INDEED × TOILETS FOR ALL

FLUSH ONCE, POWER TWICE:

Turning Toilets Into Resource Hubs

Time to Rethink the Flush

For over a century, we've relied on the same basic model to deal with human waste: flush it down with drinking water, pipe it far away, and hope someone else takes care of it. This centralized sewer system, hauling diluted wastewater to distant treatment plants, became the global default, and for good reason: it dramatically reduced cholera, typhoid, and other waterborne diseases, enabling cities to grow and life expectancy to rise.

But as urban populations surge and climate patterns shift, that model is showing its cracks.

Today's sewer systems are under immense strain. They waste water, energy, and nutrients while releasing potent greenhouse gases such as nitrous oxide, hundreds of times more harmful than CO_2. **Wastewater, including sewers and treatment, is estimated to contribute around 3% of global human-made emissions (CO_2, CH_4, N_2O).**

Heavy rainfall overwhelms these systems, spilling untreated sewage into rivers and oceans.

In England, Thames Water reported nearly 300,000 hours of raw sewage discharges in 2024, a 50% increase from the previous year. In dry periods, valuable opportunities to reuse water are lost, a critical issue when over **1.4 billion people were affected by droughts between 2000 and 2019, causing 21,000 deaths and $170 billion in economic losses** (UNESCO, 2024)

Climate change is only turning up the pressure. More frequent extreme weather events are making failures more common and more dangerous. When infrastructure breaks, communities are left vulnerable. And because today's wastewater system is highly linear, the water cleaned at treatment plants rarely returns to the supply system. It's discharged downstream, effectively lost. That means not only do we risk spreading pathogens when treatment fails, but even when it works, valuable water slips away instead of being reused where it's most needed.

Cities are responding with innovation. Paris is building a vast underground basin to prevent sewer overflows and protect the Seine. In New York, green infrastructure, like rain gardens, green roofs, and permeable pavements, helps absorb stormwater and ease the load on sewers. These solutions are impressive and necessary, but still operate within the limits of a century-old idea.

What if, instead of endlessly patching a broken system, we reimagined it entirely?

It's not just our infrastructure that needs rethinking; it's our whole relationship with "waste." For most of human history, human output was not something to flush and forget; it was valuable. **Collecting and reusing night soil and urine as fertilizer was common across the world. In Europe, cities like London ran large, organized trades before modern sewers arrived. In East Asia, especially in Edo, Beijing, and Seoul, these systems were highly organized and lasted well into the mid-20th century.**

Only in the last century, with the rise of flush toilets and centralized sewers, did this circular practice give way to a linear "flush-and-forget" model. Yet what we discard every day still holds nutrients, energy, and water, resources that, with the right systems, could be recovered locally. Believe it or not , what we flush away today could help grow the food on our plates tomorrow.

In fact, your "one-time" pee could fertilize enough soil to harvest three carrots.

It's time to stop flushing opportunities down the drain and start owning our own shit.

From Pee to Produce

So, if a single pee can help grow three carrots, imagine what a city's or even a country's worth could do.

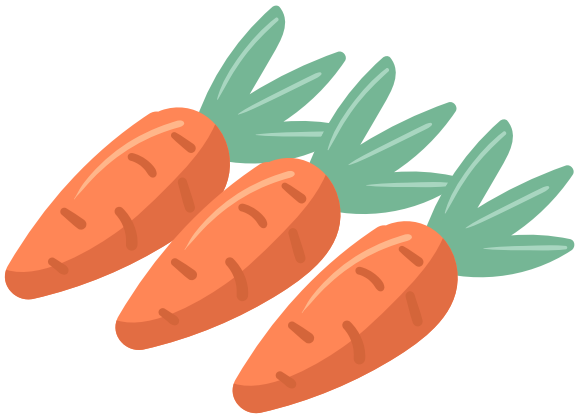
This is the promise of circular sanitation. Brought to cities, it promotes the sustainable development of urban spaces, where environmental pressures are greatest, and the potential for impact even greater. With over half the world's population already living in urban areas, and more arriving every day, cities are the place to act.

But no, this isn't about ripping out pipes or abandoning the existing sewer grid. It's about complementing it. Circular systems can work alongside current infrastructure, easing pressure on aging utilities while creating local loops that turn waste into something useful, including water, fertilizer, and energy, and even generating economic savings or new revenue streams for households and communities.

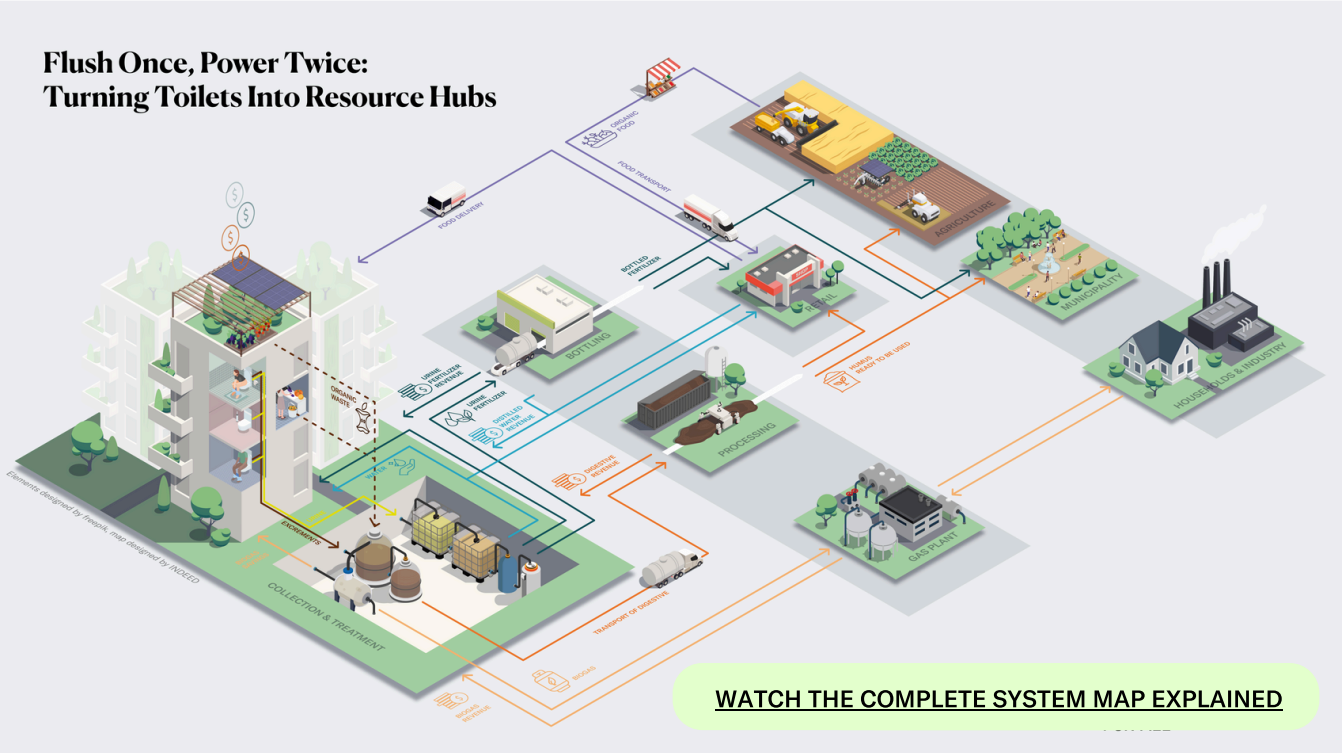
So what does it look like? Pretty normal, actually. The toilets? Same comfort, same ease of use, just smarter behind the scenes. Body outputs are separated, collected and treated to preserve their value. Urine becomes nutrient-rich fertilizer. Feces and kitchen waste are turned into biogas and compost. The entire process is clean, odorless, and seamlessly integrated into the spaces we live and work in.

And this isn't hypothetical. It's happening. Companies like Finizio are already producing certified, high-quality humus fertilizer from dry toilets. VunaNexus has developed systems that safely transform urine into Aurin, an EU-approved liquid fertilizer, while also removing pharmaceuticals and hormones in the process. These technologies are not just proven; they're being scaled, installed, and adapted to real-world settings.

Because these systems operate independently of conventional sewers, they avoid contamination from industrial discharges and urban runoff, including heavy metals and persistent pollutants like PFAS. That makes the outputs safer and the cycle more efficient.



Together with ToiletsForAll, we took a closer look at the key players driving innovation in this field and developed a comprehensive vision for the (not-so-distant) future of sanitation, bringing all the puzzle pieces together into one big picture.



A circular urban sanitation ecosystem centered around a building complex for above 30 people, highlighting not only the technologies but also the network of partners making circular sanitation work in practice.

Each apartment uses toilets that separate urine and feces. These outputs are collected in an on-site recovery unit. Urine is turned into fertilizer and distilled water. Feces and kitchen waste go into a digestion tank, generating biogas and nutrient-rich digestate.

Part of these resources can be looped directly back into the building support household self-sufficiency:

- Nutrients gained from urine nourish rooftop gardens and greeneries
- Biogas powers household energy
- Water is reused for watering plants and as non-potable household supply

The untreated digestate is sent to organic recycling partners, who transform it into high-quality fertilizer and soil conditioner.

Any surplus resources, beyond what the building community requires, can be sold or shared with others. This supports municipal services, local agriculture, and markets. In return, food grown with city-made nutrients comes back to residents' plates, completing the loop.

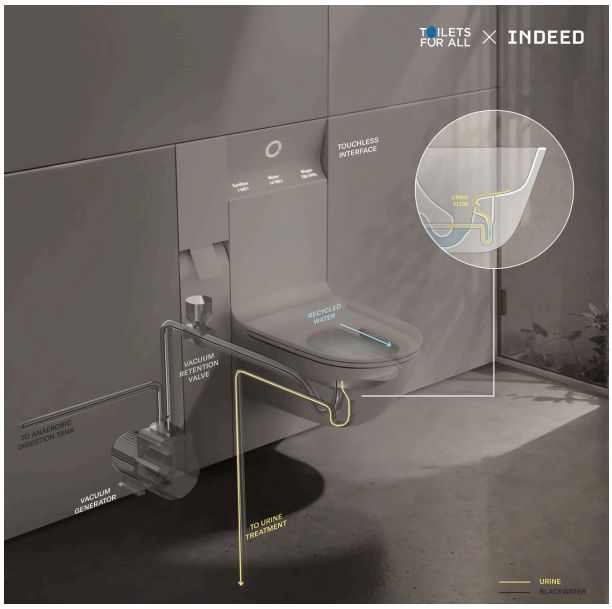
Proven Tech, Built to Adapt

The technologies behind this system have been carefully selected for their proven effectiveness. However, each component is modular, so things can be swapped, scaled, or adjusted to fit different community needs, climates, and setups.

Urine Nutrient recovery
At the front end, toilets apply the teapot effect, a clever hydrodynamic principle, to separate urine without changing the look or feel. At the back end, an urine nutrient recovery system transforms it into a safe, effective urine fertilizer.

Why it matters: Modern agriculture is pushing beyond planetary boundaries, largely because it depends on fossil-fuel-based fertilizers.

The toilet's front-end design offers the same comfort, ease of use, and sleek look you'd expect from any modern bathroom. It's seamlessly integrated into the space, with an intuitive, touchless interface that responds to a simple hand gesture to flush. On top of that, it displays real-time insights into your household's impact, showing how your daily contributions help generate fertilizer, save water, and produce biogas.



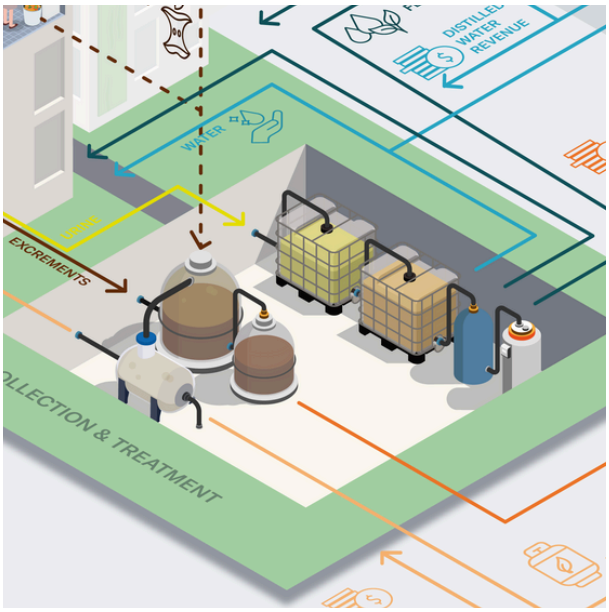
Behind the scenes, the toilet is powered by a vacuum system, a urine separation unit, and an anaerobic digestion tank. Body outputs are neatly separated and collected for specialized treatment, allowing their full value to be recovered from nutrients to energy. The vacuum technology significantly reduces water use with every flush. When used in a building setup, a single central vacuum pump is enough to serve all connected toilets, keeping the system streamlined, scalable, and cost-effective.

Nitrogen from the Haber-Bosch process consumes massive energy and drives carbon emissions, while phosphorus mining depletes finite resources and damages ecosystems.

Our urine contains nitrogen, phosphorus, and potassium, and can completely replace synthetic fertilizers. Recovering these nutrients eliminates dependence on fossil fuels and global fertilizer markets.
The bonus?

About 90% of the remaining liquid becomes valuable distilled water. Closing this nutrient loop can restore food production within safe planetary limits and make agriculture self-sufficient and resilient.

Feces and Organic Waste Recovery
Feces are flushed using a vacuum toilet system that cuts water use dramatically. Combined with kitchen waste collected through a shared disposal point, the mix heads into an anaerobic digestion tank. This setup generates biogas for household energy and leaves digestate behind, ready to become humus and soil conditioner. However, the journey of feces to the collection and treatment site can vary. Instead of a vacuum system, some alternatives include low-water flush toilets with water reuse combined with anaerobic treatment. Others, depending on community preference, may opt for dry toilets paired with aerobic composting to turn feces into high-quality humus directly on site.

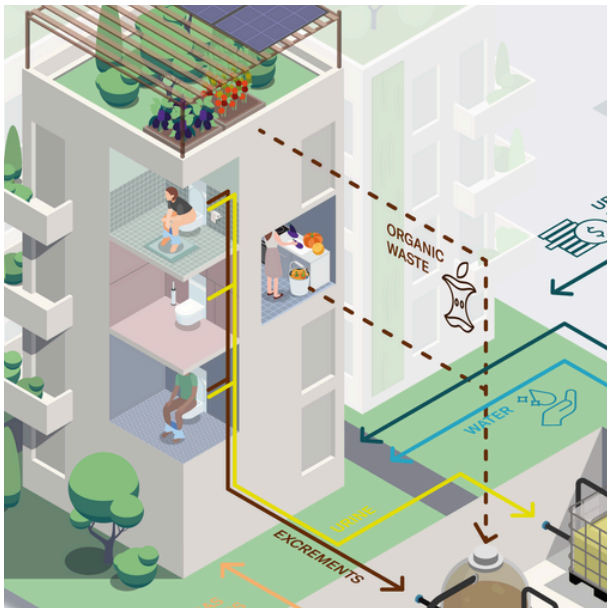


Why it matters: Feces (like urine) contain phosphorus, potassium, nitrogen, plus organic matter and micronutrients. Add carbon-rich material like sawdust or leaves, and you've got humus in the making, a powerhouse for soil fertility. In a digestion tank, mixing feces with kitchen or garden waste boosts biogas production, generating household energy, reducing dependence on external inputs, and maximizing nutrient cycling.

Humus and soil conditioners help keep soil healthy, prevent erosion, and make water use more efficient, while also restoring soil resilience, boosting yields sustainably, and cutting reliance on chemical fertilizers.

Vacuum System Integration
Vacuum toilets cut water use by up to 90% and can save up to 57 million liters over a building's lifespan (Jets® Group). They reduce infrastructure costs by up to 50% compared to conventional gravity sewers, thanks to smaller pipes, shallower trenches, and fewer manholes (UN ESCAP).

These systems are ideal for flood-prone, high-water-table, or protected natural areas, where gravity sewers are costly or risky. Vacuum systems also perform well in arid or rapidly urbanizing regions due to their adaptability and low water demand. The sealed, negative-pressure system minimizes leakage and contamination risks. While vacuum pumps require electricity, this can often be offset with on-site renewables like solar or biogas.



From Waste to Worth: A 20-Year Investment Story

We've talked a lot about the organic value and the environmental benefits of closing the loop, but now let's talk numbers.

Imagine a family of four in Hamburg, living in a 30-person building with an integrated circular sanitation system. Instead of flushing resources away, they turn their household waste into a powerful financial engine, generating an estimated €2,470 each year.
It's tangible value, created from recovered resources: fertilizer, clean water, biogas, digestate, rooftop-grown food, and lower utility bills.

Here's the annual breakdown:

- Urine-based fertilizer: €1,095
- Distilled water: €680
- Digestate: €5
- Electricity & heat savings: €84
- Water & wastewater savings: €202
- Retail replacement value of rooftop-grown food: €404

Total: €1,780 in revenue + €690 in savings per year.

And there's more. By choosing a decentralized toilet system, homeowners could avoid mandatory sewer connection fees: at least €3,345 (Hamburg Wasser) plus excavation costs. That's several thousand euros saved before the system even starts running. In some Swiss cantons, this is already the rule: no sewer connection means no fees. And momentum is growing to make this the wider standard.

Still wondering if it adds up? These assumptions come from real data, biogas yields, rooftop harvests, current energy rates, market-tested fertilizers, and German rooftop stats. (Yes, we crunched the numbers so you don't have to.)

Here's where it gets really interesting: instead of spending the €2,470 each year, the family invests it. That's €205 per month into a globally diversified fund like the S&P 500.

Over 20 years, here's the story:

- Direct contributions: €49,400
- With compound growth (8% p.a.): ≈ €120,000 portfolio

The narrative shifts dramatically. This is no longer just an ecological choice for reducing environmental impact; it is a sound, long-term financial decision. The system that closes the loop on waste simultaneously opens a path to building substantial capital, proving that the most sustainable solutions can also be the most economically intelligent, turning daily life into a legacy of wealth.

Bottom line? Circular sanitation doesn't only release stress on our current system; it's good for your wallet, too. Not bad for stuff most people flush and forget.

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Sources
Fertilizer Import Data: World Bank WITS, 2023. Germany imported 203.6 million kg of mineral/chemical fertilizers valued at $124 million.
Urine Production & Nutrient Content: Urine; based on 550L average annual urine production per adult with typical nutrient concentrations of 7.3g/L N, 0.67g/L P, 1.8g/L K.
Investment Returns: S&P 500 historical data shows compound annual growth rate of 6.2% (price only) to 9.8% (with dividends reinvested), 1926-2024.
Hamburg Water/Sewer Costs: Hamburg Wasser official tariffs (hamburgwasser.de). Connection fees vary by property; consult Hamburg Wasser for specific quotes.
Note: Figures are illustrative estimates for educational purposes.

The Rise of Certifications and Their Impact

And it doesn't stop there. Certifications like the upcoming LEED v5 are starting to recognize and reward sustainable practices such as onsite water reuse and circular sanitation systems. These certifications push the building sector toward more resource-efficient designs by giving tangible credit for reducing water consumption and closing nutrient loops right where waste is generated.

The impact? They create real incentives for developers, architects, and building managers to invest in circular sanitation solutions, accelerating adoption and proving that sustainability and economic value can go hand in hand. This means healthier buildings, happier residents, and a faster transition to truly circular cities.

Looking Ahead

It's time to scale what's already working. Let's keep piloting onsite systems in real communities, pushing for regulation that supports circular sanitation, and recognizing the certified solutions already out there. Just as important: we need to keep educating people. Reduce the yuck, grow the trust, and spread the word. The loop won't close itself.

Authors

Alex Dumler
Senior Expert
INDEED Innovation

Paul Fally
Senior Expert
INDEED Innovation

Mariana Yzusqui
Senior Expert
INDEED Innovation

Reto Wey
Co-Founder
Toillets for All

Contributors

Aowen Xu
Larissa Scherrer
Karel J. Golta

Ready to Own Your Sh*t? Be Part of the Momentum!

Do you want to see this project get attention?
Help us spread the word and co-create the next steps.

For People & Communities

Circular sanitation won't scale without awareness. If this resonates with you:

- Share this paper with your network
- Start conversations in your community
- Challenge the status quo: "Why are we still flushing wealth away?"
- Spread the word on social media
- Engage with us – give input, ask questions, share ideas

The loop won't close itself. But together, we can make it happen.

For Companies & Cities

We're assembling a consortium of forward-thinking companies to scale circular sanitation globally.

- Be at the forefront of the €109M+ market opportunity in Germany alone
- Access pilot programs and early implementation opportunities
- Shape standards and certifications
- Connect with municipalities, developers, and governments

Early partners will define the standards.

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INDEED

As a global design and innovation firm, INDEED empowers organizations to pioneer circularity. We combine deep expertise in product, service, and strategic design with innovative thinking to help you create impactful, future-proof solutions. This guide distills that experience, designed to accelerate your journey into Circular Design.

LinkedIn Website

TOILETS FOR ALL

Toilets for All is a Swiss foundation working to close the global gap in access to clean, dignified school toilets (SDG 6.2). We do this by enabling entrepreneurs, funders, policymakers, communities, and governments to advance circular, off-grid sanitation and related hygiene.