eawag
aquatic research

Sanitation concepts and knowledge gaps

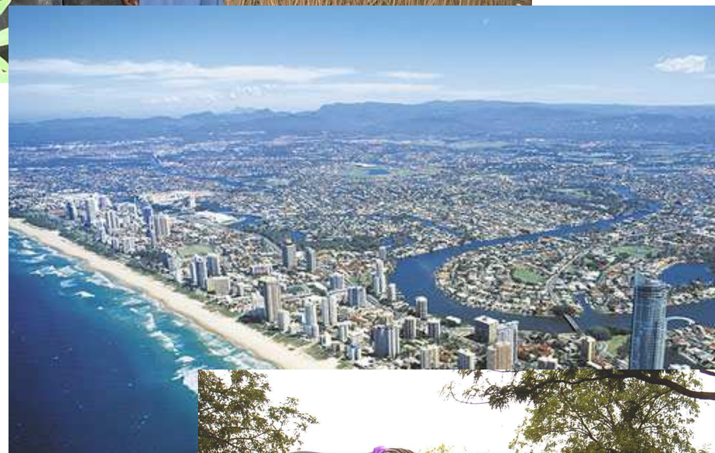
Key-note presentation

Tove Larsen, Eawag

Main services of wastewater management

URBAN HYGIENE
(‘The Sanitation Challenge’)

WATER POLLUTION CONTROL
STORM WATER
(‘Mainstream’)



RESOURCE RECOVERY
(‘Ecosan’)

eawag aquatic research

'Alternative wastewater treatment': source separation and dezentralization

Main arguments *for* source separation

- Resource recovery
- Water saving
- Simplifies feces management
- Efficient water pollution control

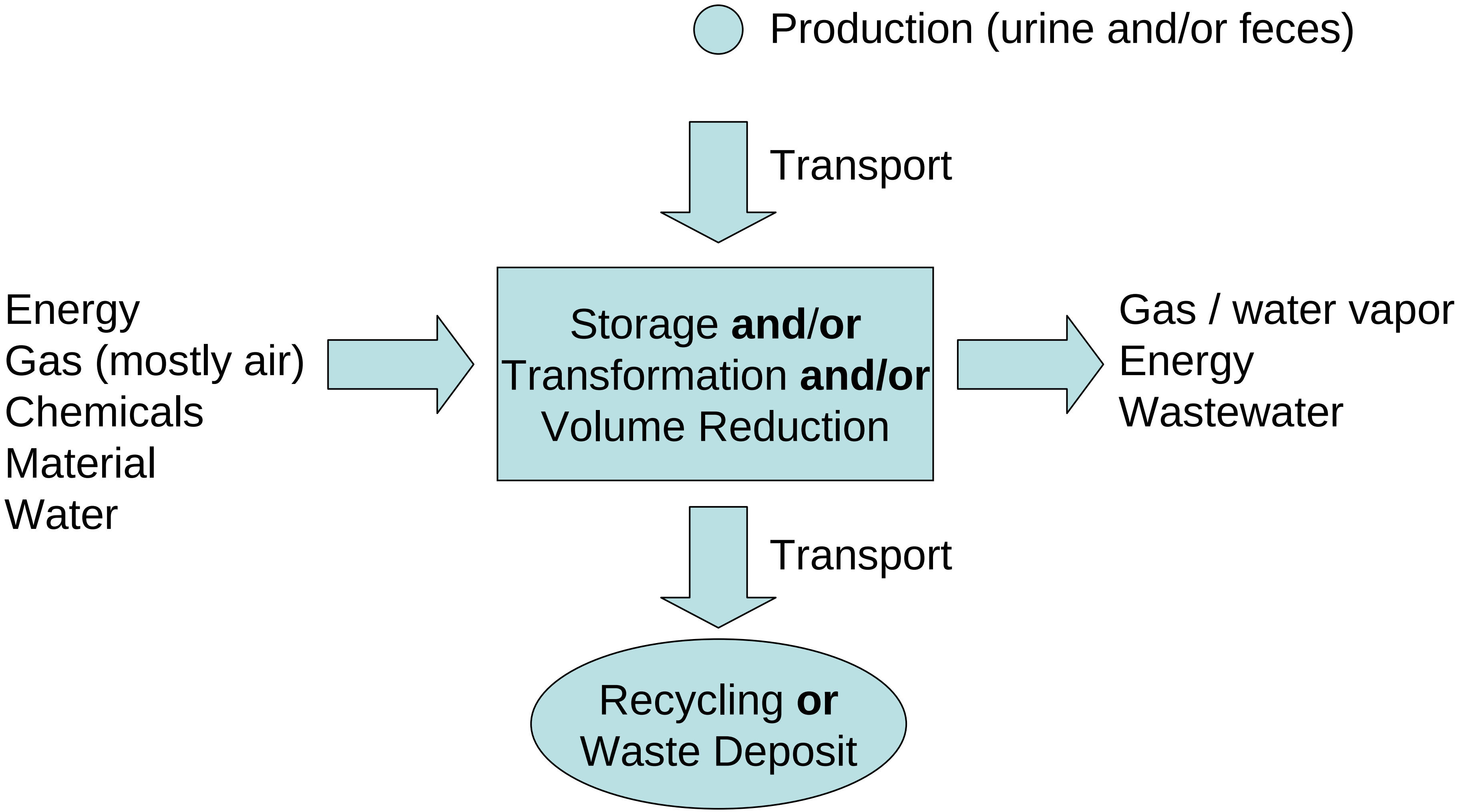
Main arguments *for* decentralization

- No water for transport
- More direct water recycling
- No capital intensive sewers
- Avoids long planning horizons

Main arguments *against* source separation and decentralization

- Lack of public acceptance
- Costs
- System effectiveness
- Monitoring
- Non-existing technology

Processing urine and/or feces



Main knowledge gaps

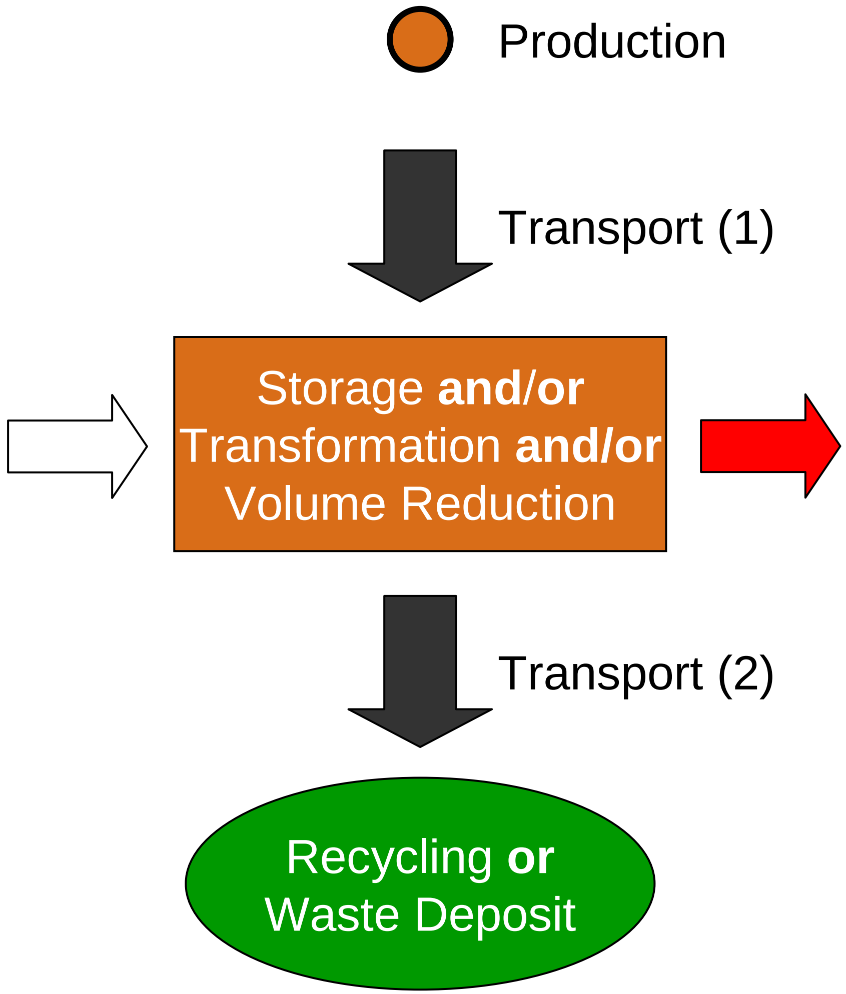
Toilet and Processing unit:
- Technology development
- Mass production

Transport (1):
- Optimizing *technical* solutions for transport *to (semi)-decentralized* processing unit

Transport (2):
- Minimizing residuals
- *Socio-economic* models for transport *from on-site* application

Energy:
- Process optimization
- Solutions for on-site applications

Recycling:
- Hygiene, Micropollutants, Salt



Main knowledge gaps

Toilet and Processing unit:

Technology development
Mass production

Transport (1):

Optimizing *technical* solutions for transport *to (semi)-decentralized* processing unit

Transport (2):

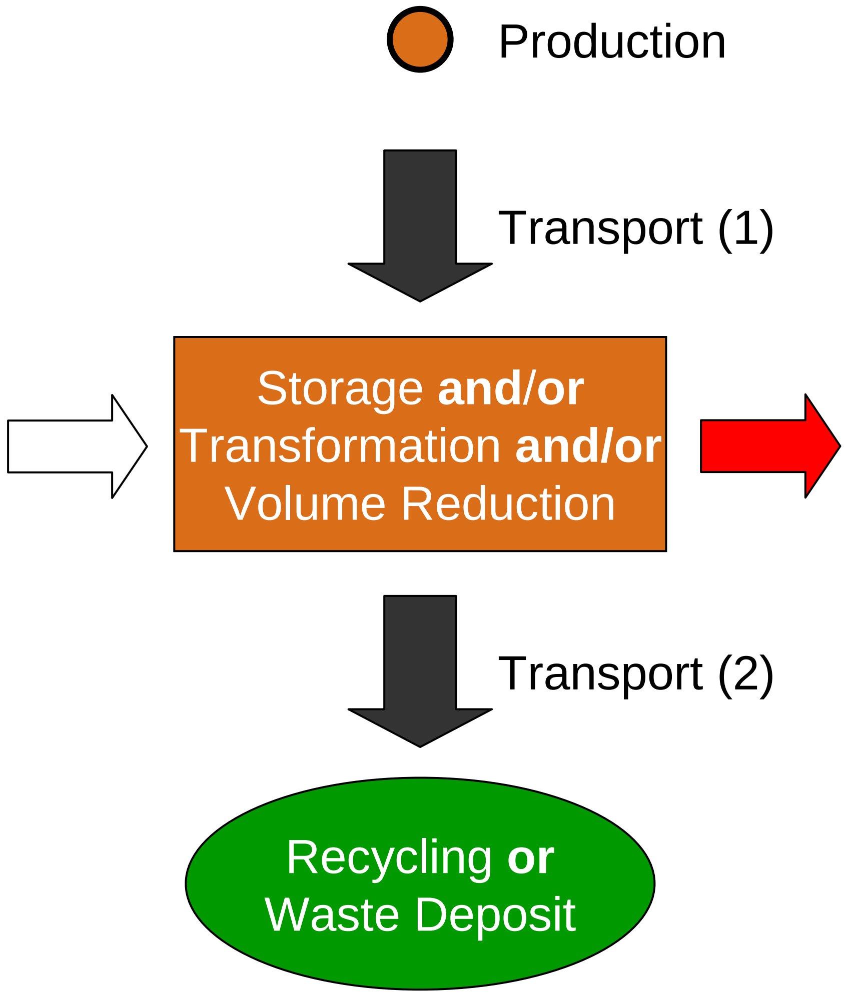
Minimizing residuals
Socio-economic models for transport *from on-site* application

Energy :

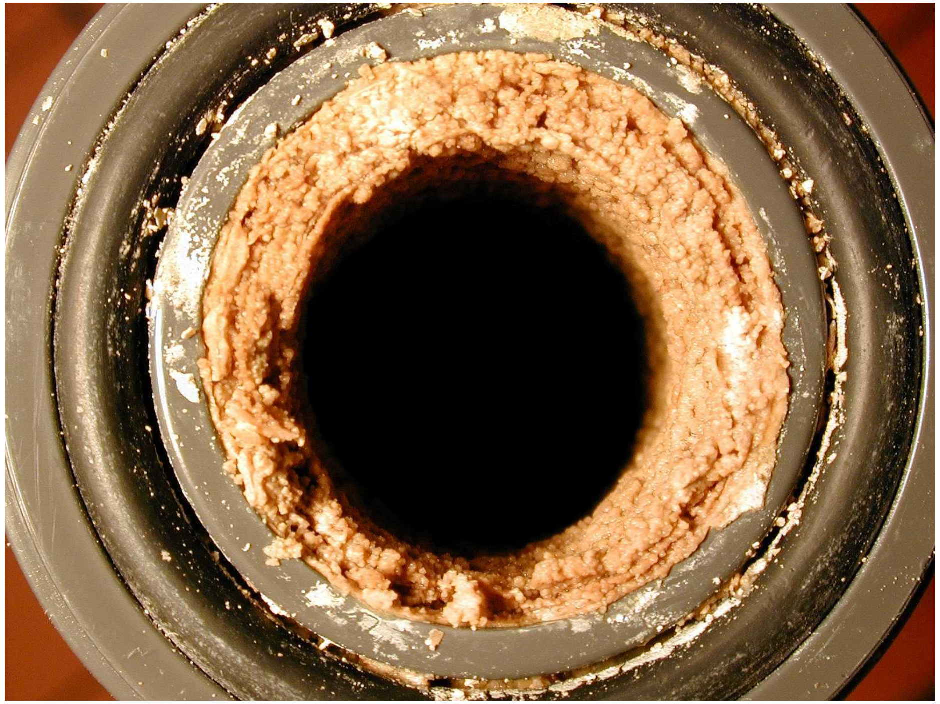
Process optimization
Solutions for on-site applications

Recycling:

Hygiene, Micropollutants, Salt



Scaling:
the main problem of transporting raw urine



Main knowledge gaps

Toilet and Processing unit:

Technology development
Mass production

Transport (1):

Optimizing *technical* solutions for transport *to (semi)-decentralized* processing unit

Transport (2):

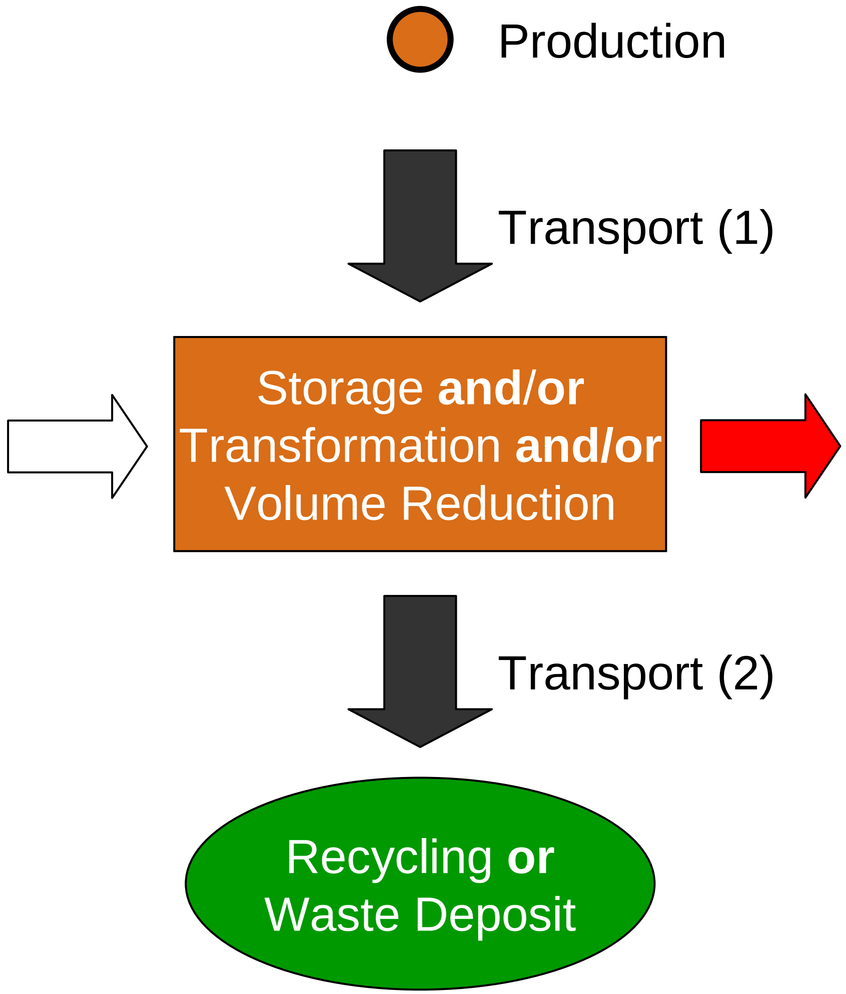
Minimizing residuals
Socio-economic models for transport *from on-site* application

Energy

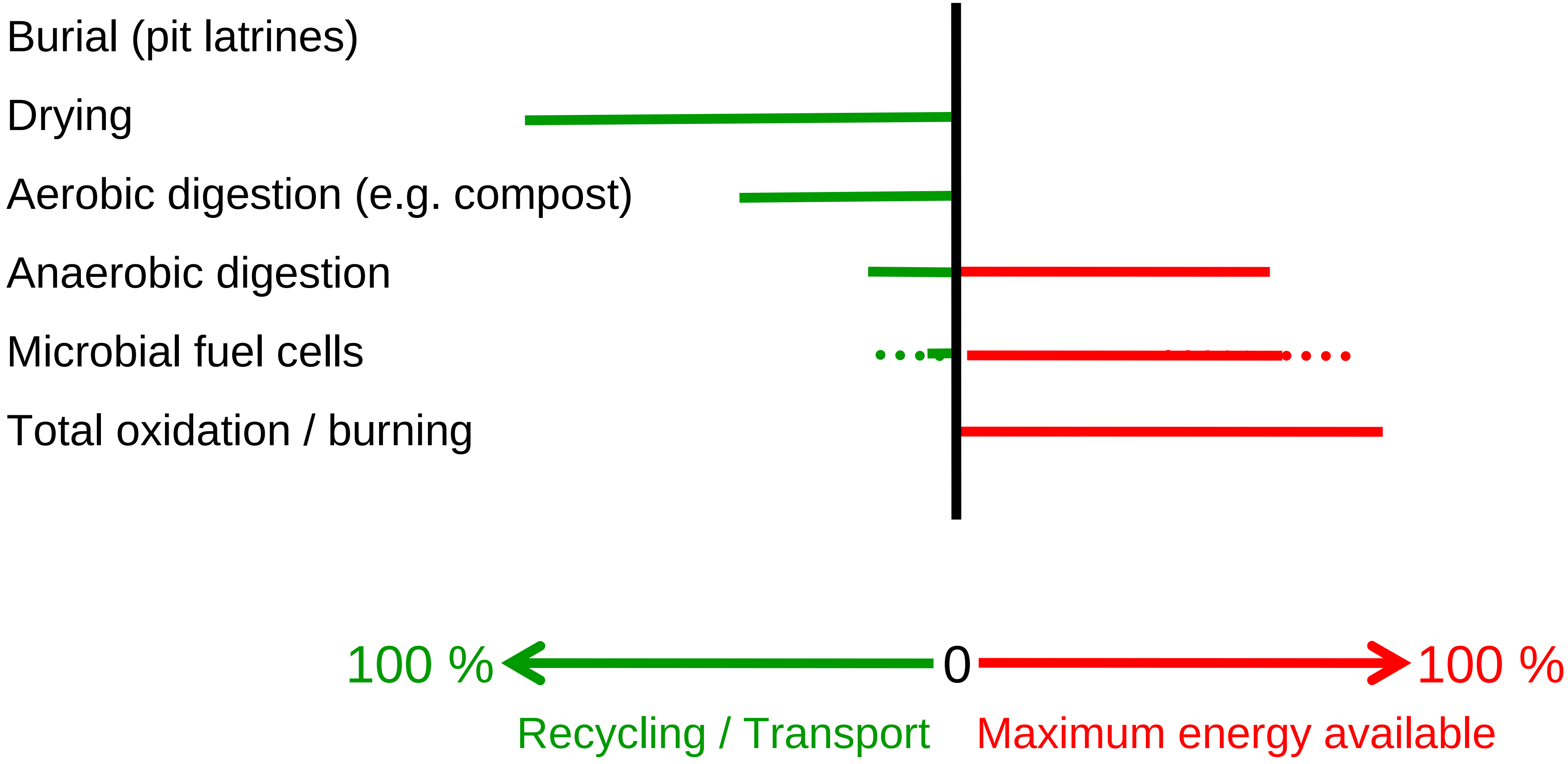
Process optimization
Solutions for on-site applications

Recycling:

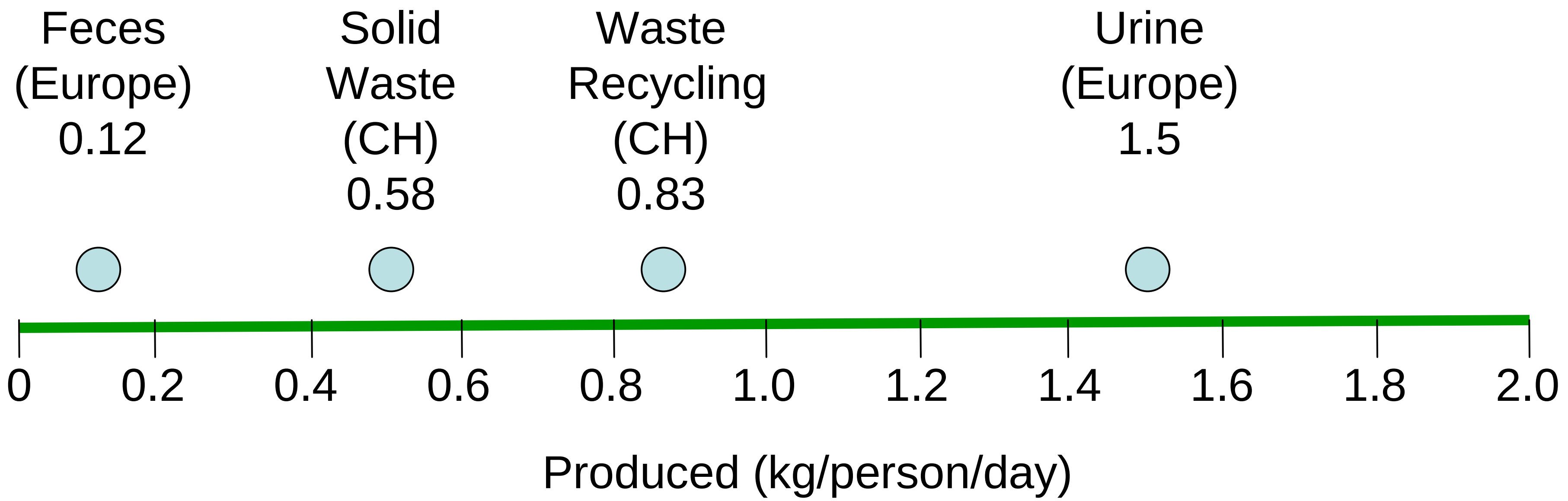
Hygiene, Micropollutants, Salt



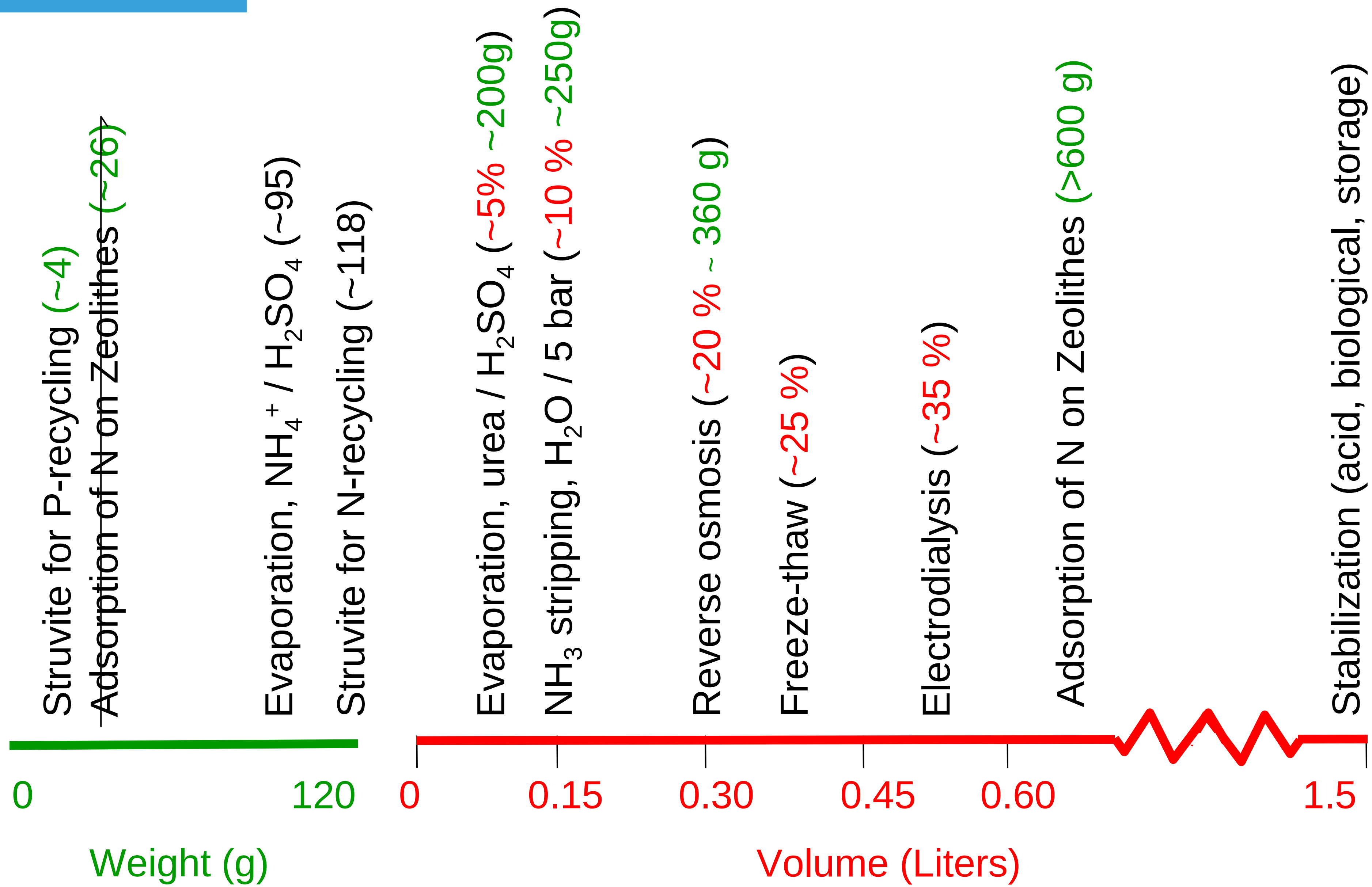
Approximate fate of organic matter in feces (~ 60 g COD /person/day)



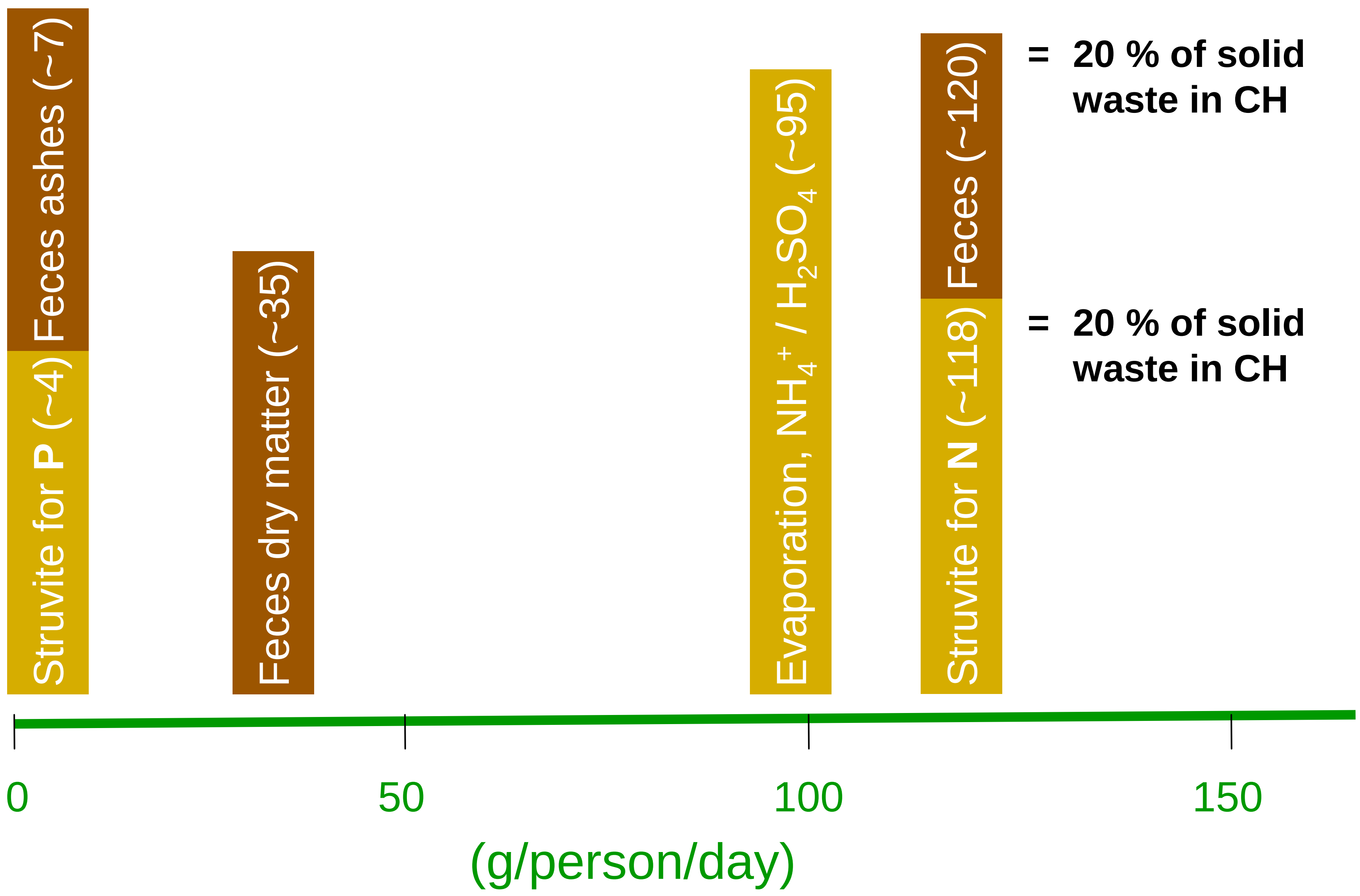
Transport: How much is much?



Recycling of nutrients from urine treatment



Comparison: amounts of urine and feces



Novaquatis (Nova 8)
Profiting from local knowledge

Photo: Edi Medilanski (Eawag)

Main knowledge gaps

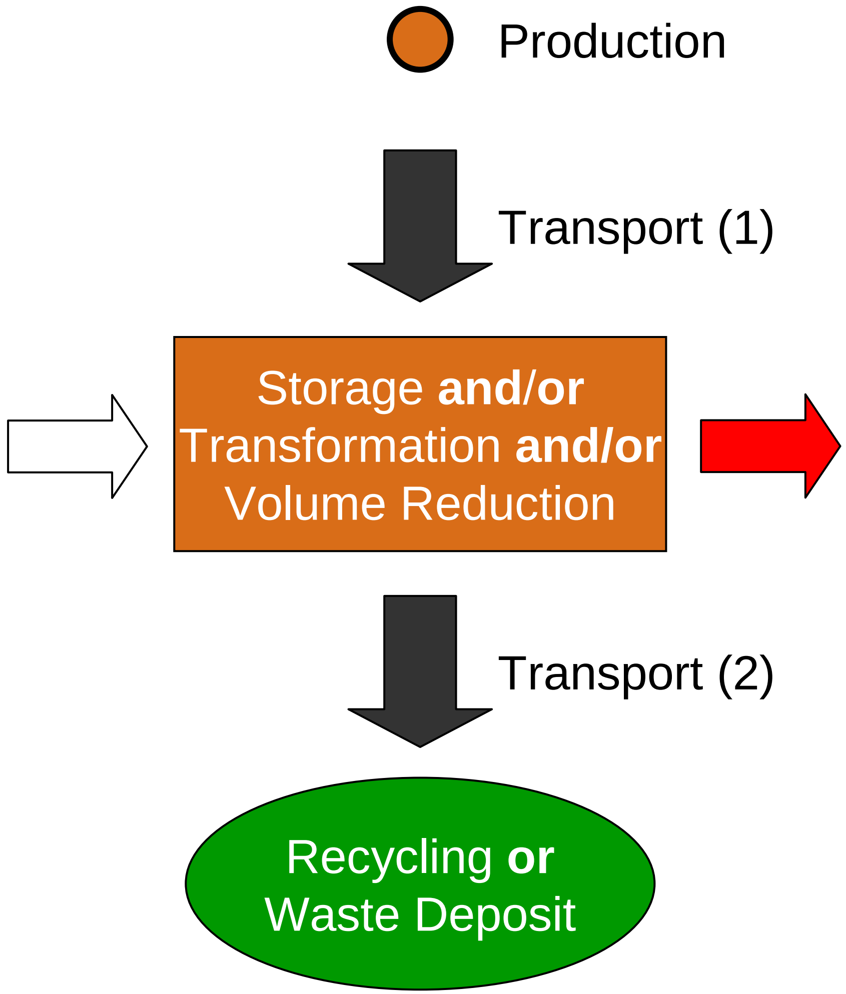
Toilet and Processing unit:
- Technology development
- Mass production

Transport (1):
- Optimizing *technical* solutions for transport *to (semi)-decentralized* processing unit

Transport (2):
- Minimizing residuals
- *Socio-economic* models for transport *from on-site* application

Energy :
- Process optimization
- Solutions for on-site applications

Recycling:
- Hygiene, Micropollutants, Salt



The hygiene aspect of recycling

What do we know?

- For feces, storage and biological processes work *to some extent*
- Urine is *less* of a problem; 6 months storage works (Caroline Höglund)

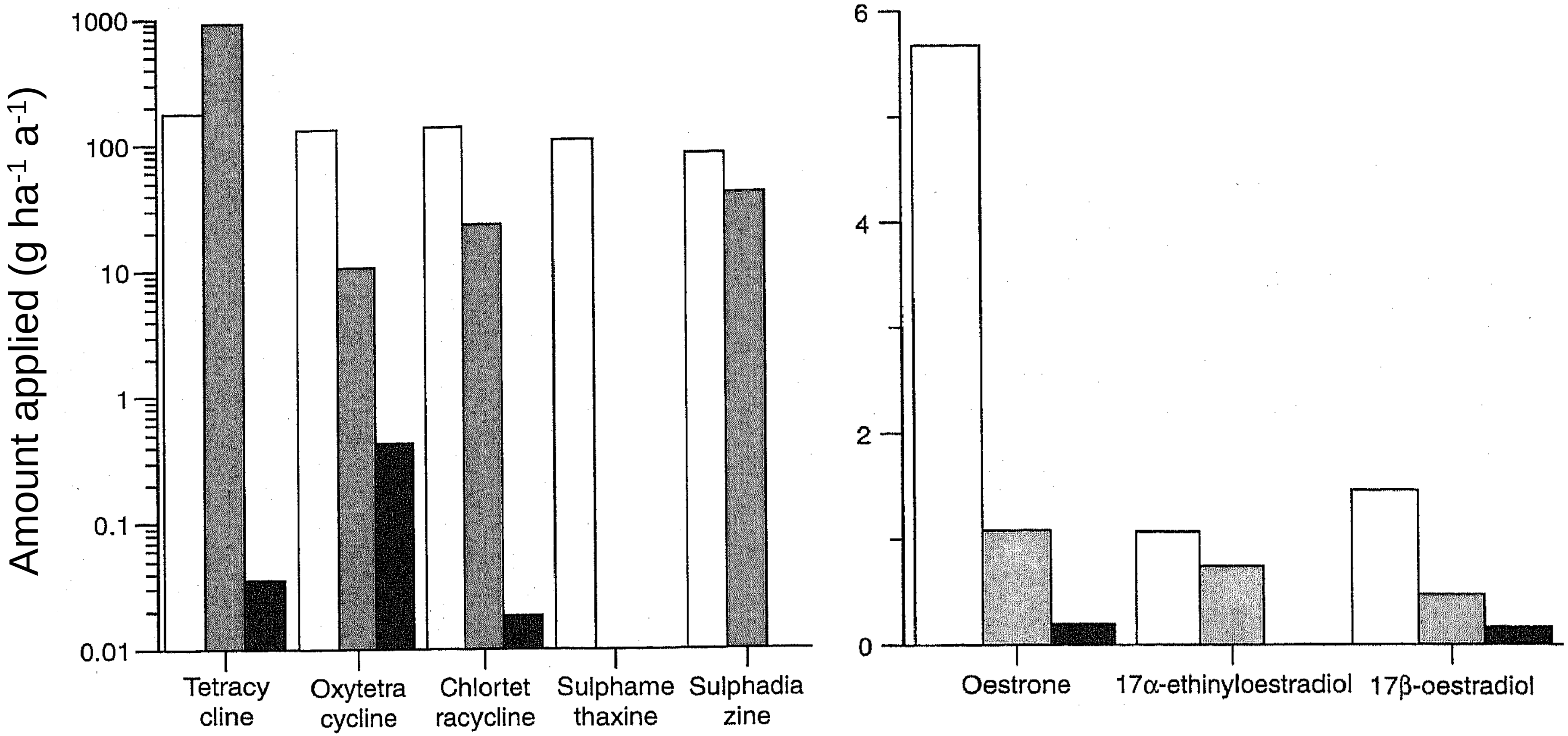
Main questions:

- Which are the relevant indicator organisms for feces and/or urine?
- Are they always the same, or do they depend on the setting?
- In which direction is research going? New methods?
- How far are we from standards, supported by cheap and efficient monitoring?

Feces market in China (Photo: Edi Medilanski, Eawag)

Are micropollutants a recycling problem?

Hammer and Clemens (2007) Water Science and Technology 56(5): 201-209



Fluxes per hectare and year using the optimum fertilizer dosage of pig and cattle slurry as well as human urine
a) Antibiotics (Figure 3); b) Steroids (Figure 4)

Average excretion of 212 pharmaceuticals

Lienert et al. (2007) Water Science and Technology 56(5): 87-96

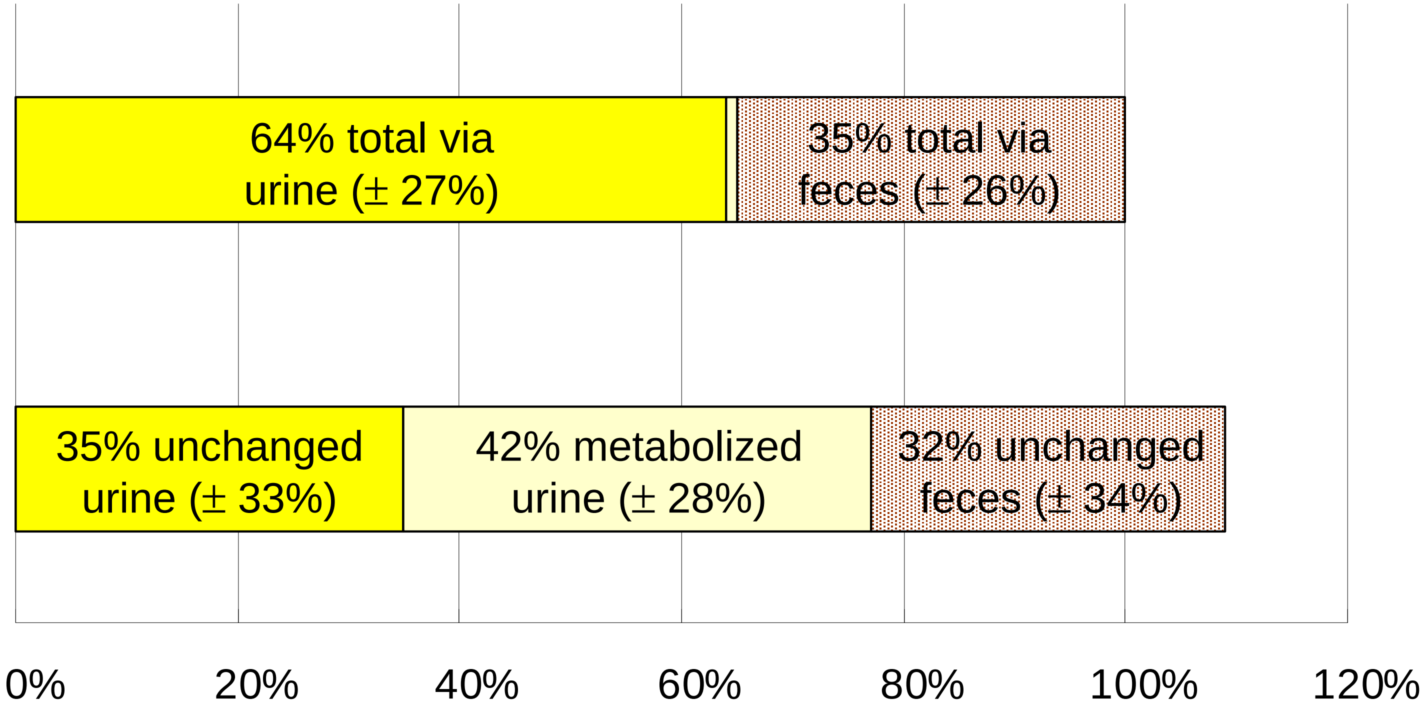
On average …

… the larger fraction of each active ingredient is excreted via urine

… ca. 42% of each active ingredient is metabolized

… metabolites are mainly excreted via urine

But data inconsistency and extreme variability from 0 – 100%



Removal of micropollutants in treatment plants: Ozonation or activated carbon

Ozonation

- *Rather* effective, but little information on transformation products
- Energy demand: 0.1–0.3 kWh/m3 (comparable to the present demand of WWTPs)
- Costs: 0.05–0.15 €/m3 (present WWTP: 0.5-2.5 €/m3)

Activated carbon

- Broad removal and total elimination of micropollutants during carbon regeneration
- CO_2 emissions: comparable to the present system
- Costs: 0.08–0.20 €/m^3 (present: 0.5-2.5 €/m^3)

Background-COD and concentration:
Important parameters for removal of micropollutants

Background COD

- Wastewater influent (100%)
- Wastewater effluent (10%)
- Urine (5%)
- Biologically treated urine (1%)

Typical European wastewater production

- Combined wastewater (100 m^3/p/year)
- Toilet (25 m^3/p/year)
- Urine (0.6 m^3/p/year)

eawag
aquatic research

For further information:
www.novaquatis.eawag.ch

Final report of the transdisciplinary Eawag project Novaquatis