



Bomin Yuan
DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Leipzig (Germany)

Motivation

Digestate treatment can reduce the costs of transport, spreading, and storage by recovering the water and processing the nutrients into fertilizer products. However, the digestate treatment process requires many steps to purify a large amount of digestate, which makes it costly and highly energy-intensive. Therefore, a more economical and efficient digestate treatment by **liquid digestate recirculation (LDR)** is investigated in this study.

On the one hand, LDR in anaerobic digesters can improve the conversion of residual biomass and increase biogas production. On the other hand, it leads to the accumulation of inhibitors and recalcitrant compounds, which are detrimental to the process above a certain level. Therefore, **the influencing factors** of LDR on anaerobic digestion (AD) are to be determined in this study.

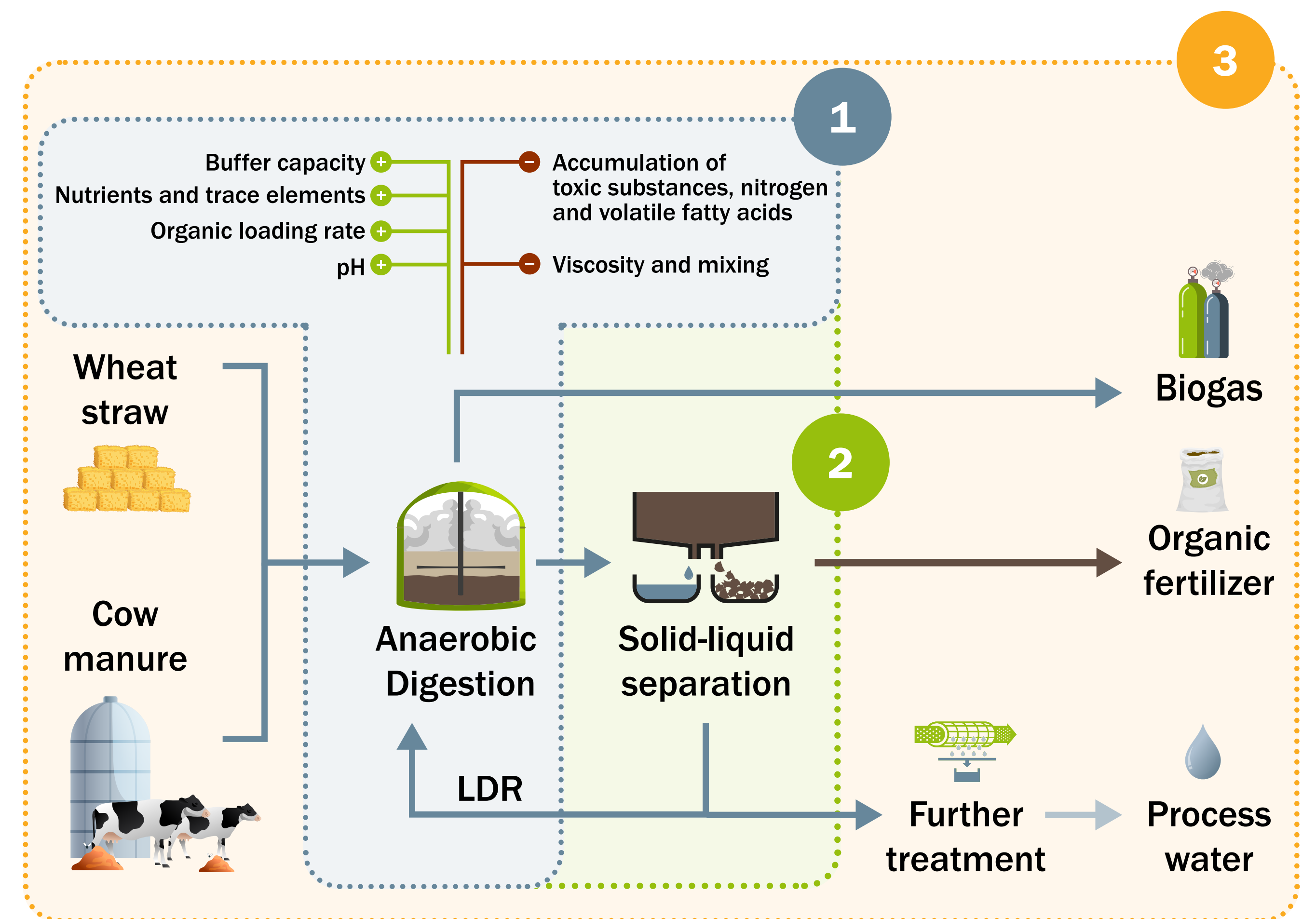


Fig. 1: The work packages in this study.

1

Digestate recirculation experiments

- Simultaneous operation of 6 identical bioreactors
- Organic loading rate = $2.5 \text{ g VS L}^{-1} \text{ d}^{-1}$
- Hydraulic retention time = 30.7 d
- Substrate without digestate recirculation:
Wheat straw : cow manure : water = 1:1:10
- Substrate with digestate recirculation:
Wheat straw : cow manure : (water + digestate) = 1:1:10

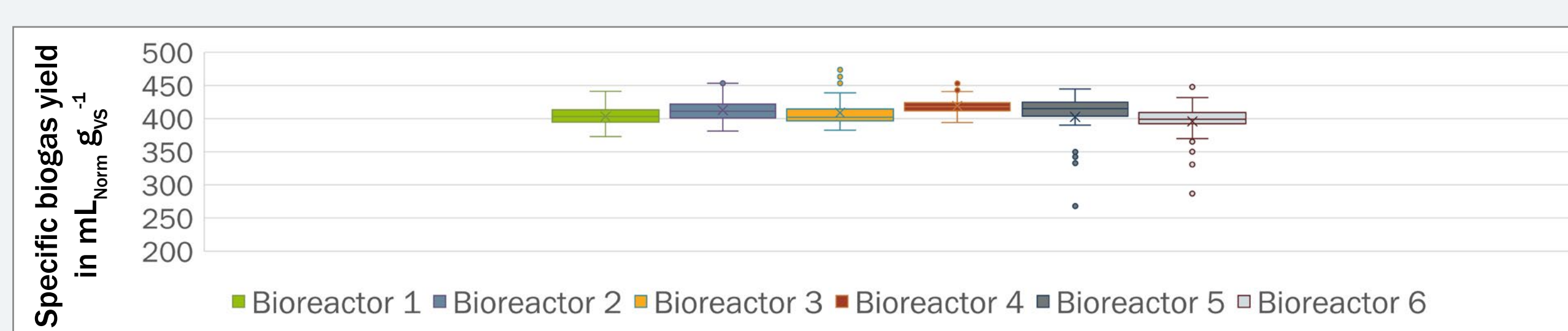


Fig. 2: Boxplots of the biogas yields in the AD experiments with 6 replicated digesters.

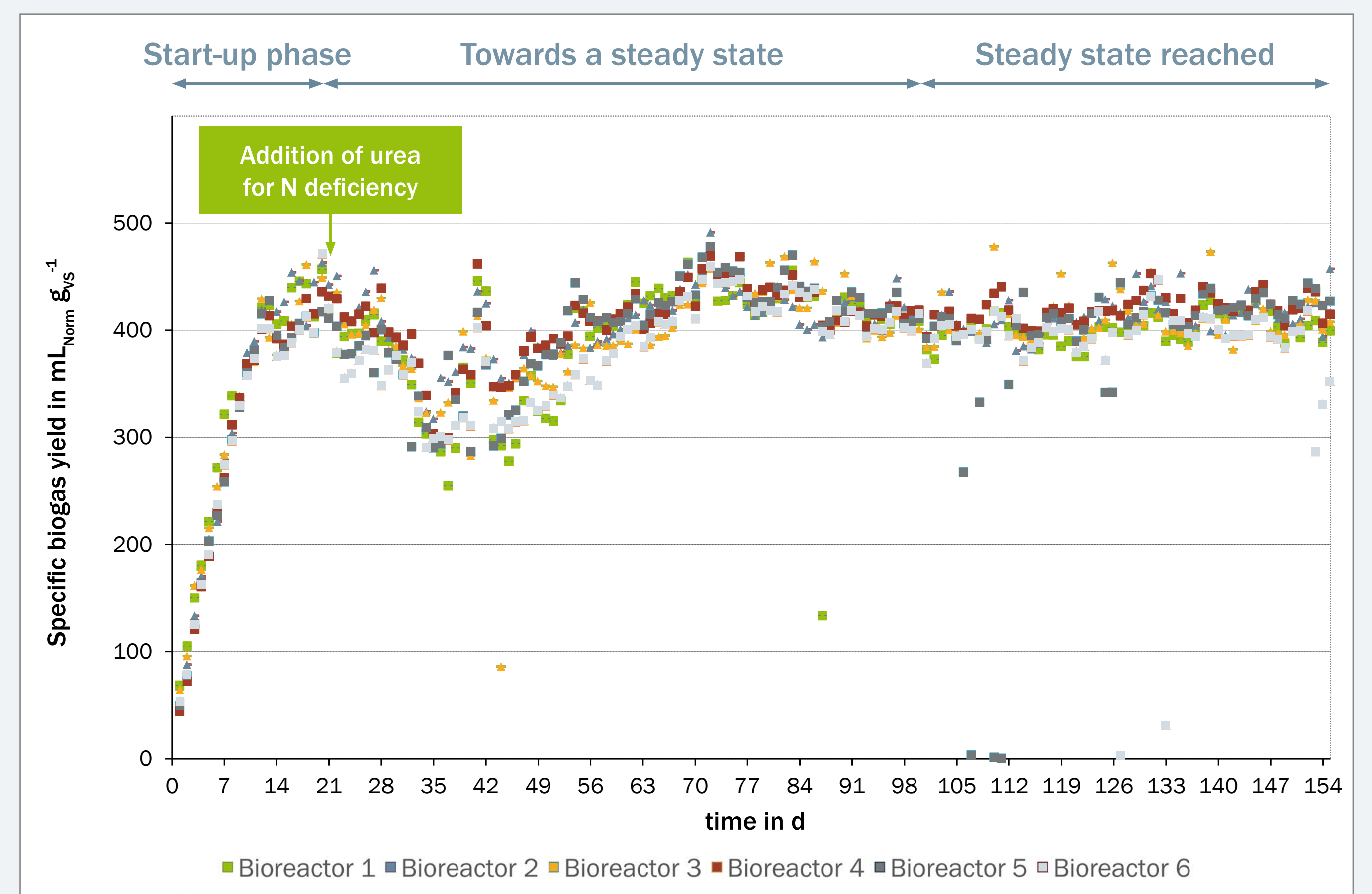


Fig. 3: Daily biogas yields from the start-up phase to the steady state prior to the LDR

2

Process modelling

- SuperPro Designer ®
- Batch mode with scheduling
- Loss in process and analysis are considered

Current results *	No recirculation	With recirculation
Methane yield [kg a^{-1}]	1.37	1.53 (11.7% increase)
Demand for additive [kg a^{-1}]	0.64	0.10 (84.4% reduction)
Demand for fresh water [kg a^{-1}]	84.76	15.75 (81.4% reduction)

*: Please note that these results will change as the model is refined.

3

Upscaling and model validation

- Pilot plant of project Pilot-SBG
- Evaluation of the contribution of digestate recirculation to the overall process



Fig. 4: The pilot plant to be used for upscaling and model validation