 75	40	10 - 70	35	10 - 65	30
Public	15 - 25	20	15 - 25	18	15 - 25	15
Loss and waste	15 - 25	20	15 - 25	18	15 - 25	15
Total	96 - 255	175		161		138

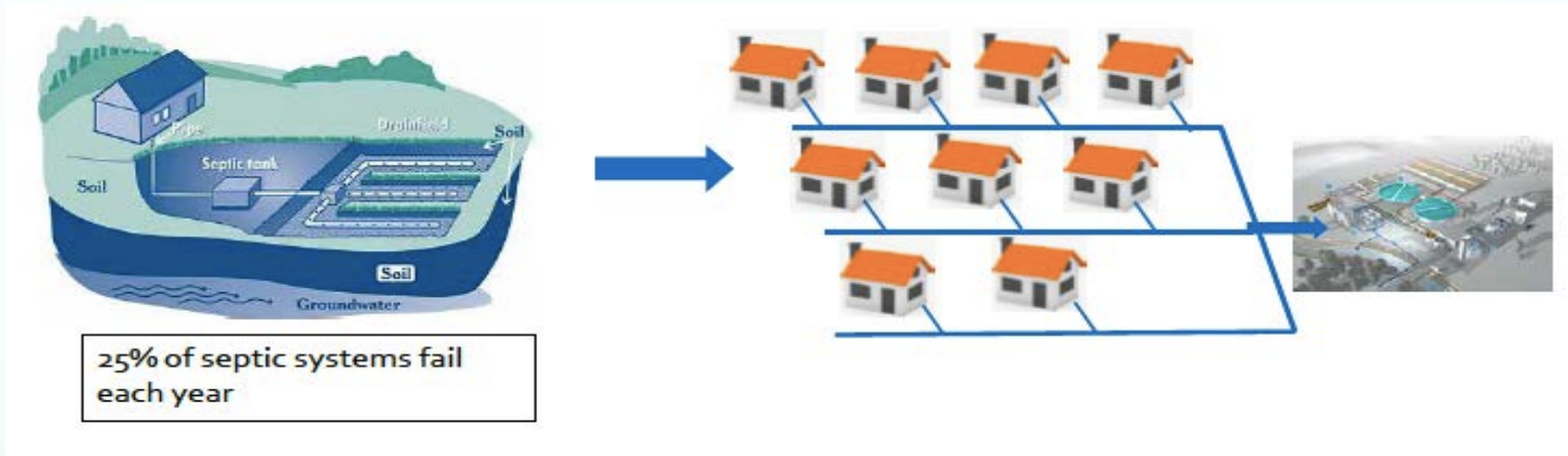
84 gal/capita•d in Bay Area to 584 gal/capita•d Northern San Diego

Today's Decentralized Treatment

- The small facilities account for nearly 80% of the total number of plants and treat less than 10% of all U.S. wastewater
- Only a few mega facilities treat wastewater for 90% of the population



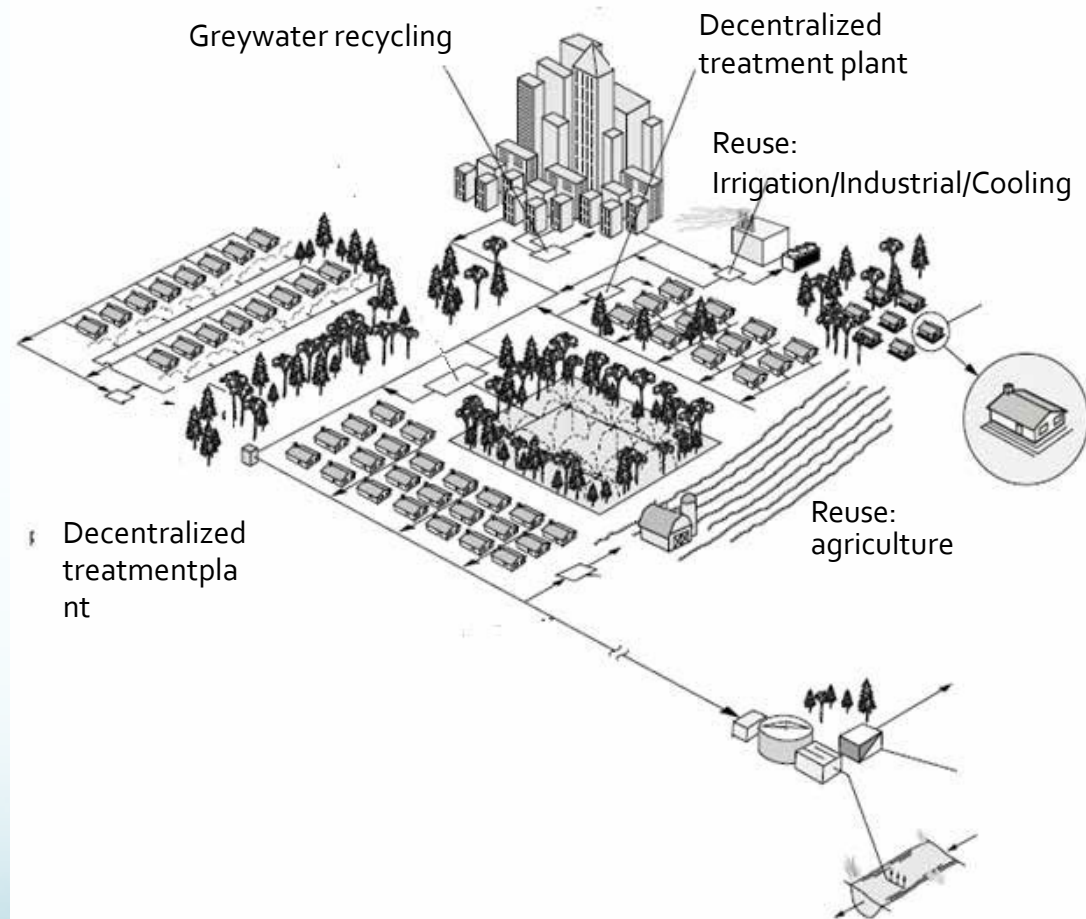
What is the solution: Decentralized Treatment and Recovery



Decentralized systems - *“A collection, treatment, and disposal/reuse of wastewater from individual homes, clusters of homes, isolated communities, or institutional facilities, as well as from existing communities, at or near the point of waste generation*

Decentralized Reuse

- Advanced treatment technologies enable efficient and localized recovery/reuse
- Recovery is more effective by application/use area



What does Direct Potable Reuse (DPR) Cost?

Supply option	Cost, \$/10 ³ gal (\$/AF)			
	Treatment	Residuals management	RO concentrate management	Conveyance facilities
ATW with RO	2.10 – 2.76 (685 – 900)	0.03 – 0.15 (10 – 50)	0.21 – 2.38 (70 – 775)	0.31 – 3.07 (100 – 1,000)
ATW without RO	1.23 – 2.15 (400 – 700)	0.03 – 0.15 (10 – 50)	n.a.	0.31 – 3.07 (100 – 1,000)
Brackish groundwater desalination (inland)	2.76 – 3.84 (900 – 1,250)	0.06 – 0.31 (20 – 100)	0.21 – 2.15 (70 – 700)	0.92 – 6.14 (300 – 2,000)
Seawater desalination	5.52 – 6.44 (1,800 – 2,100)	0.06 – 0.31 (20 – 100)	0.31 – 0.61 (100 – 200)	1.23 – 9.21 (400 – 3,000)
Retail cost of treated imported surface water	1.23 – 3.99 (400 – 1,300)		n.a.	0.31 – 1.84 (100 – 600)
Water use efficiency, conservation, and use restrictions	1.38 – 2.92 (450 – 950)			0.31 – 1.23 (100 – 400)

 OCWD unsubsidized cost

Source: Tchobanoglous, 2015

DPR Energy Cost

Technology/water source	Energy required			Carbon footprint kg CO _{2e} /10 ³ gal
	Range, kWh/10 ³ gal	Typical		
		kWh/10 ³ gal	kWh/m ³	
Secondary treatment without nutrient removal	1.35 – 1.05	1.25	0.33	0.63
Tertiary treatment with nutrient removal effluent filtration	1.95 – 1.60	1.85	0.49	0.93
Advanced water treatment	3.25 – 3.50	3.30	0.87	1.65
Ocean desalination	9.50 – 14.75	12.00	3.17	6.00
Brackish water desalination	3.10 – 6.20	5.85	1.55	2.93
Interbasin transfer of water, California State Water Project	7.92 – 9.92	9.20	2.43	4.60
Interbasin transfer of water, Colorado River water	6.15 – 7.40	6.15	1.62	3.07
Conventional water treatment	0.30 – 0.40	0.37	0.10	0.19
Membrane-based water treatment	1.00 -1.50	1.25	0.33	0.63

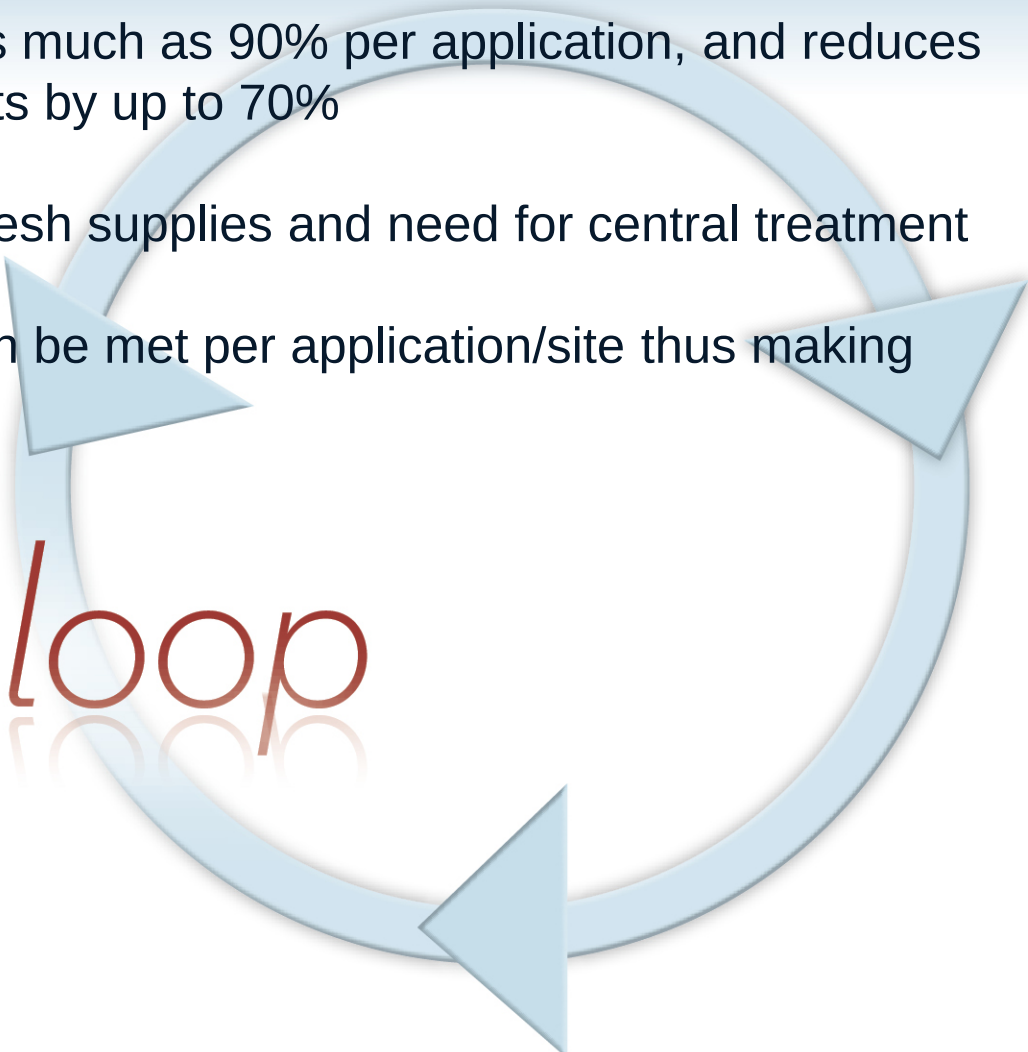
 OCWD actual energy usage

Source: Tchobanoglous, 2015

Decentralized Onsite Water Recovery Achieves High Efficiencies

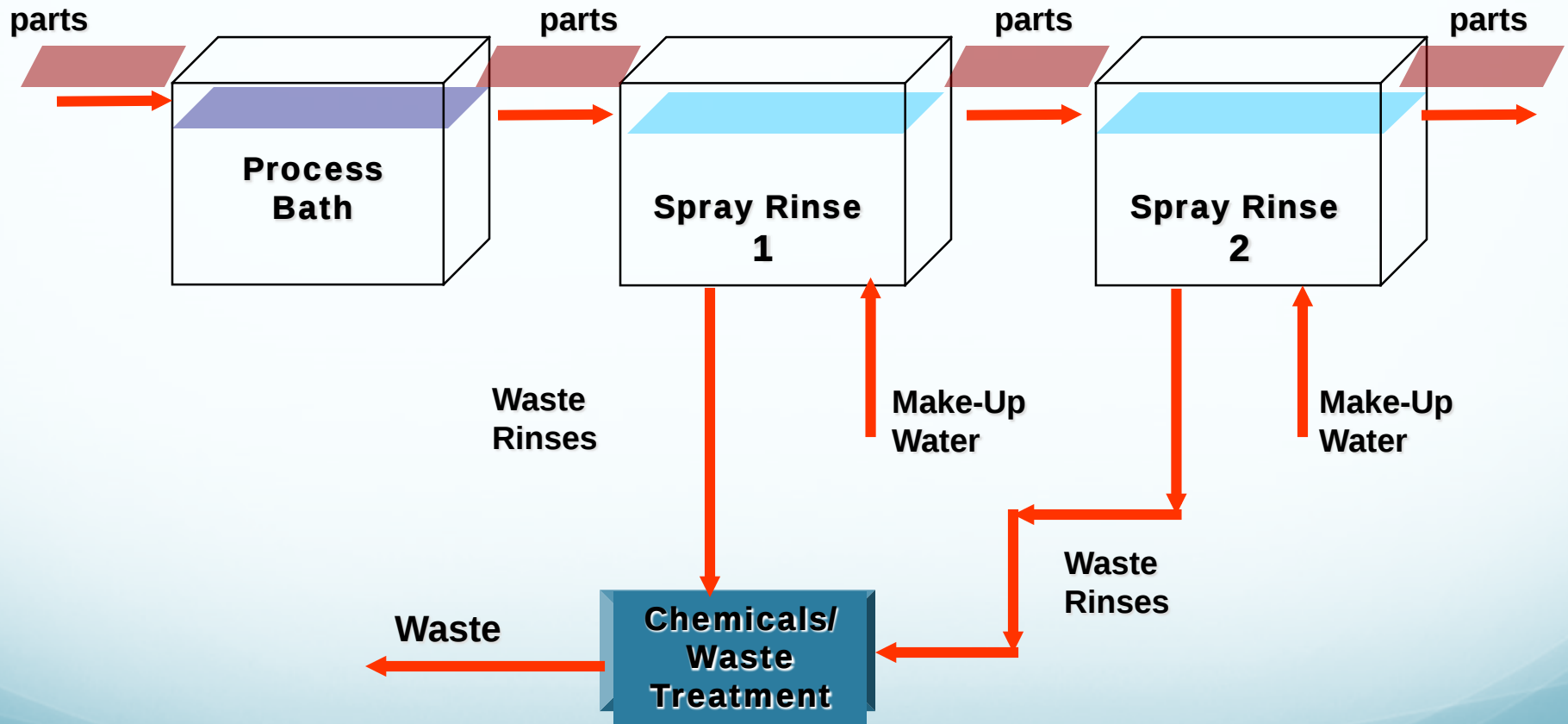
- ◆ Reduces water usage by as much as 90% per application, and reduces customer water related costs by up to 70%
- ◆ Reduces dependence on fresh supplies and need for central treatment
- ◆ Water Quality standards can be met per application/site thus making reuse cost effective

Closed-loop

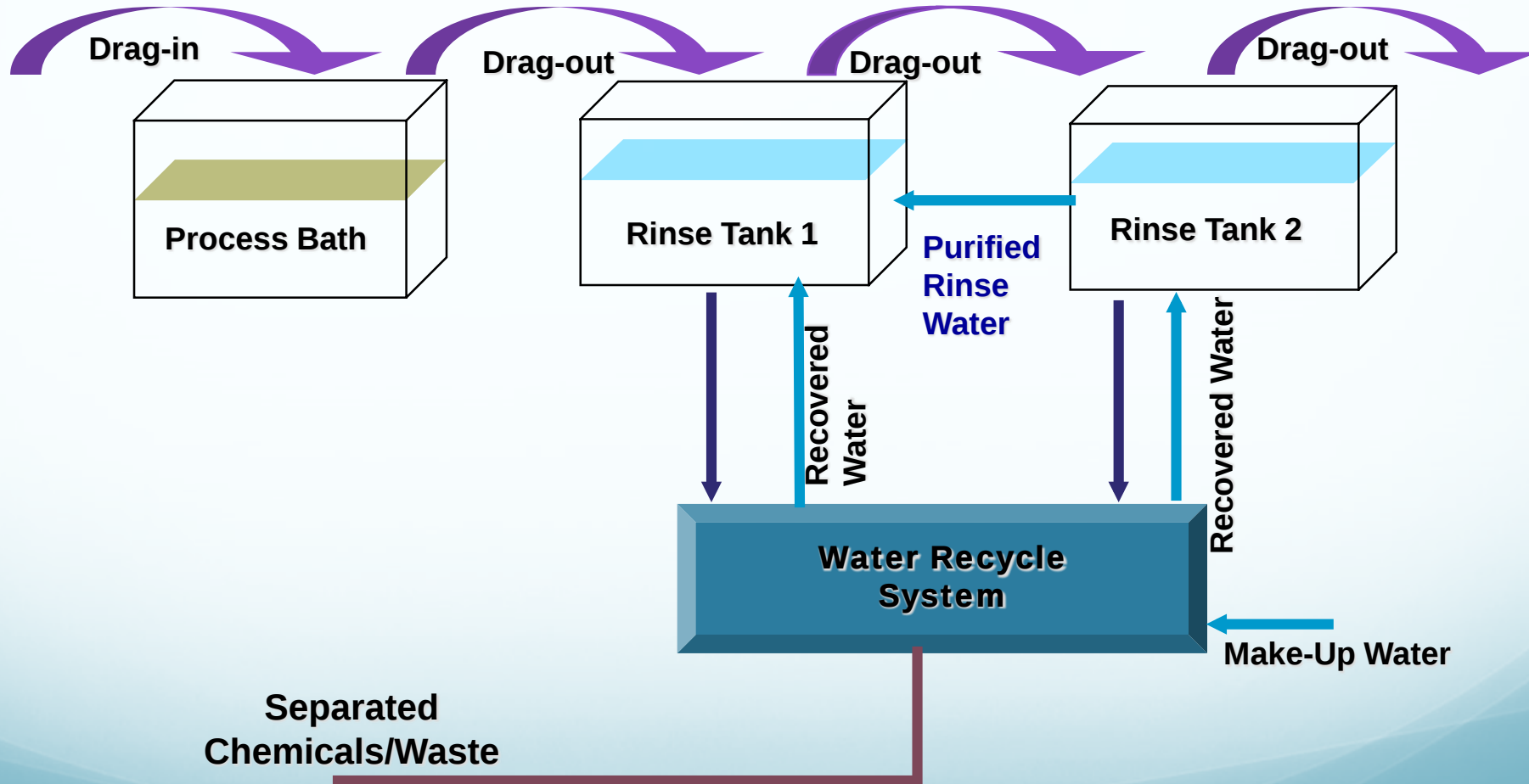


Water use in Manufacturing: metals, aerospace, high tech, food, textiles, etc.

**Process
Line**



Closed-loop Processing Wet Processes



POU Systems for Recycling of Plant Rinses



Front View

Side View

Why should water agencies support onsite recycling?

Sample Case Study

Sector	Total Annual Water Usage (gals)	Total Potential Water Savings (gals)	Total Potential Water Savings (HCF)	Total Project Cost	Average ROI	\$/Gals	\$/HCF	Percent Water Use Reduction
<i>Industrial</i>	<i>689,904,010</i>	<i>294,801,795</i>	<i>394,120</i>	<i>\$2,675,660</i>	<i>1.4</i>	<i>0.009</i>	<i>\$7</i>	<i>42.7%</i>
<i>Commercial</i>	<i>81,188,851</i>	<i>9,770,550</i>	<i>13,062</i>	<i>\$261,110</i>	<i>3.8</i>	<i>0.027</i>	<i>\$20</i>	<i>12.0%</i>
<i>Institutional</i>	<i>6,452,835</i>	<i>1,947,275</i>	<i>2,603</i>	<i>\$21,760</i>	<i>2.1</i>	<i>0.011</i>	<i>\$8</i>	<i>30.2%</i>
Total	777,545,696	306,519,620	409,786	\$2,958,530		0.047		39.4%
Average	259,181,899	102,173,207	136,595	\$986,177	2.4	0.016	\$12	39.4%

Summary

- Centralized infrastructure is up for a “big re-think”.
- Utilities are evolving “WE ARE SEEING RE-DISTRIBUTED EVERYTHING”
- Smaller, emerging systems are getting more efficient and enable cost-effective reuse
- Remote monitoring and IOT in water address the needs of a decentralized infrastructure
- Water agencies should think about offering reuse opportunities on site and funding these projects

Questions?

Bringing Technology to Water™



Sustainable Development
Awards

MUNICH, NOVEMBER 18, 2013



Exergy



The Future of Water Point of Use Recycling



Sustainable Development
Awards

MUNICH, NOVEMBER 12, 2013

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