Processing of Digestate

Project of BFE
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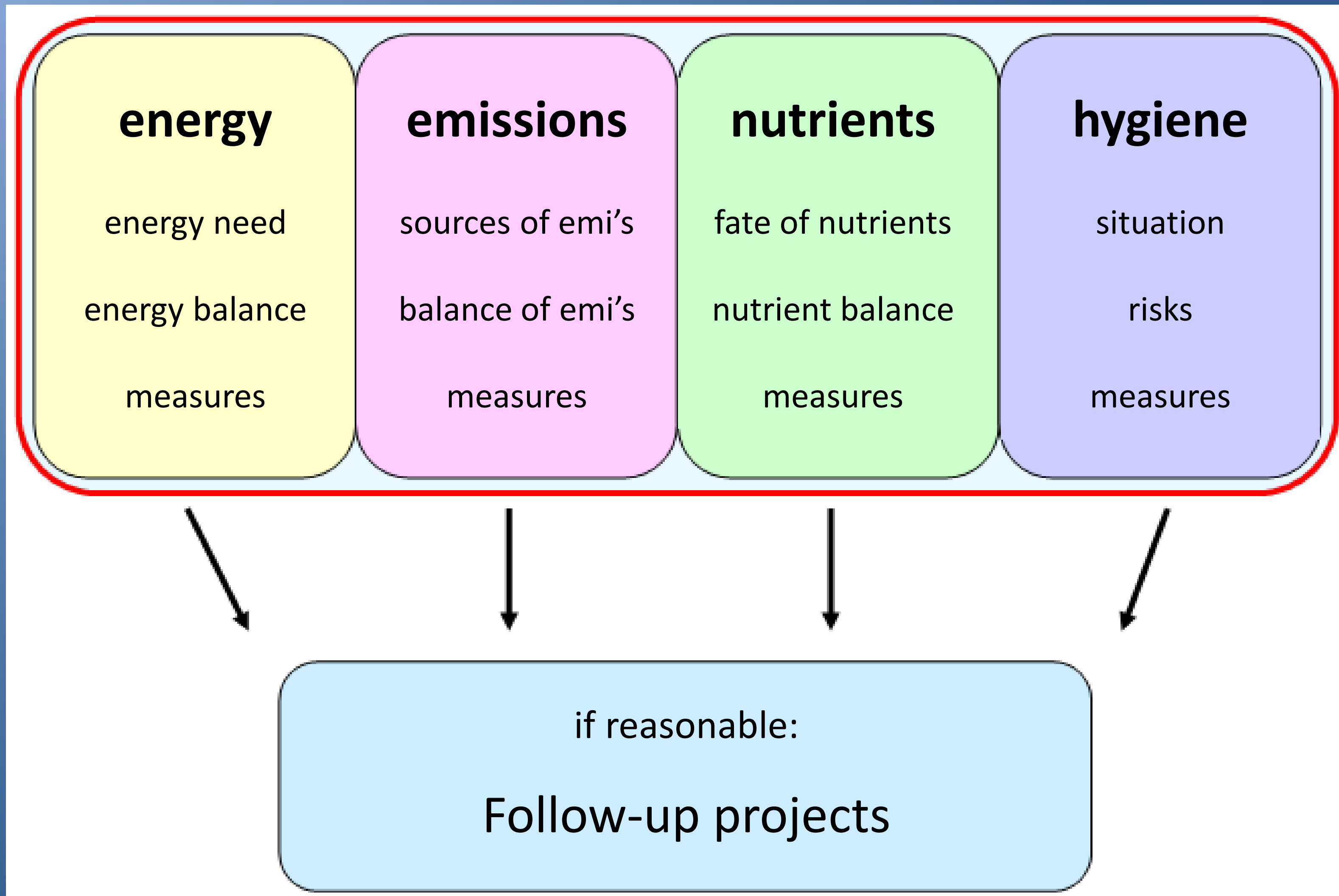
Aim of the Project

- for large biogas plants, digestate has to be transported great distances for utilisation
- transport of water needs energy
- is it reasonable to separate nutrients, notably N, from an energetic and ecological point of view?
- are there additional advantages of nutrient separation?

Modules of the Project

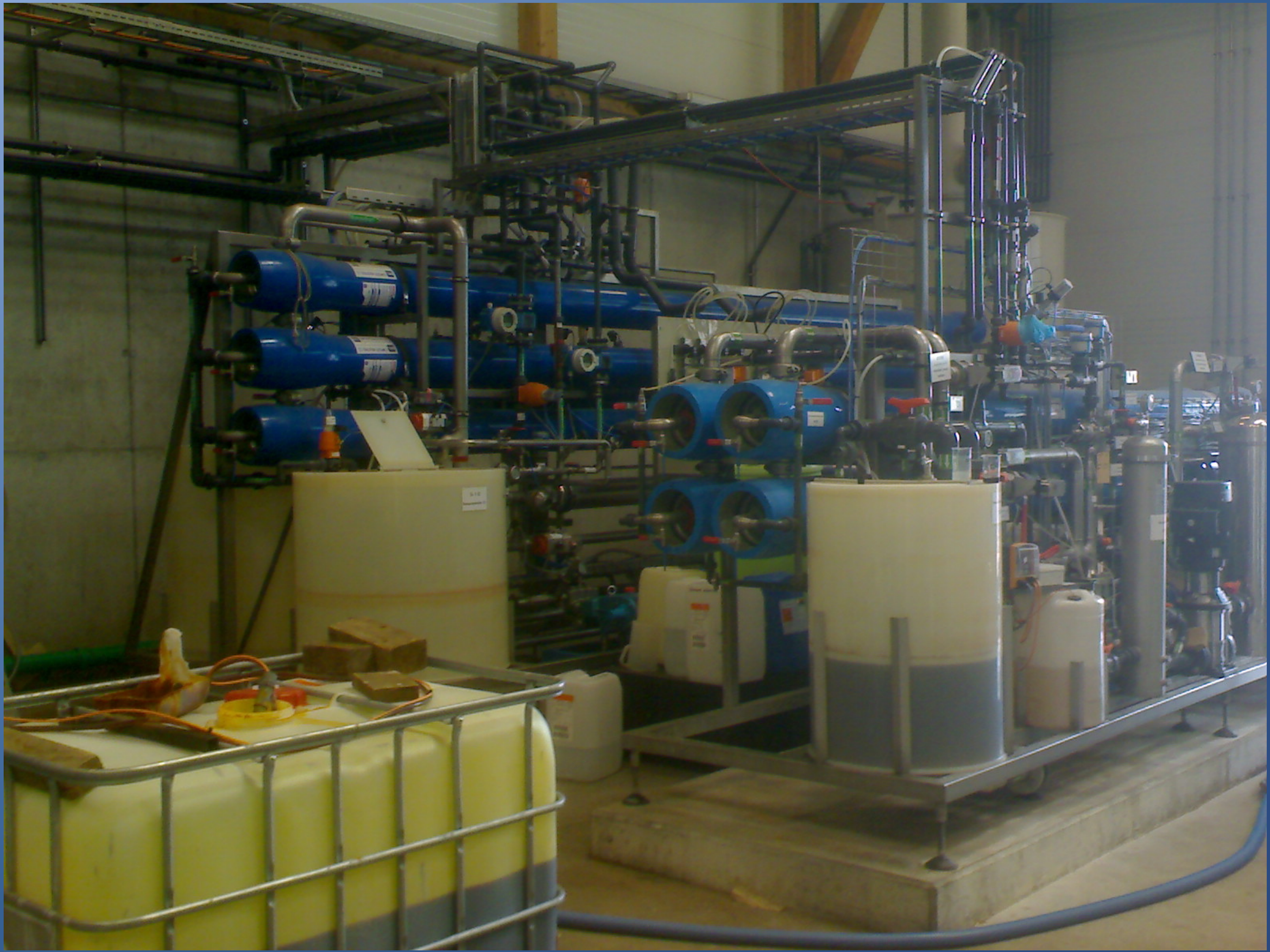


Digesters

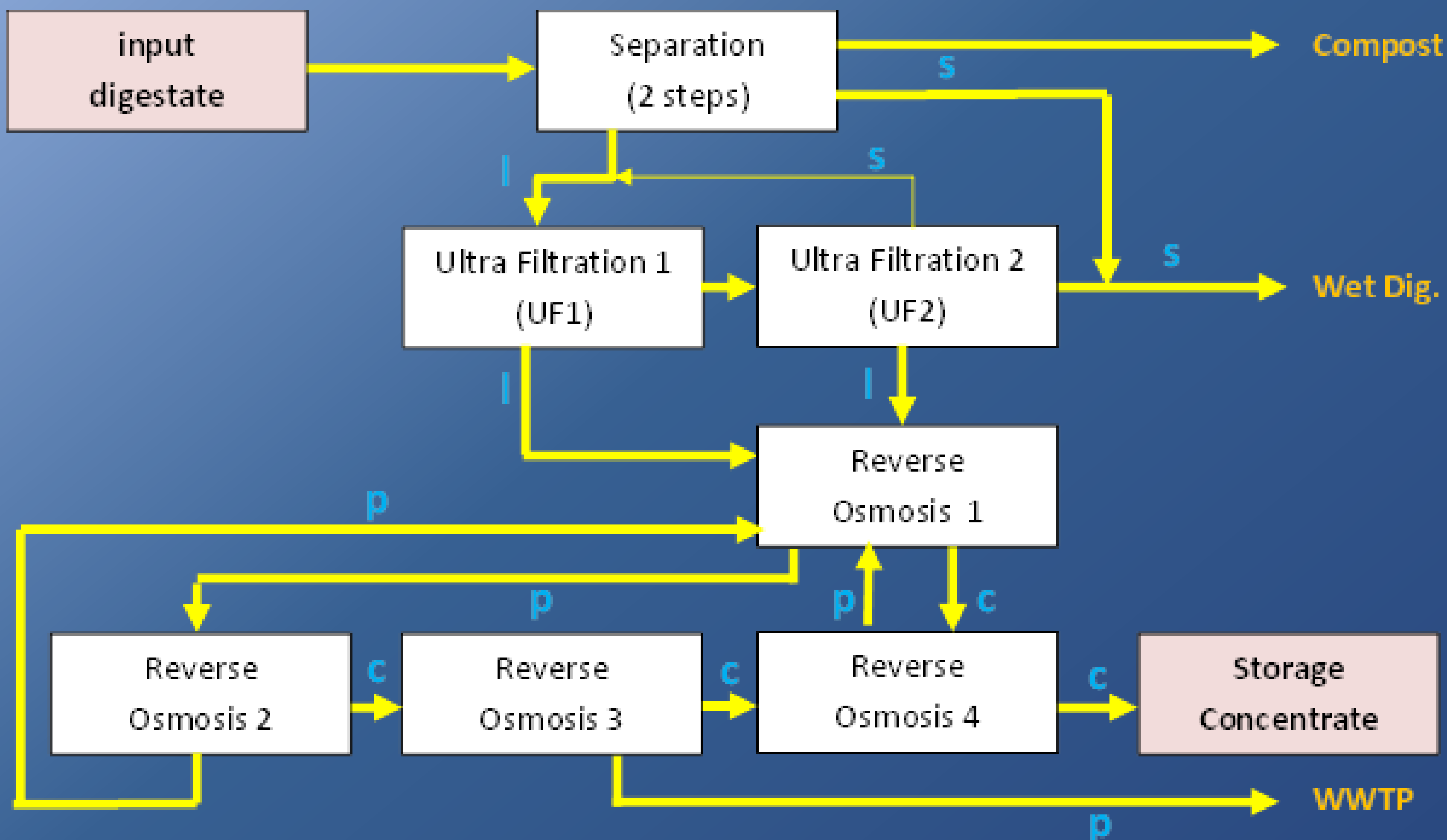
Solid/liquid separation

Ultra Filtration

Reverse Osmosis



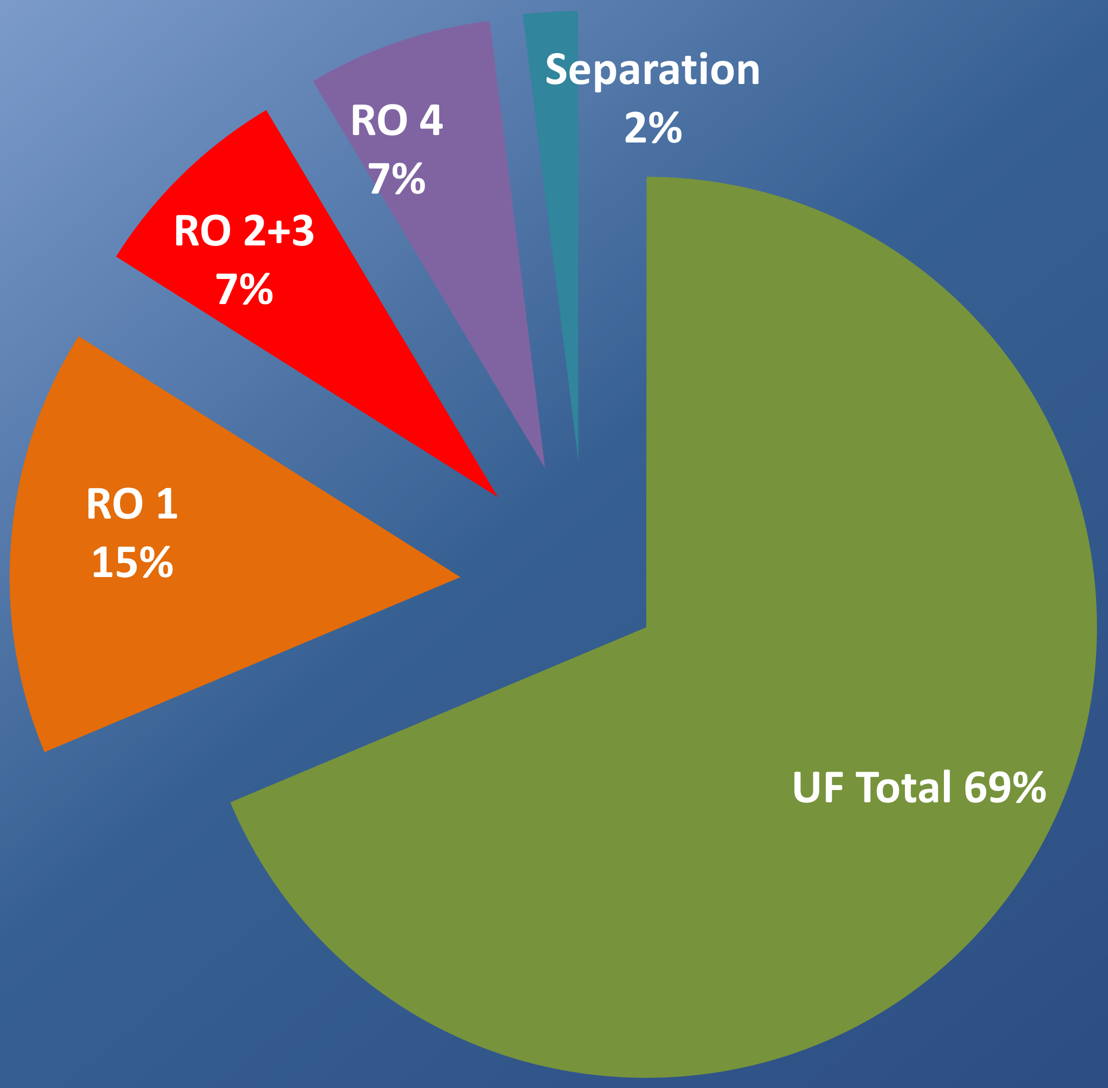
the digestate processing plant



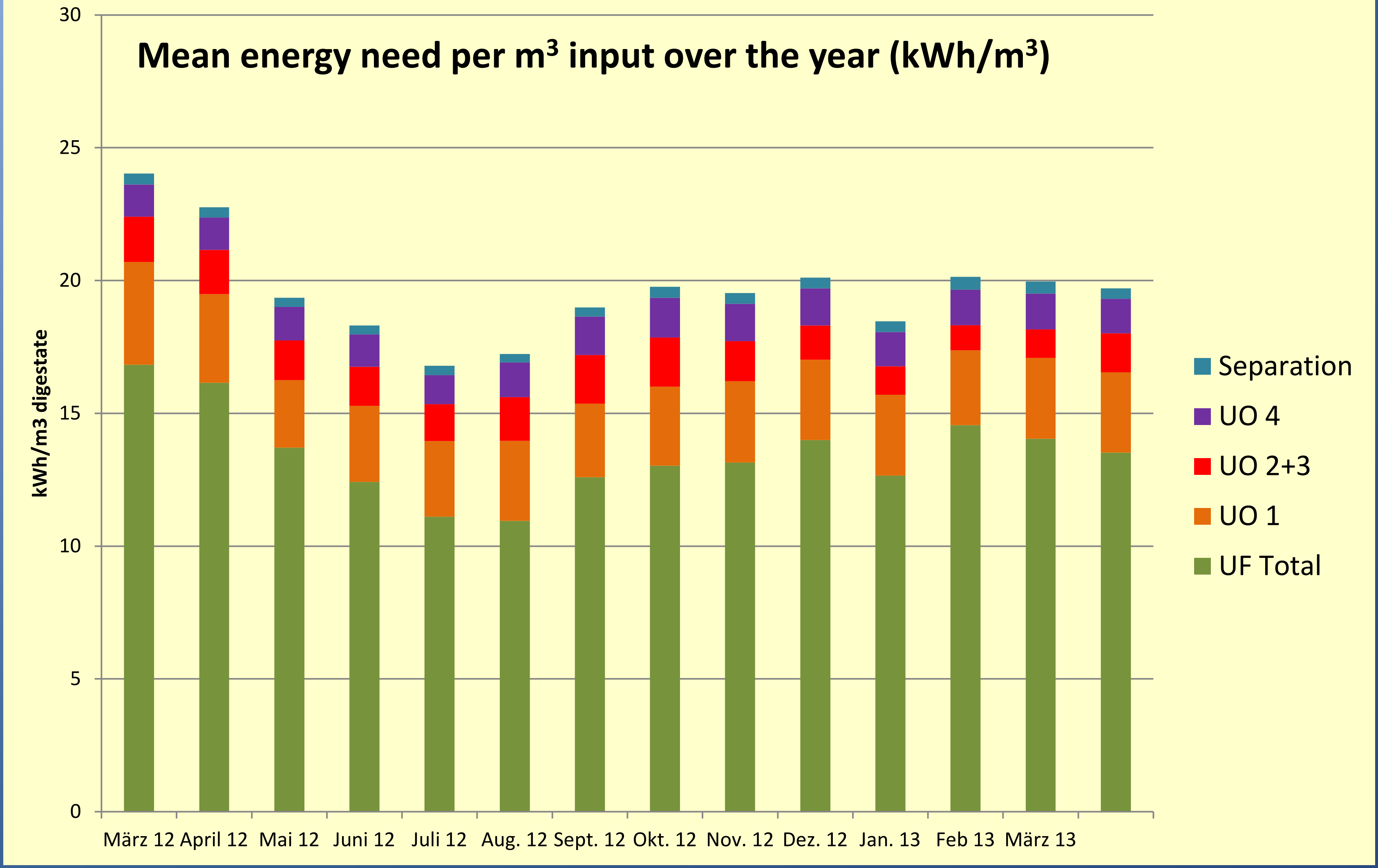
Module Energy

- energy needs of the single steps
- energy need compared to energy output
- savings of fossil fuel for transportation
- comparison of energetic costs and benefits
- are there savings of chemical fertilizers by separating the nutrients?

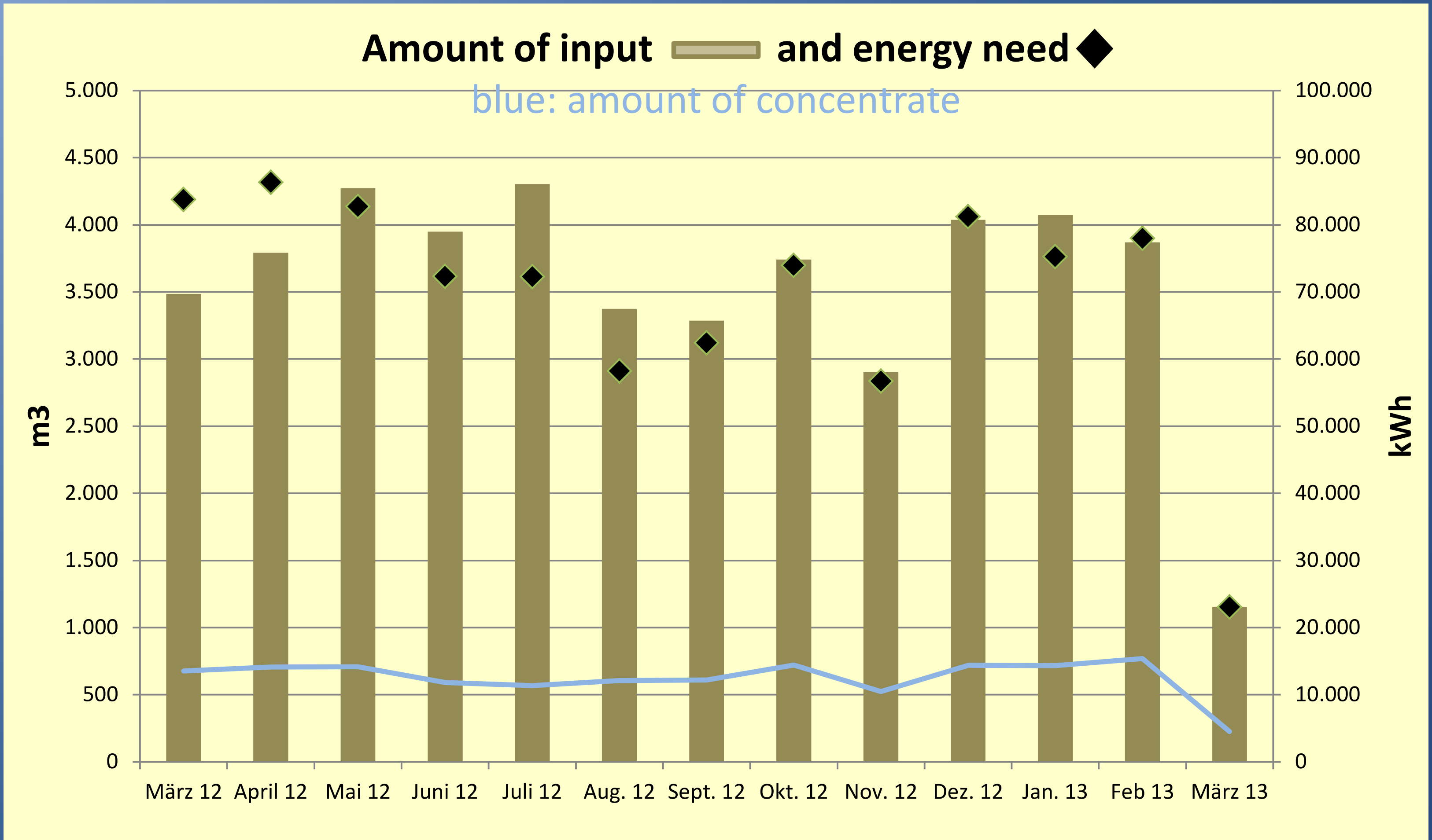
Energy need of components



Seasonal energy need



Energy need and amount treated



Energy produced and energy needed for processing

Mean yield of Biomethane (H_s) per fresh material	405	kWh/t
Electricity produced (η = 38%)	154	kWh_{el}/t
Energy need for processing of the digestate	22.5	kWh/m^3
Percentage of H_s needed for processing	5.5	%
Percentage of the electricity produced needed for processing	14.6	%

Module Emissions

three sources of emissions:

- emissions from the plant itself while processing the digestate
- emissions of the trucks while transporting and delivering the liquid fractions
- gaseous emissions while applying the fertilizer on the field

Emissions from the plant

- between delivery and digestion: identical emissions
- s/l-separation: ev. less as compared to agri digester
- no emissions from UF and RO
- emissions from storage of concentrate comparable to those, when storing liquid from l/s-separation (higher concentration in the head space – but less respiration)
- conclusion: no significant difference to a conventional plant

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Emissions from transportation

- transportation is necessary
  (here: 55 km)
- transport to the fields are reduced by a factor of 3
- drilling of concentrate doubles the ride on the field
- drilling needs 2-3 times more energy than a draghose
- final results: after experiments!
  (probably no big advantage)

Emissions from transportation

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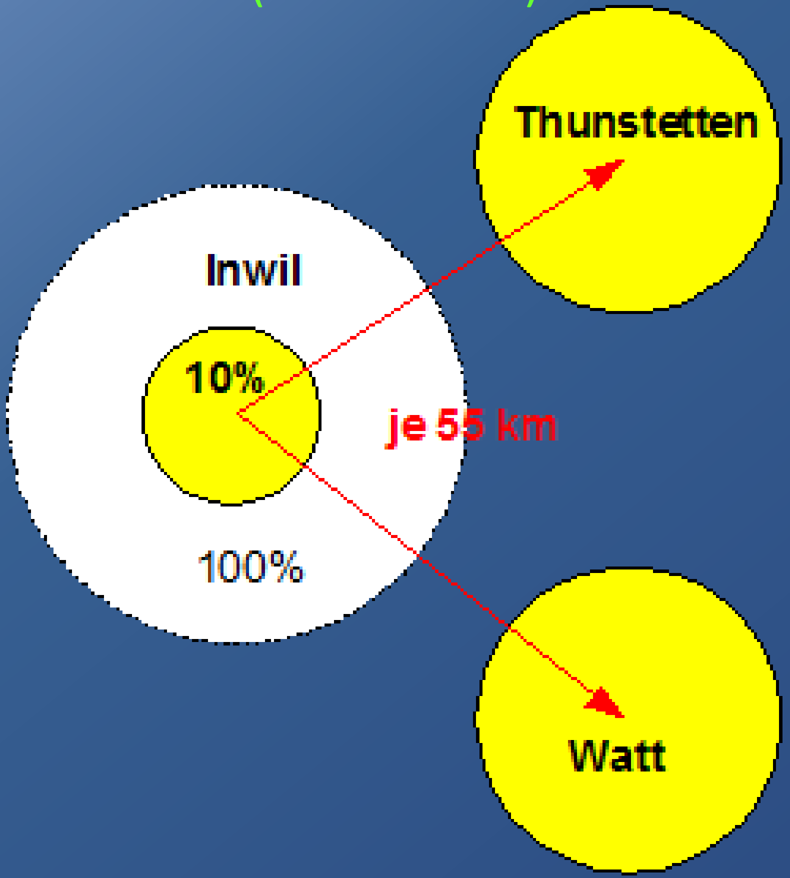

Emissions while applying

- pH of concentrate = ~ 8.1-8,3 !

(~ 10% of the Ammonium-ions are converted into Ammoniac!)

- high risk of ammonia losses
- Dutch studies indicate that losses are difficult to avoid
- conclusion: field experiments and experiments on plots will be done next month

(collaboration with BHL)

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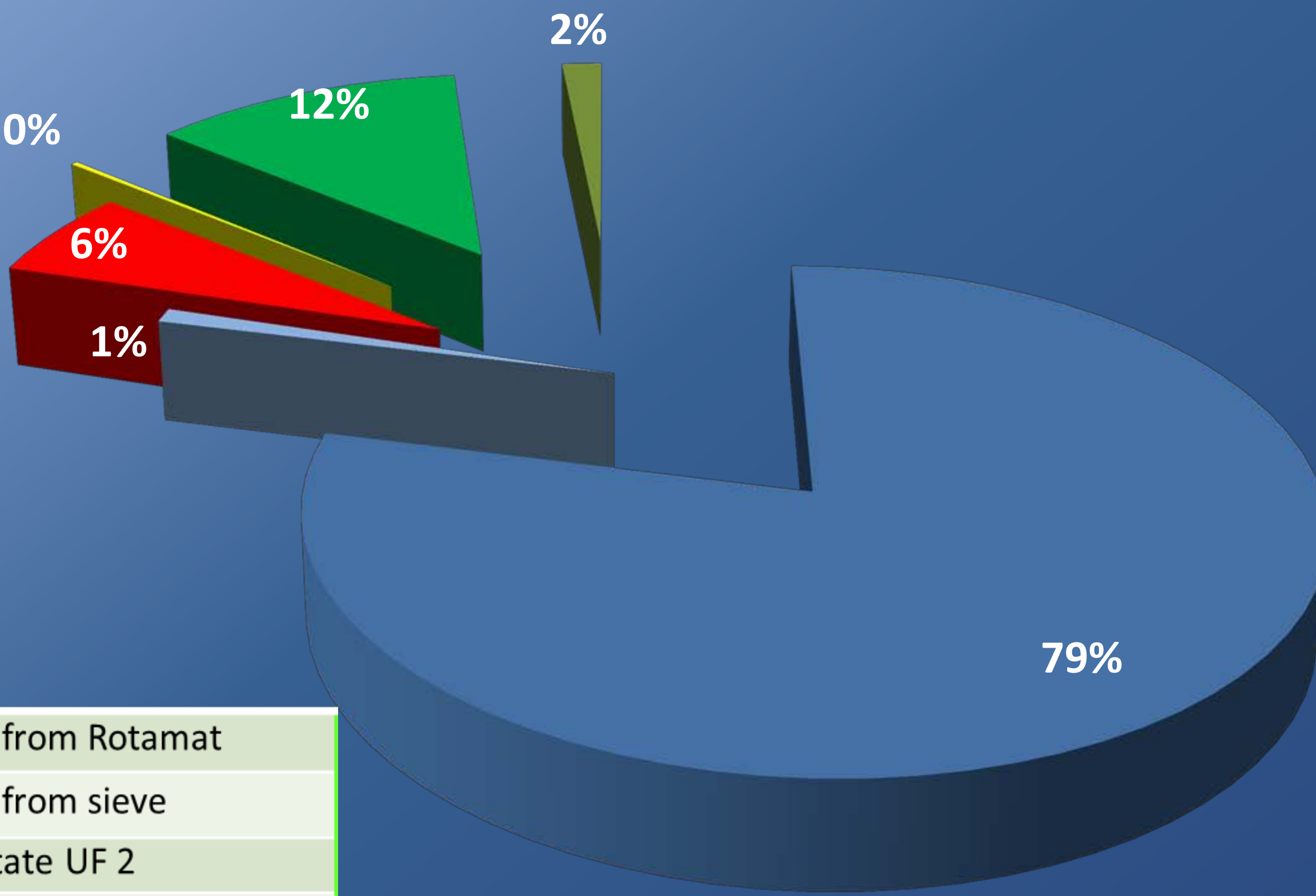
Module Nutrients

questions:

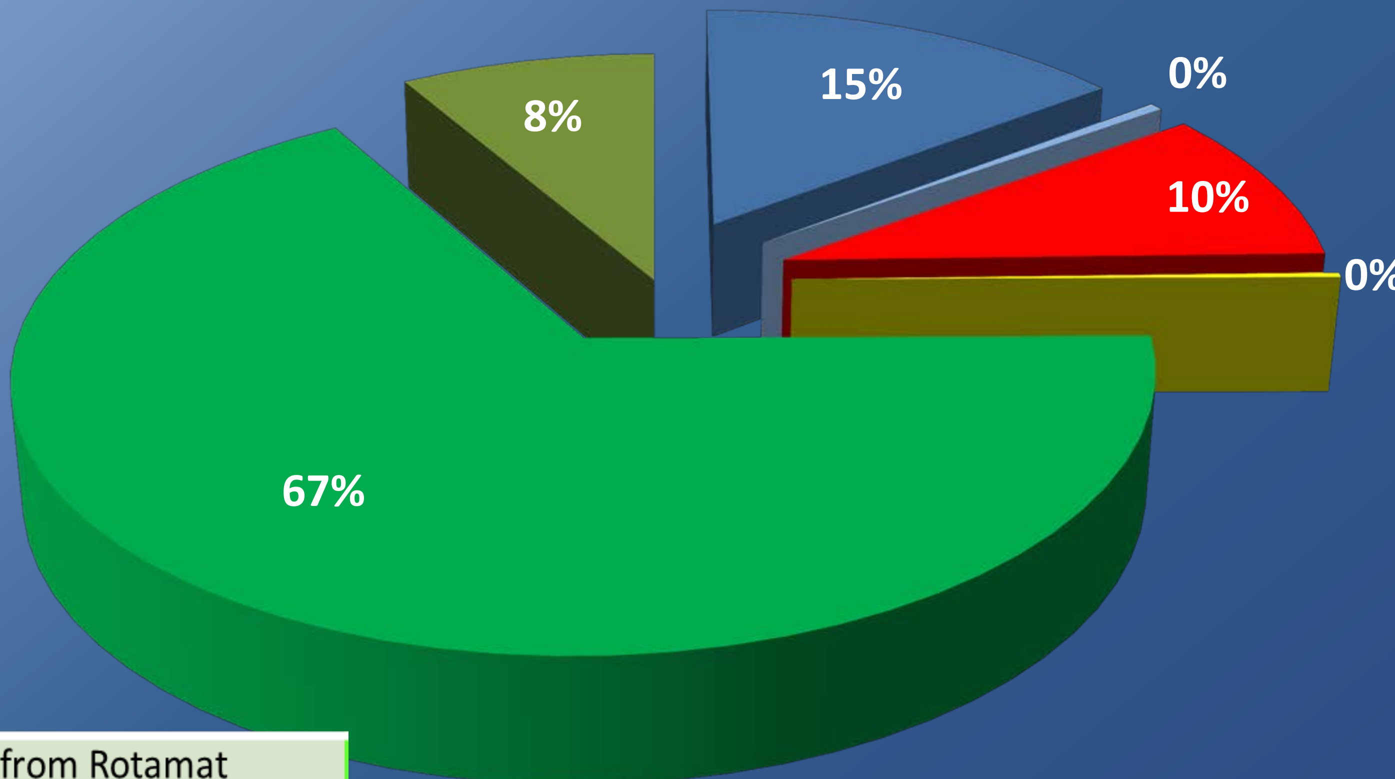
- distribution of nutrients and heavy metals in the different fractions of digestate separation
- mass balances of DM and OM
- are there possibilities for an optimization?

e.g.: fate of OM



F1.4	Solids from Rotamat
F1.7	Solids from sieve
F2.4	Retentate UF 2
F4.6	Permeate RO 3
F5.1	Concentrate RO 4
F3.3	Concentrate RO 1

e.g. Fate of Ammonium



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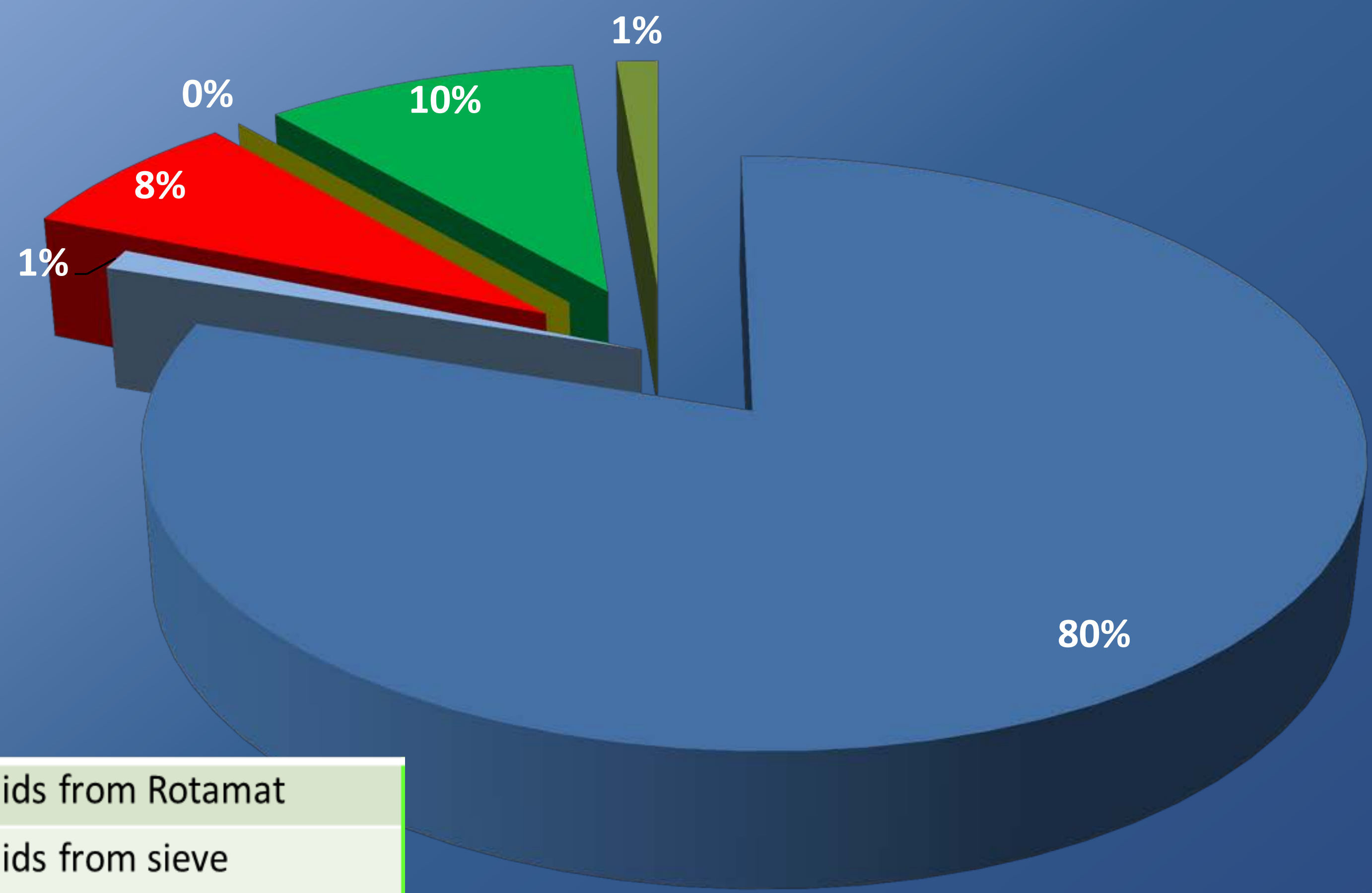
75% within the concentrate

e.g. fate of Phosphorus



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Mainly within solid fractions

(like also heavy metals)

Module Hygiene

- project in collaboration with FIBL: testing *Salmonella*, coliforme sperms, *E. Coli, Enterococcus*

- input shows partially high contaminations, especially biowaste with food waste (10^6 -10^7)

- no germs could be detected in the storage of «liquid» fraction after separation, in front of and after UF

- further measurements necessary

(n=1)

Preliminary Conclusions

- additional technical elements decrease energy yield and possibly increased environmental costs

- nutrient processing will probably only play a role in specific, well defined situations with high cattle densities

So: keep in mind!

Produce biogas from waste, as simple as possible!

Thanks for your attention!

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