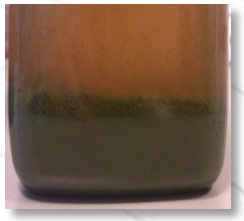
ANAEROBIC DIGESTION FOR CLOSING THE LOOP OF A BIOREFINERY FOR ORGANIC FARMING: PRODUCTION OF BIOGAS AND ORGANIC FERTILIZER FROM PROCESS RESIDUES



MARIA SANTAMARÍA-FERNANDEZ

NANNA KARKOV YTTING, METTE LÜBECK HINRICH UELLENDAHL

SECTION FOR SUSTAINABLE BIOTECHNOLOGY
AALBORG UNIVERSITY COPENHAGEN
A.C. MEYERS VÆNGE 15, 2450 COPENHAGEN
HU@BIO.AAU.DK, PH +45 99 40 25 85

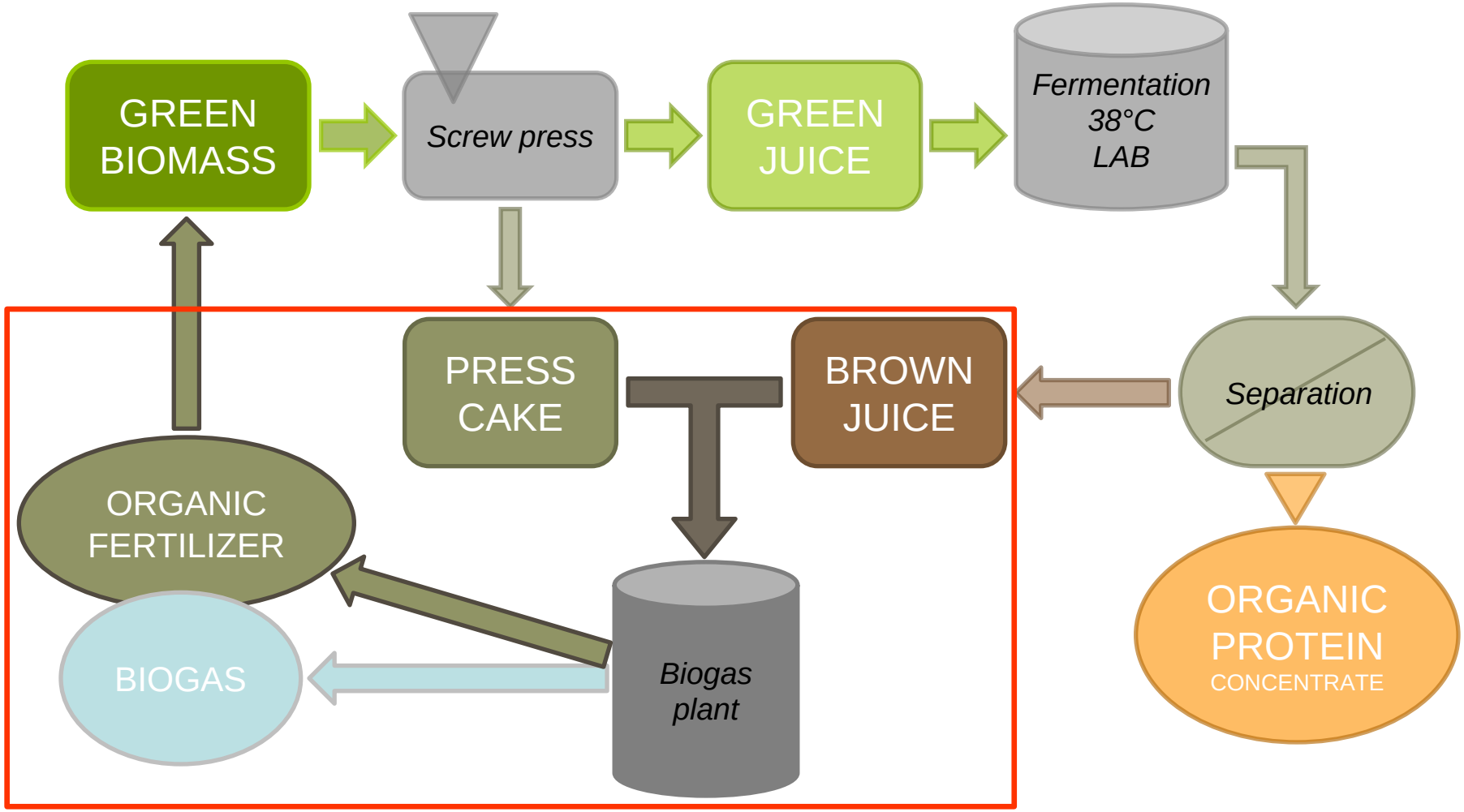
AALBORG UNIVERSITY
DENMARK

AD and fertilizer of residues from Organofinery

Outline

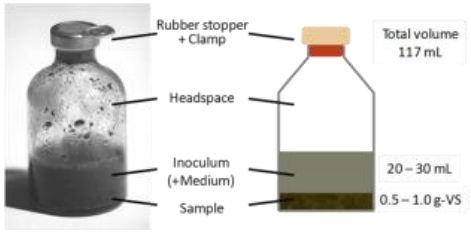
- **Organofinery** – a green biorefinery concept for organic farming.
- **Biogas production** from residues – press cake and brown juice.
- **Batch tests** of press cake and brown juice.
- **Co-digestion reactor tests** press cake + brown juice.
- **UASB reactor** for mono-digestion of brown juice.
- **Nutrient balance** for mechanical fractionation and biogas process.
- **Conclusions.**

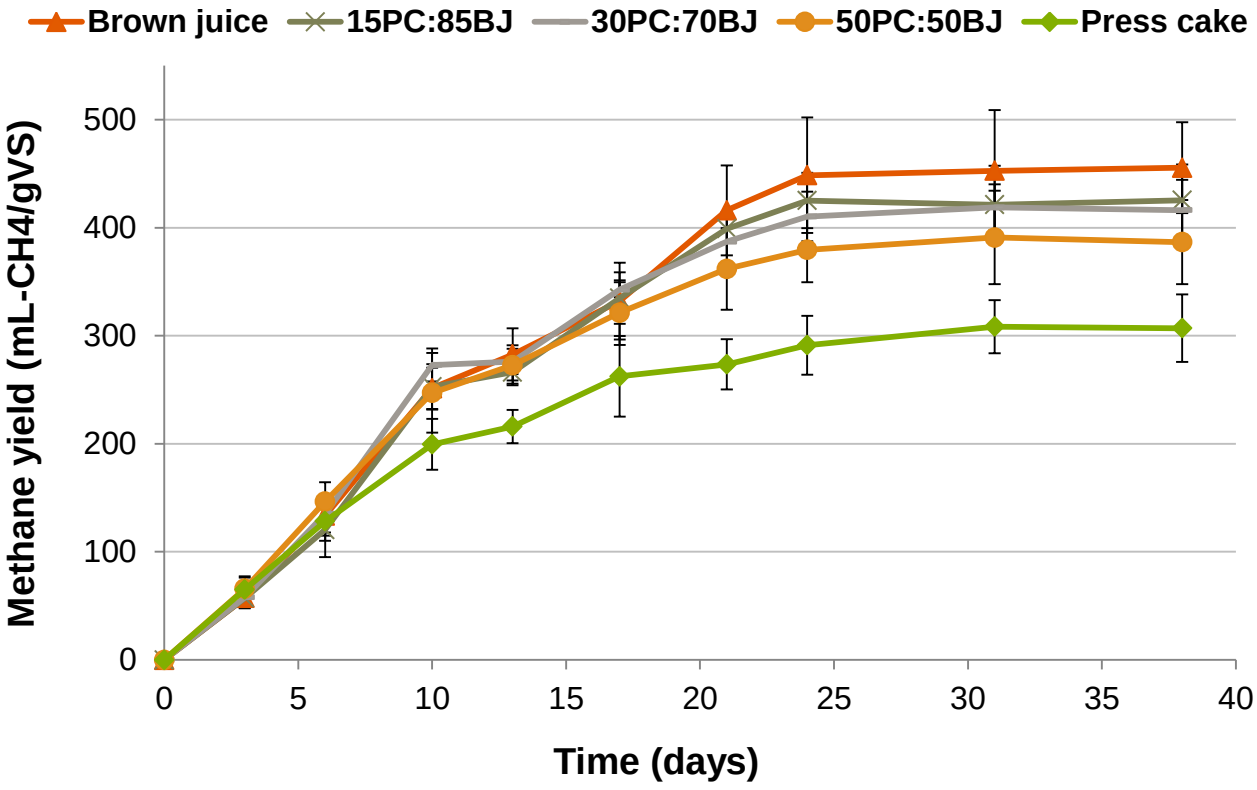
The OrganoFinery - From organic green biomass to protein feed, energy and fertilizer



Batch tests of press cake and brown juice

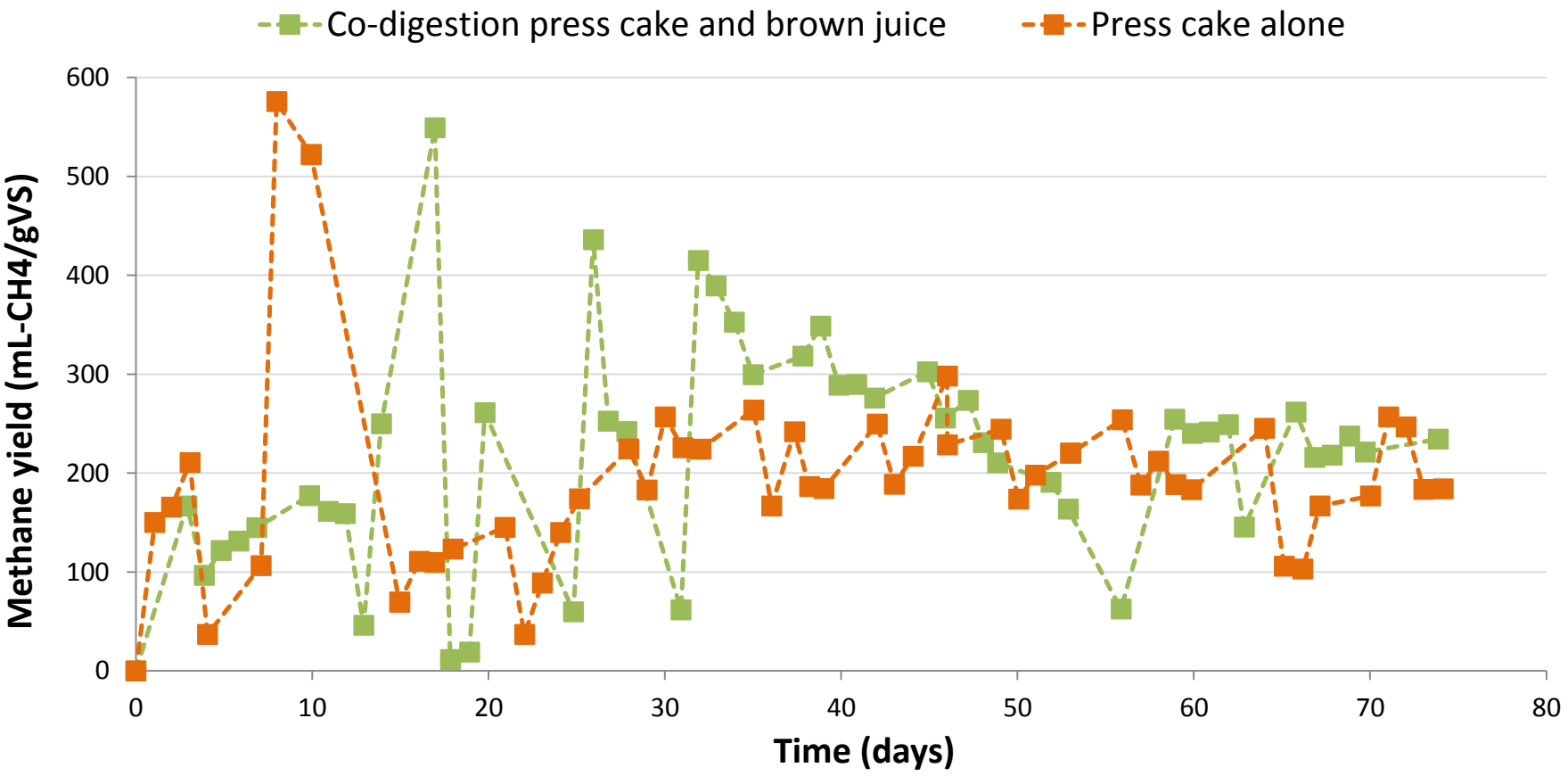
Methane yield in different mixture ratios





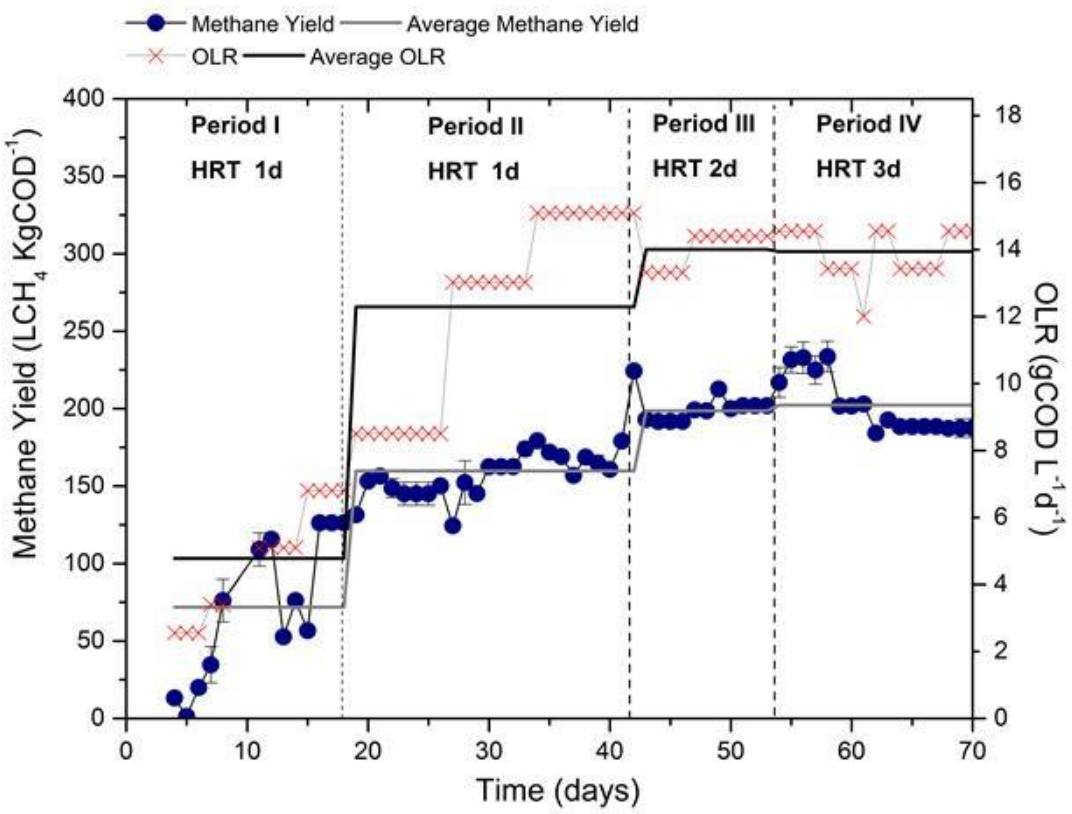
CSTR reactor tests

Press cake and co-digestion of press cake and brown juice



UASB reactor – Mono-digestion of brown juice

Brown juice, mesophilic (37°C), pH adjusted, HRT : 1-3 days



Main results for biogas production

Press cake (PC)

Brown juice (BJ)

Co-digestion PC + BJ

Batch tests (mesophilic, after 38d)

- Methane yield was **307 mL-CH_4/g-VS**.
- Methane yield was **456 mL-CH_4/g-VS**.
- Methane yield was **426 mL-CH_4/g-VS** for the 15%PC:85%BJ mix.

Reactor tests

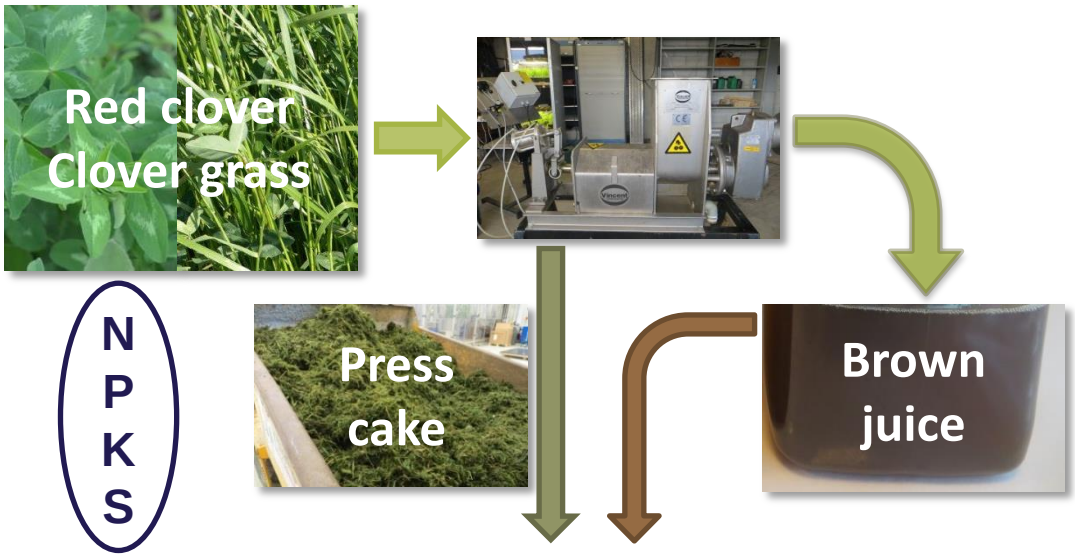
- **CSTR, HRT = 20d**, TS-adjusted by H_2O
- Stable process
- Average methane yield was **202 mL-CH_4/g-VS**.

- **UASB, HRT = 3d**, pH-adjusted
- Stable process
- Average methane yield was **307 mL-CH_4/g-VS**.

- **CSTR, HRT = 20d**, no adjustment
- Stable process
- Average methane yield was **236 mL-CH_4/g-VS**.

Nutrient recovery in press cake and brown juice

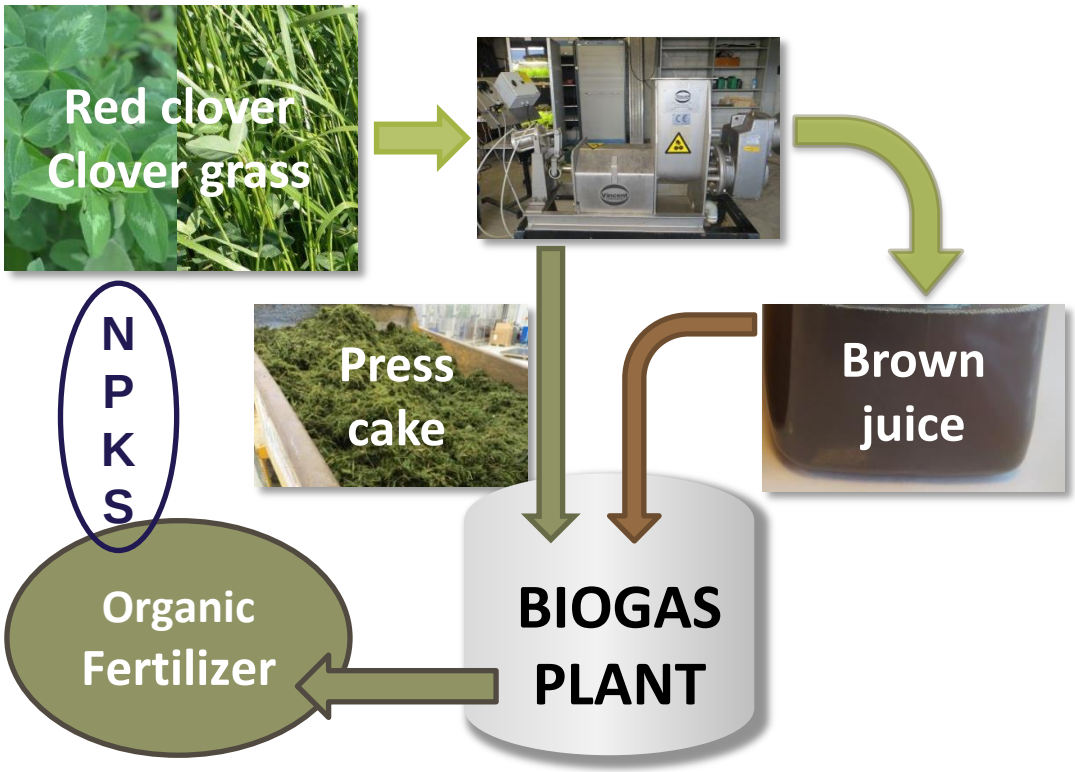
After mechanical fractionation
Nutrient conc. x mass of PC/BJ



	Press cake	Brown juice
	% of input	% of input
	Red clover	
N	52%	15%
P	53%	30%
K	43%	38%
S	52%	13%
	Clover grass	
N	60%	11%
P	56%	27%
K	39%	31%
S	55%	26%

Nutrient recovery in press cake and brown juice

Before and after AD process
Co-digestion PC+BJ, or BJ alone



	AD digestate	
	g/kg	% of input
Co-digestion PC+BJ, CSTR		
N	3.42	**94%**
NH_4^+	*2.11*	***62 % of N***
P	1.35	**>100%**
K	3.96	**99%**
S	0.52	**>100%**
Mono-digestion BJ, UASB		
N	0.39	**68%**
NH_4^+	*0.06*	***16% of N***
P	0.11	**59%**
K	2.03	**67%**
S	0.06	**56%**

Conclusions

Biogas production from residues PC and BJ:

- **42-68% of the biogas potential** is recovered in the **PC** while only **10-15%** is recovered in the **BJ.**
- Both **co-digestion of PC+BJ** and **mono-digestion of BJ** in UASB showed **stable process performance.**
- **Co-digestion of PC+BJ** in the ratio coming from the fractionation **does not need pH, nutrient or TS adjustment.**

Nutrient recovery:

- **52-60% of N, P, S** is recovered in **PC** and **11-30% in BJ** while **39-42% of K** is recovered in **PC** and **31-38% in BJ.**
- In the **co-digestion** process a **high share of** total-N is converted into **NH_4^+**, while this is only limited in the UASB process of BJ.
- **Nutrient conc. in digestate from mono-digestion of BJ** is **too low** for practical application on the field.

THANKS FOR YOUR ATTENTION

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NaturErhvervstyrelsen
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