# Reinventing the toilet

## The winners of Bill Gates' challenge must now prove that their concepts really work.

BY MARK PEPLOW

Most of us take the humble toilet for granted. But for billions of people in the developing world, it is a matter of life and death.

In 2011, the Bill and Melinda Gates Foundation issued the Reinvent the Toilet Challenge. Their goal was to get innovators around the world to come up with inexpensive, sustainable toilets that could be deployed in developing countries to reduce the death toll from poor sanitation.

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KJETIL REE

The Bill and Melinda Gates (shown here) Foundation isn't prudish about what it tackles: after toilets in 2011, the new challenge for 2013 is to "develop the next-generation condom."

Two years later, the first prototypes are ready to be field-tested. They will still face years of development work before finding widespread use, says Klaus Schönenberger, leader of EPFL's Essential-Tech project, which supports the development of technologies adapted to the needs of third-world countries. "Just thinking about the technology is insufficient," he says. "You need to think about how it will be manufactured, whether it will be sold and where it will be deployed. If that chain doesn't work, the whole thing falls apart."

The Gates Foundation specified that the new toilets should work without a sewage connection, piped water or grid electricity; they gave $400,000 seed grants to each of eight teams with promising ideas. The competitors showed off their prototypes in Seattle in August 2012.

The winning design came from a team led by engineer Michael Hoffmann of the California Institute of Technology. Adapting ideas originally developed for the U.S. military,

it relies on photovoltaic cells to power an electrochemical process that disinfects and breaks down the waste.

Hoffmann's team is now fitting two prototypes, complete with monitoring laboratories, into shipping containers bound for New Delhi, where the Gates Foundation will fund field tests this autumn. "The foundation's vision was that it could be used in places where there is no urban infrastructure, and I think we've done that," says Hoffmann.

**BEAUTIFUL TOILET**

Among the other winners, the unit developed by the Swiss Federal Institute of Aquatic Science and Technology (Eawag) snagged a special award for offering the best "user interface." "It's really very beautiful," says Eawag process engineer Tove Larsen, who led the team and credits Austrian design company EOOS for their toilet's good looks. "It's a design we would be happy to use ourselves."

The unit's back wall contains a reservoir of clean water that people can use to wash their hands, an important sanitation facility that many developing-world toilets lack. The water is recycled through a filter that contains microorganisms to munch the dirt in the water, leaving it clean enough to reuse many times.

The Gates challenge also stipulated that the toilets cost less than 5¢ per person per day to operate – still not cheap in regions where people often live on less than $2 a day. But Schönenberger points out that most public toilets in Africa are not free. "People are willing to pay a small fee," he says.

One way to keep costs down is to make a business of waste processing. Eawag's toilet collects urine and feces separately – an approach widely used in China – and stores them in containers that can be collected by a local firm to produce fertilizer that can be sold for profit.

"You have to set it up with charity, but in the long run it will be a business," says Eawag's Larsen. She hopes that each unit will be shared by two families, each paying about $7.50 a month in rent to help cover manufacturing and installation. That's a substantial investment for many families in the developing world. Whether the idea will take off remains to be seen, but "thinking in terms of business models is the right approach," says Schönenberger.


Eawag's "Diversion toilet" is being field-tested in Uganda.

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Backed by an additional $1.2 million from the Gates Foundation, along with support from the Swiss Agency for Development and Cooperation, the Eawag team installed the first working model of its toilet in April 2013 for two months of testing in Kampala, Uganda.

The winning concepts still face major hurdles – not least in finding manufacturers to mass-produce them. Schönenberger points out that although products aimed at the developing world sometimes offer "razor-thin profits," companies are attracted by the possibility of adapting new technologies to richer markets. "If such toilets could also be used at concerts, for example, you could have a sustainable business."

Ultimately, these toilets are not just aiming to save lives. Better sanitation can deliver major economic benefits by cutting a country's healthcare burden and keeping the working population healthier and more productive. "It could make a really, really big difference," says Larsen. ■