

**Title:** Durban SA RT Engineering Field Testing: Anaerobic membrane bioreactor (NEWgenerator) for onsite sanitation and wastewater recycling – Acceleration Strategy

**PI:** Daniel Yeh, Associate Professor, Civil & Environmental Engineering

**Sponsor:** Bill & Melinda Gates Foundation

**Amount:** \$1,143,175

**Period:** 2 years

It's been estimated that 2.6 billion people worldwide lack access to safe sanitation, and the consequences can be devastating for human health as well as the environment. Poor sanitation contributes to about 700,000 child deaths from diarrhea each year. Creating sanitation infrastructure and public services that work for everyone and that keep waste out of the environment is a major challenge. The toilets, sewers, and wastewater treatment systems used in the developed world require vast amounts of land, energy, and water, and they are expensive to build, maintain and operate. Existing alternatives that are less expensive are often unappealing because they don't kill disease-causing pathogens, have impractical designs, or retain odors and attract insects.

Solving the sanitation challenge in the developing world will require radically new innovations that are deployable on a large scale. In recent years, the Bill & Melinda Gates Foundation (BMGF) embarked upon an ambitious campaign to develop transformative technologies, called Reinvented Toilets (RT), which would address the sanitation challenges faced by the developing world. It is envisioned that RTs would be compact, operate independently from sewer systems, eliminate pathogens, render human wastes harmless while extracting plant fertilizers, clean water and renewable energy.

Dr. Daniel Yeh, Associate Professor of Civil & Environmental Engineering, has spent the past 15 years on a path to develop just such a solution, using a technology called anaerobic membrane bioreactor (AnMBR). In 2011, he received a \$100k seed grant from BMGF to advance the AnMBR beyond the lab into a field prototype called the NEWgenerator. In 2014, the NEWgenerator team won the \$50k Cade Museum Prize for Innovation. In 2015, a \$194k grant from the Government of India and BMGF allowed his team to field test the NEWgenerator in India with local partners. The India field trial was a great success, and resulted in commercial partners in Asia seeking technology licensing from USF.



Figure 1. NEWgenerator field trial in India.

The NEWgenerator is a compact and mobile machine that operates completely off-grid on solar energy. It is capable of recycling dirty water into clean water while extracting nutrients and energy from the wastes. NEWgenerator has potential application not just in urban slums, but also for emergencies and military applications (e.g., forward operating bases).

In Fall 2017, Dr. Yeh received a **2-year \$1.14M grant** from BMGF to continue the development of NEWgenerator and field test in Durban, South Africa. South Africa is among the countries that face tremendous challenges in providing sanitation coverage. Urban informal settlements often form rapidly and organically, creating difficulties for the local authorities to plan and provide proper infrastructure. Non-sewered sanitation technologies that can recycle water are in dire need. The NEWgenerator aims to fill that gap. Leading the project on the USF side is Dr. Robert Bair, post-doctoral research associate who was instrumental in developing the NEWgenerator technology through his PhD. The USF team will be working with the Pollution Research Group of the University of KwaZulu-Natal and other local partners who will provide in-country logistical support for the engineering field testing.

For more information on the NEWgenerator, including media coverage and videos, please visit <http://NEWgenerator.tumblr.com>.



Figure 2. Informal settlements in Durban, South Africa.



Figure 3. Container-based platforms called Community Ablution Blocks (CABs) provide sanitation and hygiene service to informal settlements in Durban, South Africa. The NEWgenerator will be coupled with CABs to provide onsite wastewater treatment and water recycling.