From flush to faucet: More places look to turn sewage into tap water

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After an Orange County resident flushes her toilet, the water flows through the Southern California community's sewer system, meanders its way to the sanitation plant, has its solids removed, is piped to a wastewater recycling facility next door and undergoes three different purification processes until it is clean enough to drink.

"It tastes like water," said Mehul Patel, executive director of operations for the Orange County Water District's project, after taking a gulp from a clear plastic cup at the sampling station, as he stood outside the final purification process facility on a warm afternoon earlier this month.

"It's just like any other water, but it's gone through a lot," he said. "People shouldn't judge where it came from, but where it is now."

No large community in the U.S., not even Orange County, is taking water from toilets and transforming it directly into clean drinking water right now. But Patel's demonstration might offer a glimpse of the future, as states and communities across the country design new plants that will do just that, giving communities more control over their water supply as the climate gets drier.

The idea is still new in many parts of the country. And officials face some pushback from skeptics concerned about the high costs of advanced purification systems and from a public not used to the idea of drinking what was once their own waste.

Every day, Orange County's Groundwater Replenishment System, known to the locals as GWRS, purifies 130 million gallons of wastewater coming from 2.5 million residents. It's the world's largest wastewater recycling plant, and the first in the United States to recycle every ounce of its county's wastewater. This system of pipes, purifiers and chemical reactions has become a required visit for any water official looking to adopt a similar program in another state.

Patel expects more visitors now that California's top water officials are slated to greenlight new rules later this month that would allow counties to purify their wastewater and inject it immediately into the drinking water supply. If approved, as expected, regulations would go into effect in July.

Currently, all of Orange County's recycled wastewater is used to replenish its groundwater aquifer and protect it from seawater intrusion. The water is later pumped out and purified once again to drinking water standards and distributed throughout the county. There are no plans to change this two-part process anytime soon.

Some Golden State communities do the same; others use their recycled wastewater to irrigate fields, water parks or merely dump it into the Pacific Ocean.

But as the state faces a drier future in which the amount of water coming from the Colorado River and the Sierra Nevada Mountains may not be reliable, top water officials say the state needs more sources of drinking water.

"We spend a lot of money and energy moving water from different parts of the state to Southern California, where it's used once and dumped in the ocean," said Darrin Polhemus, deputy director of the California State Water Resources Control Board. "That's maybe not the smartest way to deal with a resiliency question."

Communities across the country, even beyond the increasingly arid West, have been using recycled wastewater to shore up water supplies drained by larger populations, over-pumped groundwater aquifers, hotter summers and less precipitation.

Facilities are pumping out millions of gallons of recycled wastewater in Arizona, Georgia, Texas and Virginia. Regulators in Colorado, Florida, Iowa and Kansas are considering how to use it. In Arizona, for example, some cities use recycled wastewater to replenish dormant rivers and brew beer; others use it to refill underground aquifers, cool factories or keep parks and golf courses green. But rarely has wastewater gone directly into the drinking water supply.

Daniel McCurry, an assistant professor of civil and environmental engineering at the University of Southern California, expects that in two decades at least half of states will adopt wastewater recycling to meet the hydrological demands of a hotter, drier climate.

"Places you wouldn't normally think of as dry or water-stressed at all are starting to build these plants," he said. "And that's only going to accelerate.

"Anywhere that's primarily reliant on groundwater is going to have water reuse in their future."

How it works

The town of Castle Rock, Colorado, lies in a valley east of the Rocky Mountains.

Directly recycling wastewater into drinking water will eventually allow residents to hold onto more of their precious water supply. Rather than continuing to send treated wastewater into East Plum Creek, where volumes can be lost to evaporation, the town will be able to recycle its municipal water over and over at a water treatment plant that was upgraded in 2021.

"We keep more of a closed loop and we bring that water directly back," said Mark Marlowe, director of Castle Rock Water, of the incoming system.

While the plant already has the capability, it's not sending treated wastewater directly to customers yet; Marlowe says it will likely take three to five years to meet new regulations on potable reuse announced by the state in January. The rules include a full year of water quality monitoring and a community awareness campaign before

implementation.

While Castle Rock will spend more to comply with those regulations, it also expects to save money on energy costs by reducing the distance water must be moved. And the city's sewage will actually provide more predictable water quality, Marlowe said. The quality of creek water can vary wildly as salt runs off in the winters or as storms increase sediments in the water.

"There is no new water," Marlowe said. "It's really just a question of whether the water is being recycled through natural processes or through manmade engineering solutions."

In Orange County, the science of turning human waste into clean water is on full display.

After showing a Stateline reporter around the 15-acre wastewater recycling plant southeast of Los Angeles, the air around it heavy with the smell of standing water, Patel stopped at three display sinks designed for the tour frequented by local students and water officials from out of town—one filled with amber-tinted water, another yellowish and the third crystal clear, each showing what the wastewater looks like after the three purification steps.

Starting at microfiltration, wastewater is sucked through microscopic holes in hollow plastic fiber. At reverse osmosis, the water is forced through holes 1,000 times smaller in tightly wound membrane sheets, wrapped in fiberglass tubes. And at advanced oxidation, the water is hit with ultraviolet light combined with hydrogen peroxide.

From sewage to drinkable water, the process takes 20 hours.

In the next decade, Southern California cities such as Los Angeles and

San Diego plan to recycle wastewater for direct use as drinking water. Both would add more purification steps than what Orange County uses to ensure pathogens are removed before the water reaches consumers.

"As the drought has gotten worse, the interest has increased," Patel said.

Where it's going

Even in the typically water-rich Midwest, unpredictable supplies have some communities considering turning wastewater into drinking water.

In southern Iowa, the town of Osceola could become the first in the state to use treated wastewater as part of its drinking supply. Three years of drought have left the town's West Lake dangerously low, the Des Moines Register reported.

The topic came up time and again at a water conference hosted by the Kansas Water Office last month.

In one presentation, Jason Solomon, a technical assistant at the Kansas Rural Water Association, projected a map of the Neosho River pocked with toilet icons marking the dozens of places communities release treated wastewater into the river. Sometimes, those discharges aren't far from the intake valve of the next town downstream relying on the water.

His point: The current system is only one step removed from directly recycling wastewater. Rivers and reservoirs are as much a mental barrier as a physical one in terms of water quality, said Solomon, whose group assists small water providers across the state.

He thinks direct wastewater recycling is likely a ways off in Kansas given its stigma and costs. But it's an idea worth considering with recent droughts threatening drinking water supplies even in the traditionally

wettest part of the state.

"Why don't we just take it directly from the wastewater plant?" he said in an interview. "Why would we put it back in the river? It's going to get dirtier in the river."

Public perception is key

Although experts say the science is clear, convincing the public has been a challenge, including in Southern California.

Three decades ago, Los Angeles County sought to bring what the local media dubbed "toilet to tap" to the region, but officials were met with fierce resistance by politicians and residents. It stopped the project.

The "yuck" factor can be challenging, said David Sedlak, director of the Berkeley Water Center at the University of California, Berkeley.

"When you look at some communities where they haven't done water recycling yet, they have to start building legitimacy from the ground up," said Sedlak, who recently published a book on water solutions.

"Sometimes that means changing the culture of transparency and openness. And sometimes that means working with the public and bringing them on board to see and understand it."

Often, people assume the water coming from rivers is cleaner than it really is, Sedlak said; the public may not fully grasp that it can include agricultural runoff or the wastewater from some upstream communities.

A future plant in El Paso, Texas, will include an educational exhibit area so schoolchildren and other visitors can see the science behind the treatment process.

Adjacent to an existing wastewater plant, the $130 million purification facility will send treated wastewater directly back into the drinking water system. Construction is expected to begin next year, but the city has been working to educate and build trust with the public for the past decade, said Christina Montoya-Halter, the communications and marketing director for El Paso Water.

"I don't want to say it was easy," she said. "But we are in a different position in El Paso because we've been talking about the need to diversify for a long time."

The city sources water from the Rio Grande and underground aquifers, and runs a desalination plant to treat salty groundwater.

The new treatment plant, which should be running by 2027, is expected to produce up to 10 million gallons per day—or about 6% of the city's annual needs. But it's considered a crucial supply since El Paso hasn't received its full allocation of Rio Grande water in about a decade.

Gilbert Trejo, vice president of engineering, operations and technical services for the utility, said directly treating wastewater will cost roughly double the price of other treatment processes.

Trejo, who serves on the board of a national trade group promoting the use of recycled water, expects directly recycled wastewater will become mainstream as officials increasingly view it as a solution to water shortages.

"It's not just a solution for arid states and arid regions," he said. "This also solves a lot of problems in water-rich areas."