Valorisation of biogas digestate through nutrient recovery by means of membrane distillation - The “BioProfit” project

ISEC 3rd International Sustainable Energy Conference 2024
11. April 2024

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BioProfit

Profitable Valorisation von **Bio**gasgärresten durch CO_2-Speicherung und Nährstoffrückgewinnung

Initial Situation ACR - BioProfit Project

- Around 20,000 biogas plants are in operation in Europe

Without macronutrients (NPK) - no plant growth

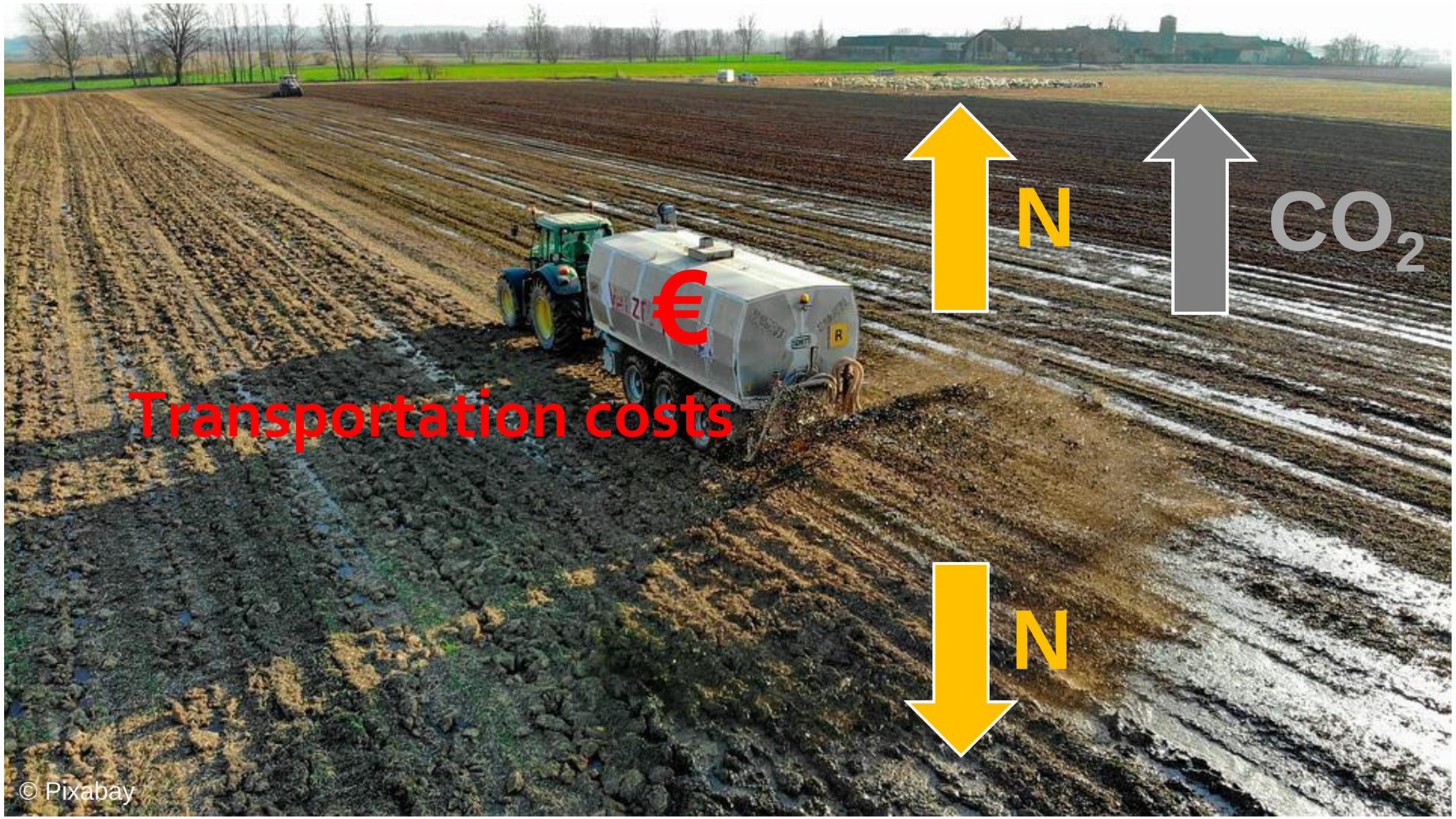
Carbon

Nitrogen –N

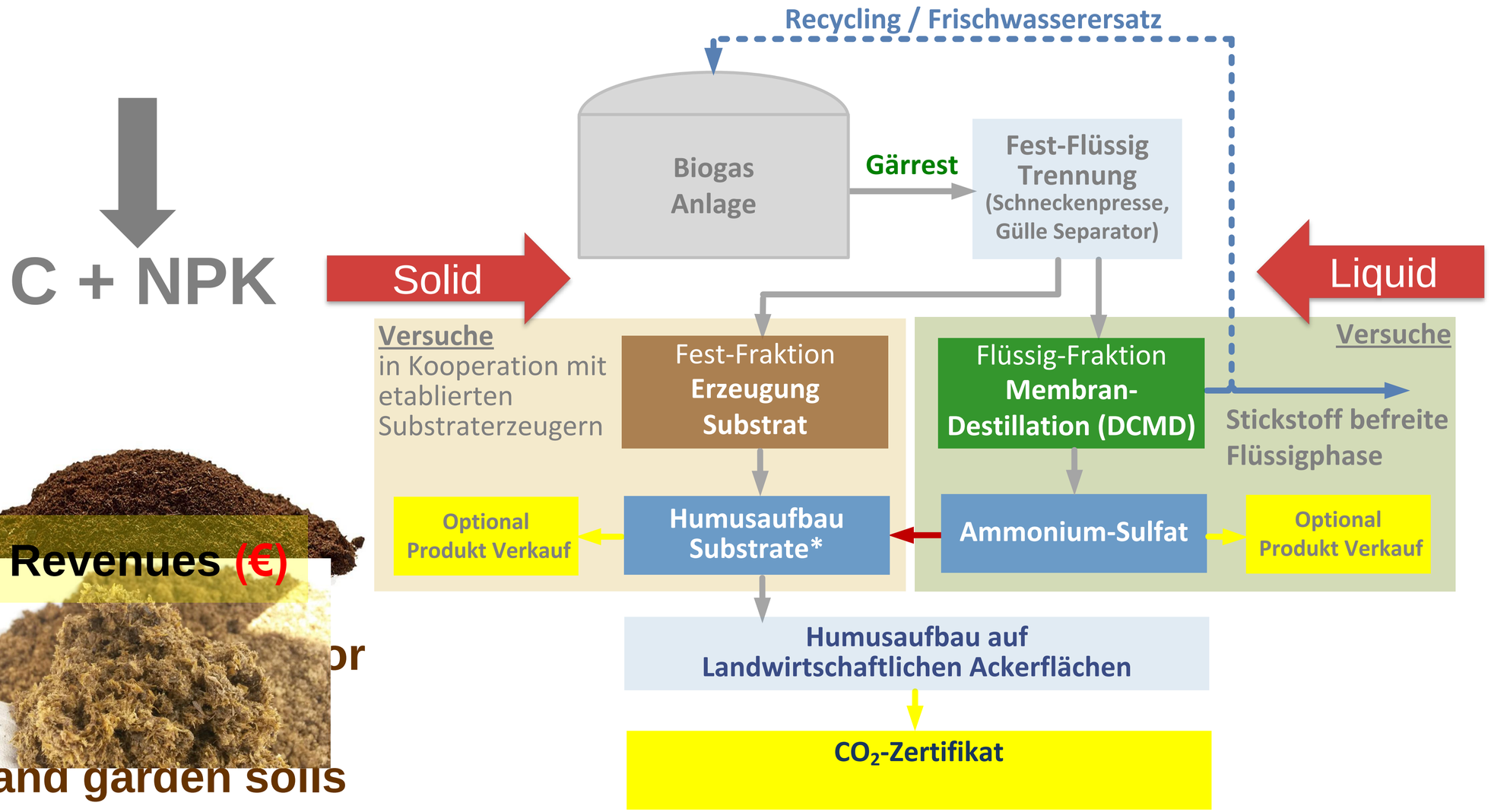
Phosphorus – P

Potassium - K

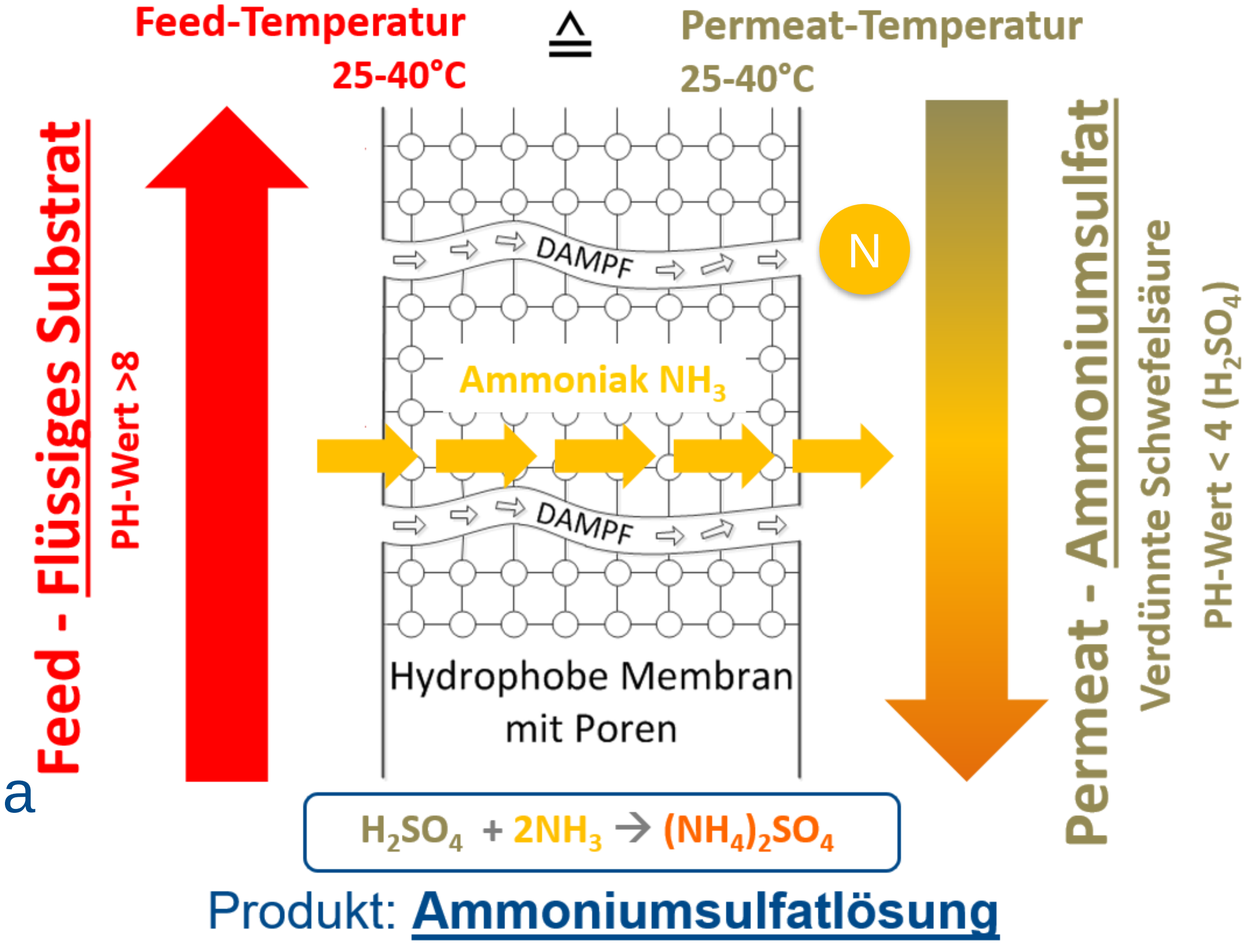
Status Quo! - Disposal of biogas fermentation residues



Visualization of the "BioProfit" solution concept



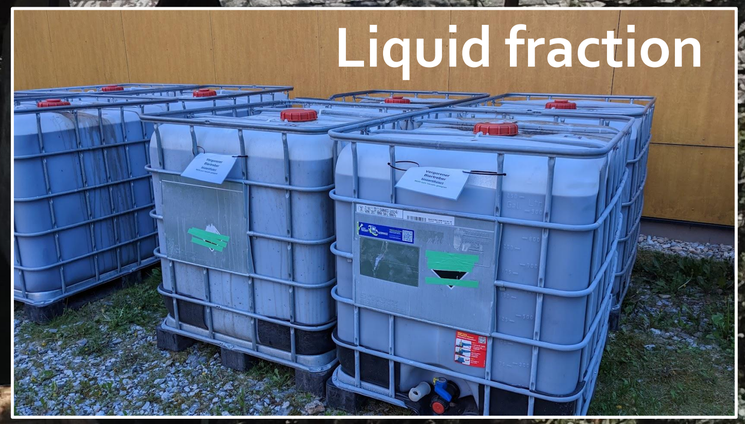
Membrane distillation process Product generation of ammonium sulphate using **isothermal DCMD**



Revenue Product (€)

Membrane distillation (MD) is a **thermally driven** separation / concentration process

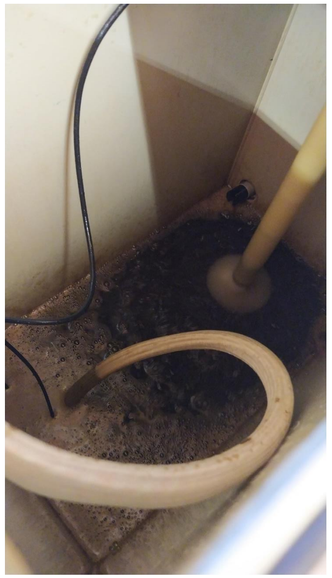
Gösser
BRAUTRADITION SEIT 1860



Phase I
Preliminary tests with an MD membrane test cell

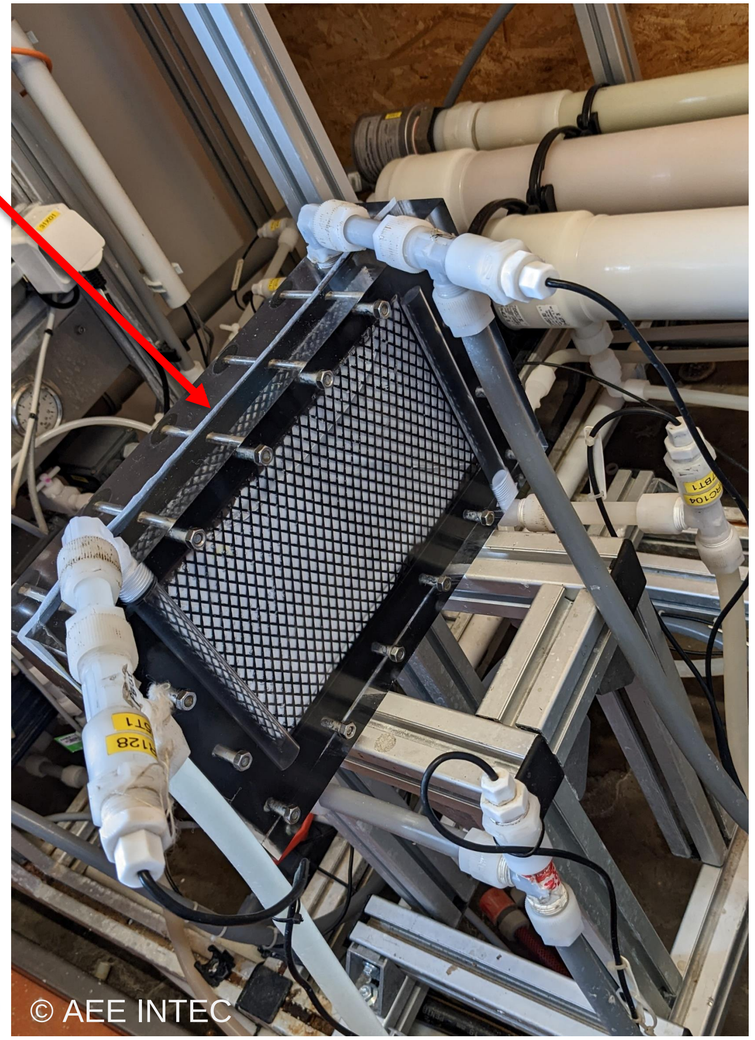
Preliminary tests with an MD membrane test cell in the laboratory

Feed side (digestate)



Permeate side

(high-purity ammonium sulphate solution)



Phase II - Endurance test 24/7 with the MD container system and large-scale membrane modules

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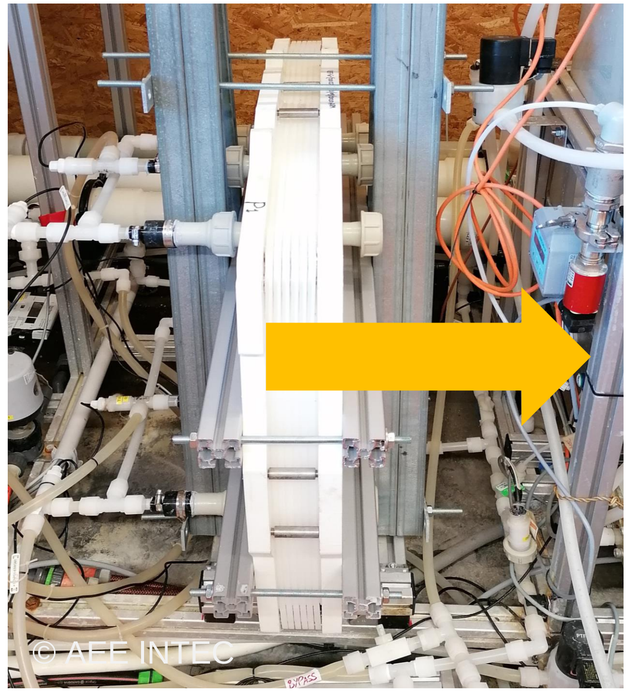
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Endurance test TARGET:
NH_4-N reduction in fermentation residue

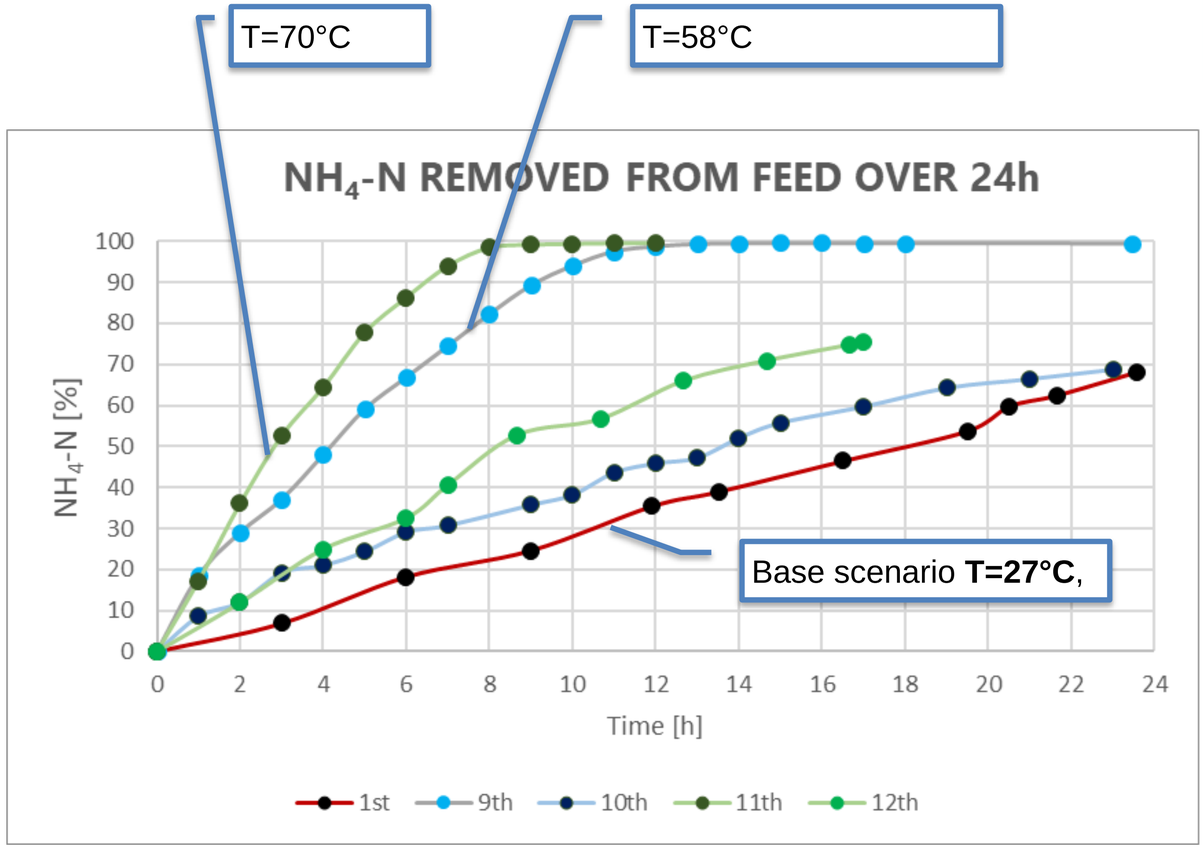
[Text]	[h]	[%]	[%]
Samples	**Abs time**	**NH_4-N retained**	**NH_4-N removed**
F0	0	100,00	0,00
F1	3,00	93,13	6,87
F2	6,00	81,79	18,21
F3	9,00	75,39	24,61
F4	11,90	64,64	35,36
F5	13,52	61,06	38,94
F6	16,52	53,57	46,43
F7	19,52	46,24	53,76
F8	20,52	40,22	59,78
F9	21,65	37,61	62,39
F10	23,58	31,91	68,09
F11	26,58	27,14	72,86
F12	29,58	21,35	78,65
F13	32,58	16,07	83,93
F14	35,58	10,25	89,75
F15	47,58	1,34	98,66
F16	50,58	1,10	98,90
F17	53,58	0,91	99,09
F18	56,58	0,86	99,14
F19	59,58	0,85	99,15

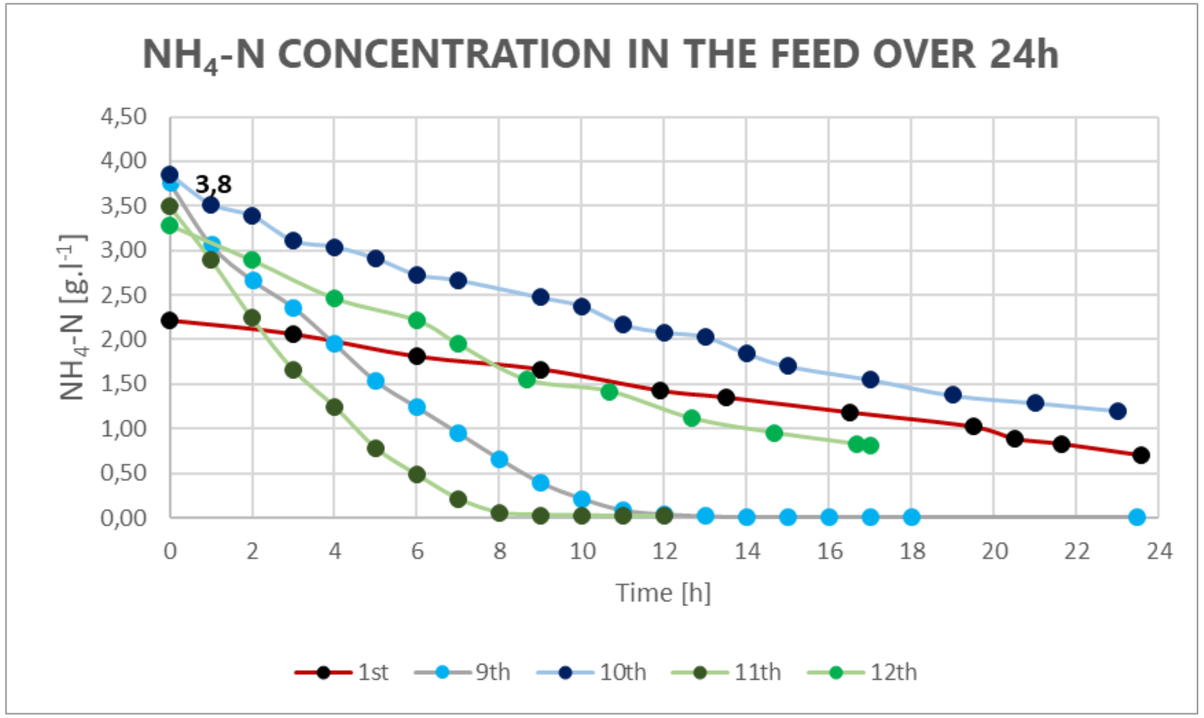
- Extensive **NH_4-N reduction** possible even at a low temperature level of **27°C**

Acceleration of the process by raising the temperature

1st average J_{flux} NH_4-N **~ 2** [$g.m^{-2}.h^{-1}$]

11th average J_{flux} NH_4-N **~ 18,8** [$g.m^{-2}.h^{-1}$]



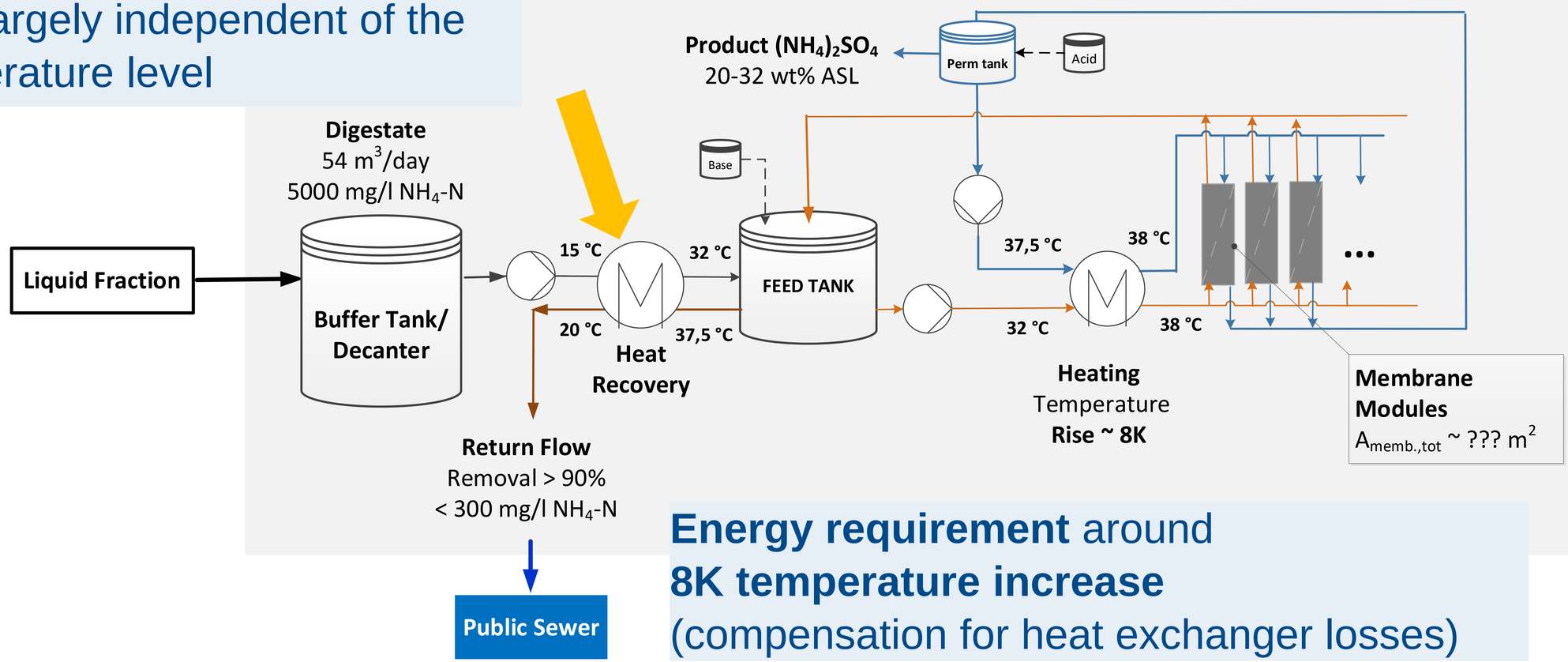


Saving thermal energy requirements through heat recovery

Heat recovery means that the energy requirement is largely independent of the operating temperature level

Göss – MD Plant Concept

- Draft Concept -



Energy requirement around **8K temperature increase** (compensation for heat exchanger losses)

Sum –Up
Development Phase I and Phase II

- The **quality targets** were achieved without any problems
- The MD process has proven to be very robust for liquids containing large amounts of particles. The process is operated at atmospheric pressure, the membrane is flooded with virtually **no pressure** and the ammonia evaporates true the membrane.
  → No particles are pressed into the membrane pores
- **Uncomplicated pre-treatment;** Mechanical solid/liquid separation of the fermentation residue and settling tank are sufficient for pre-treatment
- Use of **flocculants** (high chemical cost!) **are not required**
- The **optimum operating conditions** depend on the implementation situation and the concept of the respective biogas plant (waste heat availability). Trade-off between N-flow, operating temperature and operating costs (i.e. chemical costs)

Outlook

➢ **Next Steps:**

- Start of **Phase III - the pilot phase** together with a biogas plant manufacturer (BIOGEST - Vienna)
- Further research: Development of an organic-certifiable liquid fertilizer by using biogenic acidifiers

Thank you !

BioProfit

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und Nährstoffrückgewinnung

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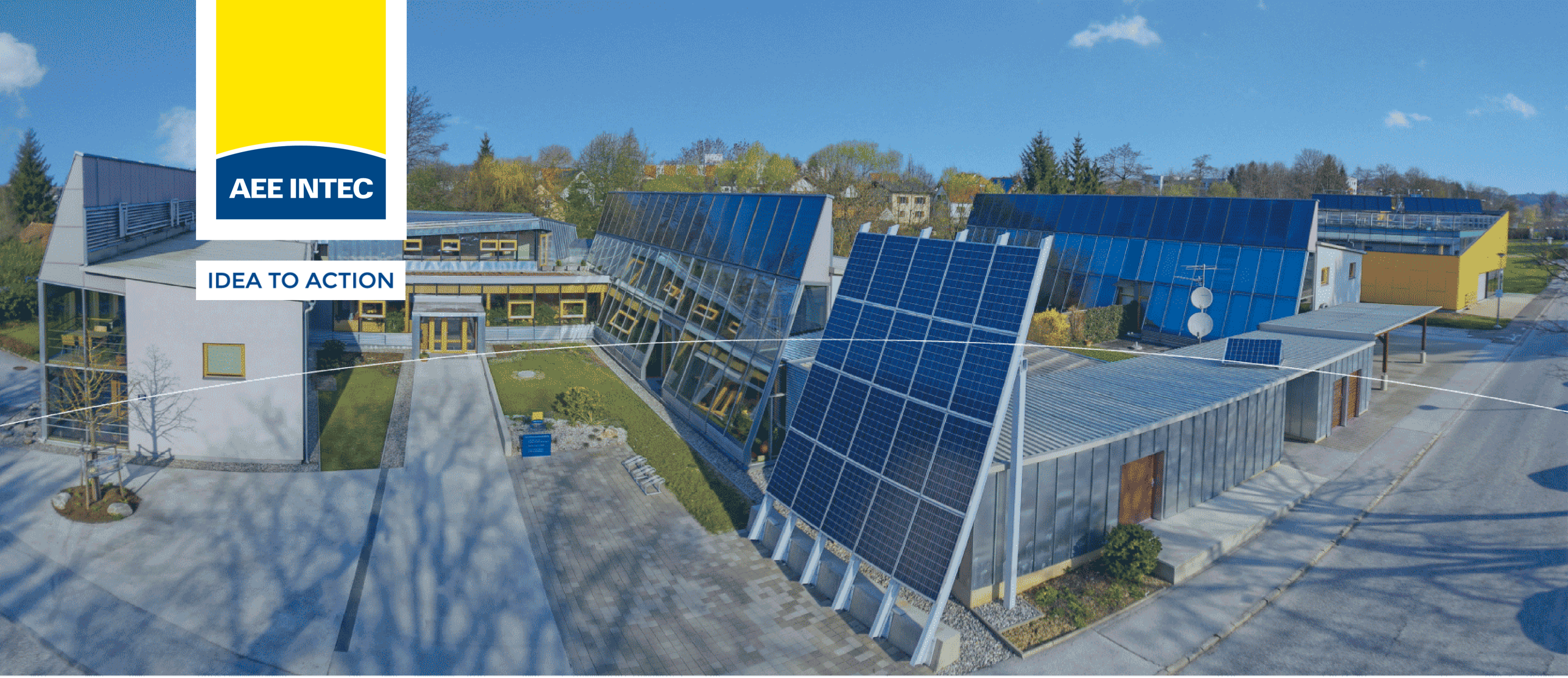
IDEA TO ACTION



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