STeP Sanitation Technology Platform

BILL & MELINDA GATES foundation

MARKET INSIGHTS FOR THE REINVENTED TOILET: US

DECEMBER 2017

Boston Consulting Group

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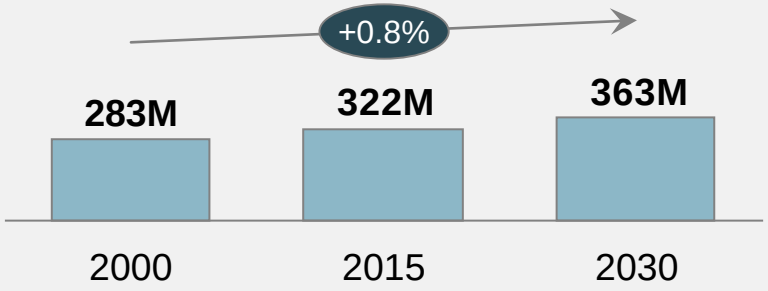
USA: Clear opportunity for RT in specialty segments, with potential upside in urban and rural mainstream

- 89% of US population has access to safely managed sanitation; gap to 100% is due to use of improved facilities where excreta is not properly treated and disposed
- ~$660M potential revenue per annum for RT; uptake driven by aging sewer infrastructure, water scarcity, and rural residences choosing RT over septic systems
- Opportunity also includes specialty markets of green building, parks, non-traditional homes, and portable toilets; may be early adopters due to unmet needs or high current costs
- Go-to-market pathway requires overcoming hurdles of fragmented selling channels and multiple layers of regulation and stakeholder dynamics in each state

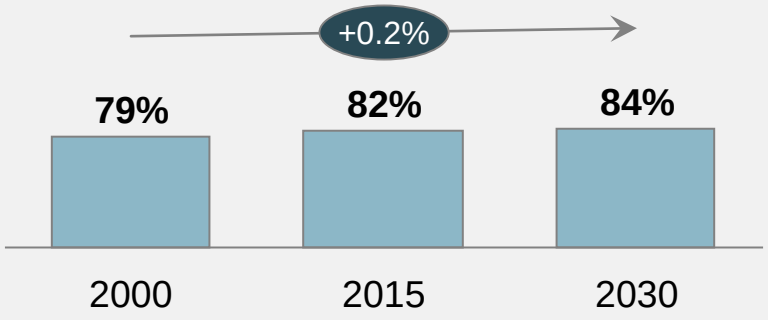
Sources: JMP WASH data 2015, expert interviews, BCG analysis Photo credit: King County, Washington (http://www.kingcounty.gov)

USA is primarily urban and sewered, but quality of sewer systems vary and about one fifth of population uses septic tanks

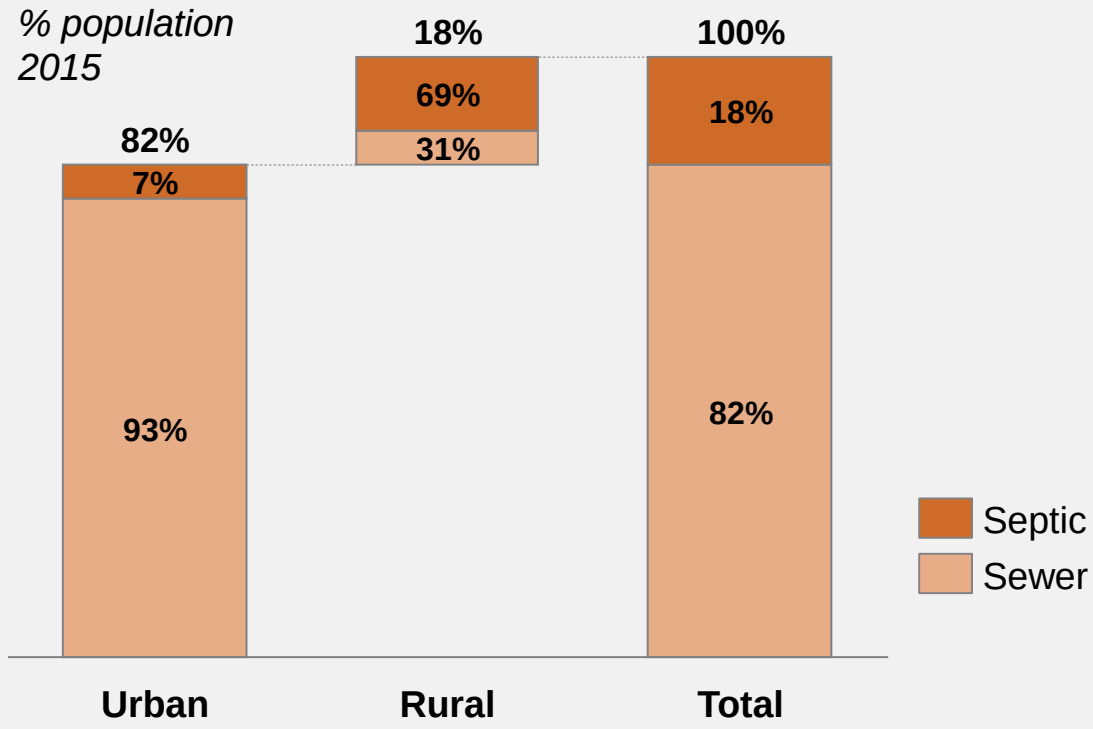
US has world's third largest population...



...And continues to urbanize



Urban areas are >90% sewered, while majority of rural residents use septic tanks



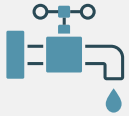
Source: JMP WASH data 2015, UN population data (https://esa.un.org)

Five key trends for sanitation ecosystem in United States

Eco leaders — *Mainstream challenges* — *Execution*

Green building

In US, green building represented an estimated 44% of commercial and institutional construction and 20% of residential construction in 2012, and continues to grow annually[4]



Aging infrastructure

EPA reports that up to 75,000 sewer overflows occur in the US each year[1]

Municipal bond sales for water and sewer projects have increased, topping $37B last year (up from $22B in 2013)[1]

Water scarcity

Drought and climate change restrict water supply, while energy and population demands increase

40 out of 50 states have at least one region expected to face water shortage by 2025[3]

Urbanization

With the slow exodus to cities, smaller towns have even less resources to run wastewater treatment plants

US has 52,000 community water suppliers, but only 15,000 WWTPs[2]

Fragmented policy

Most policies related to wastewater are set at state level (e.g. plumbing and public health codes), leading to disparate regulations on alternate sanitary solutions, and many actors to engage

1. Wall Street Journal "Recent Hurricanes Strain U.S. Towns' Aging Sewer Systems" September 2017 2. Wastewater treatment plants; Interview with CEO, National Rural Water Association
3. US Government Accountability Office, May 2014 4. Dodge Construction Green Outlook 2013 and US Green Building Council

Given US landscape and trends, several emerging uses cases for RT

		Current need	RT value prop	Examples	# HHs (2015 existing, est.)
Mainstream (moderate need, large size)	1A	Cities with sewers needing upgrades and/or alternative solutions due to water scarcity	Defrays cost and effort of upgrading sewer systems (>$600B across US)[1]; provides viable low-water option	SF facing "dire need" to fix 100-year-old sewers and water scarcity[2]	48M HH face water scarcity; 18M HH need sewer upgrade[3]
	2A	Households with septic systems: expensive to install and repair; no economy of scale	Lower cost than septic (assumes RT handles graywater); small towns may consider MURTs for WWTP[4]	~70% of rural America relies on septic tanks	22M HH; conservative estimates note ~10% have failed and need repair[5]
Specialty (high need, smaller size)	1B	Green buildings seeking water savings	Recycles wastewater for flush reuse; minimizes environmental impact	LEED residential and commercial buildings	134K HH LEED-certified + 6.8B commercial sq ft[6]
	2B	Non-traditional homes without standard flush toilet	Sanitary solution; avoids cost of pumping out blackwater tank for RVs and houseboats	Homes w/o flush toilet, RVs, boats, tiny homes	>75K HH without flush toilet[7] 102K HH live in boat, RV, etc[7] Add'l 9M HH own RV (for rec)[8]
	3	Remote sites (e.g. parks) needing sanitation solution	Allows higher use than composting toilet; no need for site excavation	Parks, rental cabins, military training sites	150K toilets in state & national parks (estimated)[9]
	4	Portable toilets in long-term use situations	Avoids cost and effort of regularly pumping out portable toilet	Construction sites, gas stations, events	2M portable toilets in long-term use (estimated)[10]

Global access

1. GAO *Water Infrastructure* report 2016 2. San Francisco Public Utilities Commission 3. Includes 130M people in US facing severe water scarcity at least part of the year; 4M served by sewer without secondary treatment; 40M served by combined sewers; US EPA and *Science Advances* Feb 2016 4. Wastewater treatment plant 5. JMP WSH data; Bridge Magazine "Thousands of failed septic tanks across the state threaten Michigan's waters" 2013; Thurston County *Septic System Failure Rates* 2017; Indiana University *Septic System Facts* 6. *LEED in Motion: Residential 2014*, p. 27 and National Green Building Adoption Index 7. US Census Bureau, American Community Survey 2016 8. American Recreation Coalition *Outdoor Recreation Outlook* 2016 9. Calculated based on 400 national and 10,000 state parks, plus >3,000 private campgrounds 10. Estimated 3M total portable toilets with 70% in long-term use; sources: Satellite Industries; IBIS World; BCG analysis

Americans lacking complete plumbing facilities more likely to be economically disadvantaged, rural, and minorities

0.4% **of Americans lack complete plumbing facilities**[1]

Includes lack of *any* of the following:
- hot & cold piped water
- bathtub or shower
- flush toilet

> Most international health & development institutions simply round up and report that 100% of U.S. citizens have access to developed water and sanitation services. The number of households involved may indeed seem statistically small... but **these are people who are falling through the cracks.** Makers of public policy – urban and rural, social and economic – need to focus on these [people] and their needs. *-Rural Community Assistance Partnership*

4X as likely to lack adequate plumbing if born into **family living below poverty** level in US

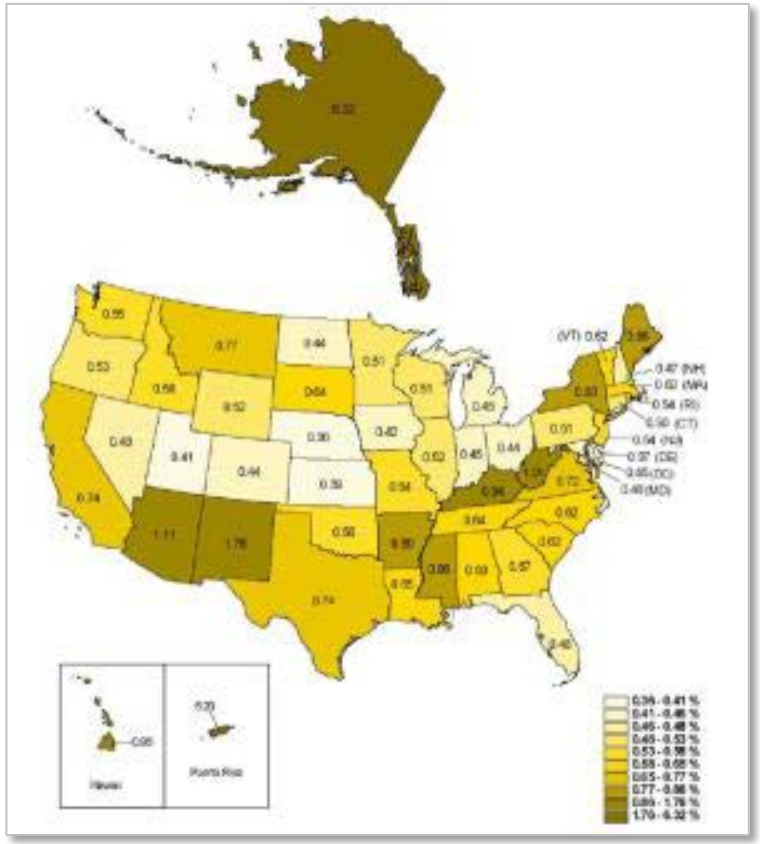
2.5X as likely to lack proper plumbing if poor and living in **rural area**, compared to poor and urban

1 in 20 **American Indians or Native Alaskans** live without complete plumbing; all ethnic groups have lower % with complete facilities than white Americans

1. American Community Survey 2015 (https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_1YR_S2504&prodType=table)
Source otherwise: Rural Community Assistance Partnership, *Still Living Without the Basics in the 21st Century: Analyzing the Availability of Water and Sanitation Services in the US,* 2004

Families across the country still live without plumbing facilities, posing significant health risks

% occupied housing units lacking complete plumbing facilities[1]



Homes lacking facilities found across the US...

- Far reaches of Alaska
- Urban centers in southern California, New York, and Illinois
- Colonias bordering Mexico
- Indian reservations and Four Corners region
- Underserved rural communities in the Southeast and New England

... leading to public health challenges

- Poor drinking water quality, leading to disease
  - E.g. Hepatitis A rate in Texas colonias was found to be double statewide rate
- Recent cases of hookworms: over 1/3rd of people sampled in poor area of Alabama tested positive

1. Includes lack of any of the following: (a) hot & cold piped water, (b) bathtub or shower, (c) flush toilet Source: Rural Community Assistance Partnership, *Still Living Without the Basics in the 21st Century: Analyzing the Availability of Water and Sanitation Services in the US,* 2004; The Guardian, "Hookworm, a disease of extreme poverty, is thriving in the US south. Why?" September 2017

Early adopter use cases employ unconventional solutions already, have latent need for better options, and possess innovative spirit

Green building

Growing portion of residential and commercial market; developers have already experimented with onsite wastewater treatment and are seeking simple, affordable solutions

Non-traditional homes

Current options for RVs, houseboats, and tiny homes (e.g., compost, vacuum or macerating toilets) often have issues with smell and high cost of frequent pump-outs; users tend to be open-minded

Parks

Sanitation is high priority because it greatly affects visitor experience; however, remote sites with high usage prove challenge to serve with current option set

Source: BCG interviews and analysis

It's very hard for people to give up a current convenience if it's working... The willingness to spend money on something new is dramatically enhanced by having a problem that needs to be fixed.

Hank Habicht, former Deputy Administrator, US EPA

Motivation to switch from sewer to RT likely to come from public actors facing challenges

Aging infrastructure

38 counties have consent decree with EPA due to unaddressed raw sewage overflows or polluted runoff;[1] additional systems are at capacity due to infill development
E.g., Pittsburgh, Portland

Water scarcity

The combination of climate change and population growth threatens water supply across the US
E.g., California, Arizona

Super storms

Recent hurricanes Harvey and Irma caused release of untreated sewage, showing cities' vulnerability to future climatic events too
E.g., Texas, Florida

Small communities

Due to shortage of WWTPs and limited funds for improving existing ones, towns are looking for new, cost-effective options
E.g., Appalachia

1. Consent decrees are established due to Clean Water Act violations
Source: BCG interviews and analysis

Potential opportunity also exists where failing septic systems need replacement or new septic systems are prohibitively expensive

Failing septic systems in need of replacement

>10% of septic systems are failing because of inappropriate design or poor maintenance[1], leading to nitrogen pollution in coastal waters (e.g., Long Island, Cape Cod) and drinking water contamination[2]

New construction with environmental constraints

New homes may need high-cost systems (up to $50K), or could be refused a building permit if they

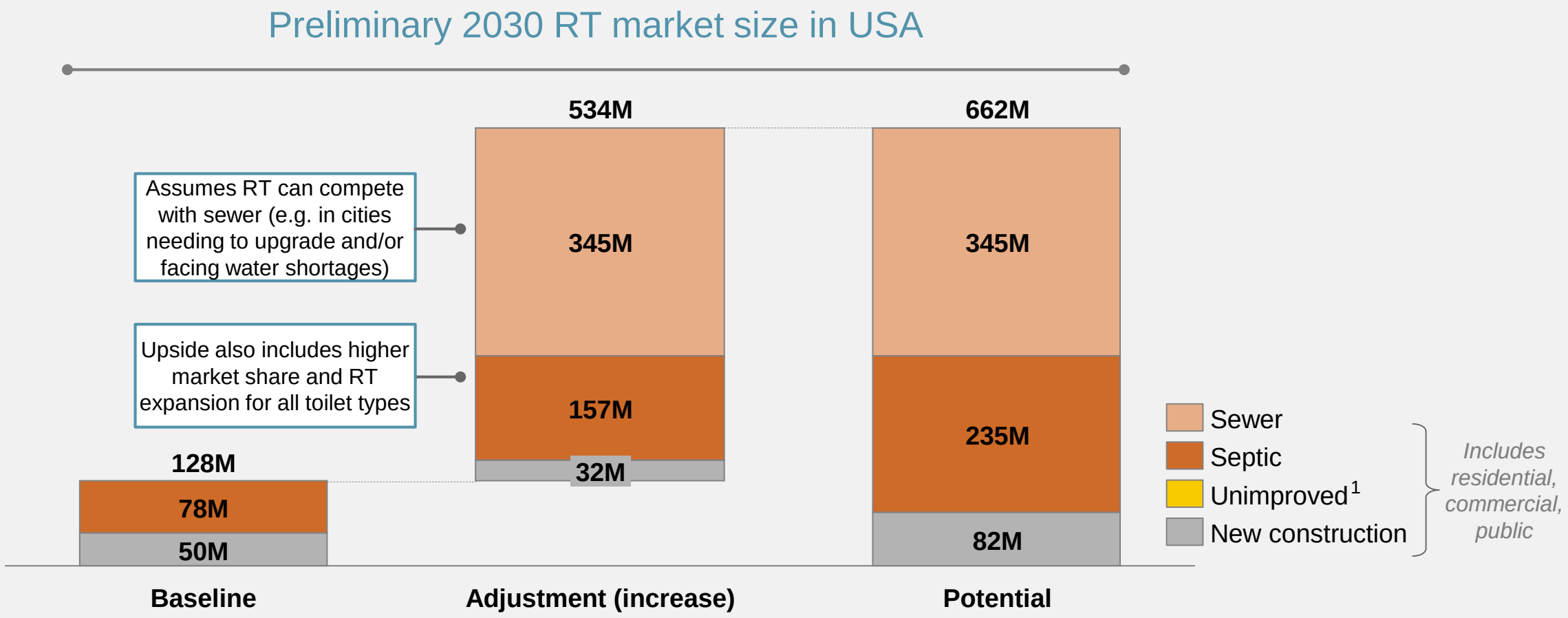
- Are close to a stream or lake
- Lack adequate space and soil permeability for drainfield[3]

Owners cannot afford to install or fix septic system

>75,000 families in the US lack a flush toilet; in addition, some poor families with toilets pipe household sewage into the nearest farm drain, woods or stream because they cannot afford a septic system

1. US EPA (https://www.epa.gov/septic/what-do-if-your-septic-system-fails); Bridge Magazine “Thousands of failed septic tanks across the state threaten Michigan's waters” 2013; Thurston County (WA) Septic System Failure Rates 2017, Indiana University Septic System Facts 2. Circle of Blue “America’s Septic System Failures Can Be Fixed” December 2015 3. BCG expert interviews; RE/MAX Realty “Massachusetts title five septic system law” 4. US Census Bureau, American Community Survey 2016 “Plumbing and Kitchen Facilities in Housing Units” 5. New York Times “A Toilet, but No Proper Plumbing: A Reality in 500,000 U.S. Homes” September 2016

Full potential market in US driven by RT adoption from sewer and septic users



1. Unimproved market size does not show in millions (full potential market size of $64.101)

Regulatory considerations: Most states require homes to have sewer connection or septic system as default; RT would need to be approved as alternative

Building codes protect public health

State codes require residences to have one of the following for removal of blackwater and graywater:

- Sewer availability
- Septic system
- Approved alternative
  - E.g. for composting toilets, states may require certain standards (NSF 41[1]) or even specific models (Sun-Mar, Clavis Multrum, etc)

Additional codes regulate safe graywater reuse

Therefore, residences could not be legally constructed or sold with RT-only sanitation system until it is approved by the state or locality

How are these rules set?

1. National organizations establish plumbing codes
   - IAMPO sets Universal Plumbing Code
   - ICC sets International Plumbing Code
2. States (or localities) usually adopt one of the codes, sometimes with modifications
   - See slide 56 for details
3. Enforced by state department of environmental quality, public health, or equivalent
   - Often requires lengthy process of individual site application, permitting, and inspection – typically overseen by local agency

1. National Sanitation Foundation (http://www.nsf.org/) 2. International Association of Plumbing and Mechanical Officials, International Code Council Sources: State Regulations: Composting Toilets, Graywater Systems and Constructed Wetlands (http://weblife.org/humanure/appendix3.html); state permitting websites (various); Sun-Mar Certifications (https://www.sun-mar.com/comp_cert.html)

Five possible pathways to approve new systems, if not allowed by existing code

Primarily a local or state play; for national regulatory impact, building codes are best levers

1

Site-specific alternate method

Impact: One building

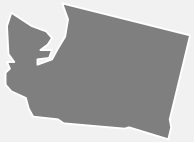
Individual buildings may apply for an exception to any section of the building or plumbing codes; would be approved building-by-building

2

Local amendment

Impact: City / county

These ordinances modify state code or address matters not in it; must be approved and ratified by city council, as well as state building code division

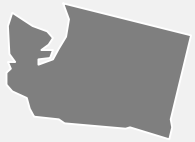


3

Statewide alternate method

Impact: Statewide

Creates an accepted alternate path to the regular building code, typically for innovative strategies; project teams elect to use alternate path (not required)

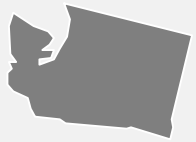


4

Building code modifications

Statewide or national

Modifications can be made to state version of building code or to national codes[1], which could lead to adoption by many states



5

Legislation

Statewide or national

Legislation can pave way for water reuse, e.g. Oregon House Bill 2080 removed barriers to graywater reuse and instructed DEQ to make rules regulating its use

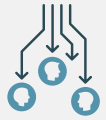
1. International Building Code (IBC) or Universal Building Code (UBC) Source: International Living Future, *Institute Achieving Water Independence in Buildings*, p. 24-25

Go-to-market considerations: Given the range of use cases, need to carefully assess channel options and ways to establish strong service component

Sales and channels

Several ways to build awareness & excitement
- Conferences (e.g. Verge[1]) and trade shows
- IAMPO green plumbing code supplement
- Demo projects (e.g. Living Building Challenge, EPA 21st Century Development)

At first, direct sales are likely best option
- Preserves margins
- Requires use of existing distribution network or third-party services



With scale, may be able to leverage existing channels for durables and plumbing supplies
- Includes commercial (Ferguson), retail (Home Depot), and specialty shops
- Prioritize based on key use cases

Install and maintain

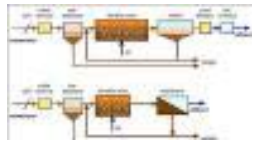
Reliability and service is a top concern across many segments
- Remote site managers need assurances for servicing in the "middle of nowhere"
- Developers want to know of any safety nets (e.g. sewer back-up), and maintenance guarantees after building ownership transition

On-board diagnostics, clear manual & diagrams, and included spare parts could increase user confidence

Consider subscription service, similar to oil refills or water softeners (e.g. Culligan)
- May be able to partner with current septic tank and portables servicing companies

1. Verge technology & sustainability conference hosted by GreenBiz 2. Manufacturers often sell to wholesale at list price * 40%

Pricing: Initial interviews noted alternate solutions to RT priced at ~$1-5K for single units and $1-3M for large, innovative multi-unit systems

	Single units				Large multi units	
	Standard septic tank	Standard portable toilet	Composting toilets	RV or marine toilet	Membrane bioreactor	Tidal wetland systems
Examples			 E.g. Phoenix, Sun-Mar, Clivus Multrum	 e.g. VacuFlush, Master Flush		Living Machine®
Use cases	Households, esp. in rural USA	Festivals, gas stations	Non-traditional homes	RVs, boats, houseboats	Green building; large-scale system	Green building; beautiful showpiece
Reported price	$3,000-$15,000 (varies by size & region)	$700-$1000 to purchase	$1000-$2000	~$2000 for toilet, pump and tank	$950,000 for 400K sq ft building[1]	$3,000,000 for 157 apartments[3]
OpEx considerations	Replacement is about every 20 years	Servicing costs ~$40 per pump out (often weekly)	State laws dictate how composted waste can be disposed	Pay for pump out every 2-4 weeks (~$30 each time)	Have onsite maintenance team; wastewater is tested by DEQ[2]	1.5 full-time engineers maintain system; wastewater is tested by DEQ[2]
Interview quotes	*"At $4K that's half the minimum cost of septic for me–but then I run into NH law requiring septic"*	*"When you are constantly renting toilets, it's easy to see the payback"*	*"If you can get [RT] to $1500, then you're competing"*	*"Right off the bat, we'd have $500 annual savings on pump outs"*	*"City offered us seed money of $500K to try the bioreactor"*	*"ROI was 3 years, with 50% water savings and our sewer bill discount"*

1. Oregon Health Sciences University; 16-story mixed use medical building 2. Department of Environmental Quality (state level) 3. Hasslo on Eighth luxury urban apartments, Portland, OR

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- Sewer
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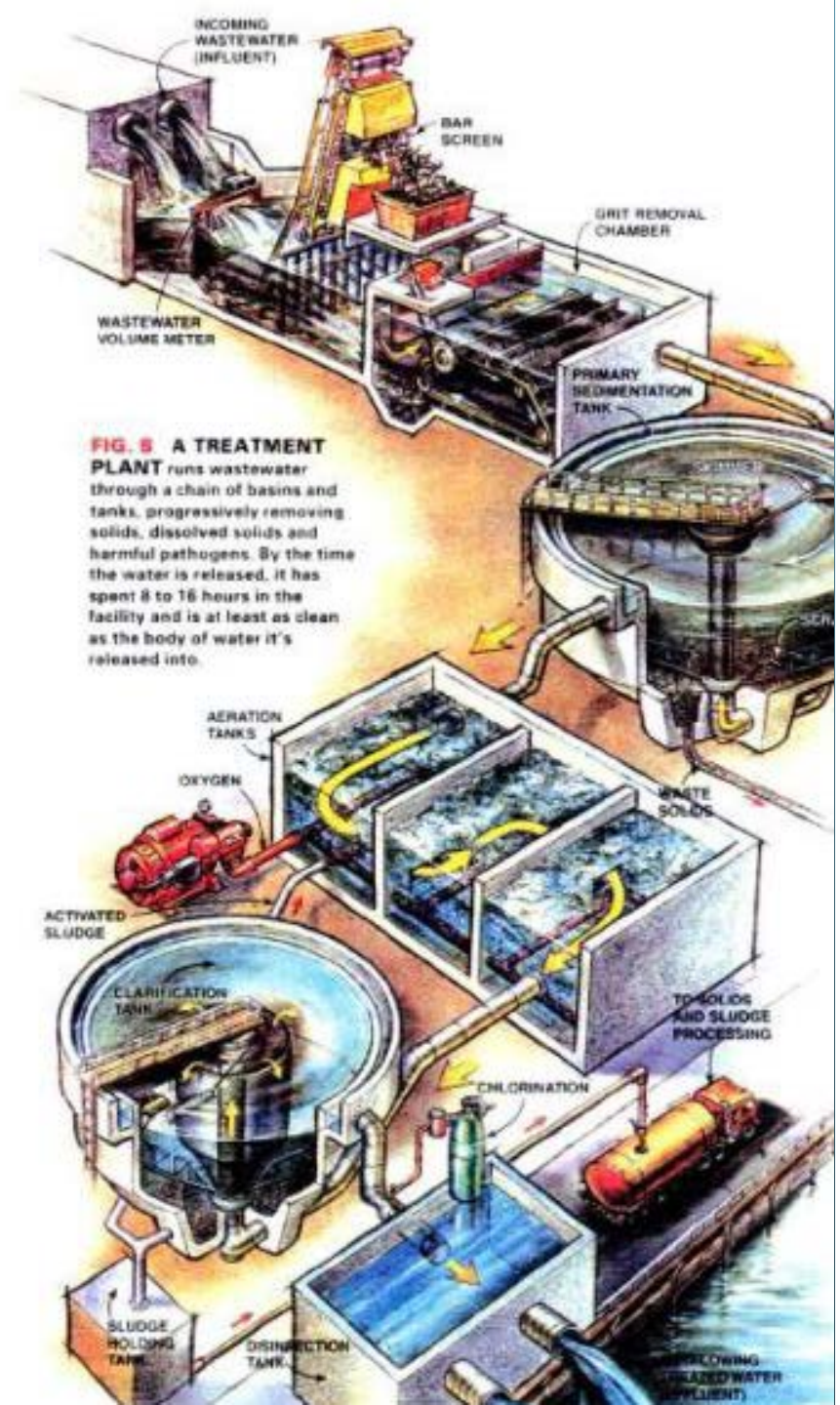


General perception is that US sewer system serves users well in most places...

> Our sewer system is one of the most amazing behind-the-scenes systems in the world. No incentive to change on consumer side, because it works well. The "flush and forget" thing is powerful.

Mike Rosenzweig, Engineer, San Francisco Public Utilities Commission

> If you have a place with centralized sewer, customers, utilities, and engineering firms all would resist change. There's lots of inertia; change is extremely slow, especially in large cities.

Hank Habicht, former Deputy Administrator, US EPA

...However, stressed infrastructure, climate change and population dynamics are motivating public actors to rethink solutions

Aging infrastructure

38 counties have consent decree with EPA due to unaddressed raw sewage overflows or polluted runoff;[1] additional systems are at capacity due to infill development
E.g. Pittsburgh, Portland

Water scarcity

The combination of climate change and population growth threatens water supply across the US
E.g., California, Arizona

Super storms

Recent hurricanes Harvey and Irma caused release of untreated sewage, showing cities' vulnerability to future climatic events too
E.g., Texas, Florida

Small communities

Due to shortage of WWTPs and limited funds for improving existing ones, towns are looking for new, cost-effective options
E.g., Appalachia

1. Consent decrees are established due to Clean Water Act violations Source: BCG interviews and analysis

Aging infrastructure: Cities with unaddressed pollution issues due to sewer system are concentrated in Midwest and Eastern USA

EPA monitors ~40 cities with Clean Water Act violations, often due to combined sewer systems

- Unaddressed sewer system
- Addressed sewer system

Recent GAO report highlights significant needs for cities with declining populations

- EPA estimates water and sewer utilities will need to spend $655 billion over the next 20 years to maintain, upgrade, or replace water infrastructure
- Midsize and large cities with a decline in population struggle to replace their pipes and treatment plants, raising risk of accidental sewage discharges and lead contamination
- Concerned that utility rates are increasingly unaffordable for low-income customers, some utilities are reducing water treatment capacity or decommissioning lines to fit current demands

Source: EPA *National Enforcement Initiative: Keeping Raw Sewage and Contaminated Stormwater Out of Our Nation's Waters* (https://www.epa.gov/enforcement/status-civil-judicial-consent-decrees-addressing-combined-sewer-systems-csos); Government Accountability Office (GAO) *Water Infrastructure* report 2016 (https://www.gao.gov/products/GAO-16-785)

Spotlight on Pittsburgh

Insufficient wastewater treatment capacity and miles of leaky pipes due to dated infrastructure

Old combined sewer system poses risks

- During wet weather, billons of gallons of stormwater runoff and sewage flow directly into rivers

Aging pipes in desperate need of repairs

- Constructed from early 1800's to mid-1900s
- Over 3,500 pipe breaks since 2014
- Concerns about lead in drinking water

$3B Estimated cost of needed capital improvements

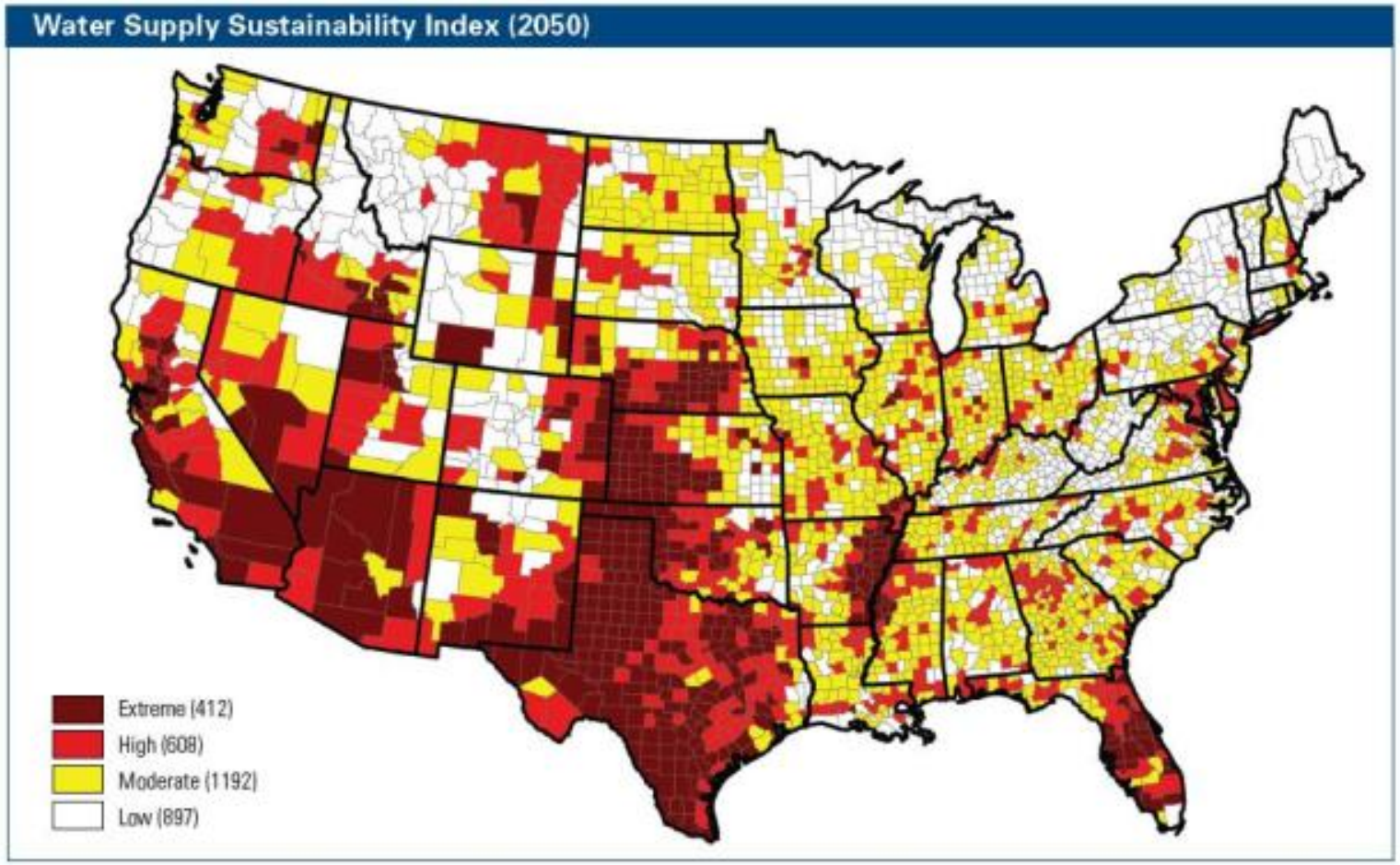
+50% Rate hike for customers by 2020

Pittsburgh launched “Green First” plan in 2016 to use green infrastructure as part of solution; EPA supports & public-private partnerships may assist

Source: PWSA Blue Ribbon Panel, Executive Summary, Nov. 2017 (https://pwsablueribbon.org); Pittsburgh Post Gazette "PWSA bills to jump nearly 50 percent over three years" Nov. 2017; CBS Pittsburgh "PWSA Audit Uncovers ‘Lack Of Leadership’ & ‘Years Of Mismanagement’" Nov. 2017; EPA "Helping Pittsburgh and Other Cities Expand Green Infrastructure"

Water scarcity: 14 states will face an extreme or high risk to water sustainability by 2050; Great Plains and Southwest US predicted to be hardest hit

Counties in USA with risks for water sustainability (i.e. demand exceeds supply)



Source: Natural Resource Defense Council (NRDC) *Climate Change, Water, and Risk* 2010 (retrieved at: https://www.nrdc.org/sites/default/files/WaterRisk.pdf)

Spotlight on San Francisco: During 2016 drought, city passed ordinance requiring onsite wastewater treatment systems in new buildings over 250,000 sq. ft.

Ordinance overview

Started in 2012 with a voluntary program that **allowed for** recycled wastewater systems, and established an approval process

In 2015, onsite non-potable water reuse became **mandatory** for new buildings over 250,000 square feet

- Must reuse graywater
- Blackwater optional

Drivers

1. Water utility drove the effort; motivation was to reduce water footprint
   - Law passed during serious drought
2. Collaborated with public health and building departments
3. Developers were also interested in streamlining process to approve these systems

Benefits & limitations

- Water use reduction and infrastructure cost avoidance
  - SF planned to build recycled WWTP on east side; likely not not needed now
- Easiest to implement in new housing stock, esp. large developments
  - Hard to retrofit
  - Scale advantages to costs and O&M

Paving path for others

San Francisco is now working with US Water Alliance to help other cities overcome barriers to onsite water reuse

National Blue Ribbon Commission is developing state policy guidance & frameworks, and identifying business models for water utilities implementing similar program

Source: San Francisco Public Utilities Commission Non-potable Water Program webpage and reports (retrieved at http://sfwater.org/index.aspx?page=686); National Blue Ribbon Commission for Onsite Non-potable Water Systems (http://uswateralliance.org/initiatives/commission); BCG Interview with Paula Keyoe, Director of Water Resources, San Francisco Public Utilities Commission

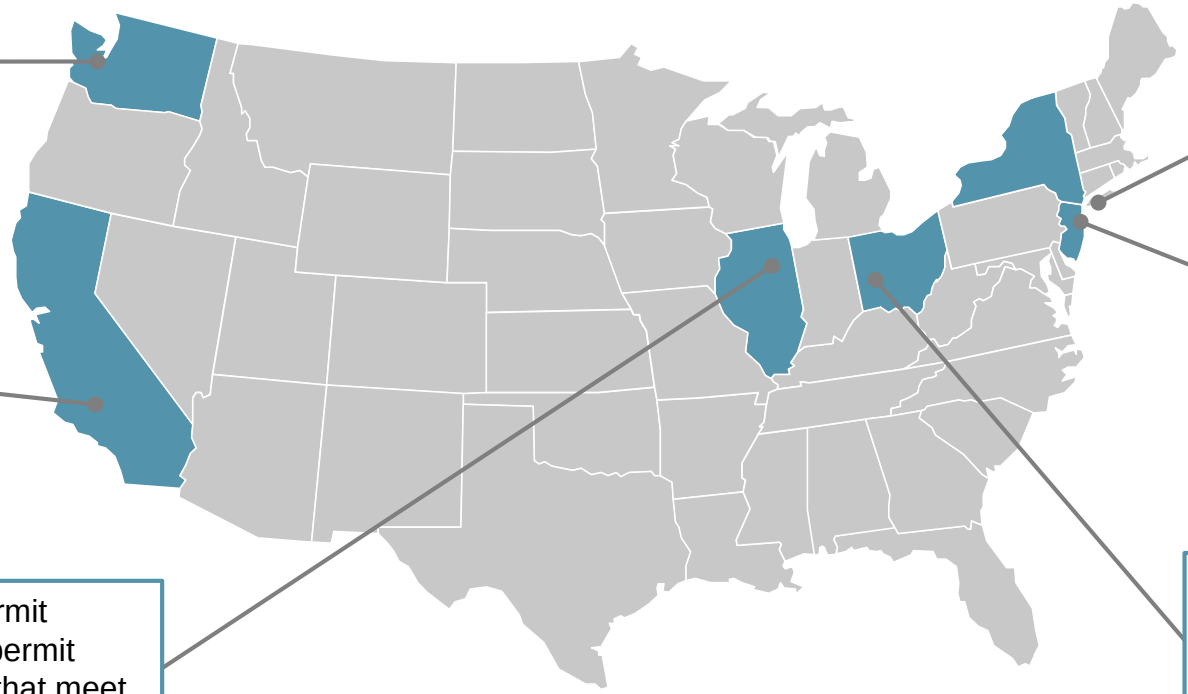
Other cities also encourage onsite water reuse through development incentives

These programs incentivize participation, but do not mandate it as in San Francisco

Seattle launched The Living Building Pilot Program in 2011 to encourage innovative green buildings

Santa Monica waives building permit fees for projects and properties that include reuse systems

Chicago's Green Permit Program expedites permit reviews for projects that meet certain LEED criteria



New York City charges discounted service rates for projects and properties that include reuse systems

New Jersey adopted business tax credits and sales tax refunds as incentives to support reuse in industrial processes

Cincinnati offers financial grants or low-interest loans for innovative projects

Source: William J. Worthen Foundation *Non-Potable Water Reuse Practice Guide*, draft – complete guide to be released in 2018

General strategies to introduce non-sewer alternatives to cities open to new solutions

Initiate working group to tackle regulatory changes

"Biggest challenge is the paradigm shift... and then the regulatory processes.

It's slow, not immediate, not overnight. It takes time, and people with right disposition and interest."

Paula Kehoe, Director of Water Resources, San Francisco Public Utilities Commission

See slide 51 for information on recommended process

Make the financial case vs. standard solutions

"Cities are doing innovative things with stormwater, as an example. Some have priced out standard gray infrastructure solution, and then used a combination of traditional and green building to meet targets."

Barry Liner, Director, Water Science & Engineering Center, Water Environment Federation

Start with awareness and pilot programs

"It starts with awareness raising, then education, then early adopters.

Use pilots so they can touch and feel them. Get the first few big hits, then go to areas that already have drivers for change."

Dominique Lueckenhoff, Acting Director, Water Protection Division US EPA Region III

Additional resources: policy and practice guides for onsite water reuse programs

	Title	Author	Description	Link
☆ 1	**Non-Potable Water Reuse Practice Guide**	William J. Worthen Foundation	Overview of the pros, cons and considerations to install, permit and operate non-potable water reuse systems	*https://www.collaborativedesign.org/*
☆ 2	**Research Library with several reports, incl. *Achieving Water Independence in Buildings***	International Living Future Institute	Current regulations in select geographies and policy strategies for promoting decentralized & net zero water	*https://living-future.org/research/#water*
☆ 3	**Blueprint for Onsite Water Systems**	SFPUC with WERF, WRF[1]	Step-by-step guide for developing a local program to manage onsite water systems	*http://sfwater.org/modules/showdocument.aspx?documentid=6057*
4	**EPA Guidelines for Water Reuse**	EPA and USAID	Authoritative reference on water reuse practices	*https://watereuse.org/wp-content/uploads/2015/04/epa-2012-guidelines-for-water-reuse.pdf*
5	**San Francisco's Non-potable Water Program**	SFPUC	Describes San Francisco ordinance, including steps developers must take to obtain permit and stay in compliance	*https://sfwater.org/modules/showdocument.aspx?documentid=4962*
6	**San Francisco Non-Potable Water System Vendors**	SFPUC	List of companies providing water recycling systems (including blackwater), i.e. could be alternatives to RT	*http://sfwater.org/Modules/ShowDocument.aspx?documentID=9673*

1. San Francisco Public Utilities Commission, Water Environment Research Foundation, Water Research Foundation

☆ *Highly recommended resource*

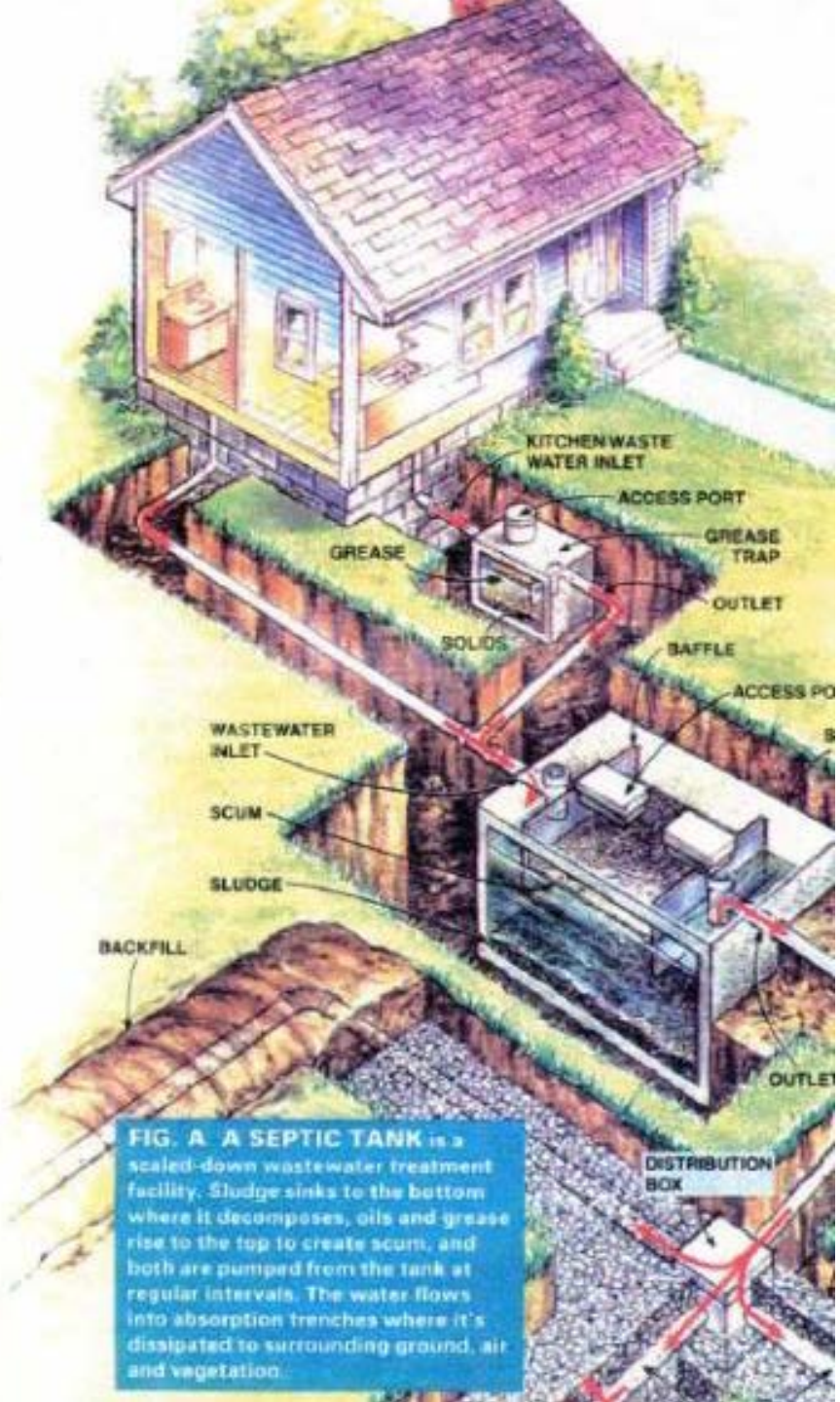
US overview

Use case deep dives

- Sewer
- Septic systems
- Green building
- Non-traditional homes
- Remote sites (e.g. parks)
- Portable toilets

Go-to-market considerations

Back-up slides



Similar to sewer, many septic system users report they work well and stay "out of sight, out of mind"

"We never did anything with ours for 25 years. We pumped it out one time, but it didn't even need it. Other than think about what goes down toilets (no trash or anything), we never gave it another thought honestly.

Contractor and homeowner, North Carolina

"I've designed systems in Ohio, Wyoming, and Virginia. I don't see an application [for RT] in any of the markets I'm involved with; there are suitable alternatives that address the challenges that soils may have.

Engineer and septic designer, Virginia

However, opportunity for RT may exist where failing systems need replacement or new systems are prohibitively expensive

Failing septic systems in need of replacement

~10% of septic systems are failing because of inappropriate design or poor maintenance[1], leading to nitrogen pollution in coastal waters (e.g., Long Island, Cape Cod) and drinking water contamination[2]

New construction with environmental constraints

New homes may need high-cost systems (up to $50K), or could be refused a building permit if they

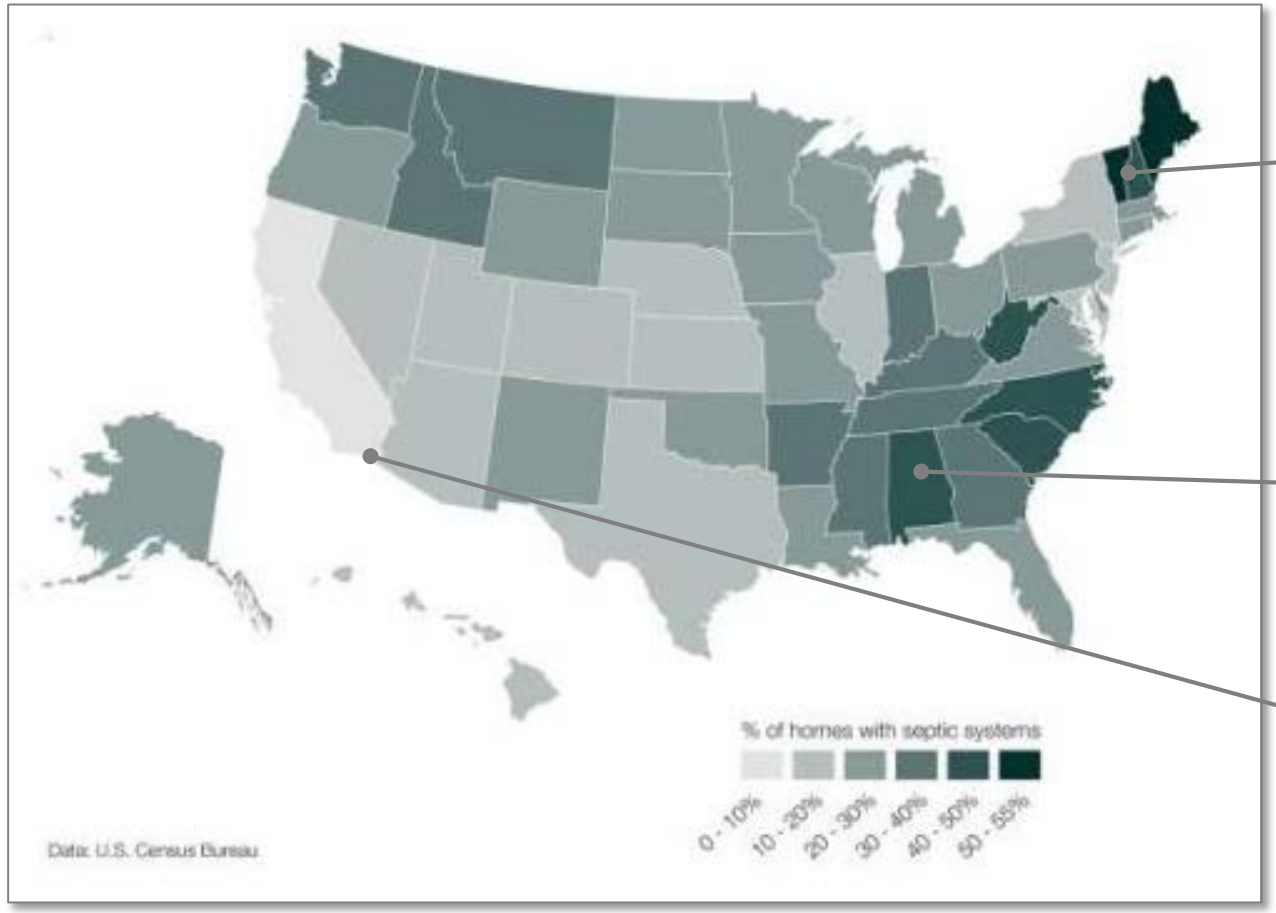
- Are close to a stream or lake
- Lack adequate space and soil permeability for drainfield[3]

Owners cannot afford to install or fix septic system

75,000 families in the US lack a flush toilet; in addition, some poor families with toilets pipe household sewage into the nearest farm drain, woods or stream because they cannot afford a septic system

1. US EPA (https://www.epa.gov/septic/what-do-if-your-septic-system-fails) Bridge Magazine "Thousands of failed septic tanks across the state threaten Michigan's waters" 2013; Thurston County, WA Septic System Failure Rates 2017, Indiana University *Septic System Facts* 2. Circle of Blue “America’s Septic System Failures Can Be Fixed” December 2015 3. BCG expert interviews; RE/MAX Realty “Massachusetts title five septic system law” 4. US Census Bureau, American Community Survey 2016 “Plumbing and Kitchen Facilities in Housing Units” 5. New York Times “A Toilet, but No Proper Plumbing: A Reality in 500,000 U.S. Homes” September 2016; Bridge Magazine “Thousands of failed septic tanks across the state threaten Michigan’s waters” May 2013

When targeting septic users, consider that the prevalence of septic varies considerably by state



New England
Vermont has the highest percent of homes on septic (55%), closely followed by Maine (51%) and New Hampshire (49%)

Southeast
More than one third of homes in SE depend on septic, with several states over 40% septic:

- North Carolina (49%)
- Alabama (44%)
- West Virginia (41%)
- South Carolina (41%)

Low case: California
Just 10% of households in CA use septic systems

Note: Based on 1990 US Census data, which is the most recent state-level septic system assessment. 2013 data on new homes built with septic follows the historic geographic patterns.
Source: US Census Bureau (https://www.census.gov/hhes/www/housing/census/historic/sewage.html); Circle of Blue (http://www.circleofblue.org/2015/world/infographic-americas-septic-systems/)

In order for users to choose RT over septic, RT will need to address several design considerations (in addition to regulatory hurdles)

1. **Graywater**
   Reduced value for users if they still need to install separate septic systems for graywater

2. **Maintenance**
   Frequency and nature of clean-out matters to septic users, who currently pump out system only every ~5 years

3. **Number of RTs per house**
   Cost comparison to septic varies if 3-bath house needs multiple SURTs or MURT

4. **Affordability**
   Competitive price important to all users; third-party funding or financing is important for low-income families

5. **RT footprint and location**
   Owners and contractors worry it may not fit into current home; also dislike of placement in bathroom (would prefer it in basement, garage, outdoor shed)

6. **Winterization**
   If stored in garage or basement, needs to handle temperature extremes

7. **Additional concerns**
   Smell and ability to function during power outage

Source: BCG interviews and analysis

For septic users, several potential trigger points in septic system lifecycle to consider alternatives like RT

	Install	Maintain		Replace
	New system	Routine maintenance	On-demand maintenance	System malfunction
Description	Install new septic tank and drainfield	Inspect for leaks; pump out scum and sludge	Repair due to broken pipe, pump failure, etc.	Replace leaky tank or clogged drainfield
Frequency	N/A	Every 3–5 years recommended	Varies	Usually 20–40 years
Cost	$3,000–15,000+	$250–500	Often ~$400–600	$3,000–7,000+
	Higher cost if limited exfiltration or need to pump water uphill (e.g., away from creek)	Frequency depends on HH size, wastewater and solids generated, and tank size	Alternative systems with electrical float switches and pumps may have more issues	Regular maintenance may extend lifecycle and delay major repair or replacement
Application in RT sizing	New construction market share	RT market expansion: not actively seeking new solution, but may upgrade as a result of RT		Replacement market share
Key uptake drivers	• Cost: RT versus septic • RT specifications[1] • State regulation	• Maintenance challenges (i.e., septic tank is • no longer “set it and forget”) • Eco-conscious mindset		• Same as for install, with additional price scrutiny

1. Includes graywater capacity, number of RTs required, reliability, and service model
Source: US EPA (https://www.epa.gov/septic/why-maintain-your-septic-system), BCG interviews and analysis

Four players in typical decision-making unit for septic systems

Homeowner

Initiates process and pays for solution, but typically leaves decisions about septic system to other actors due to inexperience

Septic designer

Engineer that conducts onsite soil percolation tests, and determines size of tank and type of system needed

Septic installer

Owns backhoe and digs hole for tank and lays pipes drainfield; may arrange purchase of the tank and other materials

Inspector / permitting agencies

Septic construction or repair requires permits from Board of Health or Dept. of Environment and local Building Department; often a septic inspector will inspect the permits

Level of potential leverage for RT

High: seeks cost savings (but cautious about untested options)

Medium: may be open to suggesting new solutions to customers

Low: likely to see RT as competition

High: motivated to have safe, sanitary options for all

Source: BCG interviews and analysis

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Green builder community is eager for continued innovation in water reuse and waste reduction

Overview

Today leading green developers have tried onsite wastewater systems; now seek lower cost, reliable solutions

Level of commitment to water reuse varies:

- "Deep greeners" pursuing net zero water
- "Mainstream green" seek pragmatic, ecofriendly options

Decision-making unit

Policy makers

State & local gov't set building code and rules or incentives to promote green practices

Influencers

- Architects
- Engineers
- Sustainability lead

All bring innovative ideas to the table

Decider

Development manager ultimately signs off on proposal; needs to see case for strong ROI

Source: BCG interviews and analysis
Photo credit: http://hassalooneighth.com/

Developers are generally excited about RT, though note "the devil is in the details"

Current options

Traditional options

- Install toilets and connect to sewer or septic

"Green" solutions

- Natural tidal wetlands and other biologic systems
- Membrane bioreactor
- Biodigester
- Water recycling systems
- Composting toilets (household scale only)

See slide 48 for list of non-potable water treatment systems

Key considerations

Lifecycle costs

- Always analyze lifecycle payback, factoring in CapEx, savings/ rebates, and ongoing OpEx
- Savings depend on utility bill reductions and any city credits

Operating challenges

- Significant maintenance often required; need clear plan for this, even when building turns over

User experience

- Ideally "no different than today"

Aesthetics

- Beauty matters, esp. if this is showcase feature of building

RT reactions

> We would love to see a new technology that's simpler and affordable. We paid $300K for large graywater system in Portland. If we could pay 300K *and* get blackwater treatment, we'd be all over it.
>
> -Director of Sustainability, leading real estate development firm

> The devil is in the details. How much maintenance? Any odor issues? How much electricity? Ongoing costs, lifecycle costs, are the largest issue.
>
> -Architect, sustainability-focused firm

Source: BCG interviews and analysis

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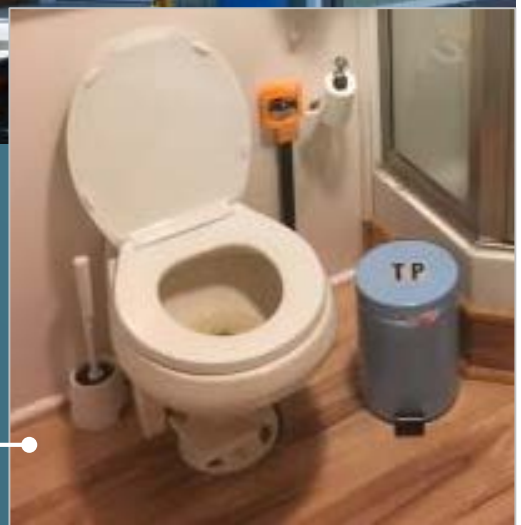

Vacuflush marine toilet

Houseboat, tiny home, and RV owners are open to alternative solutions because of mindset and needs

Overview

Natural early adopters; already receptive to different lifestyle

Accustomed to alternative sanitation solution, including some maintenance and regular pump-outs

Need specialized solutions due to current constraints:
- No sewer connection nor land for septic system
- Small home size

Decision-making unit

New construction

- Homebuilder / contractor
- RV manufacturer (e.g. Winnebago)
- Homeowner

Existing (replace/upgrade)

- Homeowner with potential input from:
  - Contractor
  - Online research
  - Sanitation shop
  - Peers

Source: BCG interviews and analysis
Photo credit: https://www.seattle-houseboat.com; BCG interview

Homeowners express interest in RT, as long as it can meet their constraints

Current options

Marine / RV toilets

- Vacuum toilet
  - e.g. VacuFlush
- Macerating toilet
  - e.g. MasterFlush
- *Challenges vs. standard toilet:* Smells, requires special toilet paper, need to pump out frequently

Composting toilets

- Several brands & models offered
  - e.g. SunMar, Phoenix
- *Challenges vs. standard toilet:* Needs to be emptied regularly; states place restrictions on where waste can be disposed

Key considerations

Footprint and form factor

- Boats, tiny homes, and RVs are very space-constrained; 1m x 2m x 0.5m processor may be too big
- Also want flexibility in positioning, i.e. placed horizontally, under floor

Maintenance

- Used to emptying in some form; need "non-gross" or hands-off process

Off-grid living

- Usually have electricity, but some tiny homes want dry sanitation
- Must be able to withstand temperature extremes

RT reactions

> “I’d be interested [in RT], specifically to avoid cleanout cost. And the negative component of the smell. We definitely have a pile of poop on our boat.
>
> -Houseboat owner, Seattle, WA

> “Most tiny house owners use some version of composting toilet. If you have one that works like a regular toilet, that eases the barrier... But challenges I see are (1) it's ugly and (2) there's not room for it in my house.
>
> -Tiny house builder, Missoula, MT

Source: BCG interviews and analysis

US overview

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Go-to-market considerations

Back-up slides

Parks and other remotes site managers "scratch our heads" about how to solve sanitation challenges

Overview

Waste management is high priority for parks because it has strong impact on visitor experience

- "It's an ironic thing for land management agency: what condition the restroom is in really matters." –National monument manager

Often a struggle to find good solutions, given these are remote sites (off-grid, no sewer access) *and* public area with high use

Decision-making unit

National or state park

- *If large:* Chief of Facilities
- *If small:* Park Manager

For purchases >$2500, must go through gov't procurement rules and get 3 competitive bids – or apply for sole-source bid if unique product

Private cabins

- Building project manager (lead contractor); may consult with owner

Source: BCG interviews and analysis
Photo credit: http://www.worldcadaccess.com

Extreme conditions—remote, exposed, and high use—demand creative solutions

Options and limitations

Non-sewer options work well with low use, but struggle with volume

- Vault toilet: Requires road access for truck to pump out; can have terrible smell if high use
- Composting toilet: Need low volume and warm enough temps to fully compost waste
- Pit toilet: Use until full, then cap & dig new pit; only works if low use
- Leave No Trace: users dig holes or pack it out; only works if very low use

Source: BCG interviews and analysis

Key considerations

- High use areas: "Max 1-2 households would not work; needs to handle industrial level of use"
- Remote and hard-to-reach: "What happens when it breaks?"
- Fully off-grid: "Most cabins don't have grid power, nor good solar"
- Extreme temperatures: "Our park is 123° in summer, and below freezing in winter"
- Public places, open to vandalism: "In a pullout, teens can come by at night... can these be secured?"
- Space constraints at some sites, e.g. along shore of Crater Lake

RT reactions

> If we could find solution that's less odoriferous and can handle high capacity use, the parks would be thrilled.
>
> -National Monument Manager, CA

> If it works is the big hurdle. If it's remote, all about reliability. Because (a) it's complicated to service out here, and (b) it's poop. If its broken, people will shit it in anyways and make worse, or just go in stream.
>
> -Facilities manager for cabin network, NH

US overview

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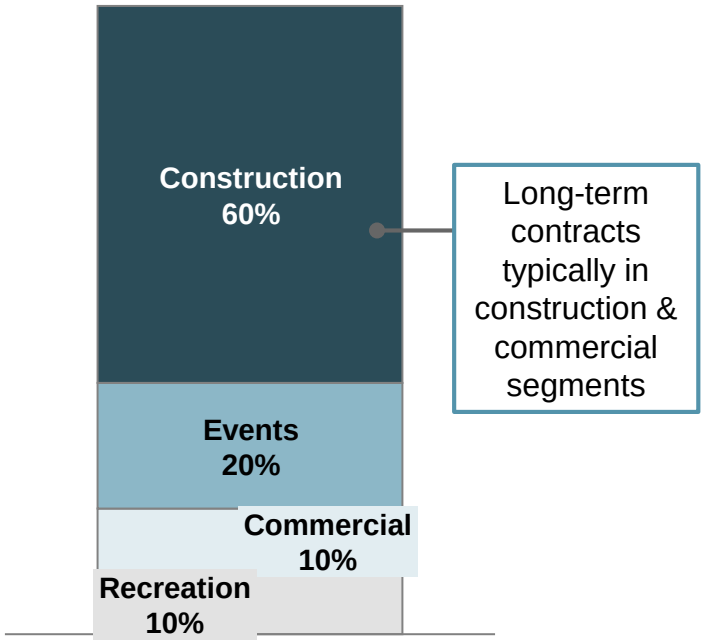
Back-up slides

Potential for RT to be used in lieu of standard portable toilets, as low-cost and eco-friendly option

Construction and events dominate portables market

Segments of portables rental market[1]



Key considerations

Current portable toilets work well in temporary use for several reasons:

- No electricity or water hook-up
- Simple installation (dropped at site) and can be moved if needed
- Durable; works in all temperatures

Value proposition for RT in this context would be:

- Saves cost by removing weekly servicing component (first realized by rental company and could be passed on to user)
- Eco-friendly: guaranteed safe waste disposal

RT reactions

> I've see on job sites where they will just shove the porta potty around with a bulldozer when they want to move it. There are some challenges if you have a more complicated system.
>
> -Engineer and septic designer

Vineyards that are constantly renting toilets for weddings can see the monetization path; it can cost over $1000 per weekend for deluxe porta potty units.

-Engineer with start-up in sanitation space

1. Definitions: Construction – building sites, usually required to have sanitary facility; Events – concerts, festivals, sporting events, etc; Commercial – companies with outdoor base, e.g. bus companies, military, mining operations; Recreation – beaches, parks, etc. Source: Satellite Industries *Guide to the portable toilet rental business*; BCG interviews and analysis

US overview

Use case deep dives

Sewer

Septic systems

Green building

Non-traditional homes

Remote sites (e.g. parks)

Portable toilets

Go-to-market considerations

Back-up slides

When you think about the years of regulatory proceedings, taking this on is not for the faint of heart.

If you go to areas that facing big issues with water supply and piping, you may have easier conversations there. But the same complexities with multiple agencies exist.

Michael Armstrong, former Sustainability Manager at the Portland Bureau of Planning and Sustainability

Recall: First need to approve RT systems, if not allowed by existing code

Five pathways to approve new systems, from hyper-local to statewide

1

Site-specific alternate method

Impact: One building

Individual buildings may apply for an exception to any section of the building or plumbing codes; would be approved building-by-building

2

Local amendment

Impact: City / county

These ordinances modify state code or address matters not in it; must be approved and ratified by city council, as well as state building code division

3

Statewide alternate method

Impact: Statewide

Creates an accepted alternate path to the regular building code, typically for innovative strategies; project teams elect to use alternate path (not required)

4

Building code modifications

Statewide or national

Modifications can be made to state version of building code or to national codes[1], which could lead to adoption by many states

5

Legislation

Statewide or national

Legislation can pave way for water reuse, e.g. Oregon House Bill 2080 removed barriers to graywater reuse and instructed DEQ to make rules regulating its use

1. International Building Code (IBC) or Universal Building Code (UBC) Source: International Living Future, *Institute Achieving Water Independence in Buildings*, p. 24-25

At local level, four government entities to engage when bringing non-sewer option to market

Building codes and permitting

National organizations (IAPMO and ICC[1]) set plumbing codes, which are then adopted by states

Code first needs to *allow* for non-sewered sanitation system like RT

To then *promote* RT, cities could offer lower development charges

State health and environment dept.

State departments regulates sanitation, including waste disposal (e.g. for composting toilets and other alternatives), and water quality standards for graywater reuse

Need to be convinced that waste and waste-water from RT are safe; may want regular tests

Municipal water utilities

In water scare regions like California, utilities could help promote RT as a form of demand conservation

However, in water-rich regions, water suppliers have little motivation to engage with alternative technologies[2]

Municipal waste-water treatment

RT may be attractive for:

- Small towns looking to replace central plant and lower costs
- Cities needing an alterative to water-intensive system

RT may face resistance if current system needs to maintain user volume to offset fixed costs

1. International Association of Plumbing and Mechanical Officials and International Code Council
Source: Expert interviews, BCG analysis

The process to develop a local non-potable water reuse program in full involves several steps, taking years to execute

Source: Blueprint for Onsite Water Systems, San Francisco Public Utilities Commission

1. **Convene a working group**
   Establish a small working group to guide the development of the local program
2. **Select the types of alternate water sources**
   Narrow the specific types of alternate water sources covered in the program
3. **Identify end uses**
   Classify specific non-potable end uses for your program
4. **Establish water quality standards**
   Establish water quality standards for each alternate water source and/or end use
5. **Identify and supplement local building practices**
   Integrate your program into local construction requirements and building permit processes
6. **Establish monitoring and reporting**
   Establish water quality monitoring and reporting requirements for ongoing operations
7. **Prepare an operating permit process**
   Establish the permit process for initial and ongoing operations for onsite water systems
8. **Implement guidelines and the program**
   Publicize the program to provide clear direction for project sponsors and developers
9. **Evaluate the program**
   Promote best practices for onsite water systems
10. **Grow the program**
    Explore opportunities to expand and encourage onsite water systems

Sales: Start with building awareness and offering direct sales; expand to leveraging existing channels

Build awareness

Developers & architects
- Conferences
- Living Building Challenge
- Pilot projects (e.g. DOD, Indian Health, green build)

Contractors & septic designers
- Trainings
- Trade shows
- State/local website (list of approved systems)

Homeowners
- Press about pilot projects
- Online communities

Sell direct (B2B or B2C)

Direct sales are common for other "ecofriendly" toilets
- Pheonix & Clavis Multrum composting toilets
- Living Machine natural wetland system

Could include direct sales to customers, developers, and institutions (e.g. national parks)

Also consider selling to RV or mobile home manufacturers
- E.g. Winnebago

Leverage existing channels

Commercial: trade-oriented, new construction
- E.g. Ferguson, Keller

MRO: Maintenance, Repair, Ops
- E.g. Granger

Retail: consumer-oriented, replace or upgrade existing
- E.g. Home Depot, Lowes

Specialty shops
- Marine sanitation
- Green building supply

All expand sales opportunities, but reduce profit margin

Source: BCG interviews and analysis

There are established ways to serve all use cases in US, but it is a fragmented process due to buyer diversity

		Buyer	Influencers	Manufacture & distribute	Sell (channels)	Install & maintain
1A	Sewer (i.e. standard toilet connected to sewer)	Homeowner Developer	Contractor, engineer, architect, government (via building code)	Durables manufacturing plant; distribute primarily to wholesale players	Standard commercial, MRO & retail channels	Owners and developers both want reliable systems
2A	Septic system	Homeowner	Septic designer, septic installer, contractor	Tank: local concrete co. Piping: commercial plumbing suppliers	Direct to septic installer RT: County sanitarian could suggest RT	Owner personally cares about easy maintenance
1B	Green buildings	Real estate developer	Architects, engineers, contractors, firm sustainability lead	Varies	Direct for large systems; otherwise contractor purchases wholesale	Maintenance is important to lifecycle and ROI calculations
2B	Non-traditional homes, e.g. houseboats, RV, tiny homes	Homeowner RV/boat manufacturer	Peers, online communities, specialty shop staff	Custom manufacturing facility (e.g. for vacuum or composting toilets)	Specialty shops (marine sanitation, tiny homes) Installed in new RV/boat	Must fit into small footprint; smell is a top concern
3	Remote sites (e.g. parks)	Director of facilities	Park visitors Peers at other parks	Custom manufacturing facility (e.g. for composting toilets)	Direct to park via gov't competitive bid process	Easy to repair in remote location; durable in extreme temperatures
4	Portable toilets	Construction manager; event planner	Established company practice; online search	Regional providers distribute to local buyers	Direct rental business RT: Partner with existing co. to add RT to offering	Rental companies already handle as normal part of contract

Source: BCG interviews and analysis

US overview

Use case deep dives

Sewer

Septic systems

Green building

Non-traditional homes

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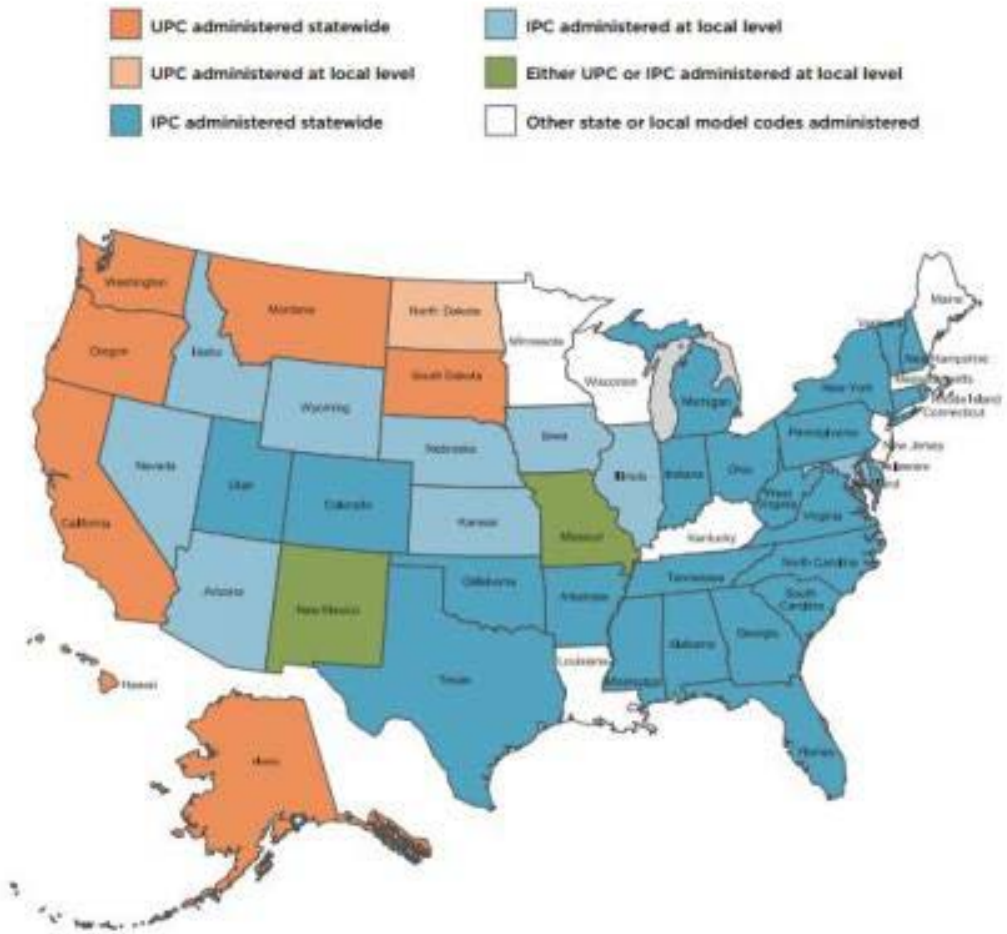
Most state or local plumbing codes are modeled after the codes set by two national organizations



Plumbing Codes

Existing plumbing codes provide a context for a local program and identify the current requirements that can be built upon or expanded. The plumbing codes for most communities are modeled after the International Plumbing Code (IPC) or the Uniform Plumbing Code (UPC).

- **IPC:** The IPC addresses graywater systems for flushing of toilets and urinals and for sub-surface landscape irrigation. The IPC also establishes the minimum acceptable level of safety to protect life and property from the potential dangers associated with supplying potable water and the conveyance of wastewater. (See Chapter 13, IPC 2012.)
- **UPC:** The UPC addresses alternate water sources, including recycled water, rainwater, graywater, and onsite treated non-potable water for a number of identified non-potable applications. The UPC indicates that water quality standards should meet the applicable water quality requirements determined by the Public Health Authority Having Jurisdiction. (See Chapters 16 and 17, UPC 2012.)

The IPC and UPC have been amended by some states and local municipalities to establish their own laws, guidelines, and codes to further refine allowable uses, minimum water quality criteria, and treatment requirements. Some codes may not allow onsite water systems and will need to be amended before a local program can be implemented.

IPC published by International Code Council (ICC)

UPC published by International Association of Plumbing and Mechanical Officials (IAMPO)

Source: San Francisco Public Utilities Commission, *Blueprint for Onsite Water Systems*, p. 8

Non-potable water system vendors that treat blackwater (I)

List published by San Francisco Public Utilities Commission

These are mostly large-scale treatment systems, i.e. competitors to MURT; household SURT with toilet would be unique on this list[1]

Company name	Alternate water sources treated	Website	General information
Acqualogic	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://www.acqualogic.com	Acqualogic builds, installs and services modular and compact water recycling systems for the reuse of graywater, blackwater, stormwater and other alternative water sources. Acqualogic systems are advanced biological treatment systems that can be employed in new or retrofit projects for flows up to 150,000 gallons per day
Alliance Environmental	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://www.alliance environmentalllc.com	Alliance Environmental, LLC is a collaborative of engineers, scientists and planners with broad based experience in environmental engineering and sustainability consulting. The Alliance team specializes in analysis and design services and implementation of integrated systems and sustainable solutions for both the built and natural environments
AquaCELL	Graywater, blackwater, and other alternate water sources	http://www.dewater.com/ aquacell.html	Aquacell builds and operates water recycling plants. The company has systems for either graywater or blackwater recycling and can be retrofitted to existing structures or integrated into a new development
AquaPoint	Graywater, blackwater, and other alternate water sources	http://www.aquapoint.com/	AquaPoint has a portfolio of fixed-film treatment technologies to address a wide variety of alternate water sources and treatment standards
BIOCLERE	Graywater, blackwater, and other alternate water sources	http://www.bioclere.co.uk/ bioclere.php	BIOCLERE is a biological wastewater treatment plant which is safe to operate and reliable. The system copes with small to medium amounts of wastewater, from single family homes to sites with a population of up to 2000 people

1. SF ordinance applies to buildings over 250K sq. ft., hence the focus on large processing systems; SFPUC Director of Water Resources noted, "We haven't seen anything like this [SURT]. These structures include the toilet itself; the systems we have are what's outside processing." Source: SFPUC *Non-Potable System Resource List*

Non-potable water system vendors that treat blackwater (II)

List published by San Francisco Public Utilities Commission

Company name	Alternate water sources treated	Website	General information
Biohabitats	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://www.biohabitats.com/	Biohabitats offers integrated water management strategies for a variety of scales. Biohabitats embrace “regenerative design,” a model that respects Earth’s ecological limits, heals damaged ecological processes, integrates green infrastructure, and catalyzes a mutually beneficial relationship with the land
General electric	Graywater, blackwater, and other alternate water sources.	http://www.gewater.com/products/packaged-systems-wastewater.html	With a simple and expandable building-block design, GE’s packaged plants can be quickly set up in virtually any location. They feature scalable treatment capacities (from 50 gallons to 5 million gallons per day) that can be increased as wastewater treatment demand grows
Integrated water strategies	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://www.waterrecycling.com/	Integrated Water Strategies (IWS) develops systems that recycle wastewater and stormwater for residences, businesses, industry and institutions. Their projects issue responsibility in water management by offering at-the-source treatment and maintain environmental integrity by using low-impact technology
Living machine	Graywater, blackwater, rainwater, and other alternate water sources	http://www.livingmachines.com	Living Machine® Technology blends cutting-edge science and engineering with plants and beneficial bacteria to efficiently treat and reuse wastewater, providing lasting water solutions for communities everywhere. Based on the principles of wetland ecology, their patented tidal process cleans water, making the Living Machine® an energy-efficient system that meets high quality reuse standards
Natural systems utilities	Graywater, blackwater, rainwater, and other alternate water sources	http://www.naturalsystemsutilities.com/	Natural Systems Utilities (NSU) is a distributed water infrastructure company that plans, designs, builds, owns, and operates on-site, ecologically based water systems. We create and run fully integrated water supply, wastewater treatment, and reuse systems for a variety of scales

Source: SFPUC *Non-Potable System Resource List*

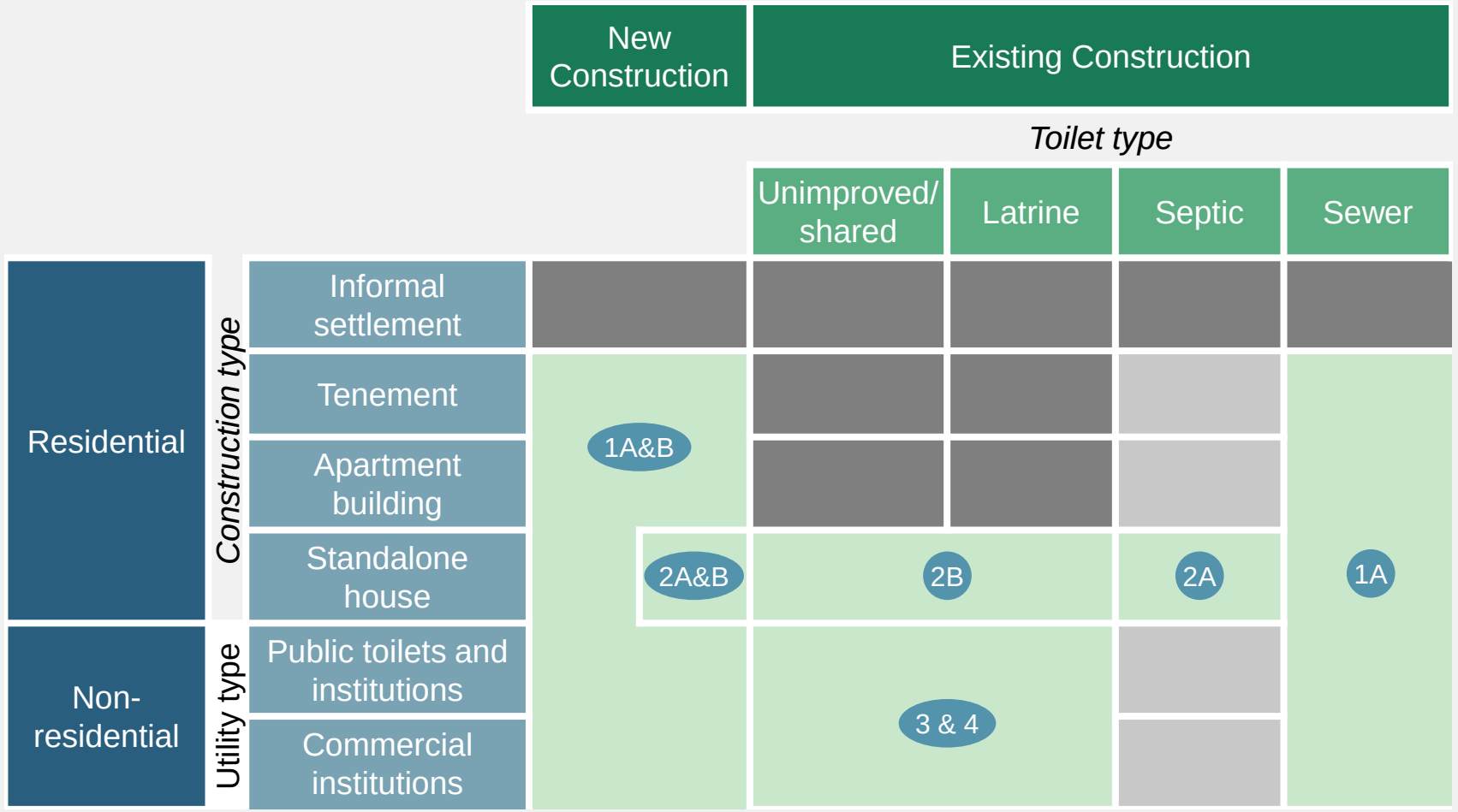
Non-potable water system vendors that treat blackwater (III)

List published by San Francisco Public Utilities Commission

Company name	Alternate water sources treated	Website	General information
Organica	Graywater, blackwater, and other alternate water sources	http://www.organicawater.com/	Organica develops systems that treat and recycle wastewater using Integrated Fixed Film Activated Sludge (IFAS). Organica offers a variety of products and services to help customers build and operate space and energy efficient biological wastewater treatment plants
PERC water	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://www.percwater.com	PERC Water Corporation is a leading water infrastructure company that develops, designs, builds, operates, and manages water and wastewater infrastructure throughout the United States. PERC Water's track record includes the design of 60 water and wastewater infrastructure projects over the past 16 years, 22 of which we have built and placed into operation. Our unique project approach results in certainty of cost, risk management, schedule and water quality for our clients
Sustainable water	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://sustainablewater.com/	Sustainable Water is a leading provider of water reclamation and reuse solutions. Sustainable Water's ecologically-driven projects bring together teams of experts comprised of seasoned water industry veterans, world-class design engineers and award winning commercial contractors who have built hundreds of high-profile, first-of-their-kind, multi-million dollar projects
Water control corporation	Graywater, blackwater, rainwater, stormwater, and other alternate water sources	http://watercontrolinc.com/	Water Control can build a packaged, turnkey solution to virtually any commercial or institutional water treatment issue. They have and in-house team of professionals and local representatives to assist from conception to commissioning, to service and upkeep. Every installation is performed by a licensed plumbing/mechanical contractor

Source: SFPUC *Non-Potable System Resource List.* Includes disclaimer: "By providing this sample list of current technologies, the San Francisco Public Utilities Commission does not endorse, warrant, or make representations or endorsements as to the accuracy, quality or completeness of the information and companies listed."

Selected use cases in US map to overall RT segmentation



Selected use cases

- 1A Sewer systems needing upgrades and/or facing water scarcity
- 2A Households with septic tanks
- 1B Green building (new)
- 2B Non-traditional homes
- 3 Remote sites (e.g. parks)
- 4 Portable toilets (long-term)

Preliminary focus segment for RT | Lower priority for RT | Nearly non-existent in US

Note: Use cases #3 and 4 could include new construction too, but likely not fast-growing