Transformative Sanitation Technologies

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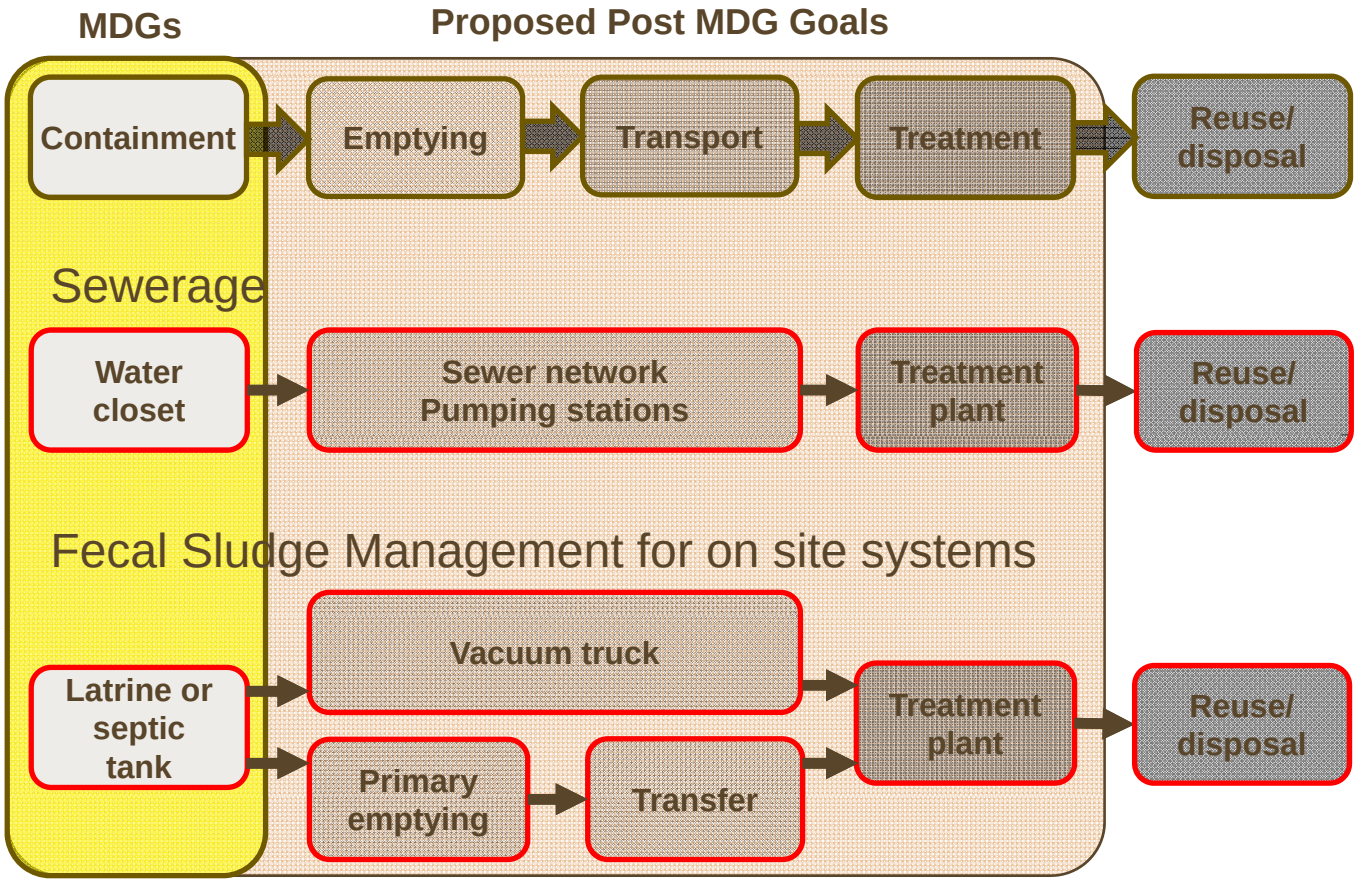
BILL & MELINDA GATES foundation

THE SANITATION CRISIS

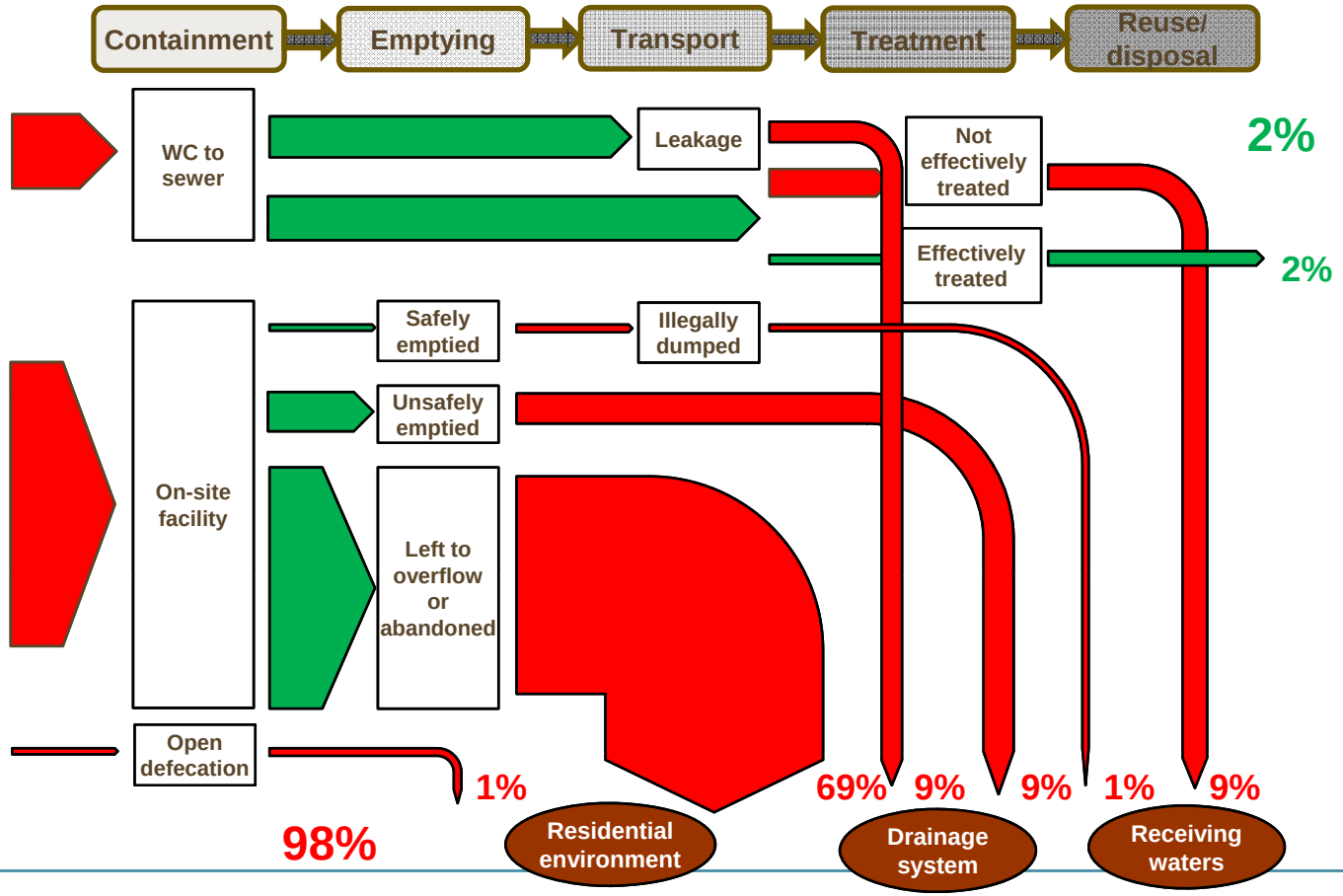
- ~2.5 billion people practice open defecation or lack adequate sanitation facilities
- An additional 2.1 billion urban residents use facilities that do not safely dispose of human waste
- More people die from poor sanitation than measles, malaria, and HIV/AIDS combined

THE SANITATION SERVICE CHAIN

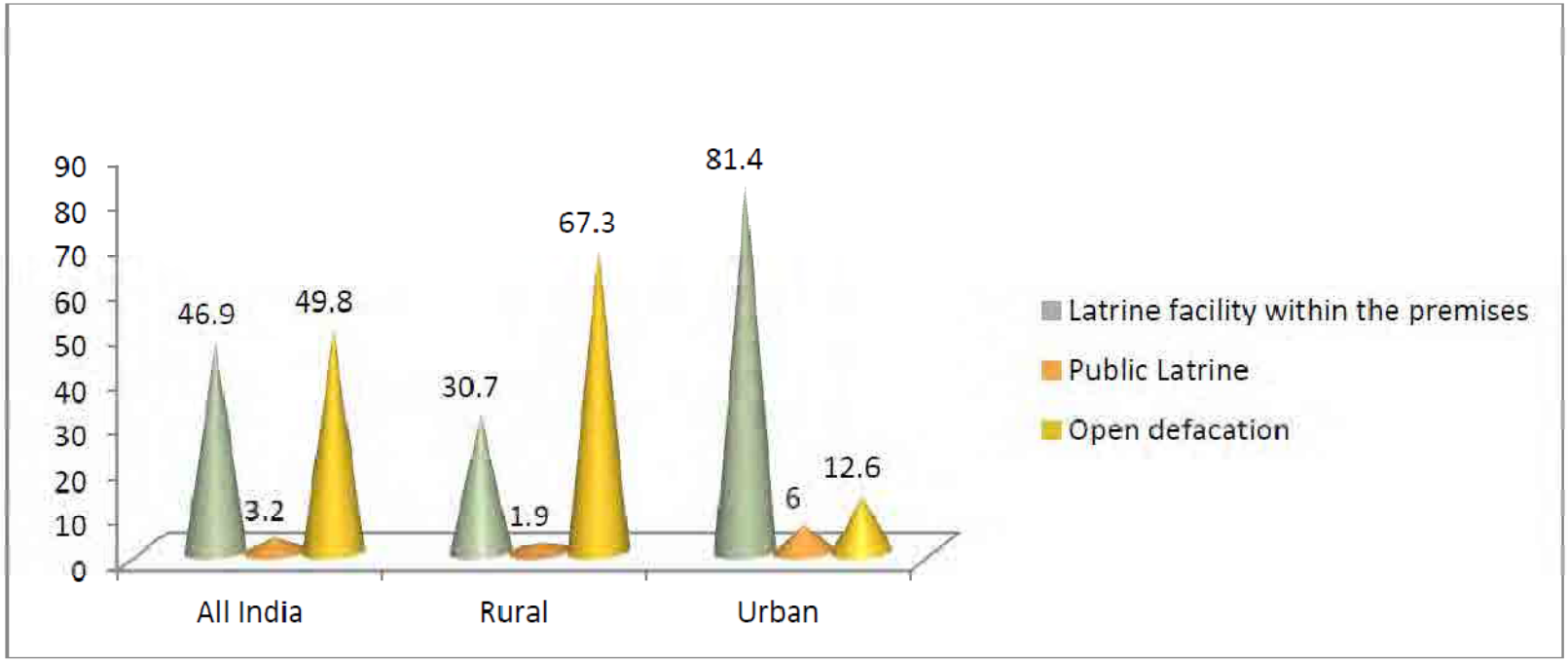


POOR FSM: INSTITUTIONAL OPEN DEFECATION

SLUDGE DIRECT TO THE ENVIRONMENT: NO SERVICE CHAIN

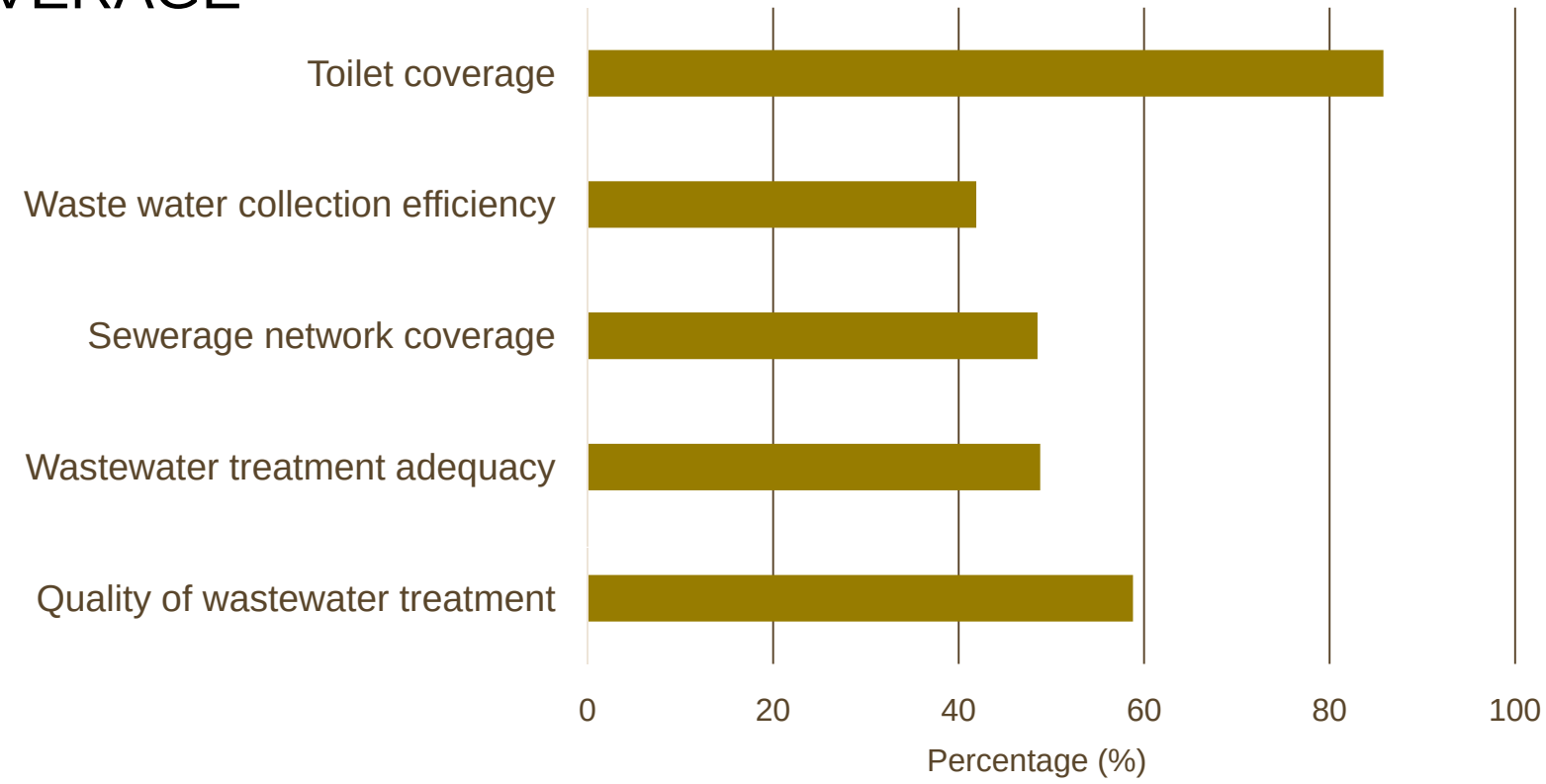


HOUSEHOLDS BY TYPE OF LATRINE FACILITY (%) – CENSUS 2011

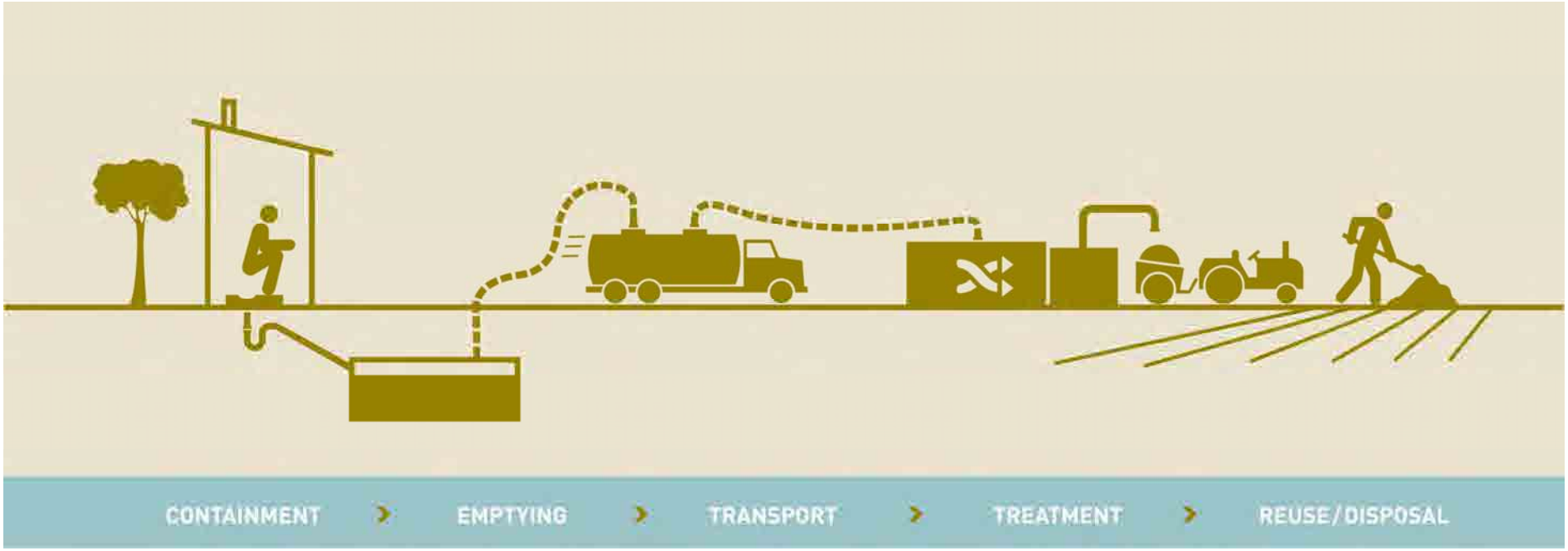


As per census 2011, 46.9% households have latrine facility within the premises, whereas the position at rural and urban are 30.7% and 81.4% respectively.

INDIAN SEWERAGE & SANITATION SERVICES - NATIONAL AVERAGE



THE SANITATION SERVICE CHAIN



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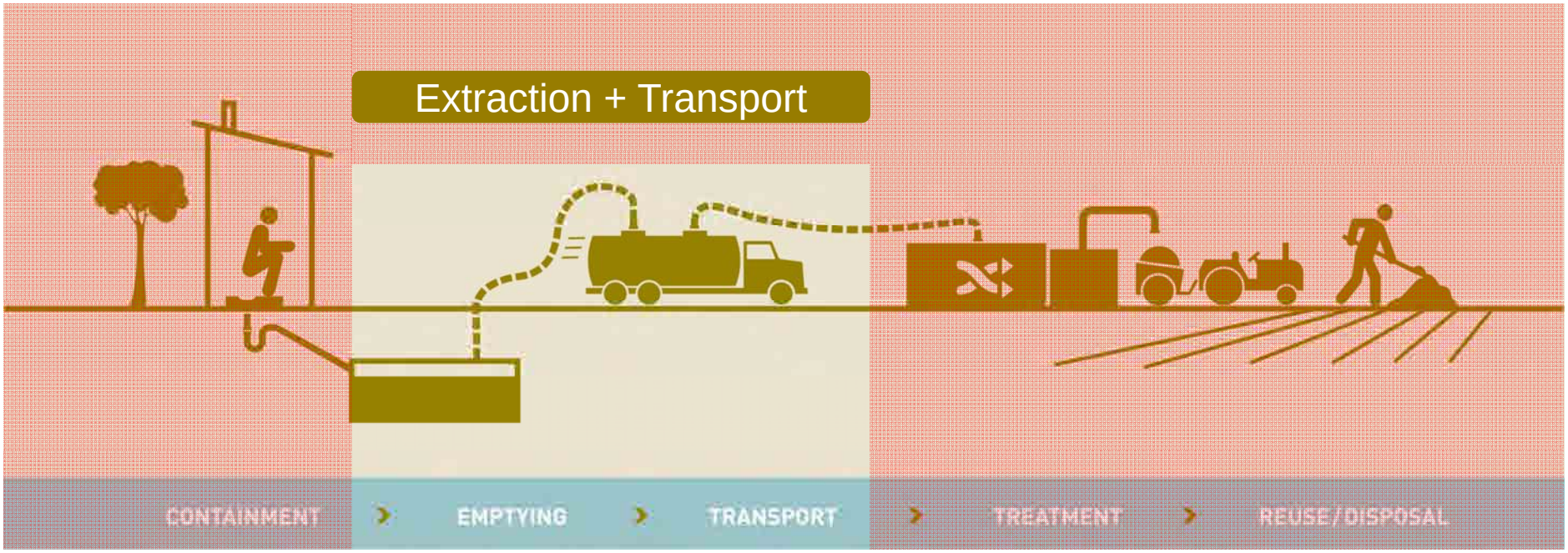

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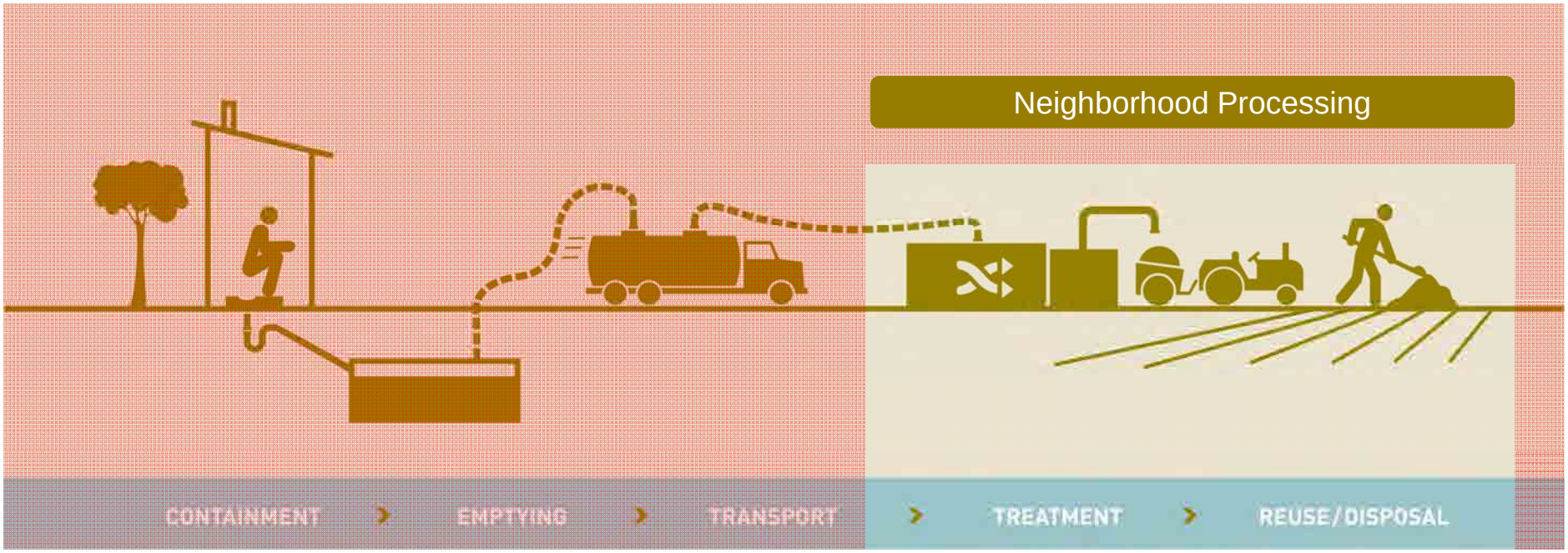

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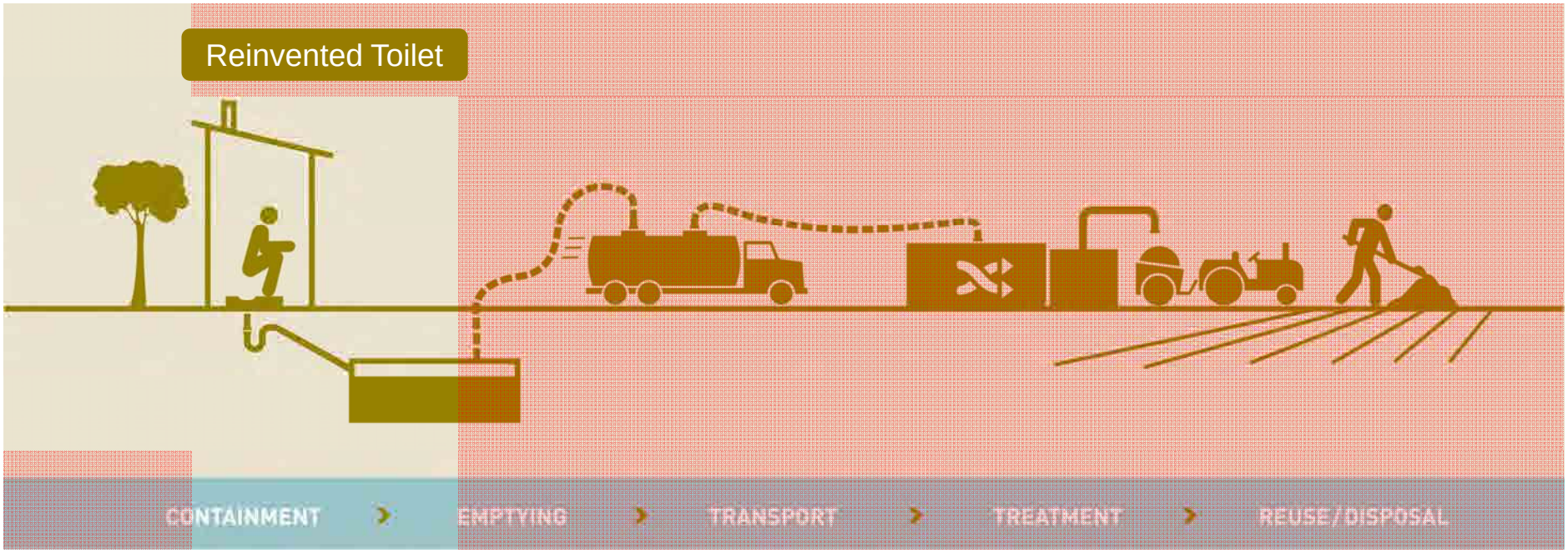

PORTFOLIO BREAKDOWN

Reinvented Toilet

- $0.05/person/day
- No grid power
- No plumbed water
- No pathogens
- User demand

Extraction + Processing

- Access 90% of pits
- 1 m^3 per hour
- Dewatering at site
- Detrash at site

Neighborhood Processing

- Decentralized
- Products of use
  - Power
  - Agricultre
  - Water

Biologically & Environmentally Safe • Sustainable

EXAMPLES OF APPROACHES

Urine

Urine + Feces

Feces

Dilution

Filtration

Evaporation

Reverse

Osmosis

Activated Carbon

Disinfection

Forward Osmosis

Freeze Drying

Drying

Electrolysis

Insects

Lipid Extraction

Pyrolysis

Torrefaction

Combustion

Pyrolysis

Hydrothermal

Oxidation

Composting

Fuel Cells

Water Recycling

Power

Agricultural Use

HYDROTHERMAL CARBONIZATION TOILET - LOUGHBOROUGH UNIVERSITY

Designed to retrofit existing toilets

- Can take mixed waste
- >2500 hours unit operation on sewage sludge
- Undergoing field testing and value engineering in China
- Next model will be the size of a small bathroom cabinet

- **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

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NANOMEMBRANE TOILET – CRANFIELD UNIVERSITY

- **Nanomembrane:** Passively extracts water
- **Nanobead:** A low cost process for the recovery of high quality water.
- **Water-less flush:** Uses a unique mechanism to transport faeces and urine into the toilet whilst blocking odour and the user's view of the waste.
- **Integrated pelletiser:** Assists drying and ultimately gasification for energy recovery
- **Mobile:** Can be moved around the house and stored
- 1st prototype expected Q4-2015

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BIOCHAR COMMUNITY PROCESSOR – CLIMATE FOUNDATION

- **Final Engineering Development:** Prakruti Renewable Energy, South Bangalore
- **Bangalore Test Site:** Jakkur Bangalore Water Sewage Sludge Board, December 2014
- **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
- Sampath Kumar +91 98 455 43783

COMMUNITY PROCESSOR – JANICKI BIOENERGY'S

- **Processing Fecal Sludge:** On-site in USA
- **Senegal Test Site:** Ships Q1 2015, to Dakar, Senegal for deployment to a treatment works
- **Consumption:** Approx. 100-150 loads of 10 m3 trucks / day
- **Population served:** 100,000 people
- **Electricity Produced:** net 300 kW continuous
- **Potable Water Produced:** 50-70 m3 / day

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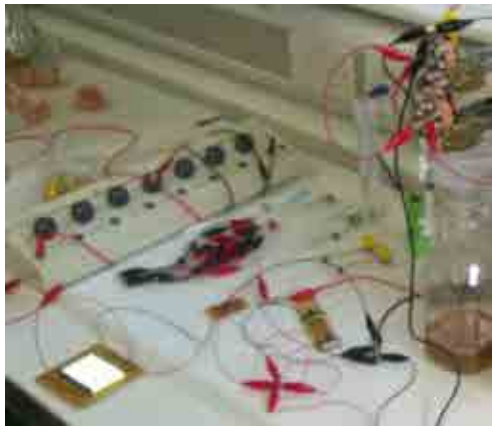
URINETRICITY – BRISTOL ROBOTICS LAB



Urine microbial fuel cell: Charging cell phones; powering a cubicle LED light array, next a street light (Oxfam)

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: CalTech, USA; UKZN, SA

Discussing field testing: Mahatma Gandhi University, Kerala; RTI International; ROCCA; Kohler; American Standard

Goal by end of Proof of Concept: Integrated urinal generating a continuous 500 mA

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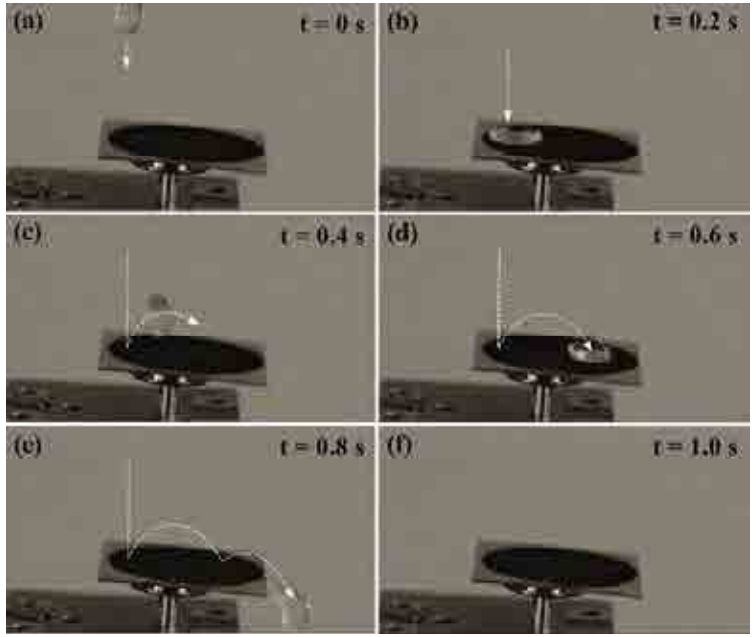
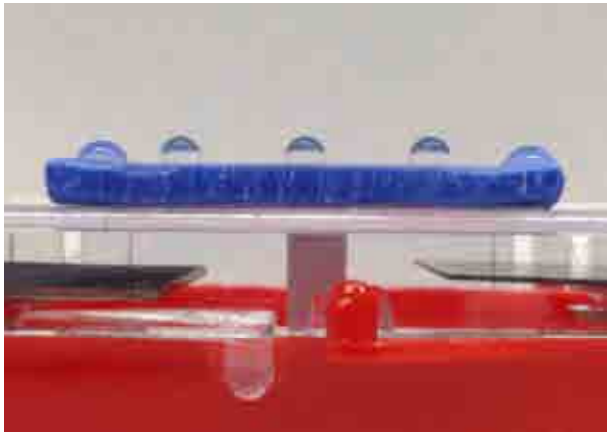
SUPERHYDROPHOBIC SURFACE – UNIVERSITY OF ROCHESTER INSTITUTE OF OPTICS



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

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