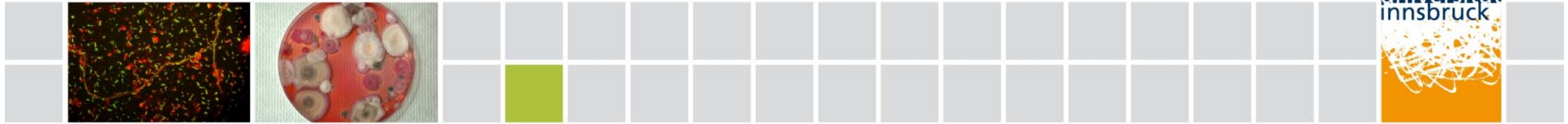




Microbes in waste management make our blue planet greener

Heribert Insam
Univ. of Innsbruck, Austria

M Probst, C Ebner, T Pümpel, A Knapp, A Walter, SM
Podmirseg, M Fernandez-Delgado Juarez, M Gómez-
Brandón, B Wett



The superchallenges of the 21st century

(W. Verstraete ®)

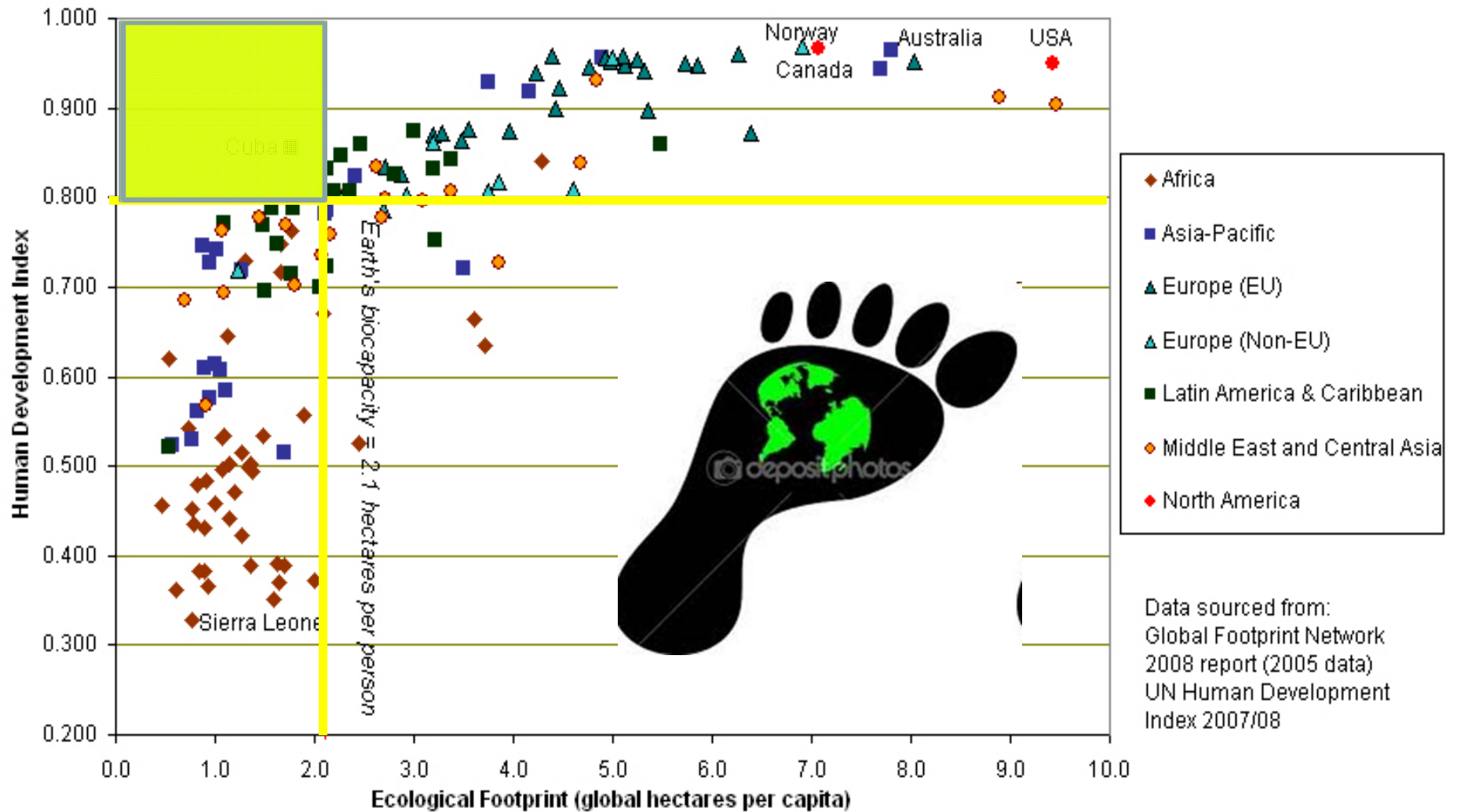
1. Increase of atmospheric CO₂

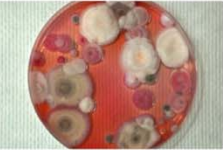
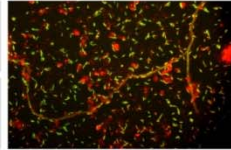
→ Global Warming

2. Energy crisis

3. Sustainable use of resources (water, soil, phosphorus, etc. etc.)

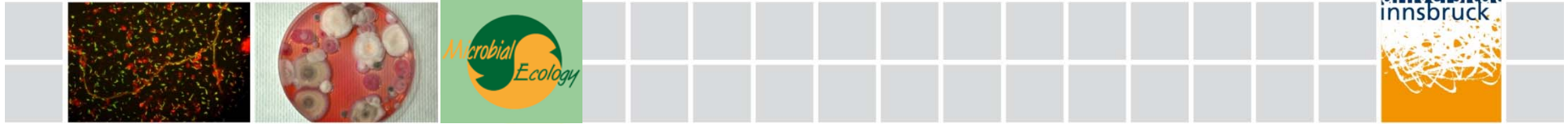
Human Welfare and Ecological Footprints compared





Microbial Resource Management

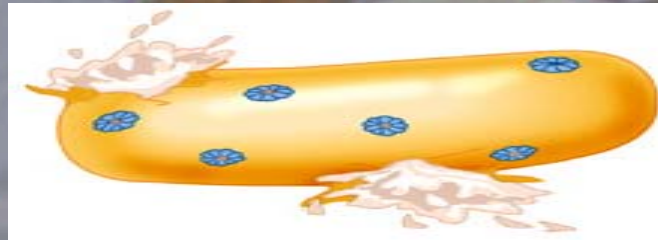
- **Biomethanisation**
(Pretreatment, microbiota, modelling)
- **Advanced products**
(Lactate, protein)
- **Wastewater treatment**
(DEMON[®], co-fermentation)
- **Soil effects**
(biomass ashes, digestates)



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Pretreatment strategies for lignocellulosic wastes



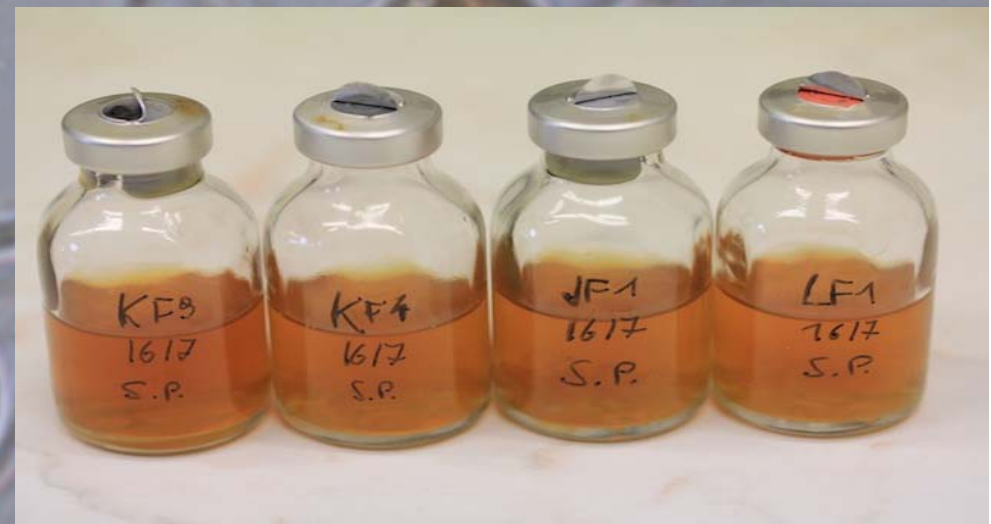
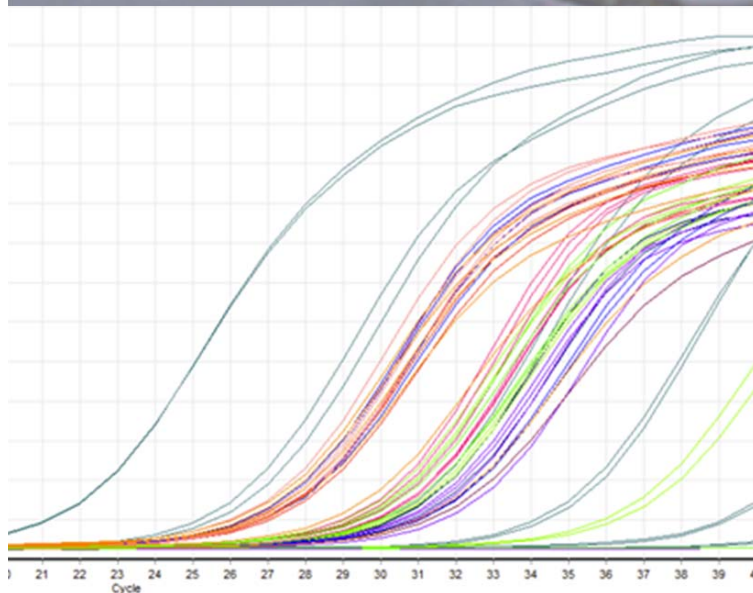
Cellulosomes
Rumen fluid
>30% increase in CH₄

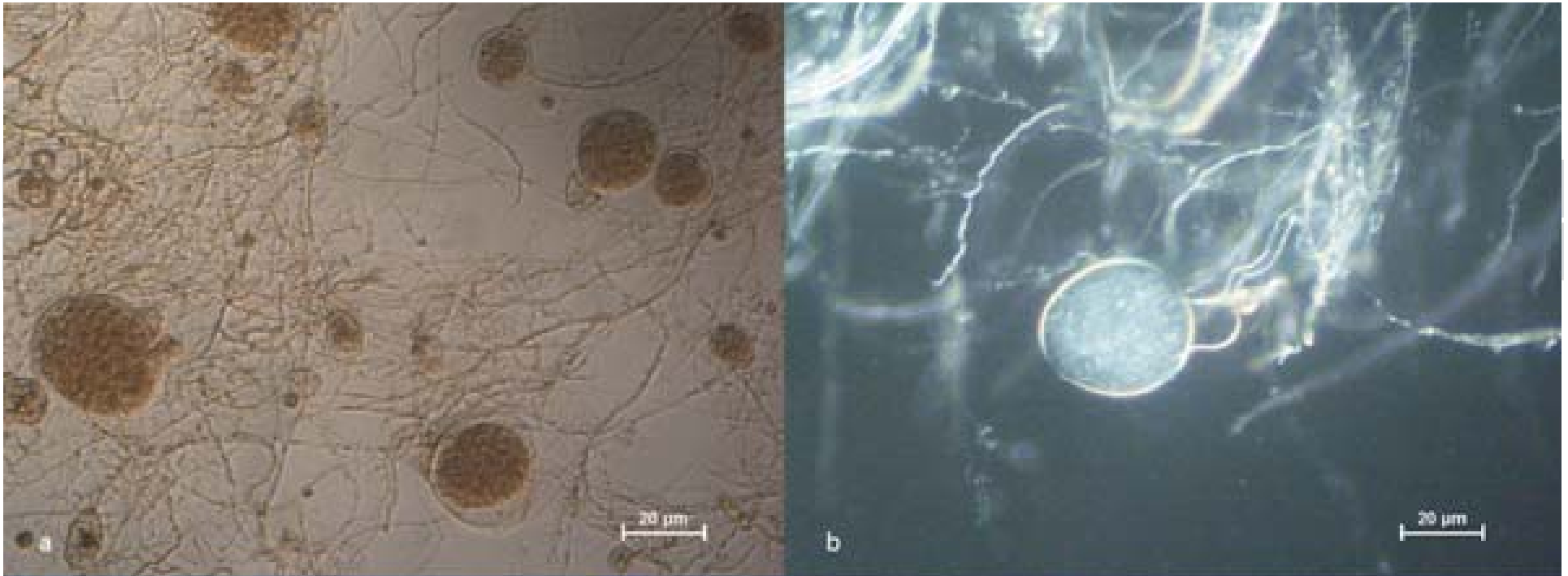


Dr. Podmirseg

Neocallimastix

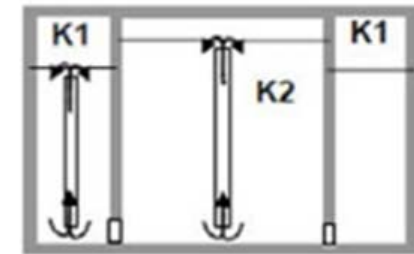
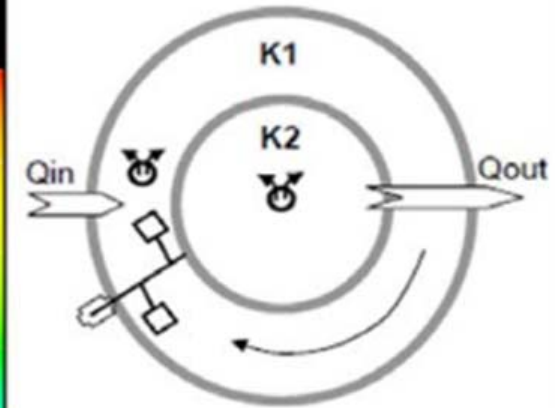
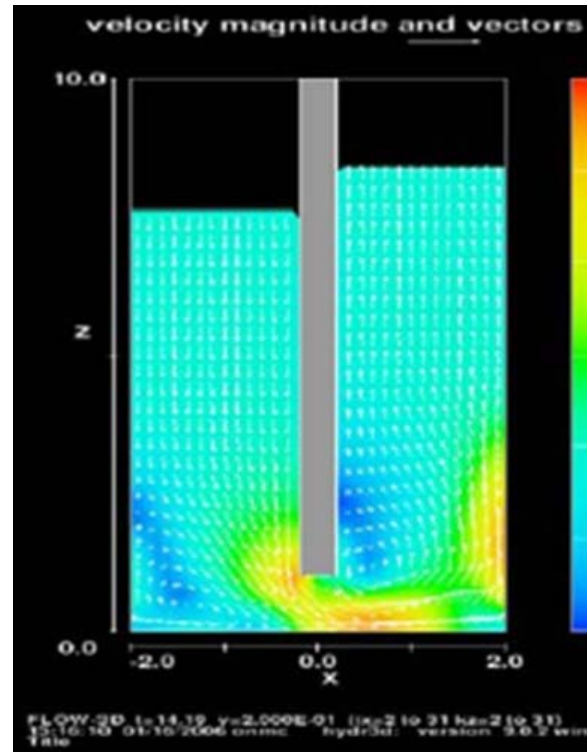
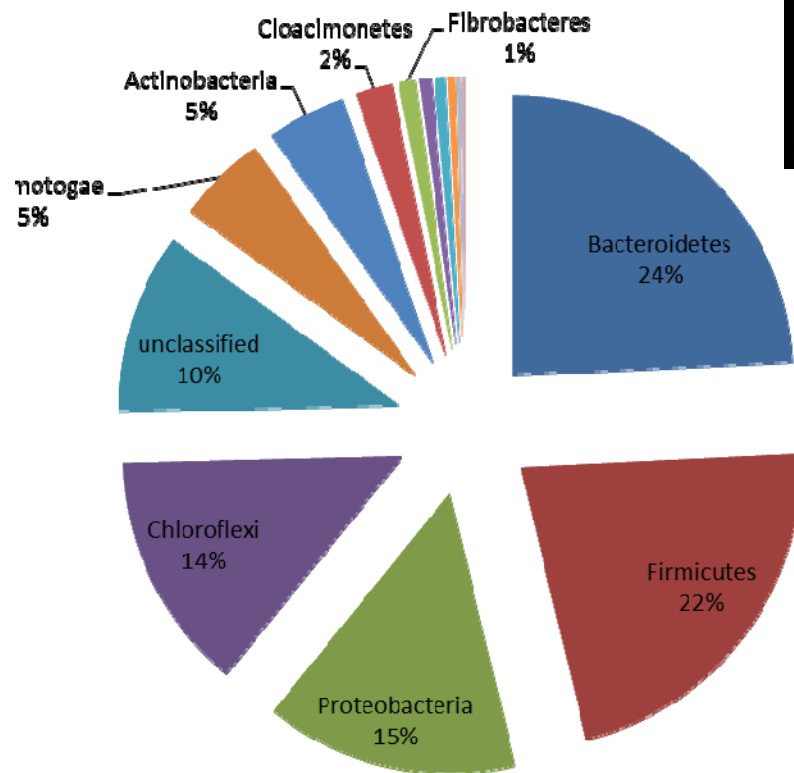
Neocallimastigomycota – culture collection





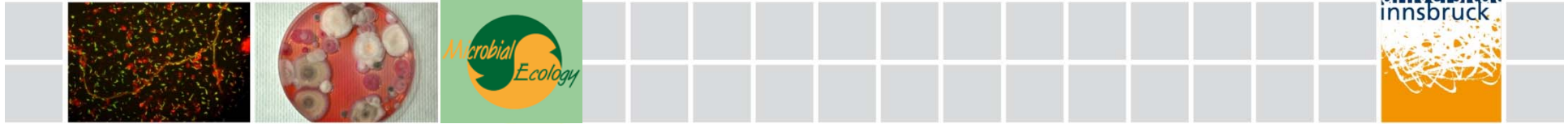
Neocallimastix frontalis, a- b: Mycelium and sporangia in different growth stages up to containing zoospores (light micr.).c: Sporangia stained with Calcofluor white. d: Sporangia stained with DAPI, nuclei visible in the sporangia and the mycelium. (Leis

60 plants
world-wide



Thermo-Gas-Lift +
Swip-swap technology

BIO-2-GAS



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Valorisation of Biowaste – lactic acid



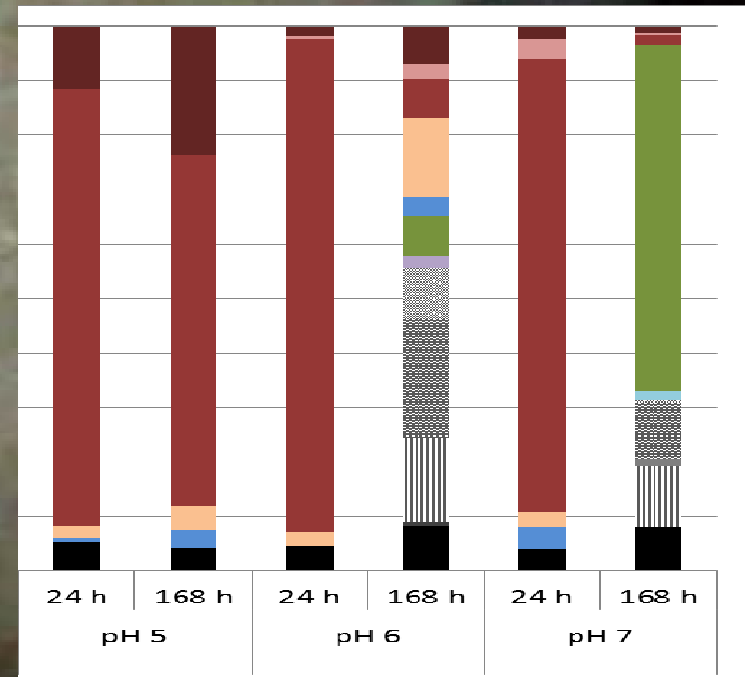
$5\text{g C}_{\text{lactic acid}} \text{g}^{-1}\text{C h}^{-1}$ and a concentration $> 30\text{gL}^{-1}$

high biogas potential of the remaining sludge

Circular Economy

cristalline

polylactate



Probst et al. (2015) (a) A closed loop for municipal organic solid waste by lactic acid fermentation. (b) End-product inhibition and acidification limit biowaste fermentation efficiency; both in Bioresource Technology

Protein from Black Soldier Fly

Growth rates of larvae (weight)

larvae

>40% Protein
>30% Fat



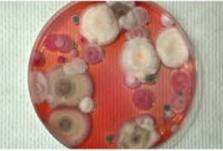
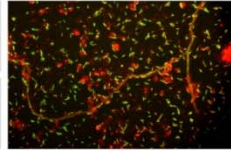
Day 1 Day 6 Day 10 Day 14 Day 17

pupae

- 100% hen fodder
- 1/3 digester sludge, 2/3 hen fodder
- 1/2 digester sludge, 1/2 hen fodder
- 2/3 digester sludge, 1/3 hen fodder
- 100% digester sludge
- Organic solid waste

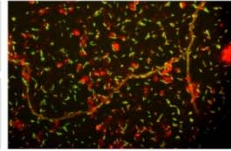
Andreas Walter



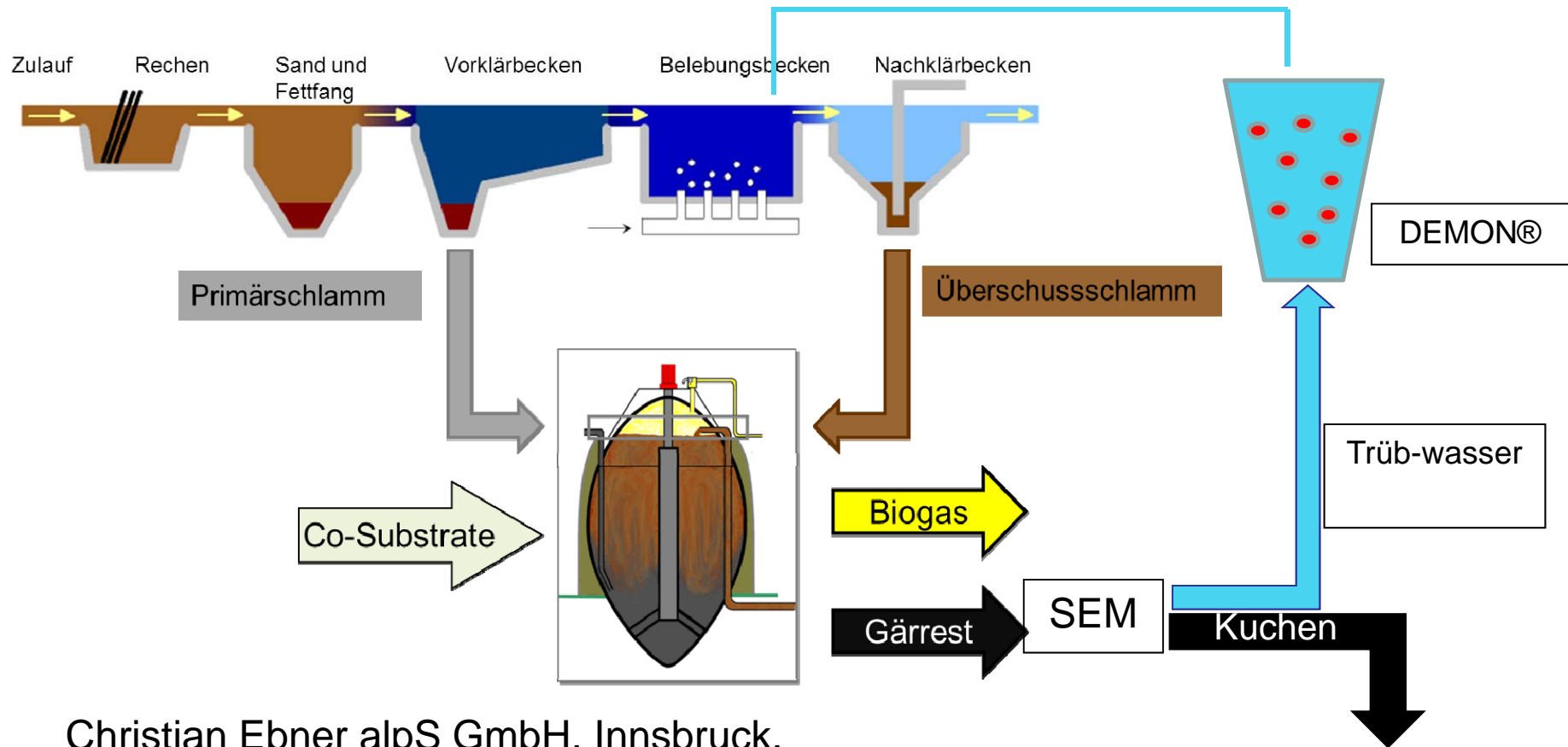


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Abwasserreinigung Filtratwasserbehandlung



Christian Ebner alpS GmbH, Innsbruck.

Kooperation mit ARA Zirl, Inst. f. Infrastruktur

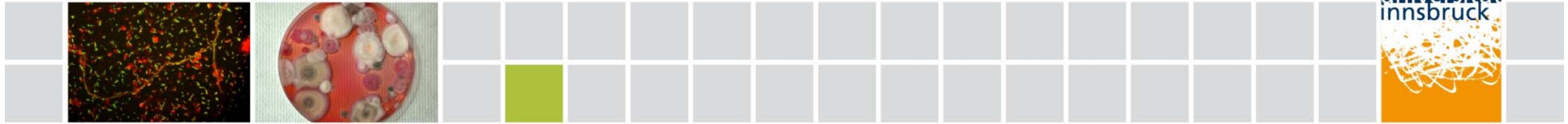
Anaerobic ammonia oxidation

- Saves energy in WWTP
- WWTP turned to powerplant



**AnAmmOx-
Granule**

More than 70
DEMON® - plants
worldwide



Co-fermentation of Wastewater sludge + OFMSW (biowaste)

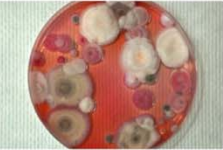
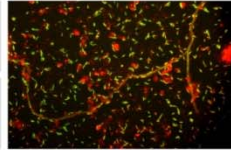
Priming effect:

30% increase in methane production

25% decrease in residual anaerobic sludge

Aichinger et al. 2016 (2016) Water Research

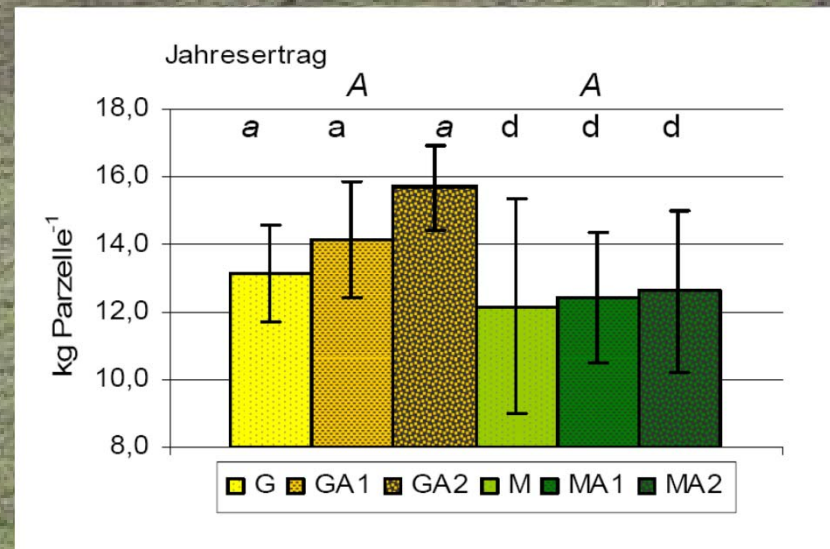
Insam and Markt (2016) Water Research



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Effects of anaerobic sludge and biomass ashes

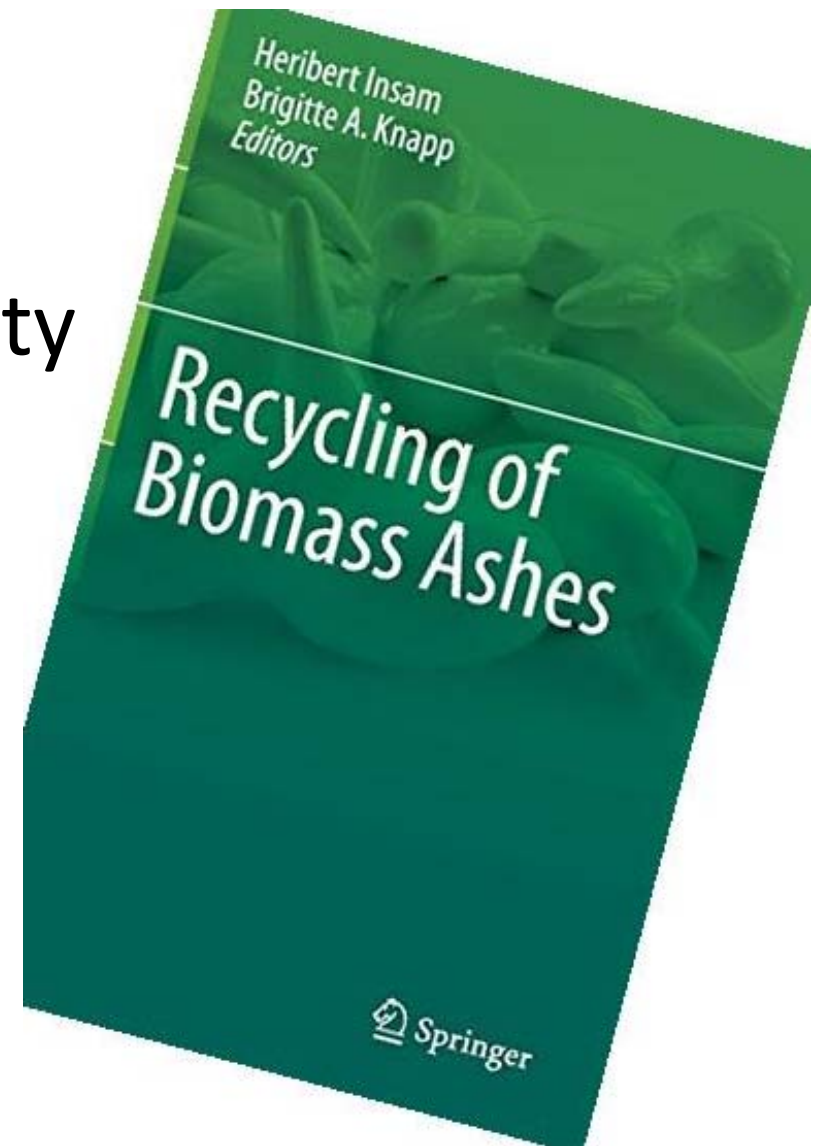


Biogas slurry:

- Higher nutrient availability
- Reduced pathogens

Biomass ashes:

- Recovery of phosphate
- Lime replacement
- Micronutrient supply

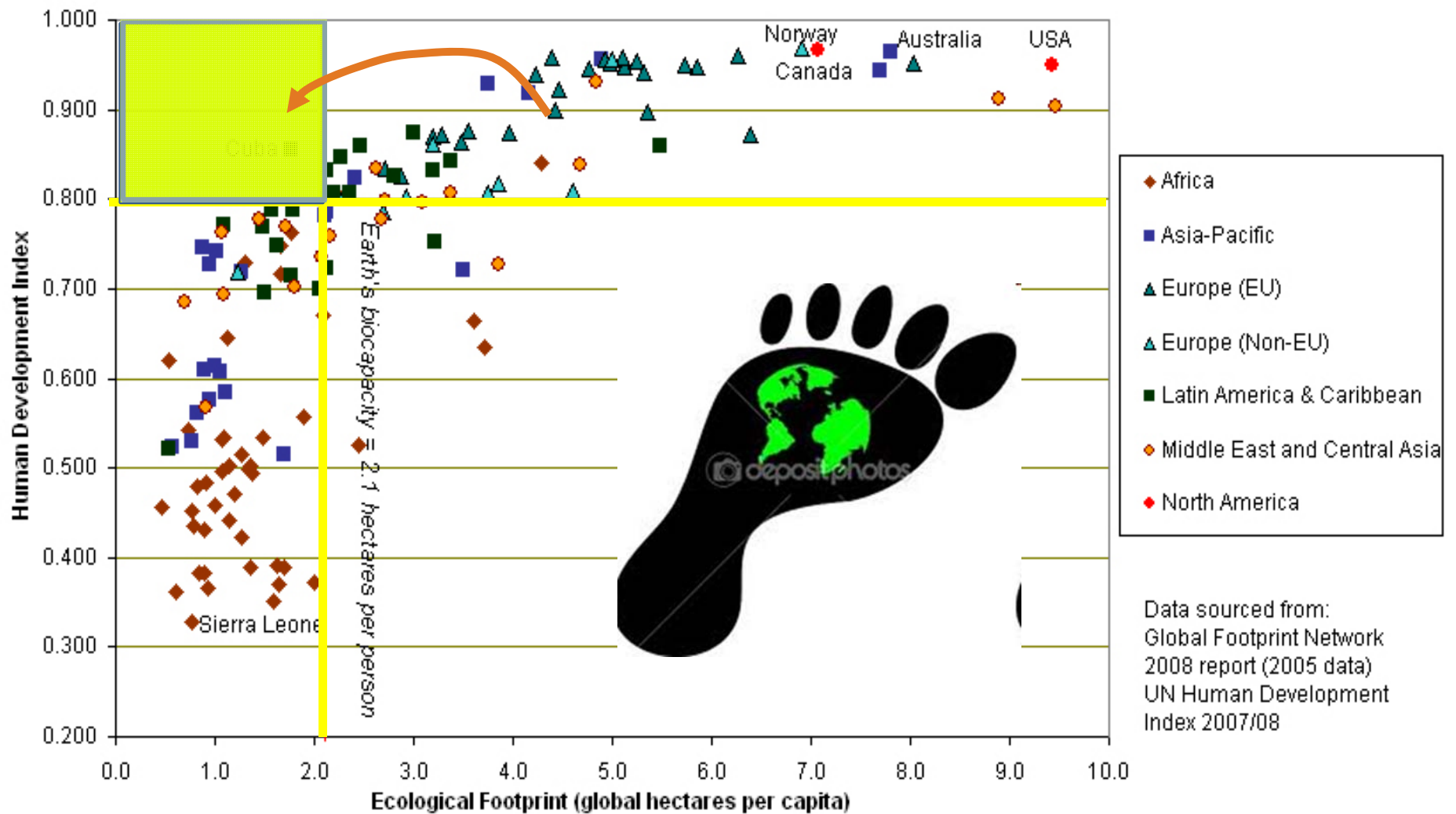


Insam et al. 2015 Soil Biology and Biochemistry 84

Fernandez et al 2015 Waste Management 46:155-164

Fernandez et al. 2015 Science of The Total Environment 511

Human Welfare and Ecological Footprints compared





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Thank you for your attention