Transformative Sanitation Technologies

Carl Hensman, Ph.D.
Program Officer
Water, Sanitation & Hygiene (WSH)

BILL & MELINDA GATES foundation

Sanitation ladder used by the JMP for monitoring of achievement towards the sanitation target of the MDG (WHO & UNICEF 2008)

Rung	Description of what counts towards achievement of rung
Improved	Facilities that ensure hygienic separation of human excreta from human contact. They include: • Flush or pour-flush toilet/latrine to: – piped sewer system – septic tank – pit latrine • Ventilated improved pit (VIP) latrine • Pit latrine with slab • Composting toilet
Shared	Sanitation facilities of an otherwise acceptable type shared between two or more households. Shared facilities include public toilets.
Unimproved	Facilities that do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines.
Open defecation	Defecation in fields, forests, bushes, bodies of water or other open spaces, or disposal of human faeces with solid waste.

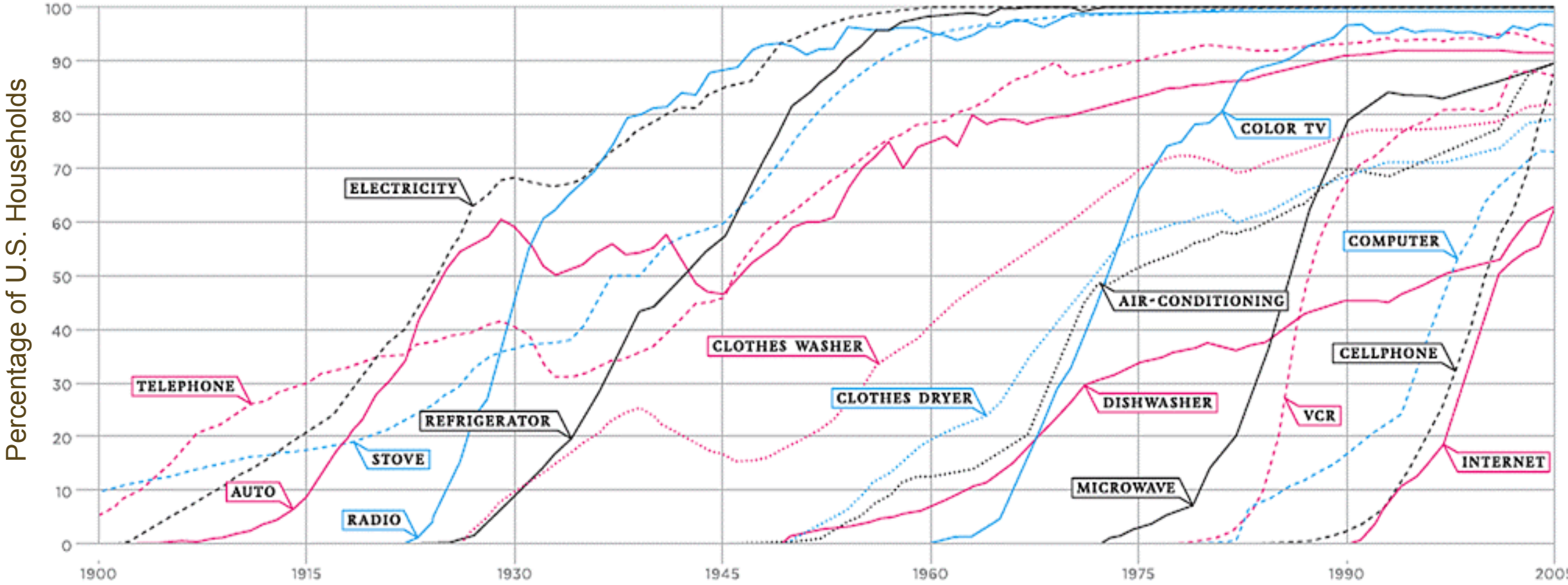
The sanitation ladder – a need for a revamp?
E. Kvarnström, J. McConville, P. Bracken, M. Johansson and M. Fogde, *Journal of Water, Sanitation and Hygiene for Development, 01.1, 2011*

		Function	Indicators
Environmental functions	7	**Integrated resource management**	Indicators will differ and depend on flowstreams from the full environmental sanitation system (urine, faeces, greywater, faecal sludge, wastewater as below but also including water provision, stormwater management and solid waste management) and context
	6	**Eutrophication risk reduction**	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater)
	5	**Nutrient reuse**	(i) X% of N, P, K excreted is recycled for crop production, (ii) Y% of used water is recycled for productive use
Health functions	4	**Pathogen reduction in treatment**	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater) and also whether the flowstream will be used productively afterwards or not
	3	**Greywater management**	(i) No stagnant water in the compound, (ii) no stagnant water in the street, (iii) no mosquitoes or other vectors
	2	**Safe access and availability**	(i) 24-hr access to facility year-round, (ii) facility offering privacy, personal safety and shelter, (iii) facility is adapted to needs of the users of the facility
	1	**Excreta containment**	(i) Clean facility in obvious use, (ii) no flies or other vectors, (iii) no faecal matter lingering in or around latrine, (iv) hand-washing facility in obvious use with soap, (v) lid, (vi) odour-free facility

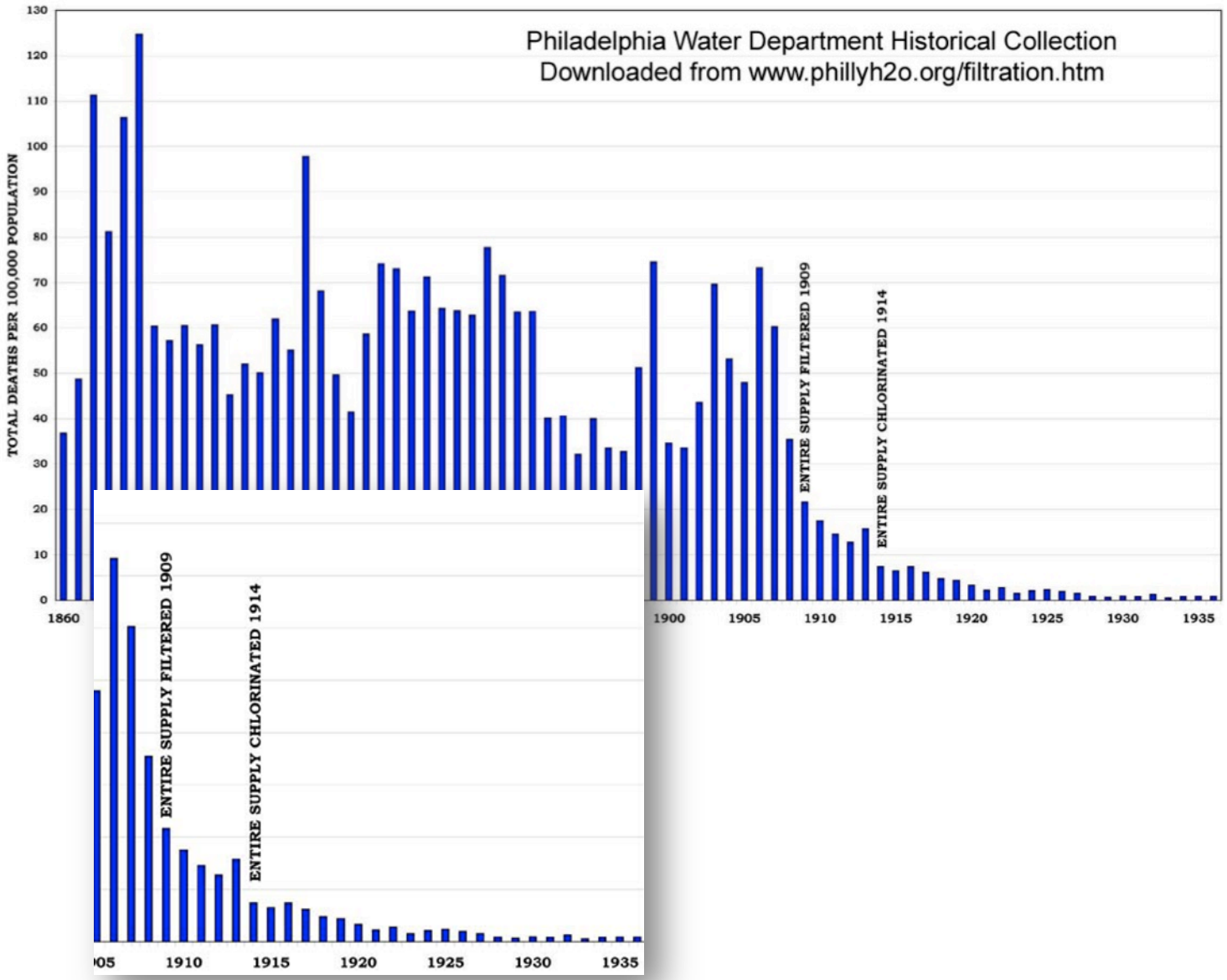
*Note that moving up the ladder means that the functions below have also been fulfilled!

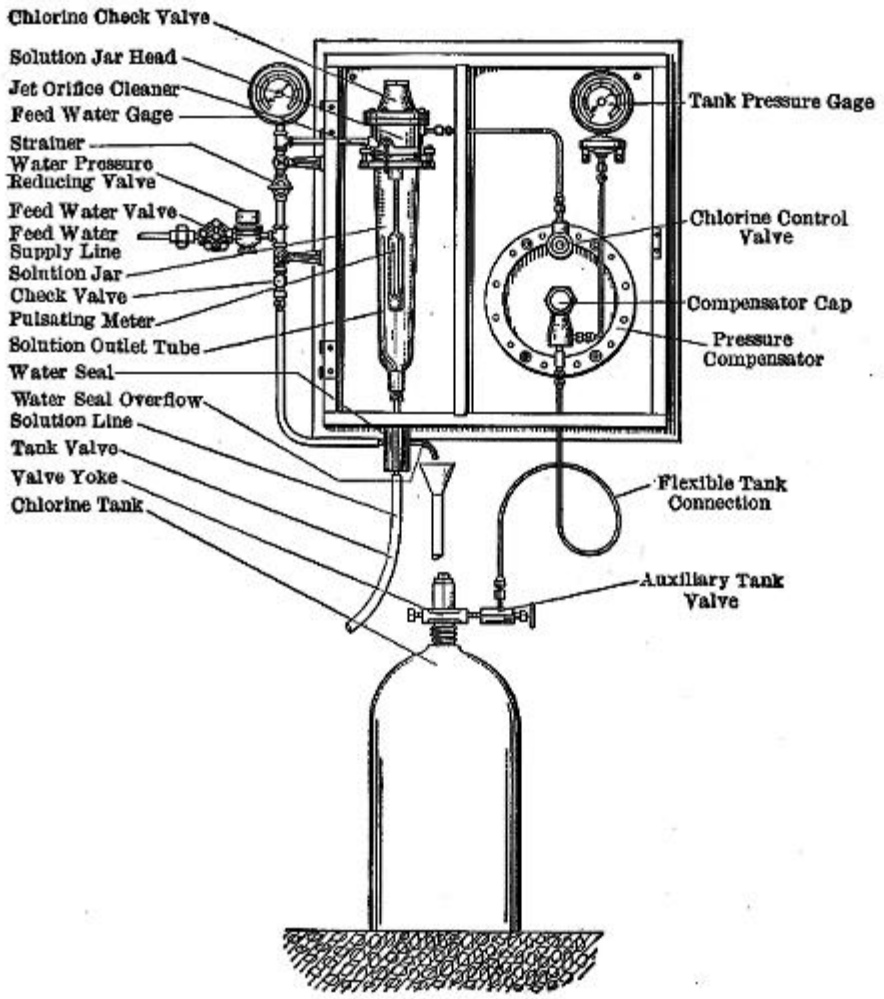
The End-Users Sanitation Ladder

Transformative Technology



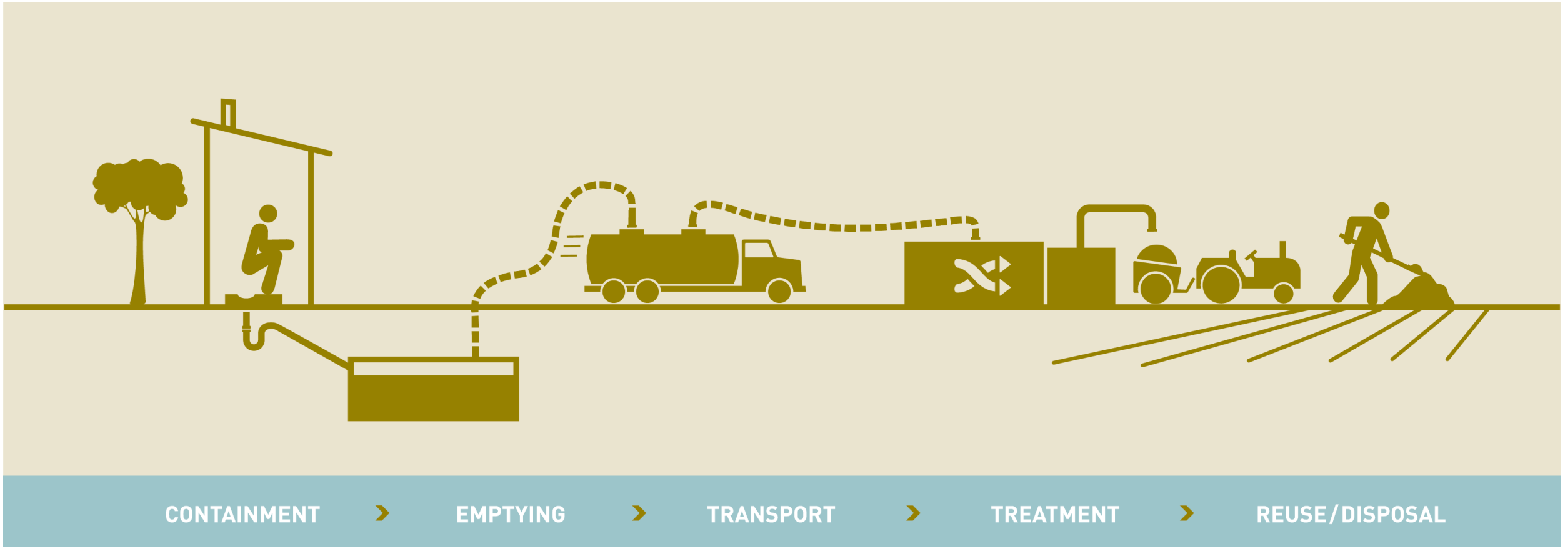
Transformative Technologies in Sanitation



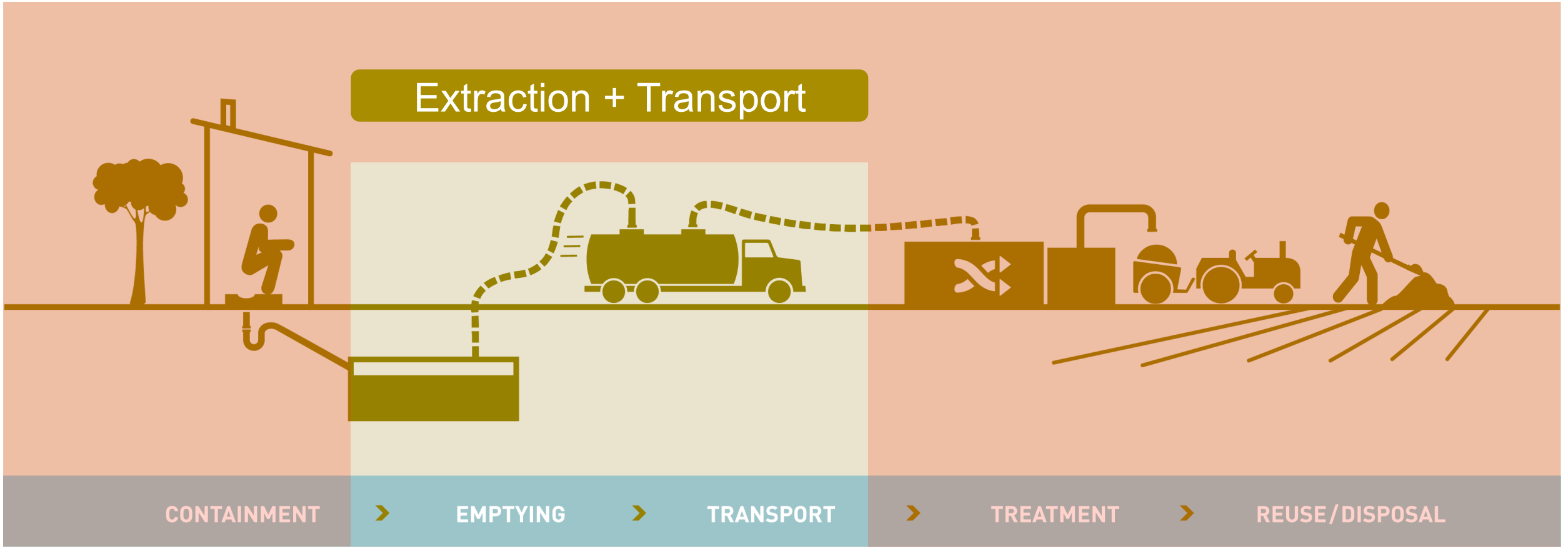


Manual Control Chlorinator for the liquefaction of chlorine for water purification, early 20th century. From *Chlorination of Water* by Joseph Race, 1918.

The Sanitation Service Chain



The Sanitation Service Chain



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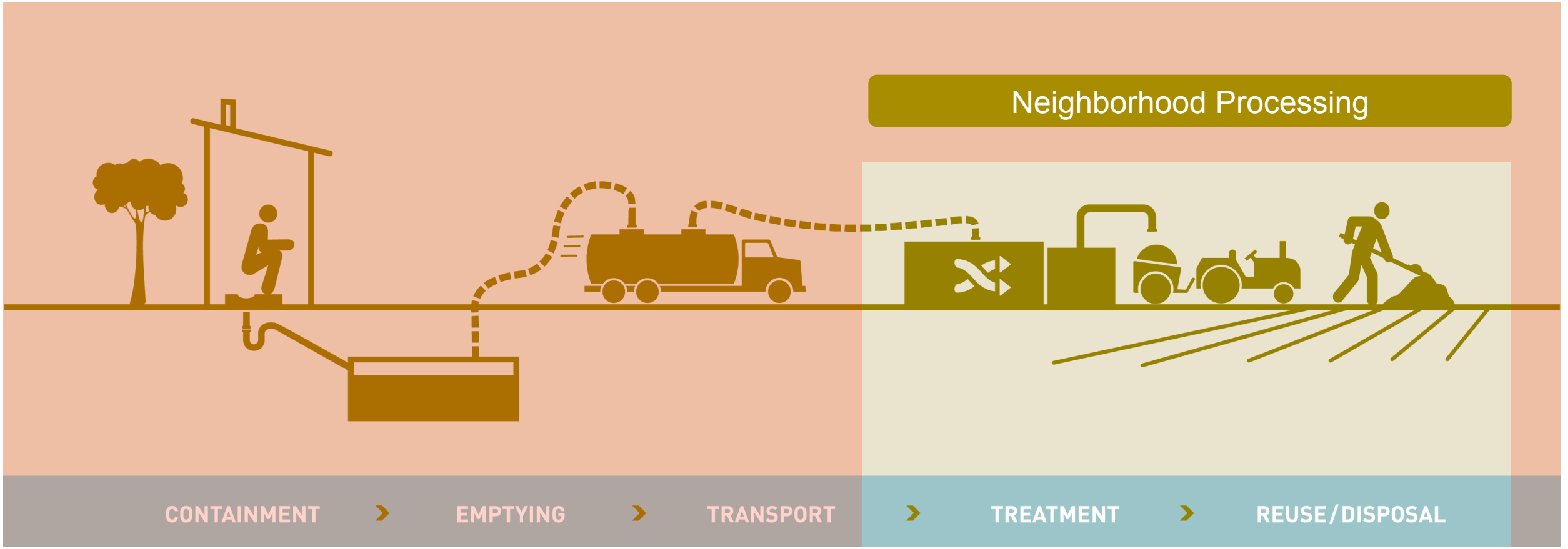

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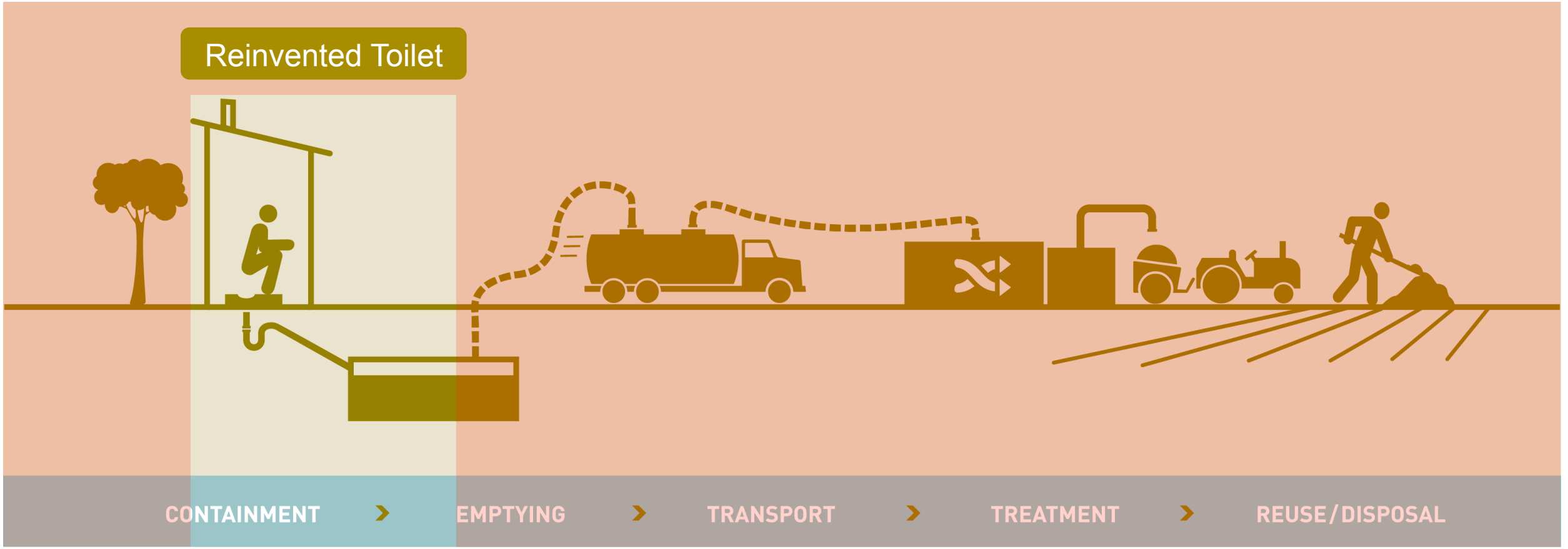
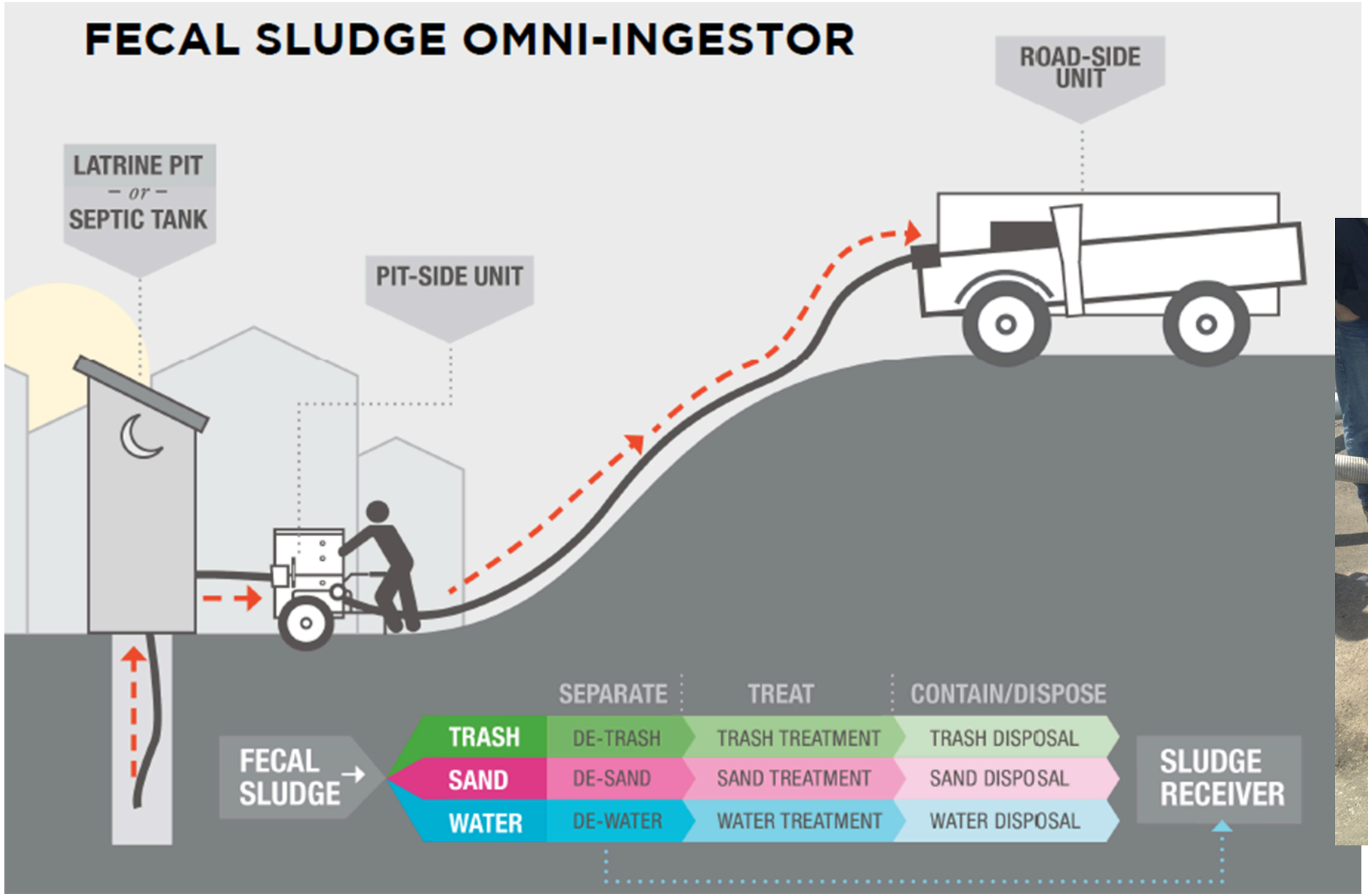


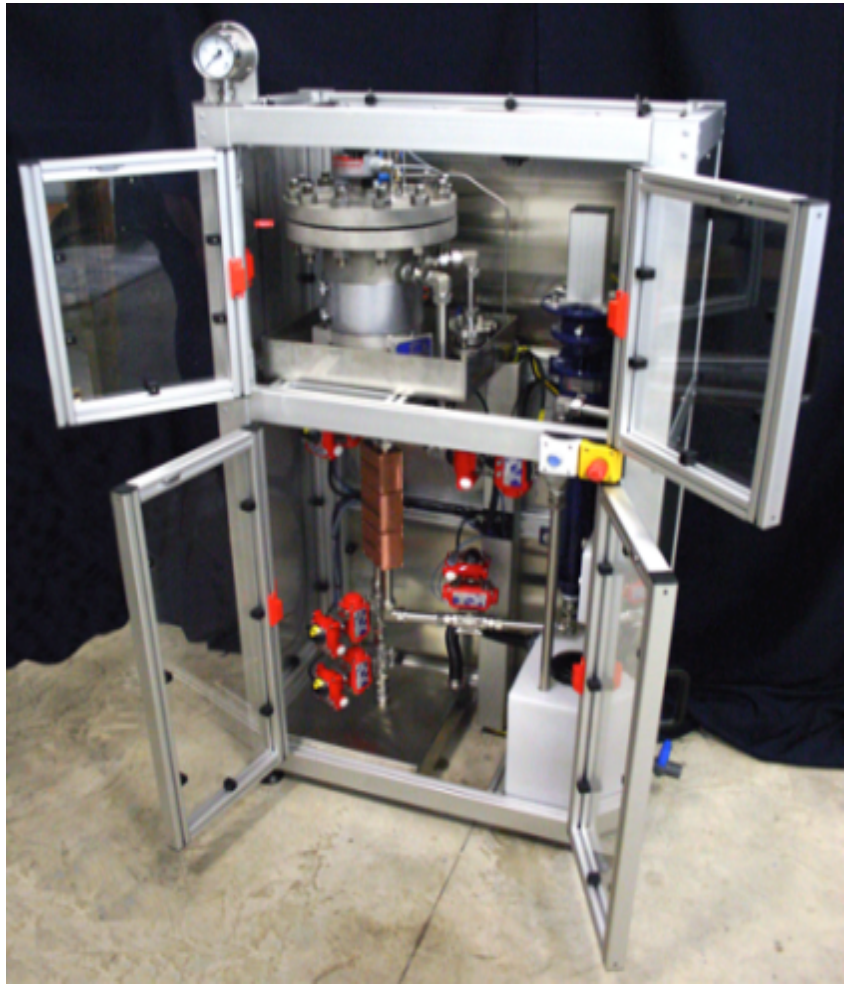

FECAL SLUDGE OMNI-INGESTOR
ROAD-SIDE UNIT
LATRINE PIT
– or –
SEPTIC TANK
PIT-SIDE UNIT
SEPARATE
TREAT
CONTAIN/DISPOSE
FECAL SLUDGE
TRASH
DE-TRASH
TRASH TREATMENT
TRASH DISPOSAL
SAND
DE-SAND
SAND TREATMENT
SAND DISPOSAL
WATER
DE-WATER
WATER TREATMENT
WATER DISPOSAL
SLUDGE RECEIVER

Electrochemical Process – Kohler/Caltech

"I'm a regulator with the County of Sonoma Permit and Resource Management Department here in California...How far along are you with a prototype of the toilet system that was selected in the Challenge?"

Yixing Elementary School toilets in Yixing (Wuxi), China

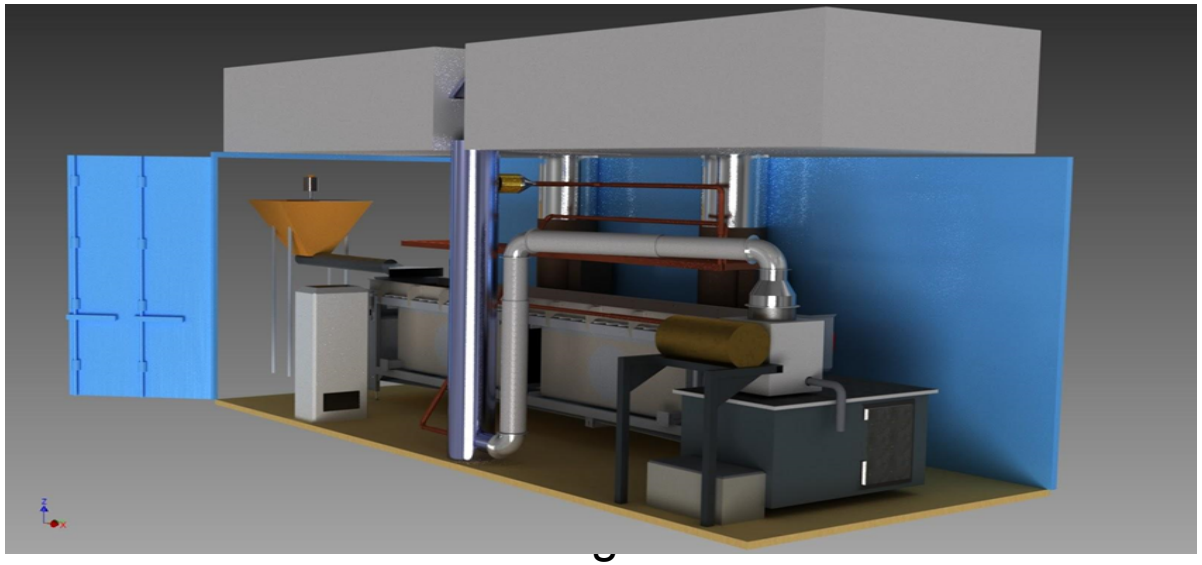
Hydrothermal carbonization toilet - Loughborough University



- Can take mixed waste
- >2500 hours unit operation on sewage sludge
- Completed 3-months field testing and value engineering in China
- Version 3. Already CE Certified in the UK

- **Safe:** Removes pathogens from human waste in single process.
- **Small:** Suitable for household use (6-40 users and extendable to 100).
- **Switchable:** Can work on DC or AC or both- Working towards an off-grid solution

Biochar Community processor – Climate foundation



- **Final Engineering Development:** Prakruti Renewable Energy, South Bangalore
- **Bangalore Testing:** 1 ton/day Jakkur Bangalore Water Sewage Sludge
- **Service 10,000 people:** Using 20 hours / per day operation
- **Fecal sludge and municiple waste:** Accepts mixed organic waste
- **Turnkey operation:** Currently being operated by Bangalore tradesman
- Cost US$80,000

Janicki Youtube

Community processor – Janicki Bioenergy's

- **Senegal Test Site:** Being commissioned at a Dakar treatment works
- **Consumption:** Approx. 100-150 loads of 10 m^3 trucks / day
- **Population served:** 100,000 people
- **Target Electricity Production:** net 300 kW continuous (future versions)
- **Potable Water Produced**
- Cost US$2 million

Urinetricity – Bristol robotics lab

Urine microbial fuel cell: Charging cell phones; powering light arrays

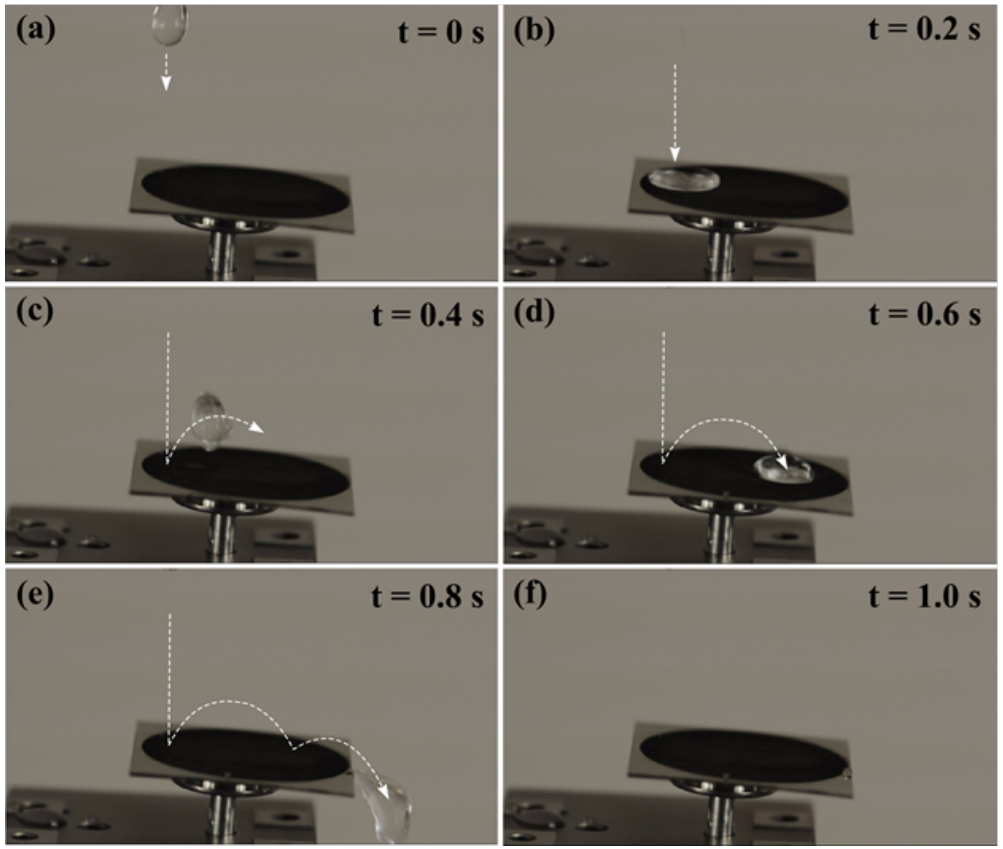
Size reduction: Reducing size, cost and complexity of MFC using 3-D printing.

No polymer membrane: Ceramic support for the design also acts as a membrane

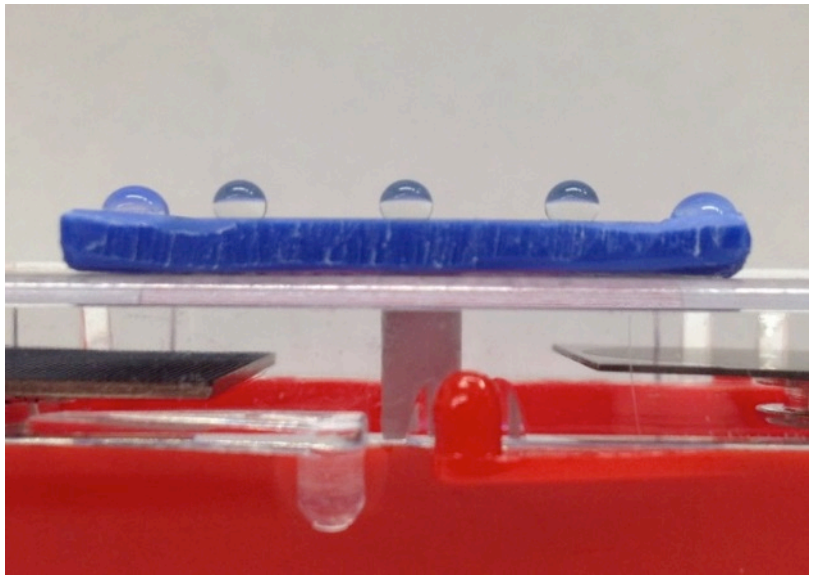
Field testing: Lighting of the cubicle on the university campus. 10 stall system, sponsored by Oxfam and successfully deployed at a 275,000 person, 3 day music festival in the UK.

Oxfam Phase II: Powering an LED street light for refugee camps

Superhydrophobic surface – University of Rochester Institute of optics



Superhydrophbic laser etched



Thermal transfer = hydrophobic (Sato pan)

- Can this surface structure be volume manufactured?
- Modifying existing molding infrastructure
- Optimize transferability and cost of plastics

guo@optics.rochester.edu

Manual Control Chlorinator for the liquefaction of chlorine for water purification

Chlorination of Water by Joseph Race, 1918