TECHNOLOGICAL INNOVATION AND STRATEGIES FOR WASTEWATER TREATMENT

NATIONAL RESEARCH AND DEVELOPMENT INSTITUTE FOR INDUSTRIAL ECOLOGY

ECOIND

EXCELLENCE IN RESEARCH AND ENVIRONMENTAL SERVICES

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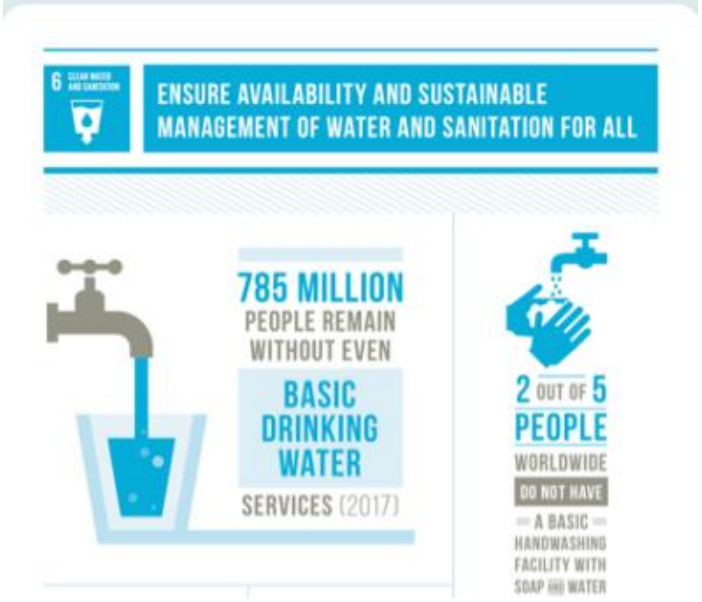
Novaqua alliance

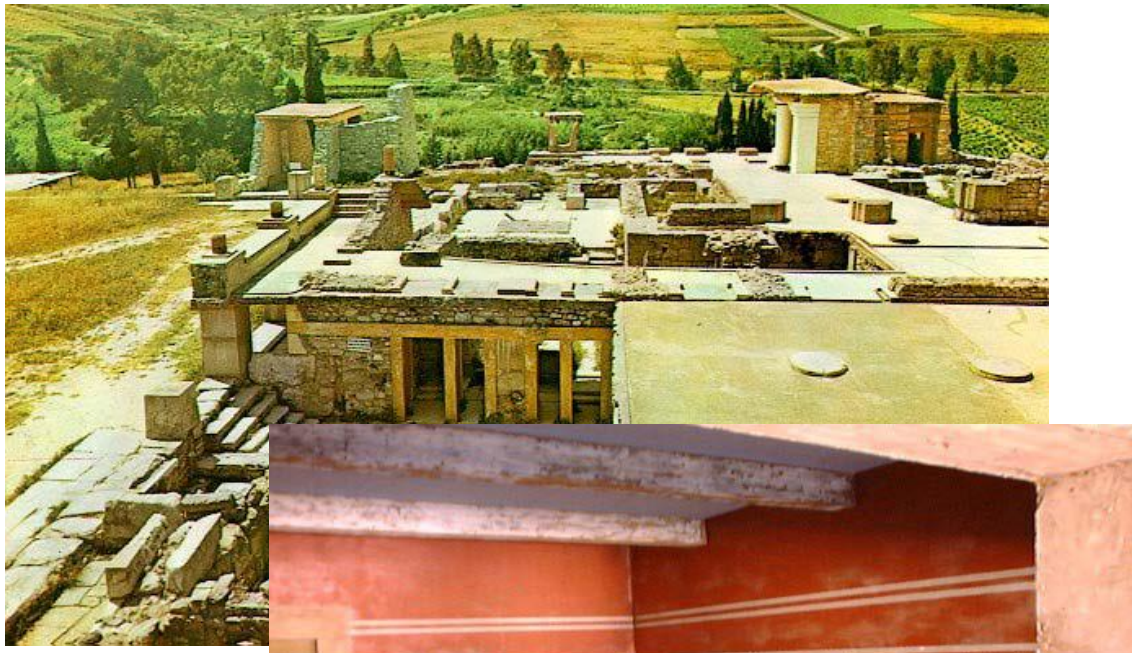
EU WATER FRAMEWORK DIRECTIVE

- Water is not a commercial product like any other but, rather, **a heritage which must be protected, defended and treated as such**

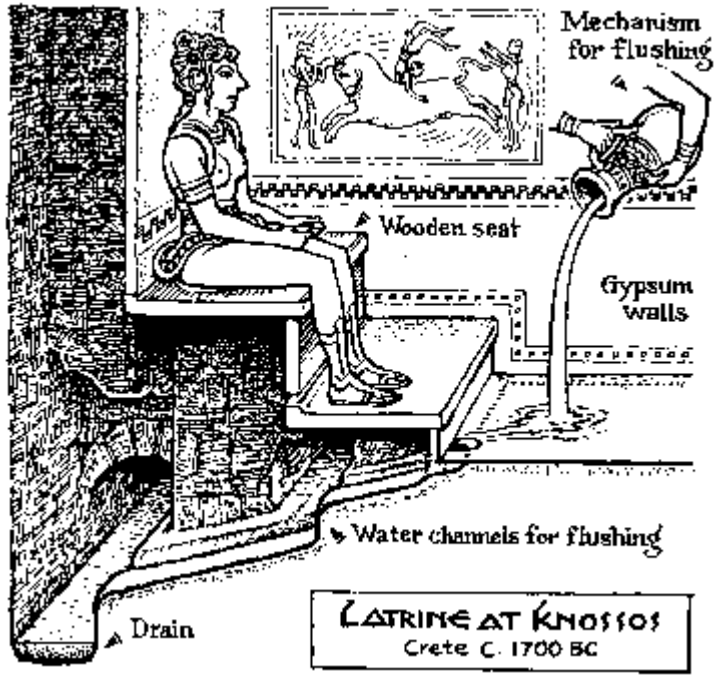
SDG 6: Ensure access to water and sanitation for all



HISTORY OF SANITATION



MINOAN PALACE, KNOSSOS - 1700 B.C.



An Abridged History of Onsite Wastewater, Steve J. Steinbeck, et al. 2005

ROMAN EMPIRE: SEWAGE TRANSPORT

- Roman toilets: private and public
- “Flushing”- first sewage lines towards thereceiving surface waters

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ROMAN LAW ON FEACES DISCHARGE (500 B.C.)

Dejecti Effusive Act :
If any person threw or poured anything from the room of a house upon a place commonly frequented by people, and thereby caused damage, the praetor's edict gave the injured party an action against the occupier of the house.

Note: Applicable during the day.
Note: not applicable only for staining clothes .

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MORE RECENT INNOVATIONS

Moule Patent (**1869**): Dry Earth commode

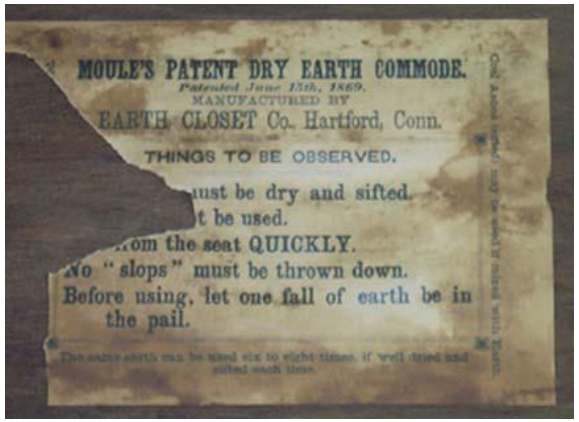
Use instructions:

The earth needs to be dried and sifted.

No sand should be used.

Stand up from the seat quickly.

Before use, let one fall of earth be in the pail.



- **Water toilets in antiquity:**
  - Indus valley, Knossos ,
  - Bahrain,
  - Rome

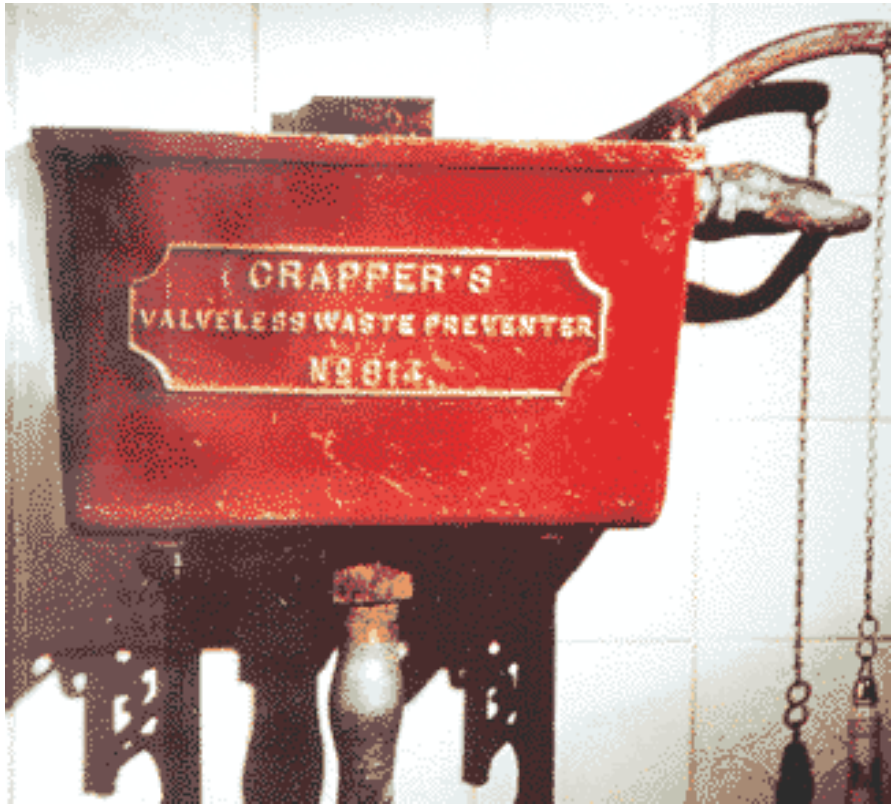
- **Later inventions**

  - Sir John Harrington (1596)
    - Toilet for Queen Elizabeta I

  - Alexander Cummings (1775)
    - trap “S”

  - Sir Thomas Crapper (1880s)
    - Valveless waste preventer (siphon)

  - Thomas McAvity Stewart (1907)
    - Vortex washing toilet



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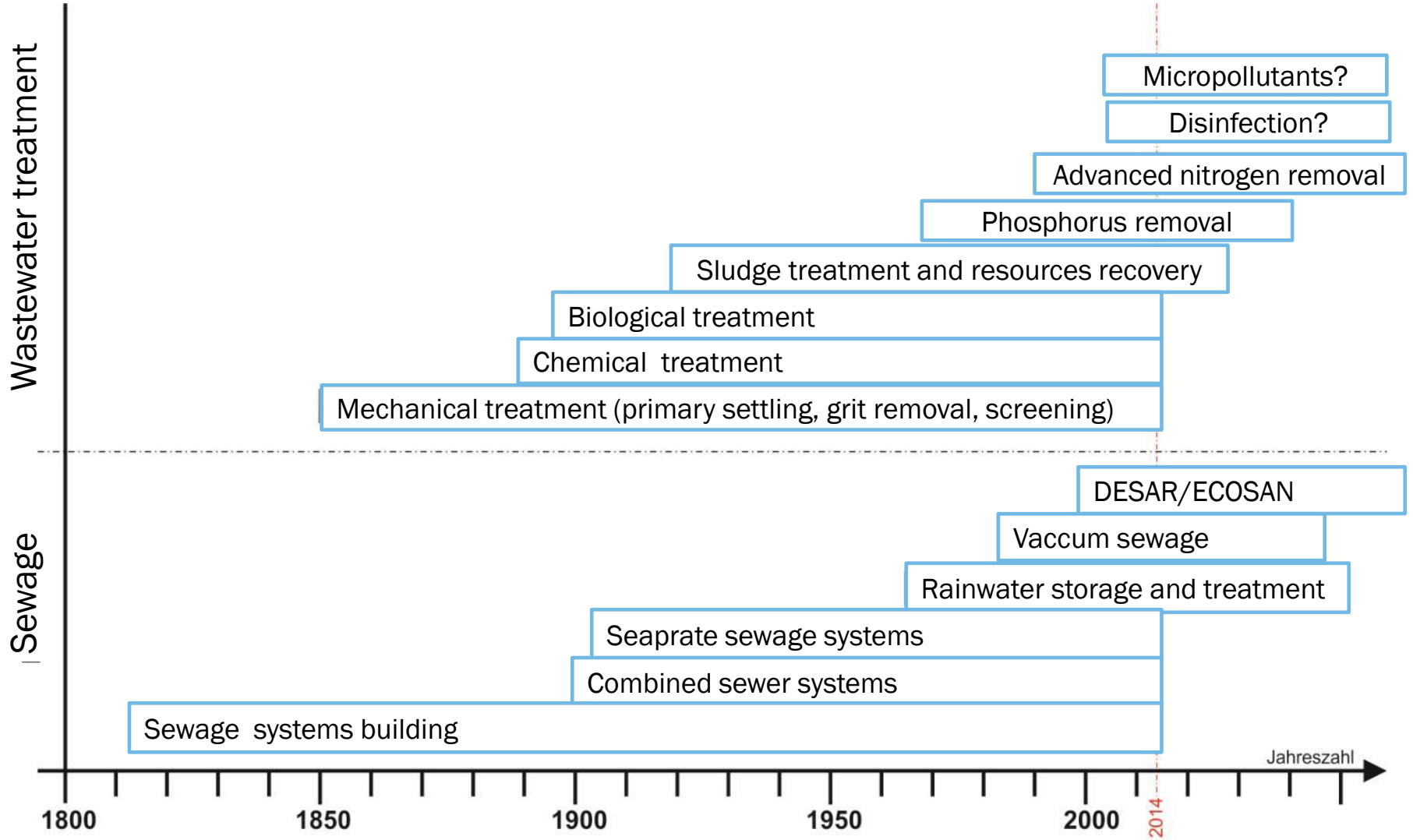
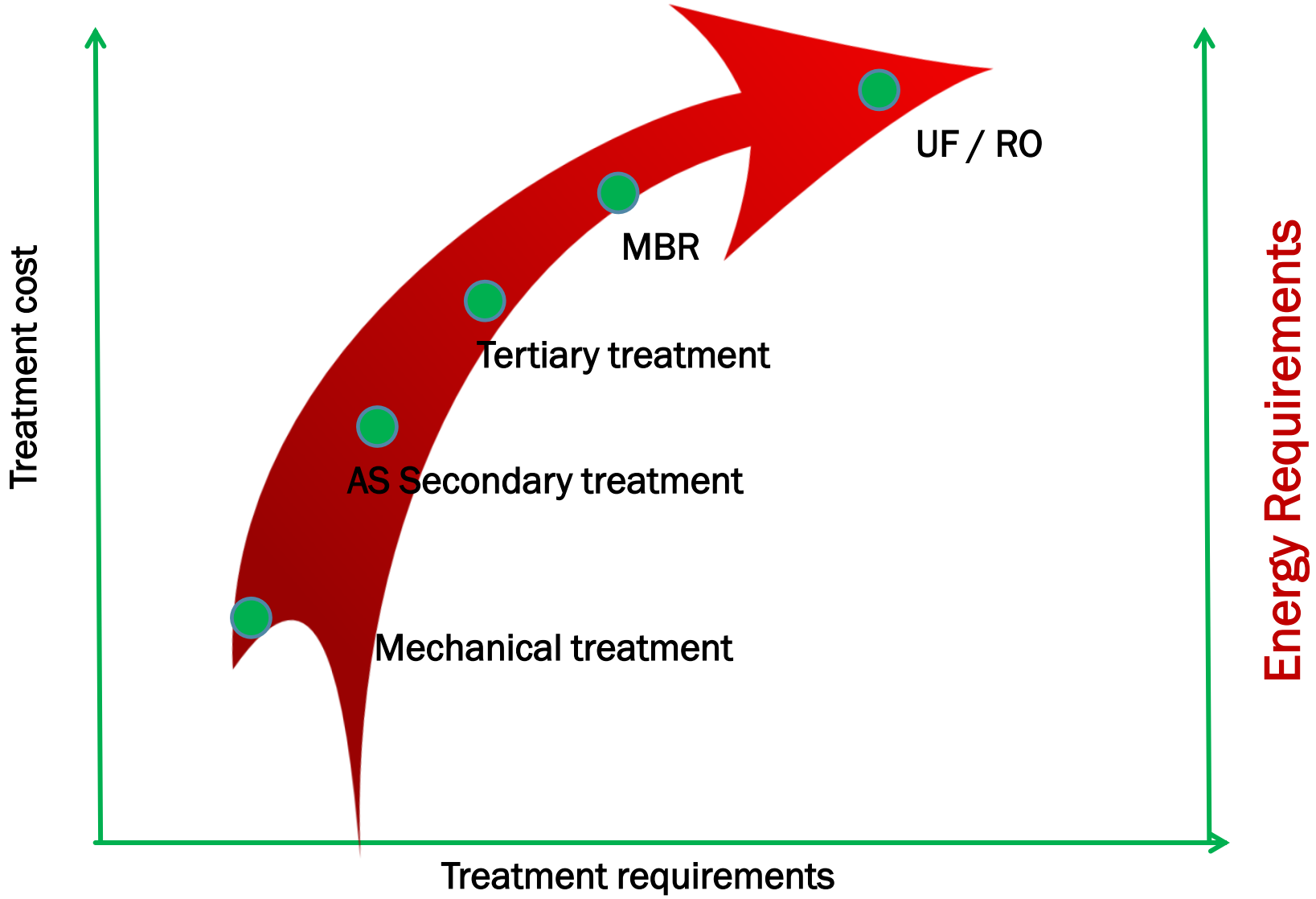
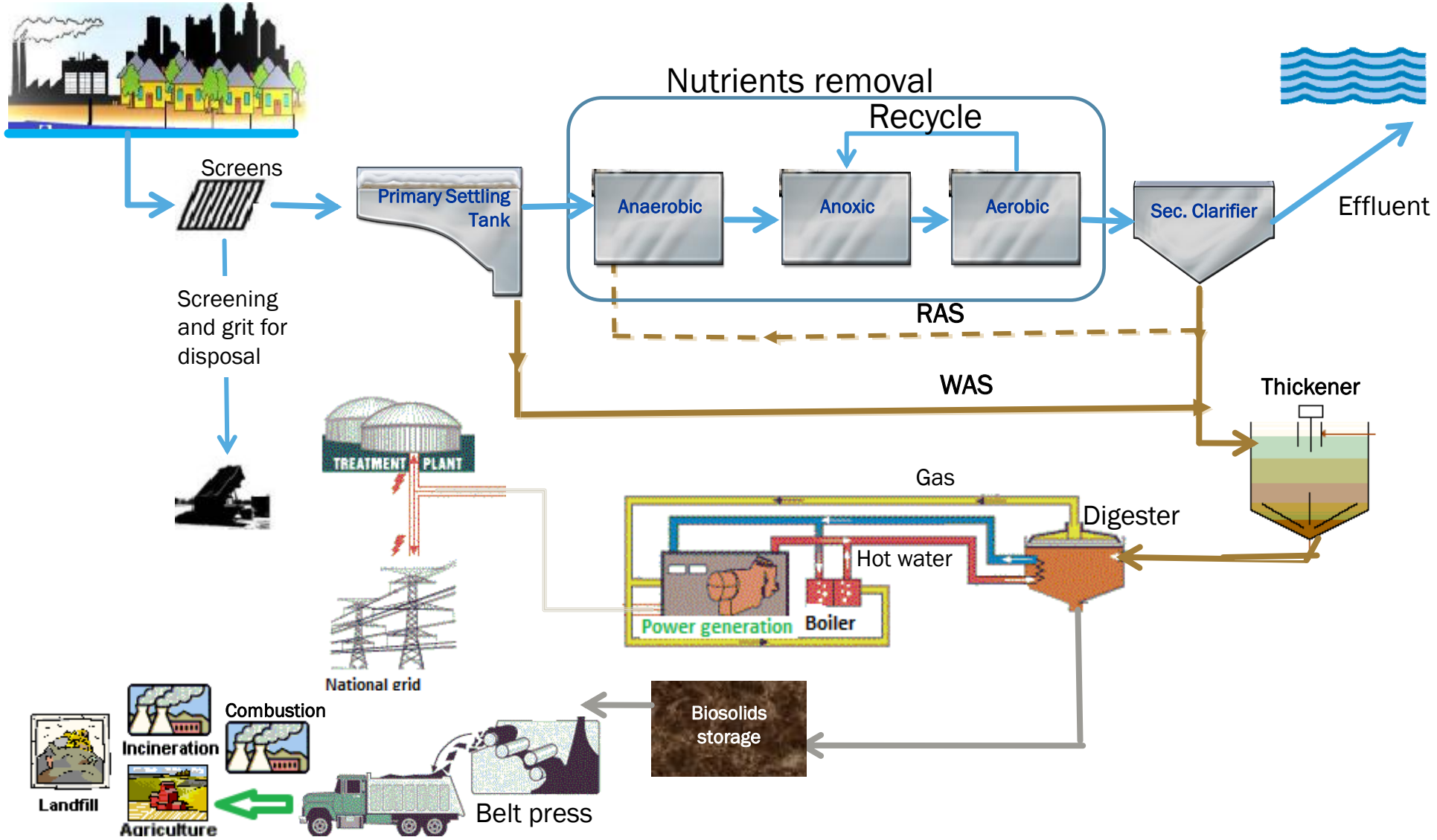
Current state of development



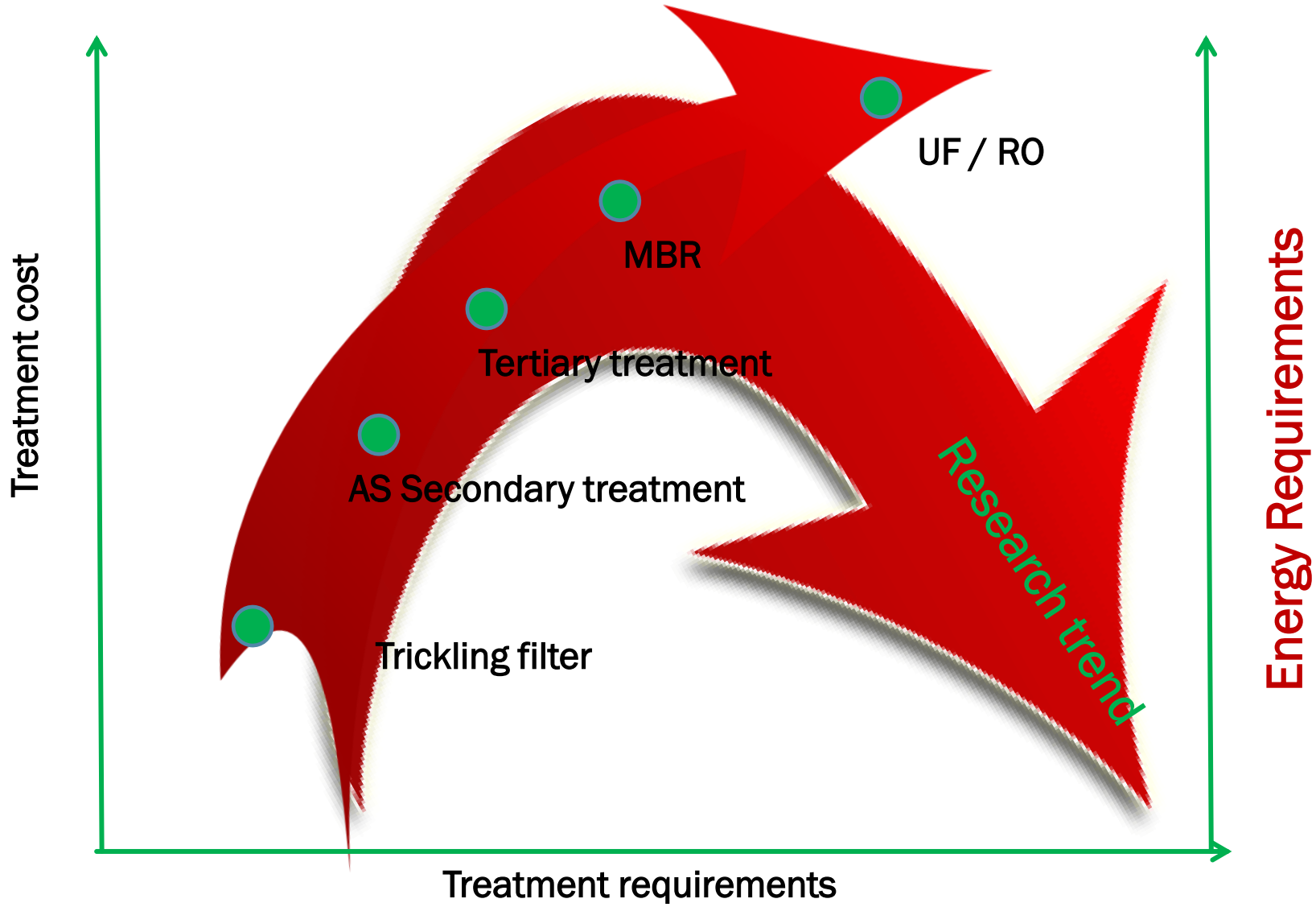
Technological progress



COMMON CONFIGURATION OF LARGE WWTP



Technological progress



Different roads for the same goal “Sanitation for all”

1. Optimization of wastewater treatment processes
   - Increase efficiency
   - Increase treatment capacity
   - Decrease investment, operation and maintenance costs

2. Rethinking wastewater treatment
   - New biological solutions for wastewater treatment

3. Low-cost nature based sollutions
   - Decentralised/centralised
   - Easy to install
   - Maintenance free or low maintenance
   - Nature based

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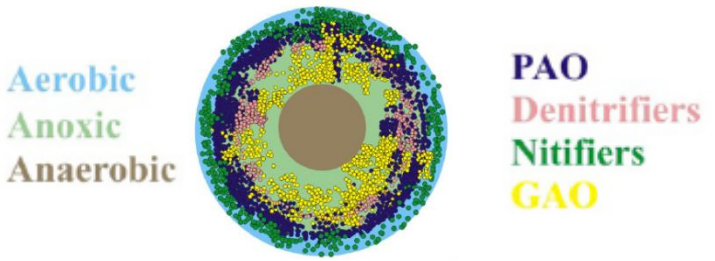
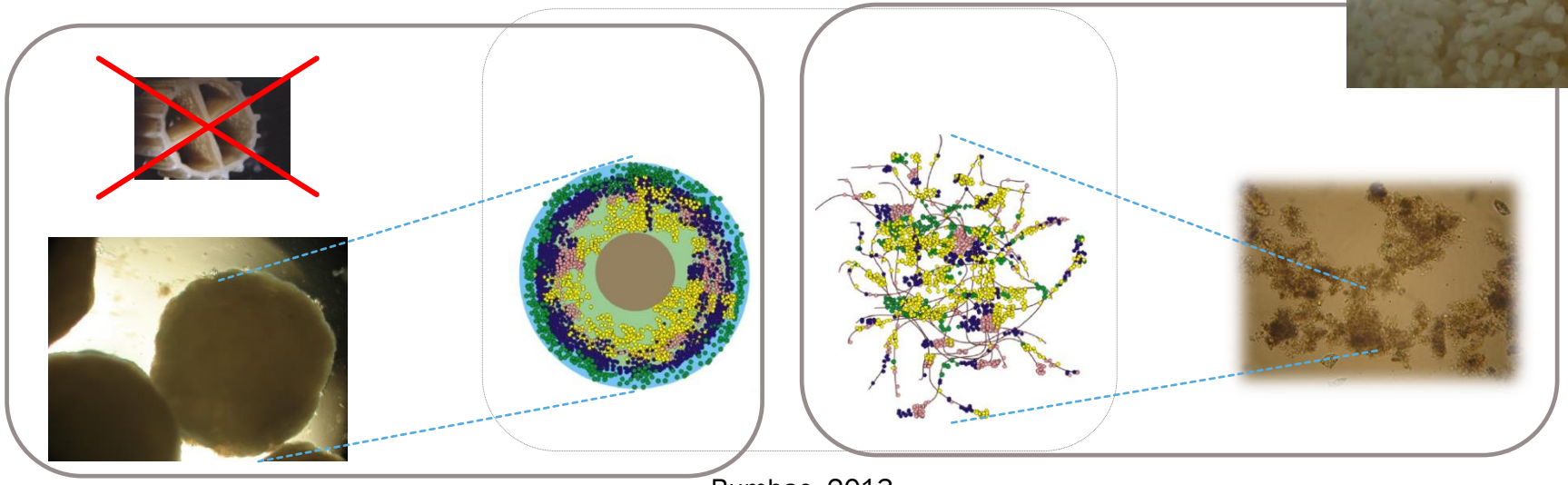
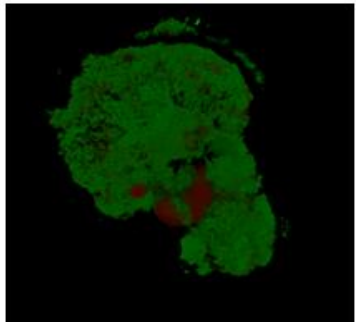


Adapted from von Loosdrecht, 2012

Ex: AGSBR TECHNOLOGY

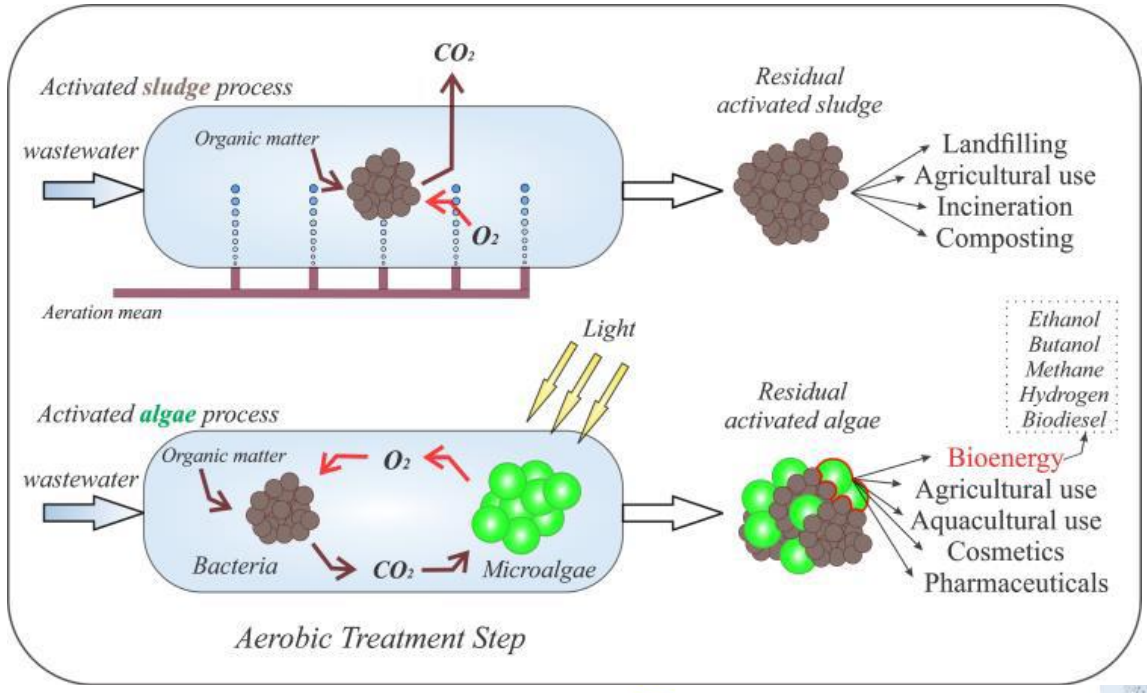


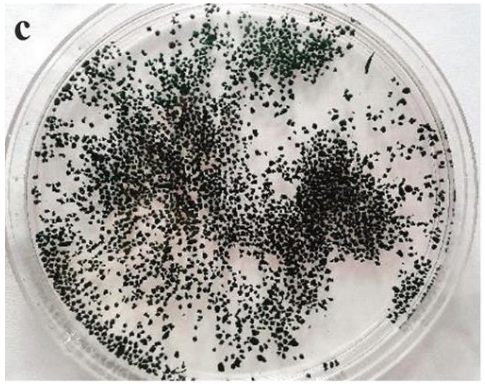


Bumbac, 2013

2. Rethinking wastewater treatment

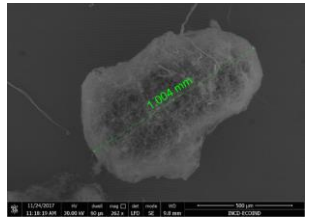
- New biological solutions for wastewater treatment

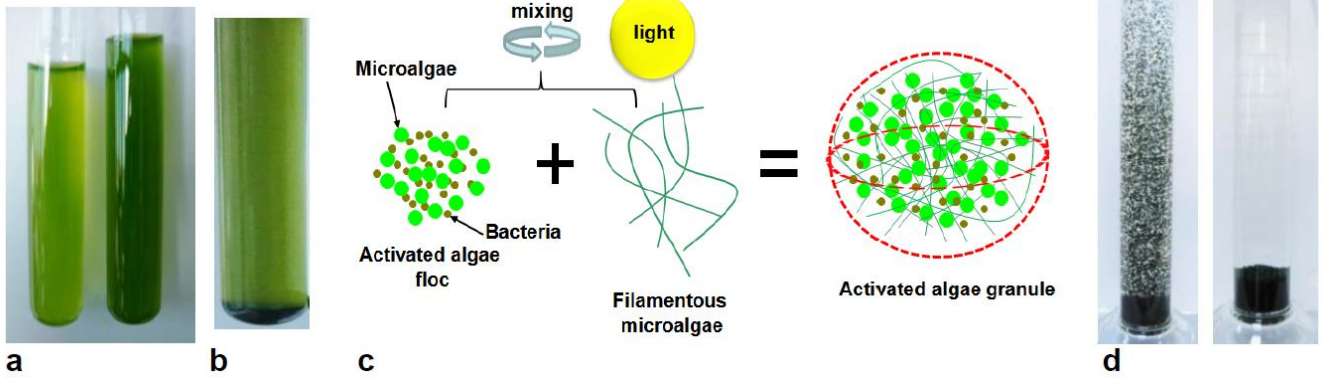


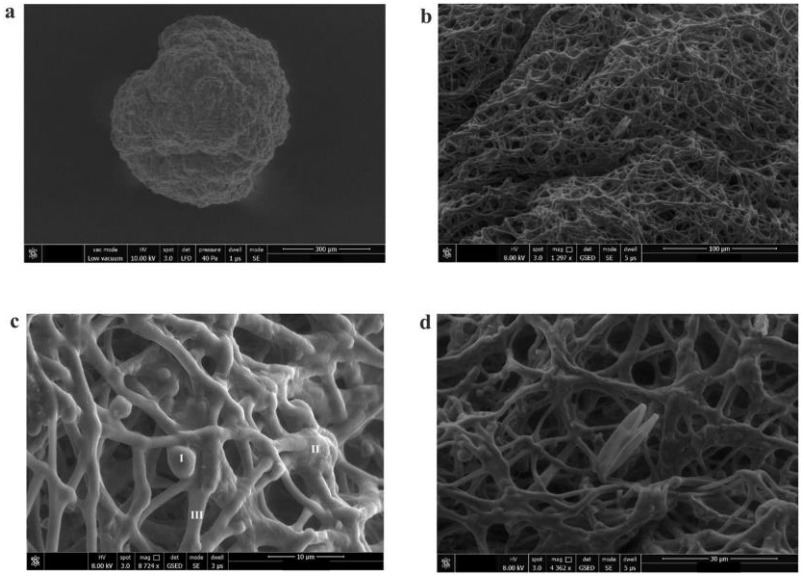


Graal recovery

next generation of wastewater treatment



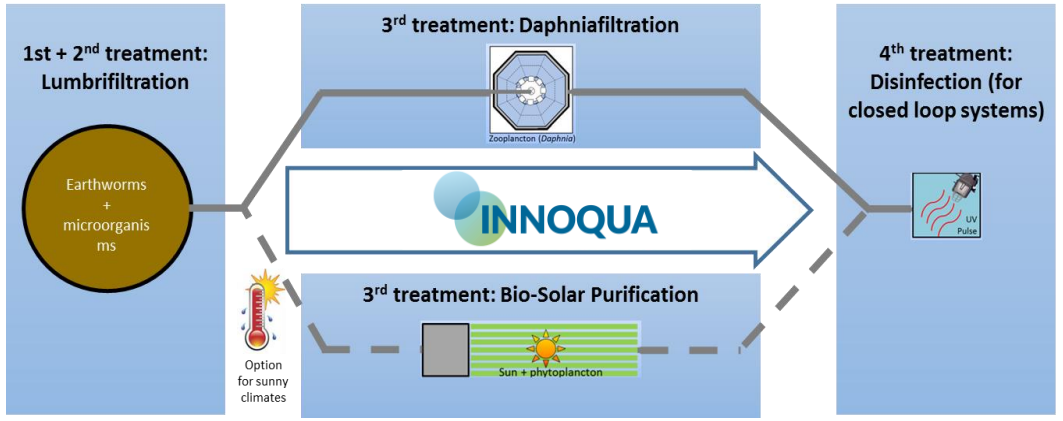




https://www.graalrecovery.com

3. Low-cost nature based sollutions

- Decentralised/centralised
- Easy to install
- Maintenance free or low maintenance
- Nature based



4 Modular Technologies

Lumbrifilter

- Primary and secondary treatment
- Aerobic system utilising earthworms and bacteria
- Removes BOD, suspended solids, ammonium

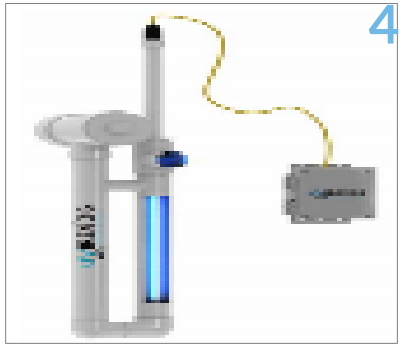
Daphniafilter

- Tertiary treatment
- Daphnia species consume very fine suspended solids, including bacteria
- Biofilm removes nutrients and other pollutants

Bio Solar Purification

- Tertiary treatment
- Biofilm removes nutrients and other pollutants

UV Disinfection

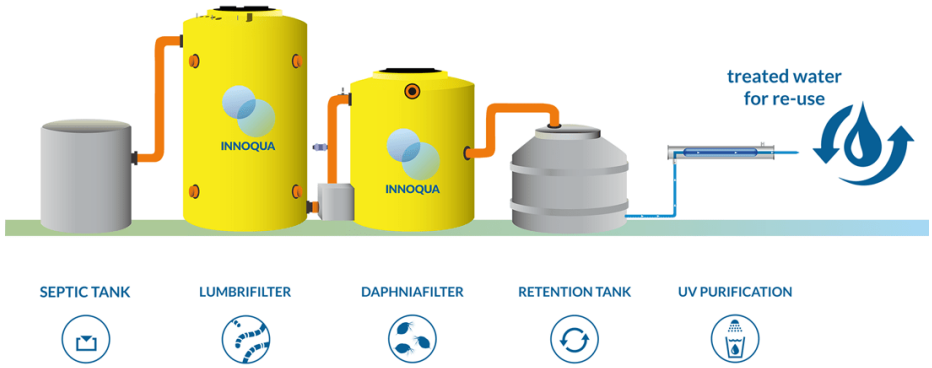


- Disinfection
- Optimised UV lamp configuration kills pathogens in treated wastewater

INNOQUA WORLDWIDE DEMONSTRATION

Prototype	**Configuration**
Ireland	**LBF+DF+UV**
Spain	LBF+DF+BSP
Demosite	**Configuration**
Ireland Ecuador	**LBF**
Italy	**LBF+UV**
France Romania Scotland	**LBF + DF**
Tanzania Turkey	**LBF + DF + UV**
India Peru	**LBF + DF + UV** LBF + BSP
France	**Lumbricomposting**

Lumbrifilter (Ireland) – municipal wastewater (primary settled)



IRELAND – PILOT & DEMO-SITE

% Removal - average effluent value in ()					
COD	BOD_5	TN	TSS	NH_4-N	TP
78 (111)	93 (15)	40 (23)	80 (23)	88 (4)	29 (5)
Surface Removal Rate ($g/m^2.day$)					
192	115	10	30	13	1.1

- Top up woodchip (once a year)
- No other maintenance

Lumbrifilter +UV system

	Inlet lumbrifilter (mg/L) n = 24	Outlet lumbrifilter (mg/L) n = 24	Removal efficiency (%)	Local discharge Regulation (mg/L)
TSS	316	23	93	80
COD	998	143	86	160
BOD	391	16	96	40
NH4	88	10	87	15

Lumbrifilter +DF +UV system
Lumbrifilter +BSP

(India &Peru)

Wastewater characteristics
TSS: 940-4030mg/L, aver. 2190mg/L
BOD: 600-2000mg/L, aver. 1165mg/L
COD: 1104-4190mg/L, aver. 2241mg/L
NH_4-N: 60-144mg/L, aver. 104mg/L
wastewater **temp.:** 20.8 up to 38.8°C

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		TSS mg/L	BOD mg/L	COD mg/L	NH_4- N mg N/L
LFi_n	average; STD N	2190 +/- 951	1165 +/- 369	2242 +/-851	104 +/-23.7
	max	4030	2000	4190	144,0
	min	940	600	1104	60,1
LF_{eff}	average; STD N	271 +/- 186	90 +/- 76	371 +/- 217	15.2 +/- 8.5
	max	615	300	803	37,0
	min	36	14	86	2,7
efficientcy [%]	average; STD N	88 +/-8	93 +/-6	83 +/-10	85 +/-10
	max	98	98	94	98
	min	62	75	60	54
Overall Performance					
DF+UV	average	98	99	96	94
BSP	average	87	97	90	97

https://www.novaqua-alliance.com

The nature-based solutions the planet was waiting for

our projects

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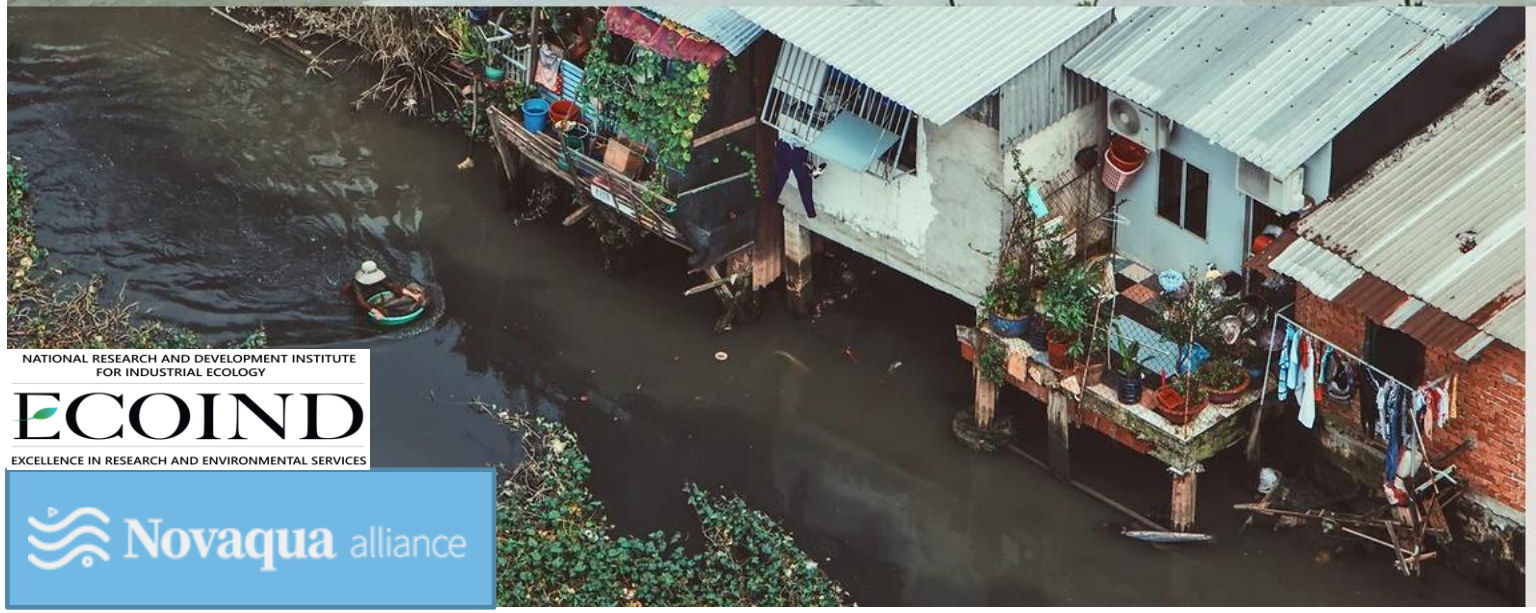

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Novaqua alliance

We want to tackle the sanitation issue around the world

We are an organisation who aims to promote the use of Nature-Based Solutions (NBS) for wastewater treatment.

With our origin in the european granted project INNOQUA 2020.Our main goal is to tacke the sanitation issue around the world.

AND THIS IS HOW WE DO IT