

NORWEGIAN UNIVERSITY OF LIFE SCIENCES
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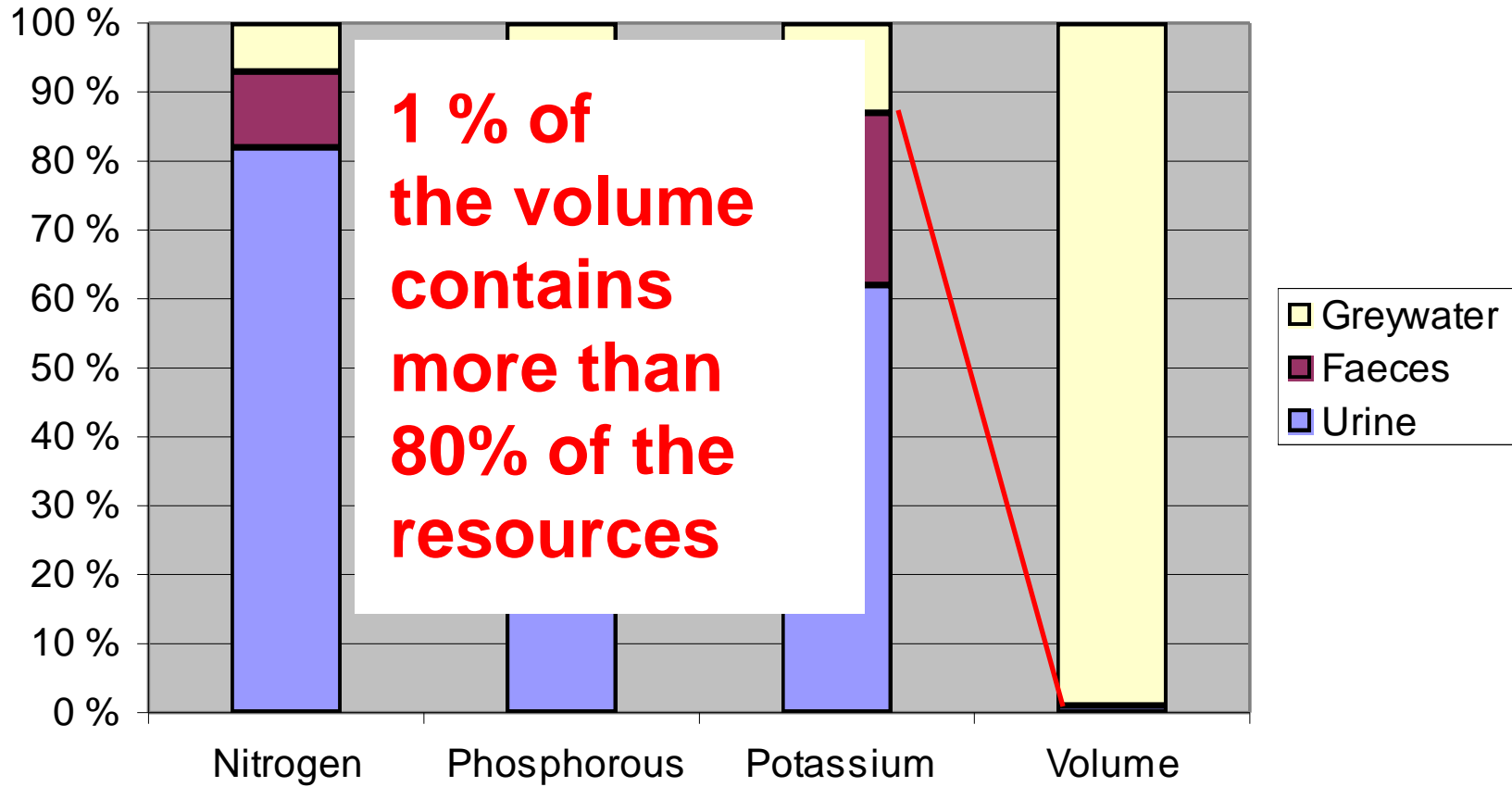


Source separating sanitation in Europe

Daniel Todt, Petter D. Jenssen



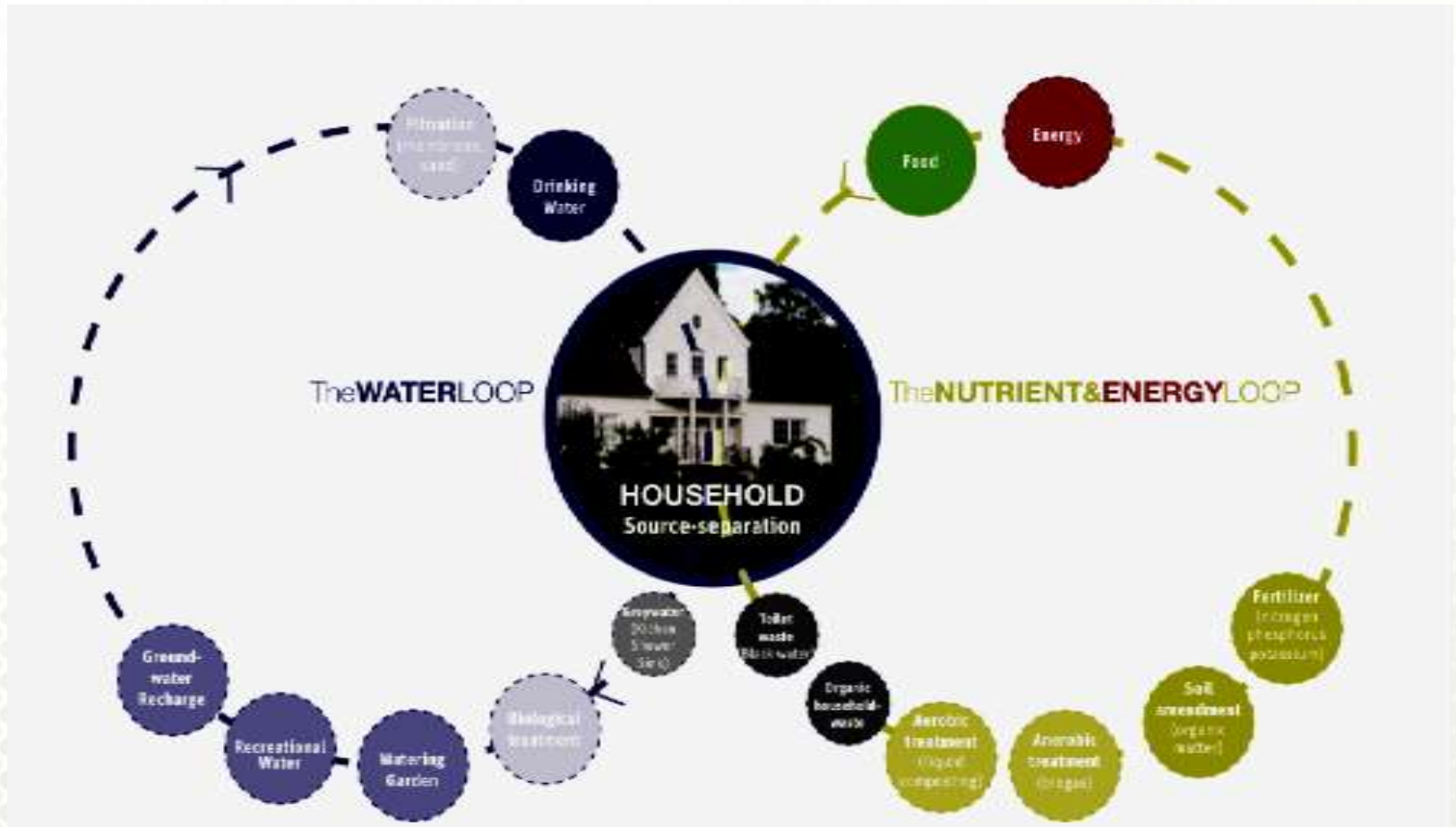
Nutrients and volume in domestic wastewater



(Jönsson et al., 2000)



Source separation of wastewater



(Alsen and Jenssen 2005)

Contribution from the toilet



- * 90 % of N
- * 80 % of P
- * 80 % of K
- * 40-75 % of org. matter
- * Majority of the pathogens

Available toilet options for water saving and nutrient recycling

Composting /dry sanitation

- + zero water consumption (0 - 0.1 liter/visit)
- + material can be treated into compost that can be used as fertilizer
- + equal or higher reduction of pathogens than water based systems and high reduction in risk of exposure (Stenström 2001)
- Little social acceptance in Western Europe

Urine diverting

- + little water consumption (0.2-4 liter/flush)
- + urine can be easily converted into a save and high valuable fertilizer
- separate pipe and urine storage tank required

Low flush and vacuum toilets

- + little water consumption (0,5 - 1 liter/flush)
- + high social acceptance and same user comfort than water toilets
- need for a appropriate solution for blackwater treatment

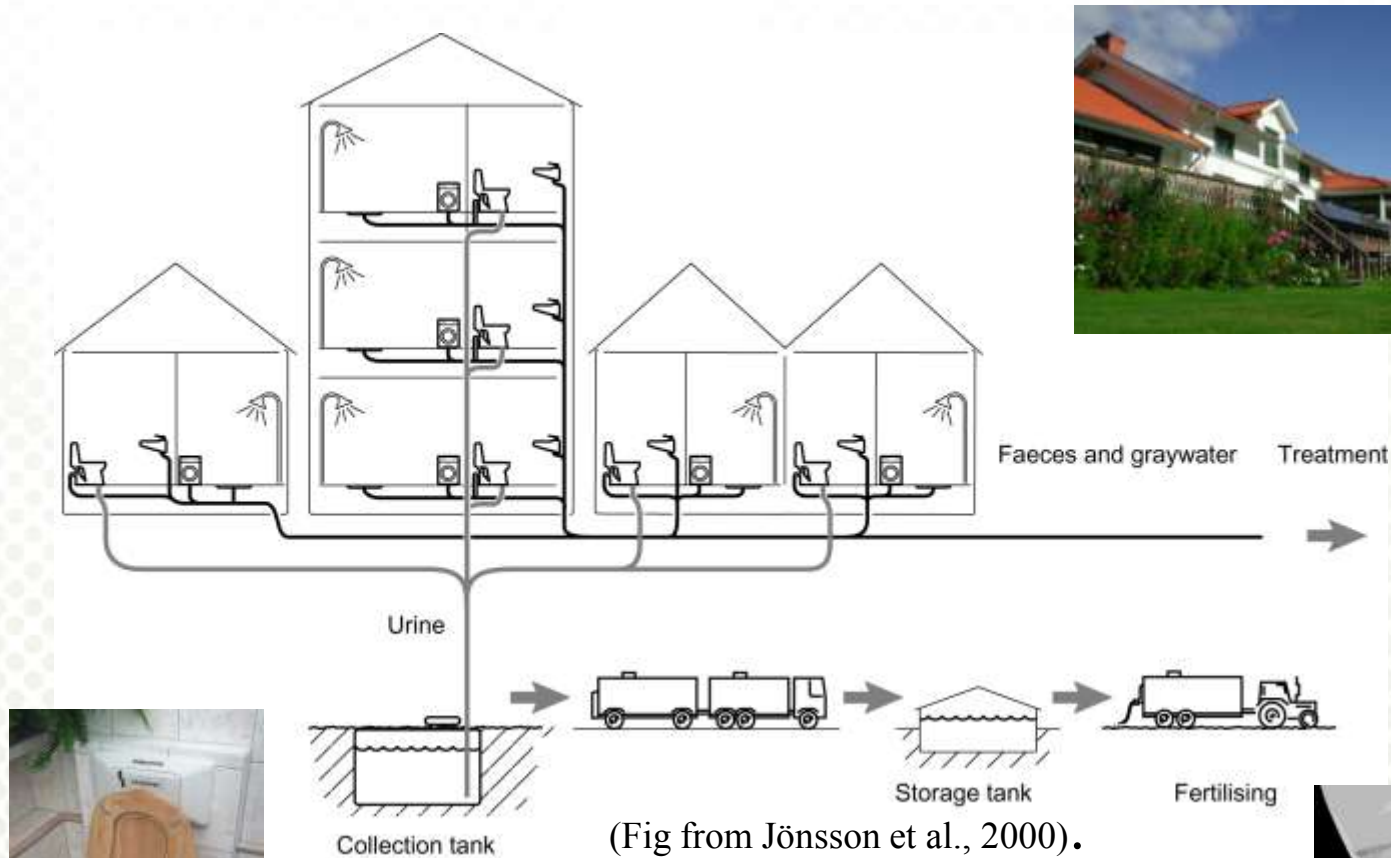
Composting toilet at roadside facility – Sweden



Elected the best roadside facility in Sweden 2003



Urine diverting and nutrient recycling as successfully implemented in Kullön Vaxholm and Understenshøjden Stockholm, Sweden



SANBOX – an example for a low flush water based sanitation system for remote tourist facilities



SANBOX is the outcome of the EU FP7 program "Research for the benefit of SME"



SANBOX – a source separating sanitation solution for remote tourist facilities – the idea



Washing facilities



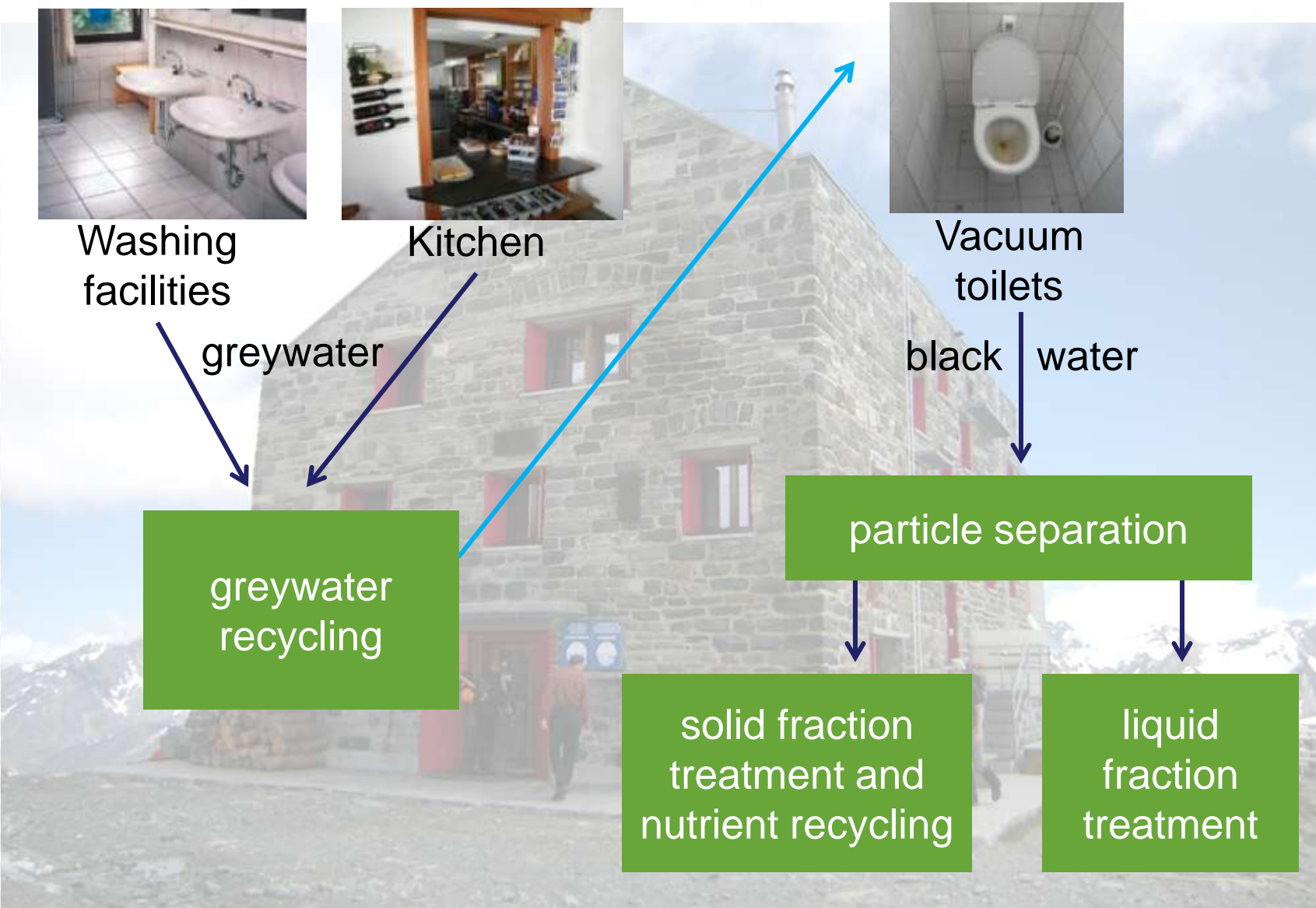
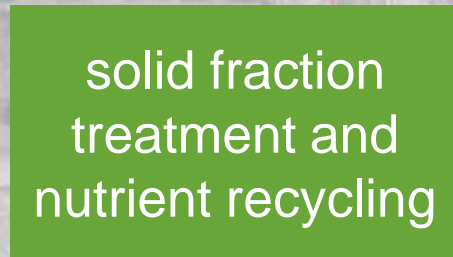
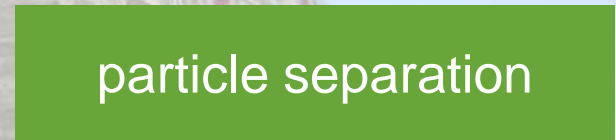
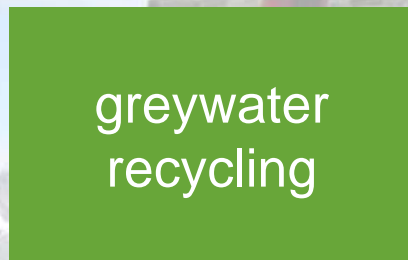
Kitchen



Vacuum toilets

black water

greywater



Three prototypes for different scales and climatic conditions



Review of some potential technologies for treatment of greywater and blackwater from water based toilets

Greywater

Constructed Wetland (CW)

- + simple, cheap, little energy consumption
- high treatment performance
- high space requirement

Compact fixed film biofilter

- + little energy consumption
- high treatment performance
- vulnerable for clogging at high grease load

Membrane bioreactor (MBR)

- + high treatment performance
- high energy requirement, technically complex system, vulnerable for membrane fouling at high grease load

Blackwater

Anaerobic treatment (UASB)

- + energy production, relatively simple system, no need for particle separation
- high temperature needed, post treatment required

Fixed film biofilter and CW

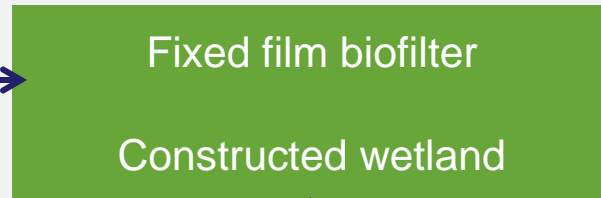
- + low energy consumption
- simple system
- low nitrification performance on high loads, space requirement

Membrane bioreactor (MBR)

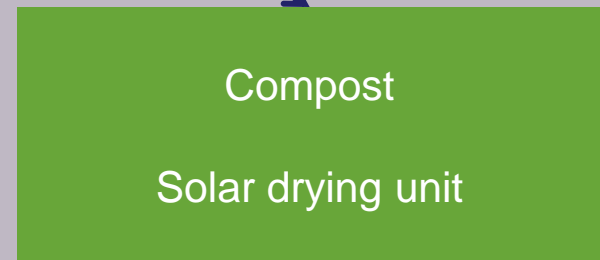
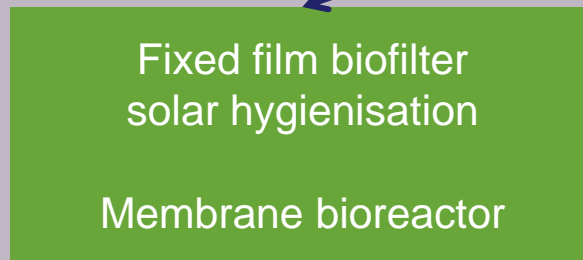
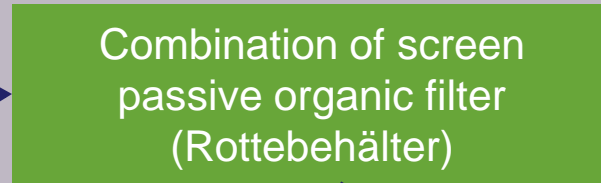
- + high treatment performance, also for nitrogen
- energy requirement, technically complex system, vulnerable process, need for pH stabilisation

The technical components of SANBOX

Greywater



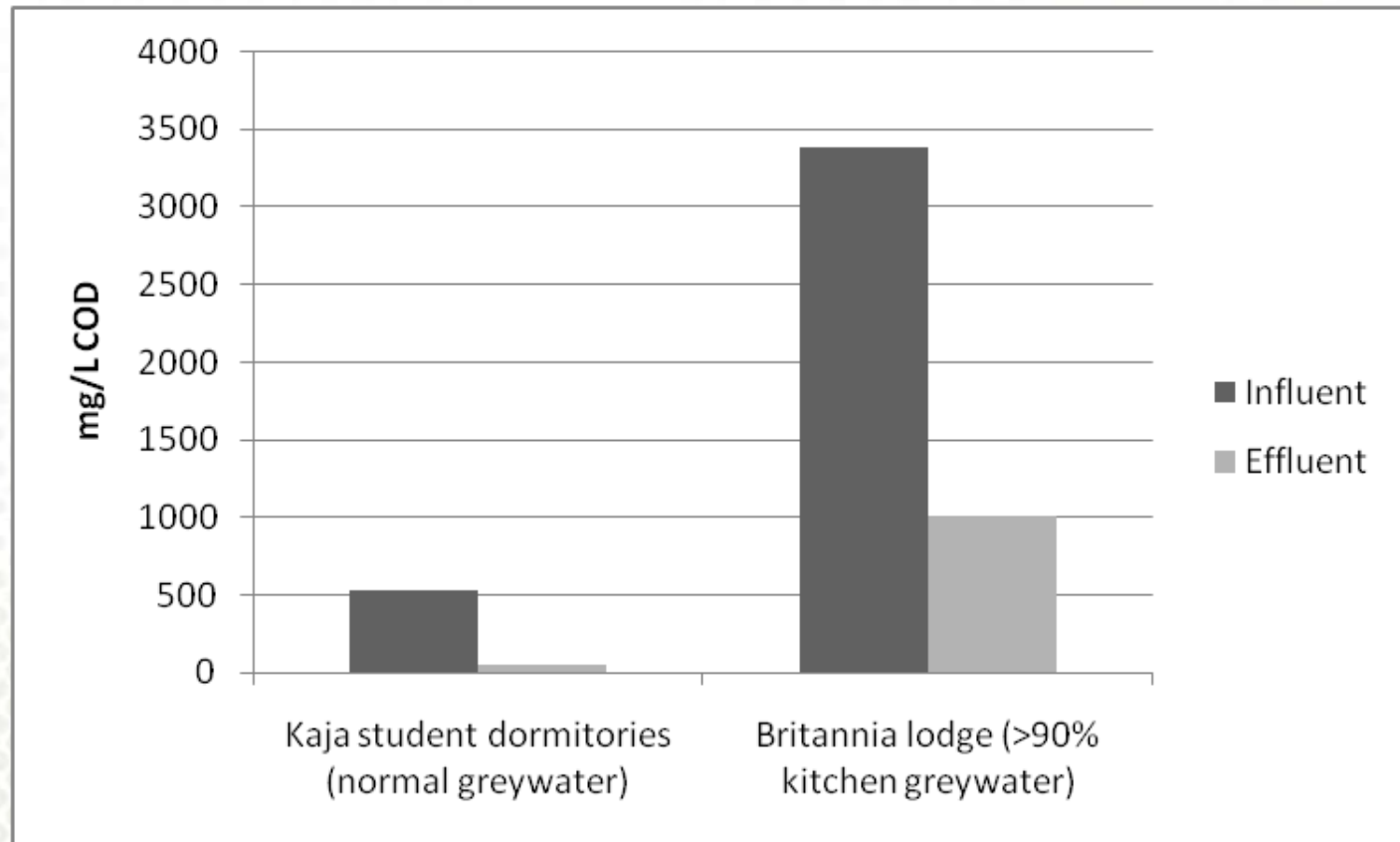
Blackwater



Discharge or infiltration

burning material or fertilizer

First results Greywater treatment / recycling

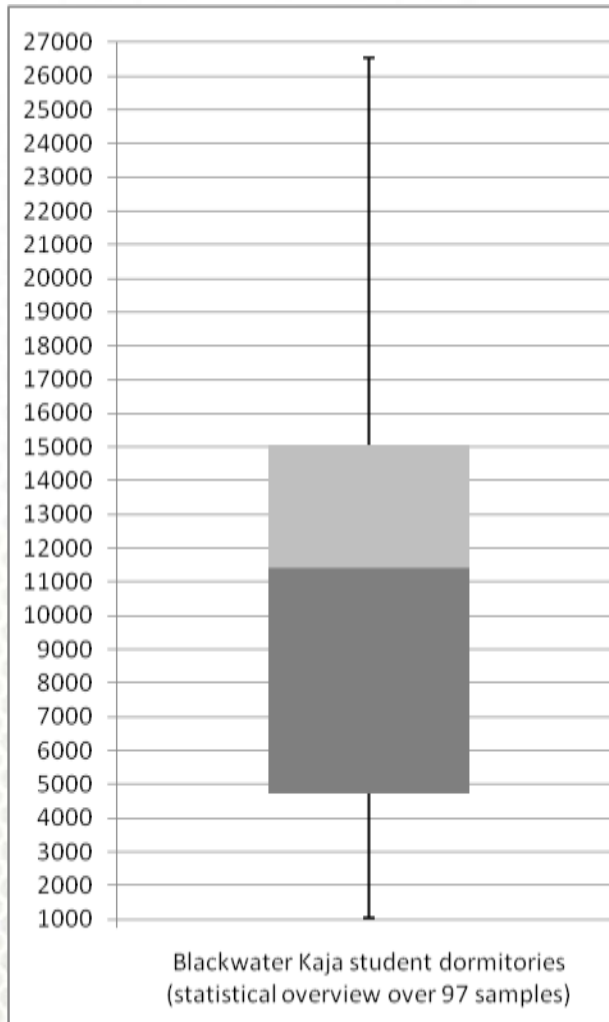


First results Greywater treatment / recycling

- Fixed-film biofilters are robust and high performing systems for greywater treatment reaching swimming water quality in effluent under normal condition
- At places with mostly kitchen wastewater, such as Britannia lodge additional reaserach is needed to deal with the challenging combination of grease and detergents from the dish washing mashine

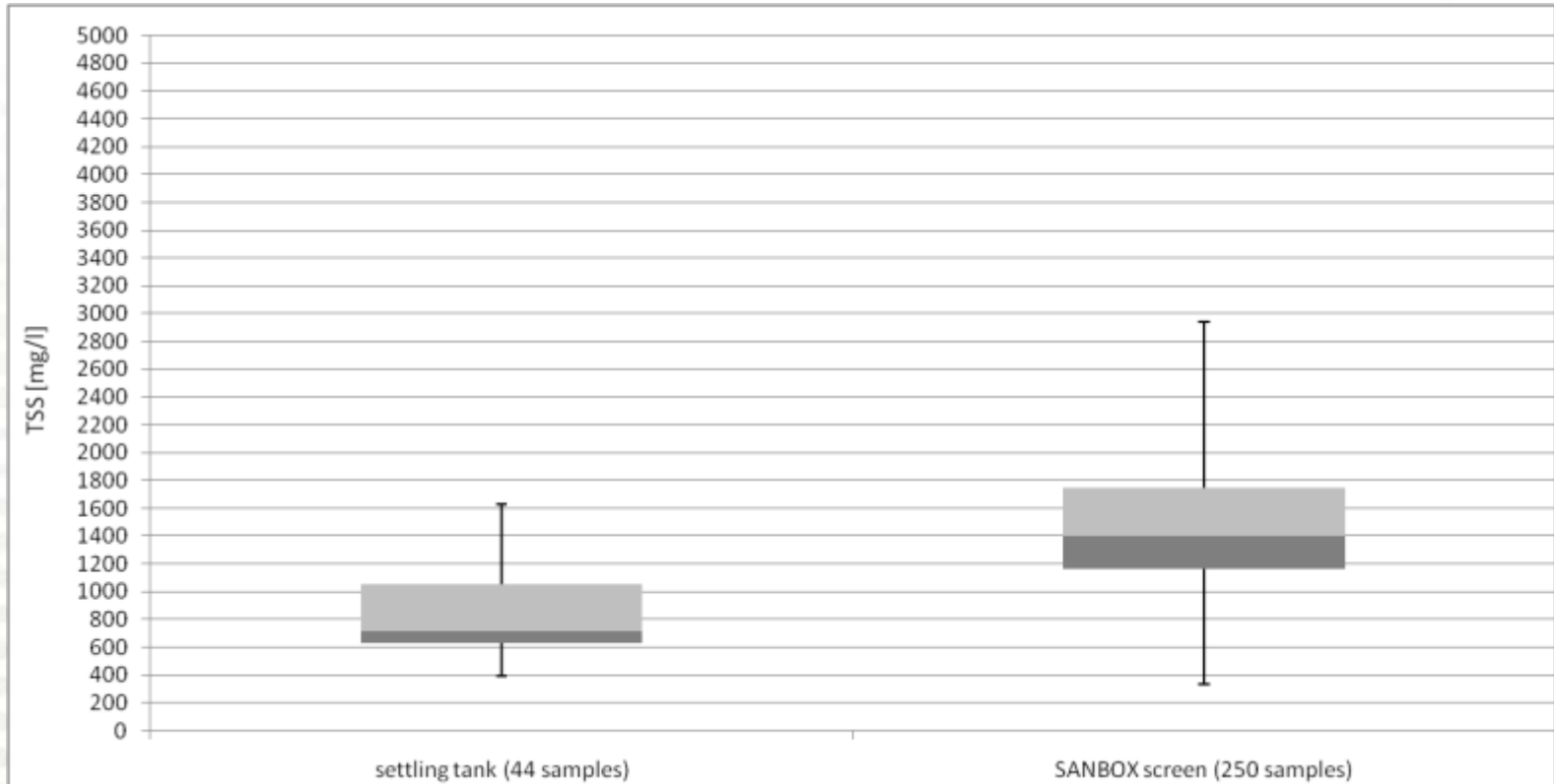


High particle content – the first main challenge regarding treatment of concentrated blackwater



- Results on TSS content from a blackwater assessment at Kaja student dormitory in Ås, Norway (97 samples taking over a periode of 4 months)
- TSS varies from 5000 – 15000 mg/l
- In average a TSS content of 11000 mg/l has to be expected

Options for particle removal tested with blackwater from Kaja student dormitories in Ås



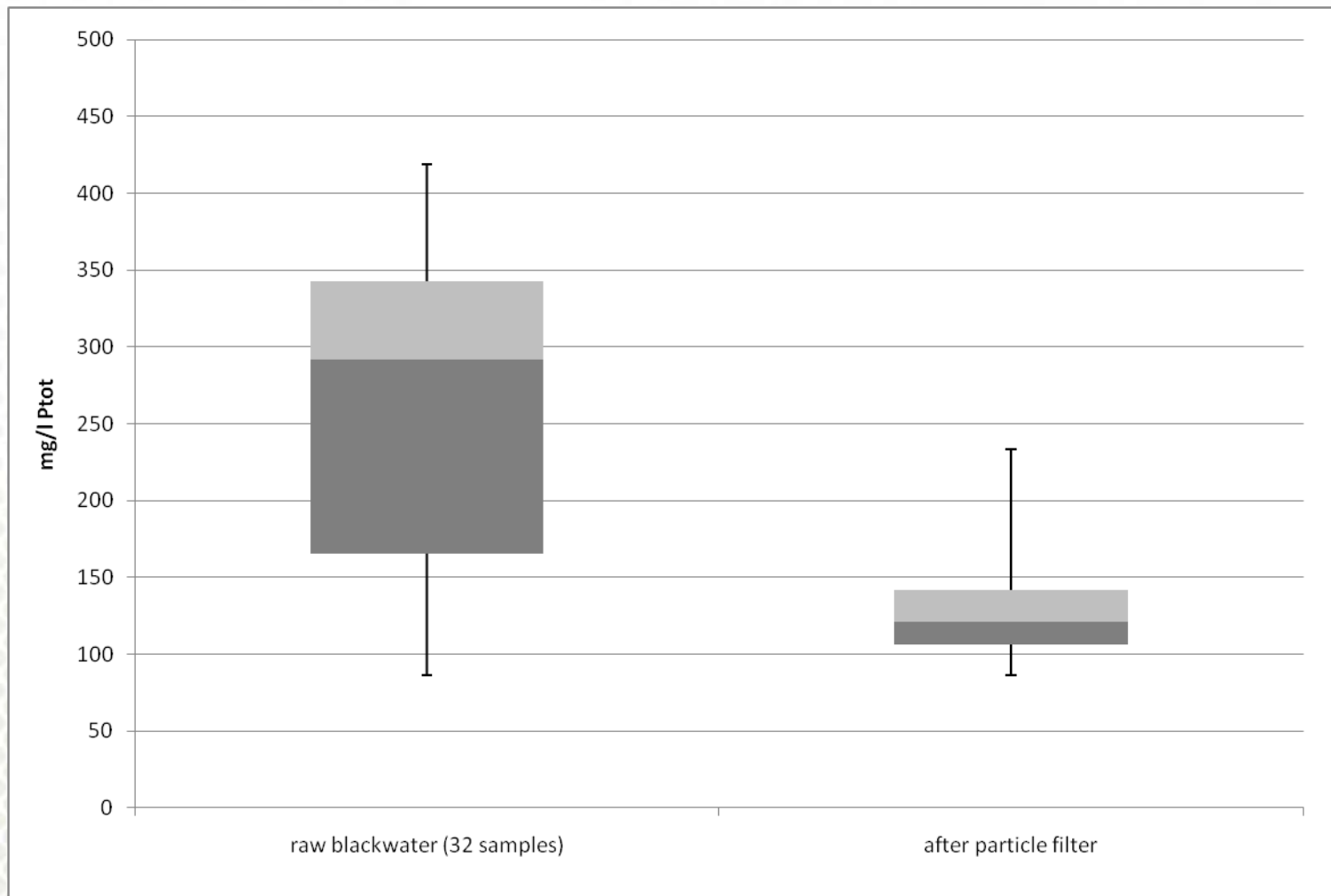
Solid residues with 2 - 5% dry matter

wet composting, biogas

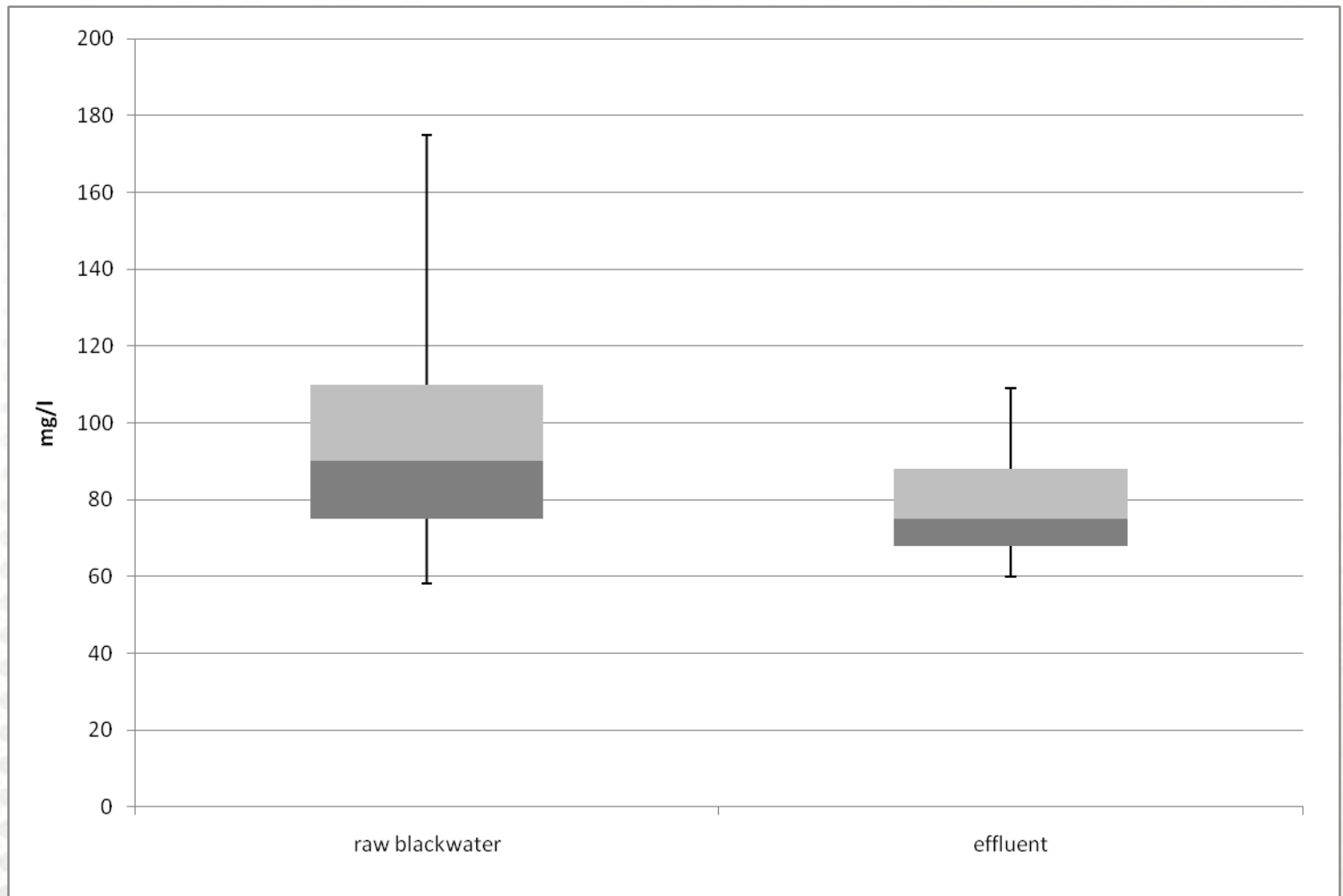
Solid residues with 12-15 % dry matter

solar drying, composting, biogas

Phosphorous reduction in SANBOX screen



Reduction of dissolved phosphate in SANBOX screen



Options for liquid fraction treatment

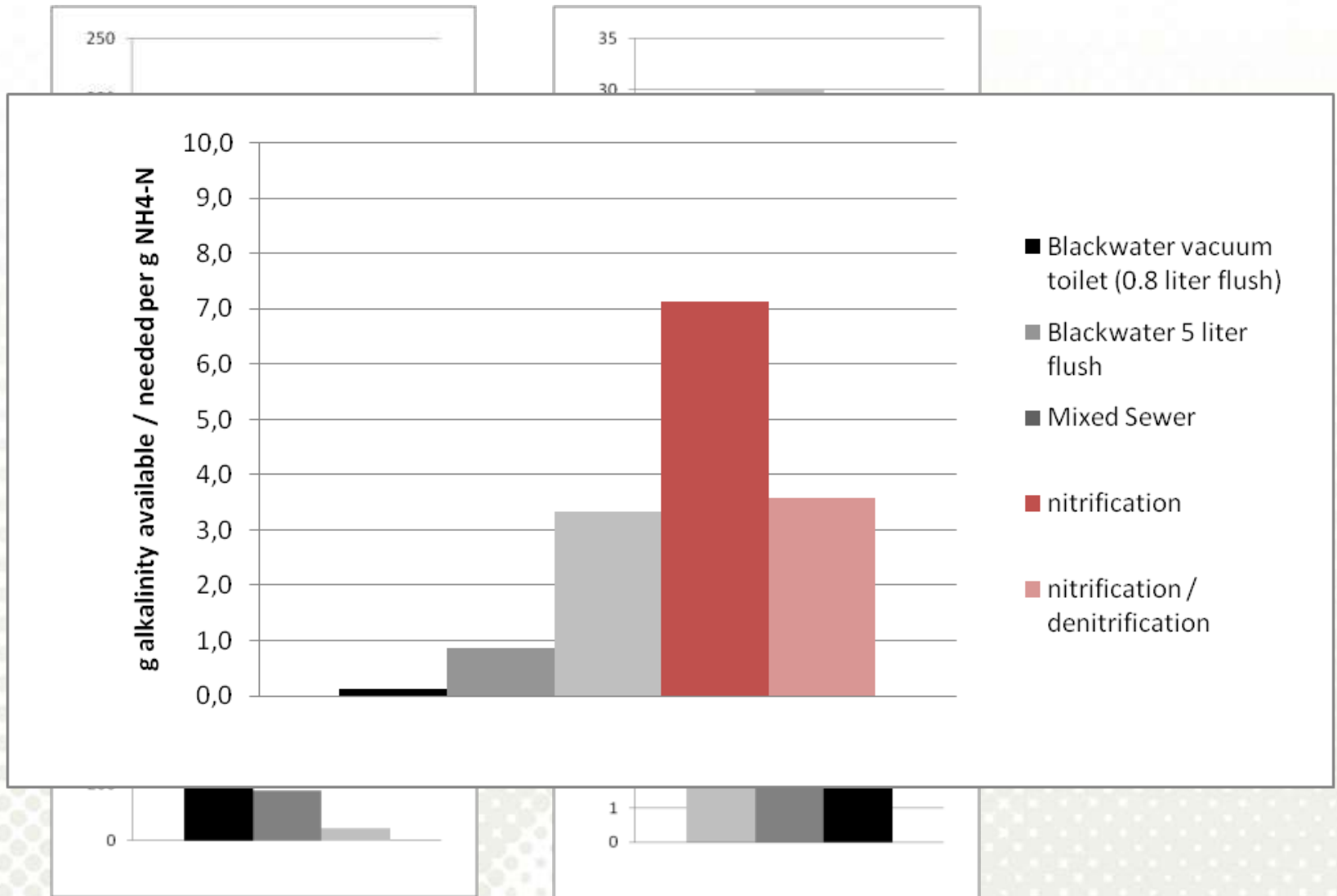
Fixed-film biofilter and solar hygenisation (Implemented at Soline national park and Britannia lodge)

- simple system without complex controlling and maintance
- produces hygieniszed effluent at places with enough solar radiation
- more research is needed to improve nitrification

Membrane Bioreactor (Implemented at Kaja Studentdormitories)

- high treatment performance on COD, Ammonia and pathogens
- higher energy consumption per PE than fixed-film biofilter
- need for pH control due to lack of alkalinity in concentrated blackwater

Alkalinity shortage – a challenge regarding nitrification of concentrated blackwater

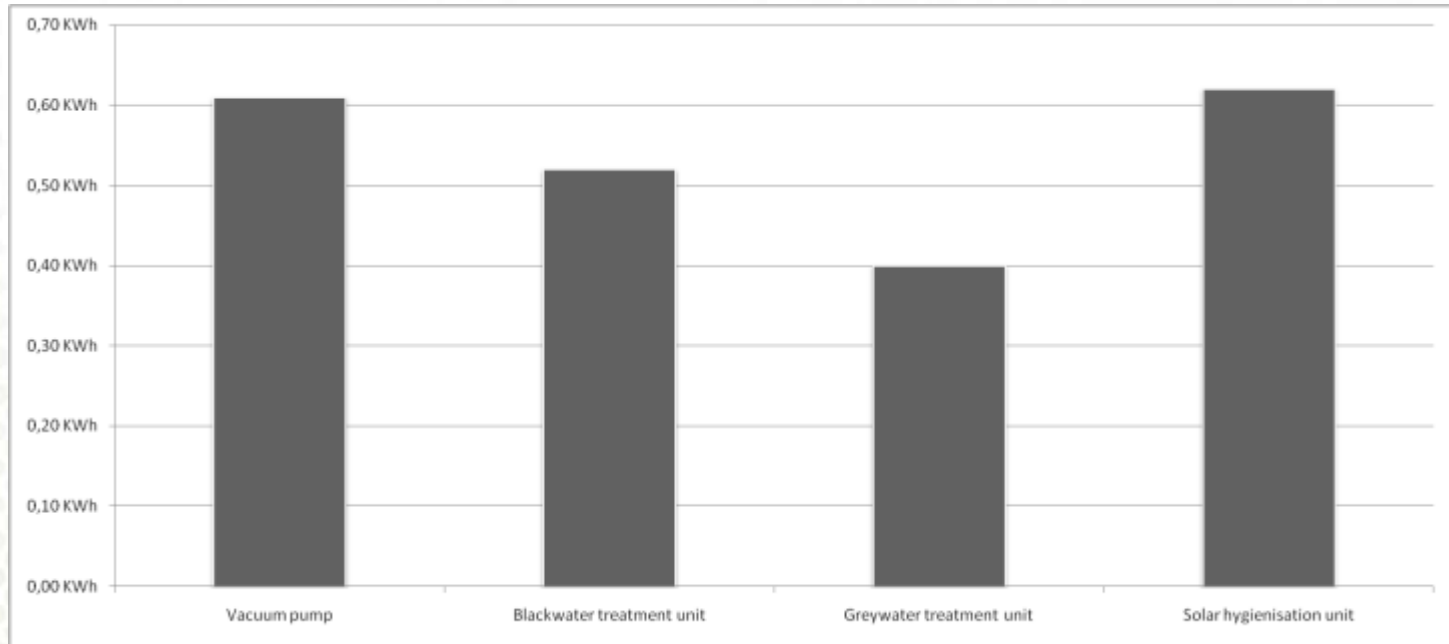


Options for solid post treatment

- Solar drying and use as biofuel
- Composting together with kitchen and other green wastes
- Biogas

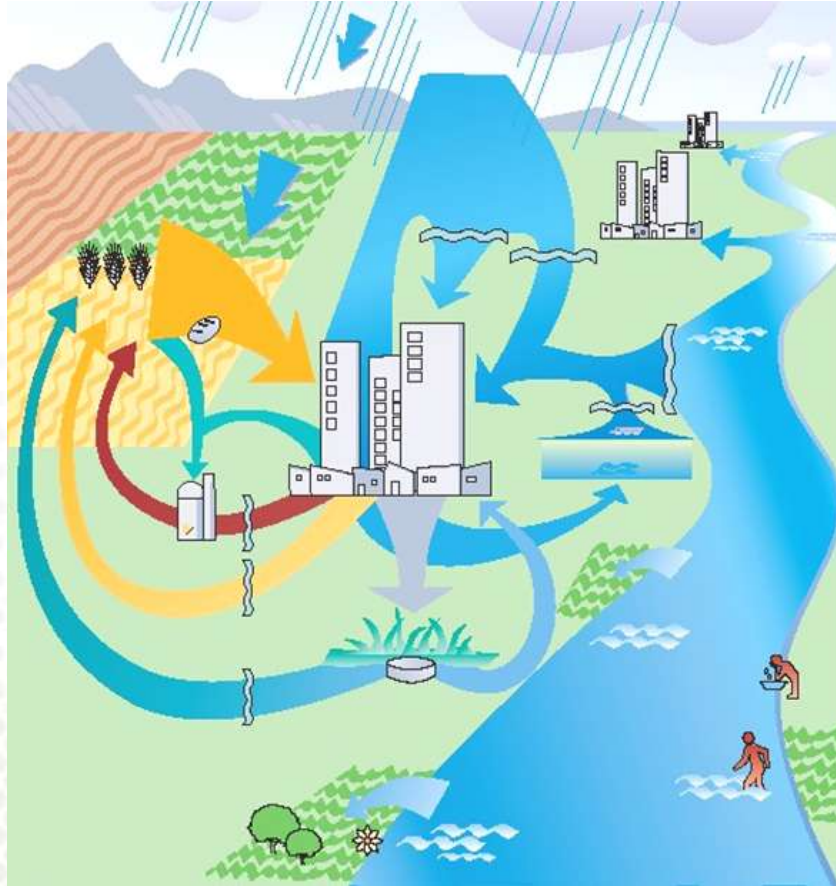


Average energy consumption of the SANBOX system at Britannia lodge (kWh per day)



- Total daily energy consumption was between 2 and 3 kWh
- The average energy consumption of the total system per 100 toilet flushes was at 1.44 kWh

SANBOX a step closer to a future vision



Thanks
for
the
attention

