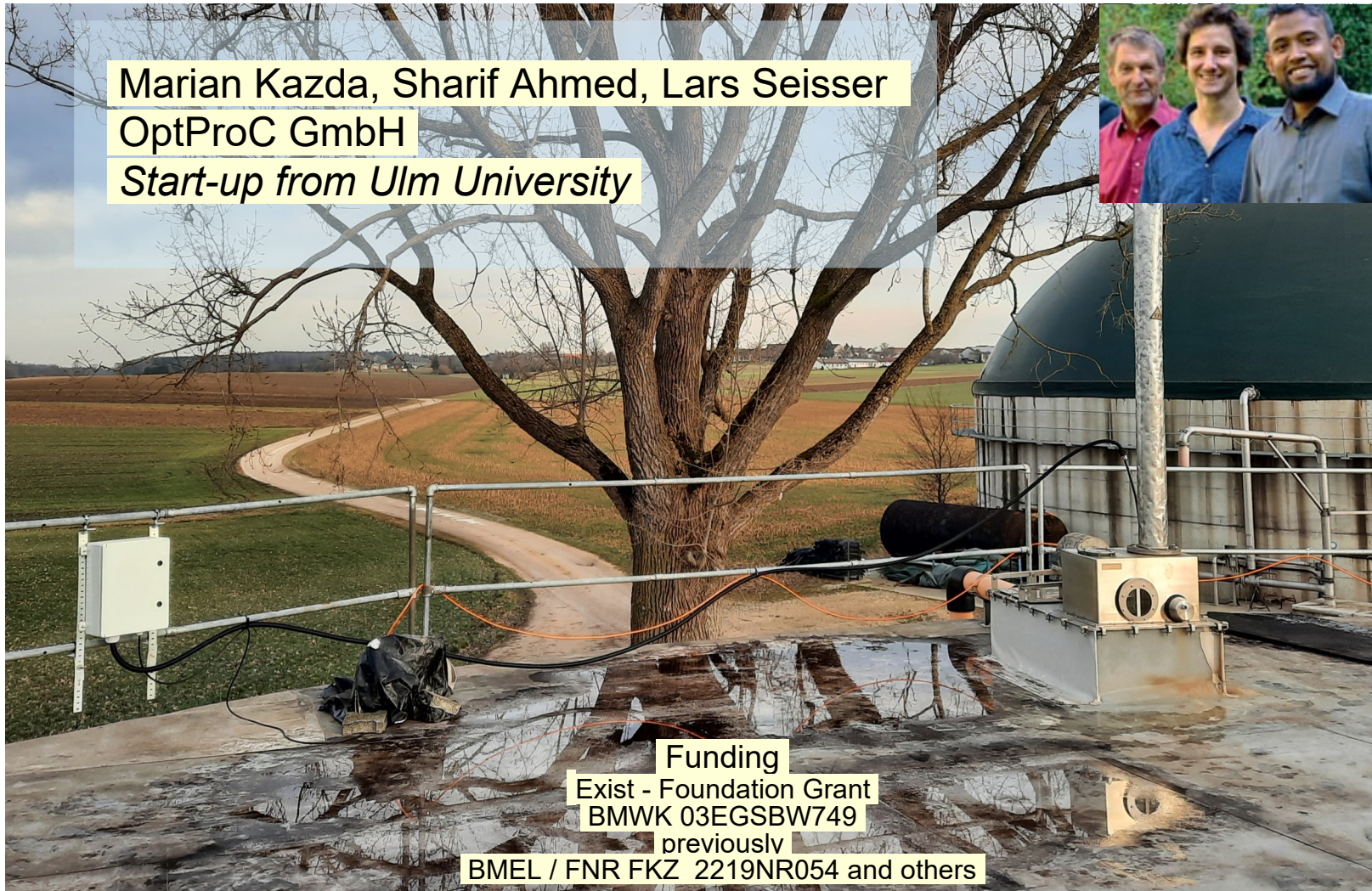


Controll of flexible biogas production through CO₂ in the biogas slurry

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Start-up from Ulm University



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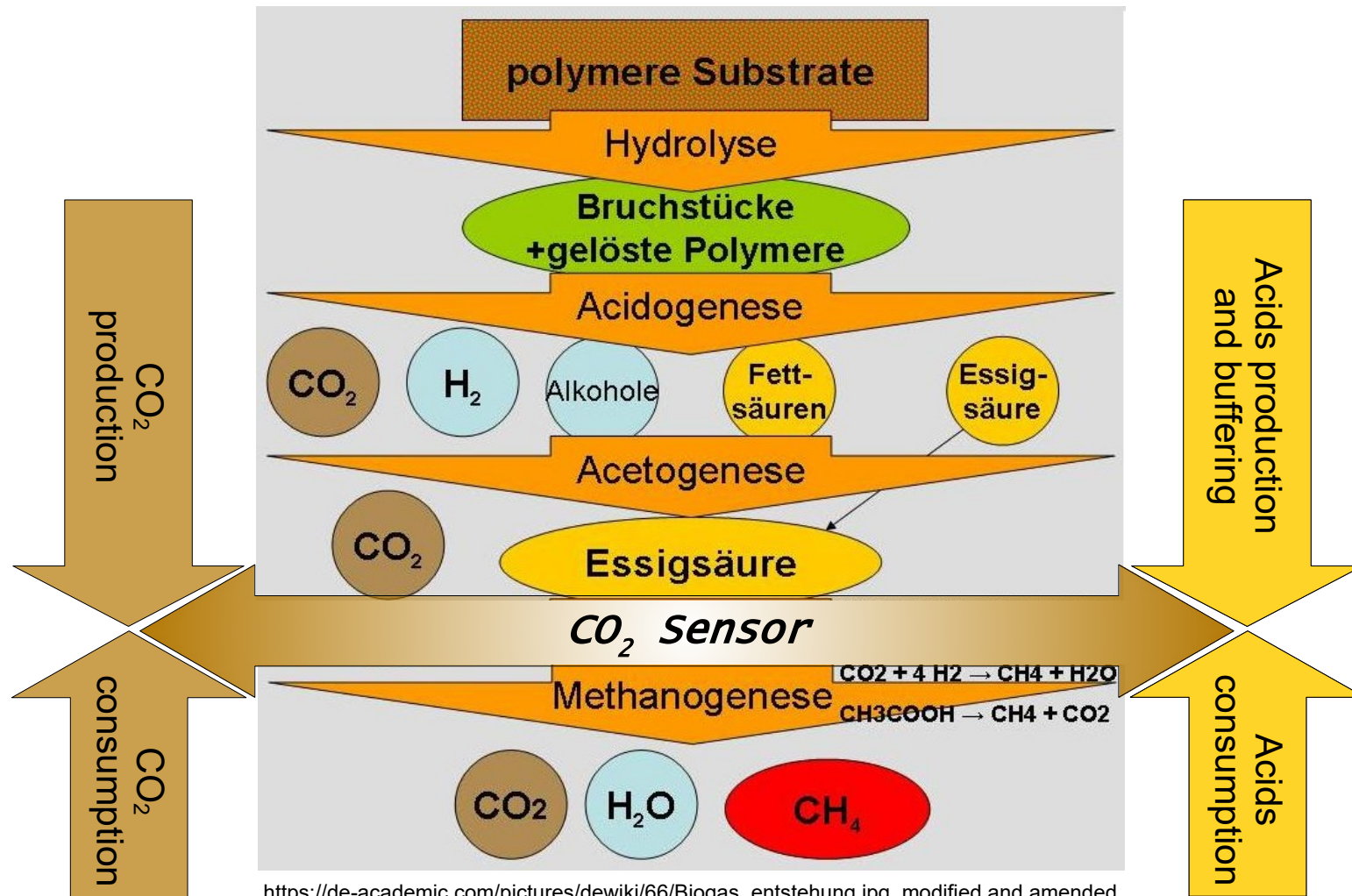
Controll of flexible biogas production through CO₂ in the biogas slurry

Rationale

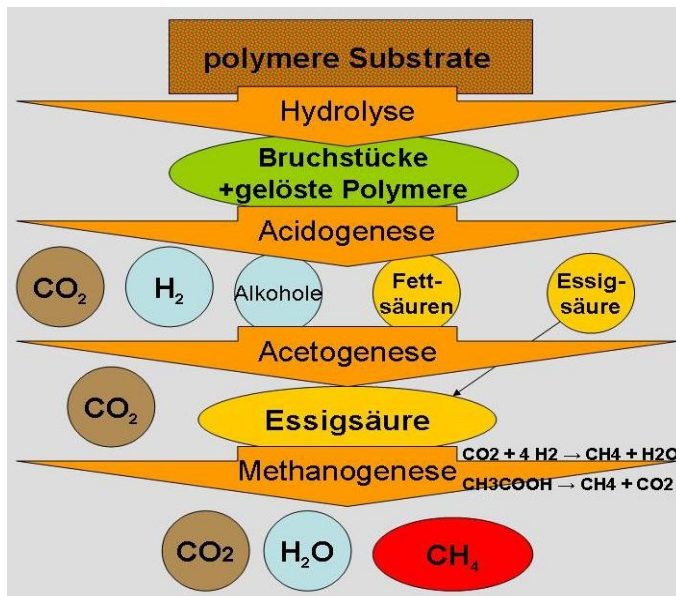
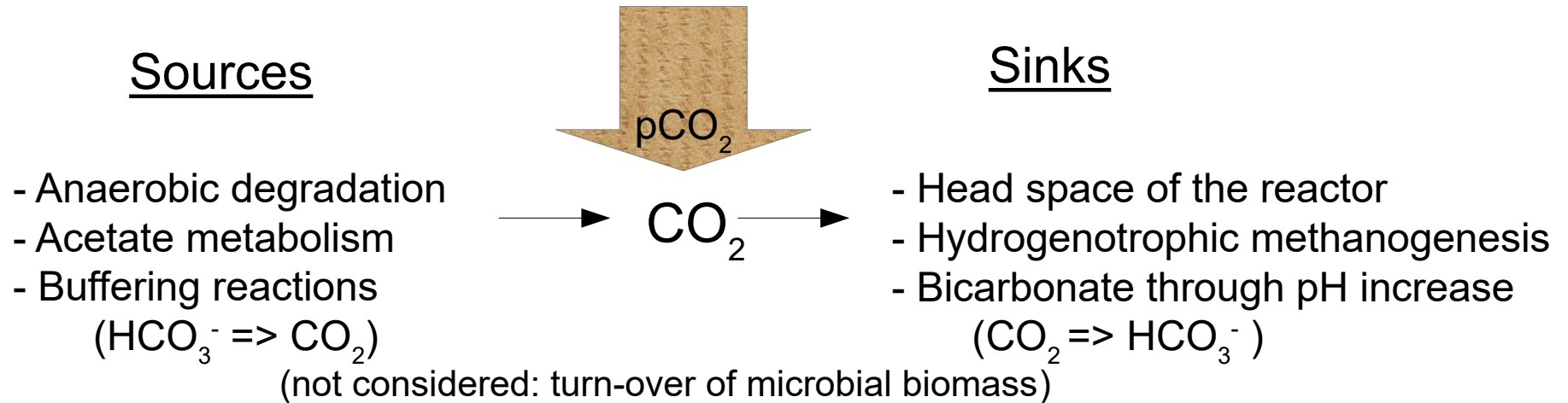
Flexible biogas production
requires intensive process monitoring



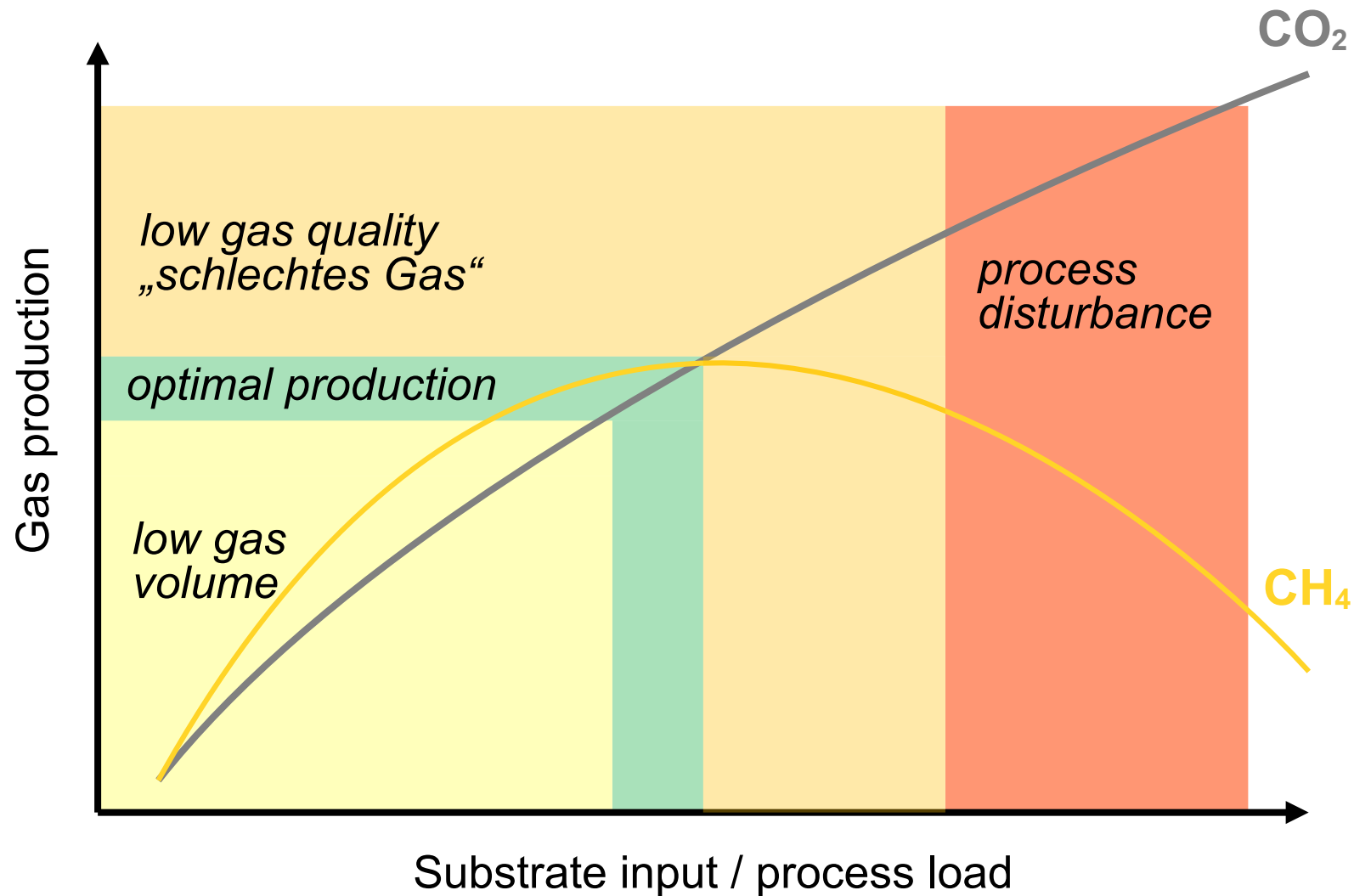
Process monitoring through CO₂ in the slurry



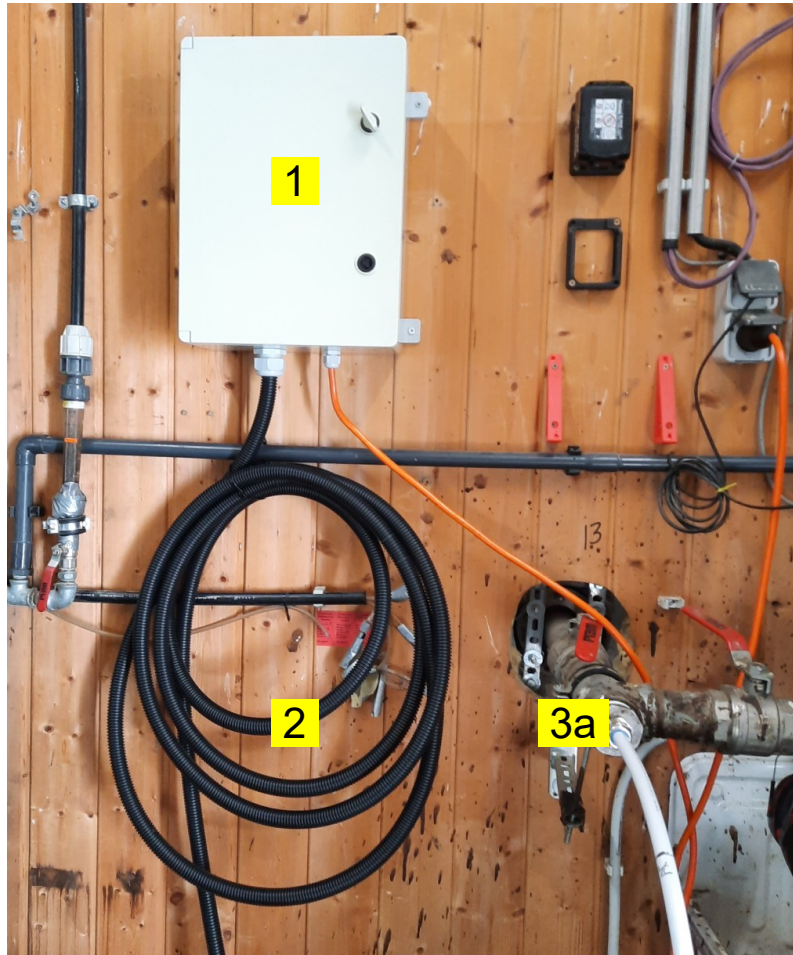
Source / Sink – Concept for CO₂ in the reactor slurry



Experiences from the biogas practice



Implementation

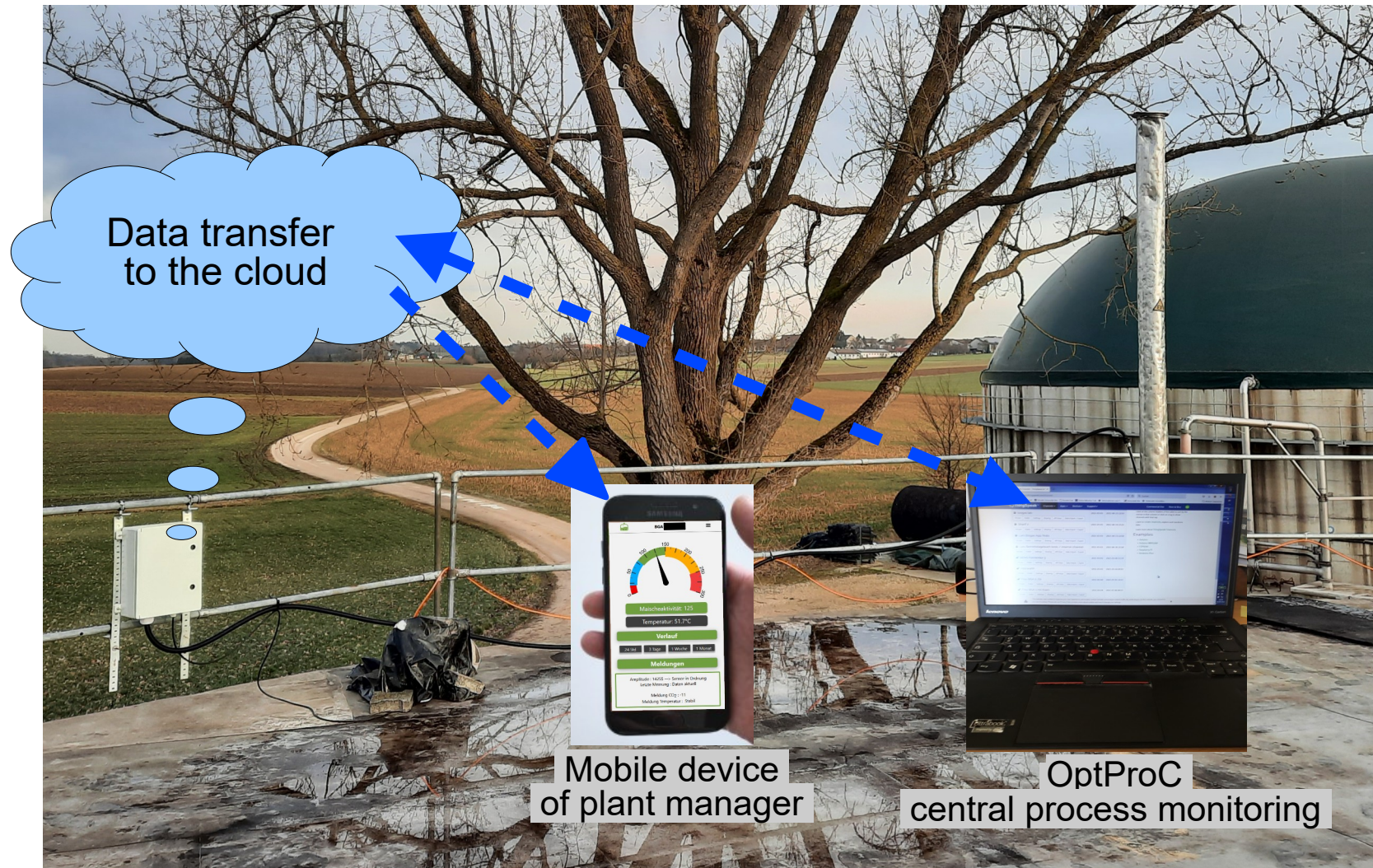


European patent EP 3 867 349

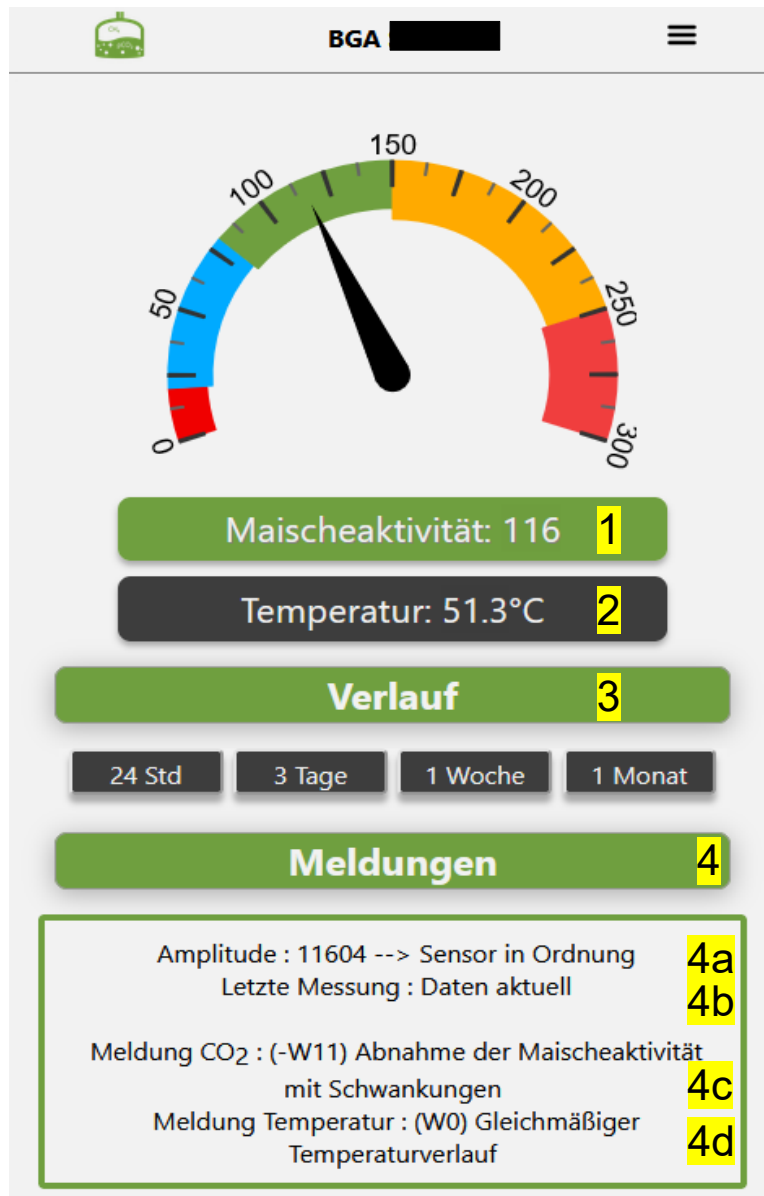


- 1** Measuring unit
Electro-optical module for CO₂ and temperature (Pt 100)
Data assessment every 30 minutes evaluation and transmission to the cloud
- 2** Signal line to the slurry (8 m)
- 3a** Measuring rod (2 m, 1 – 2" screw adapter) with replaceable sensing head (side access)
- 3b** Measuring rod with protected wiring (top access through reactor ceiling)

User-friendly real-time monitoring

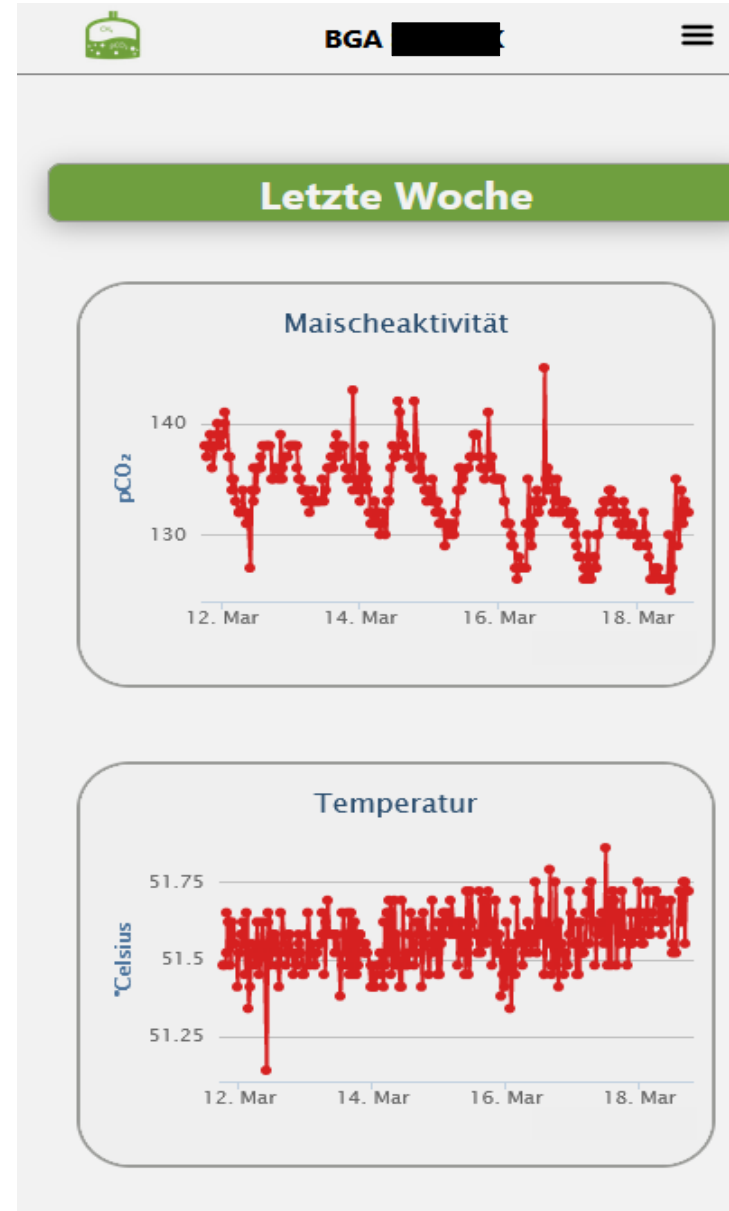
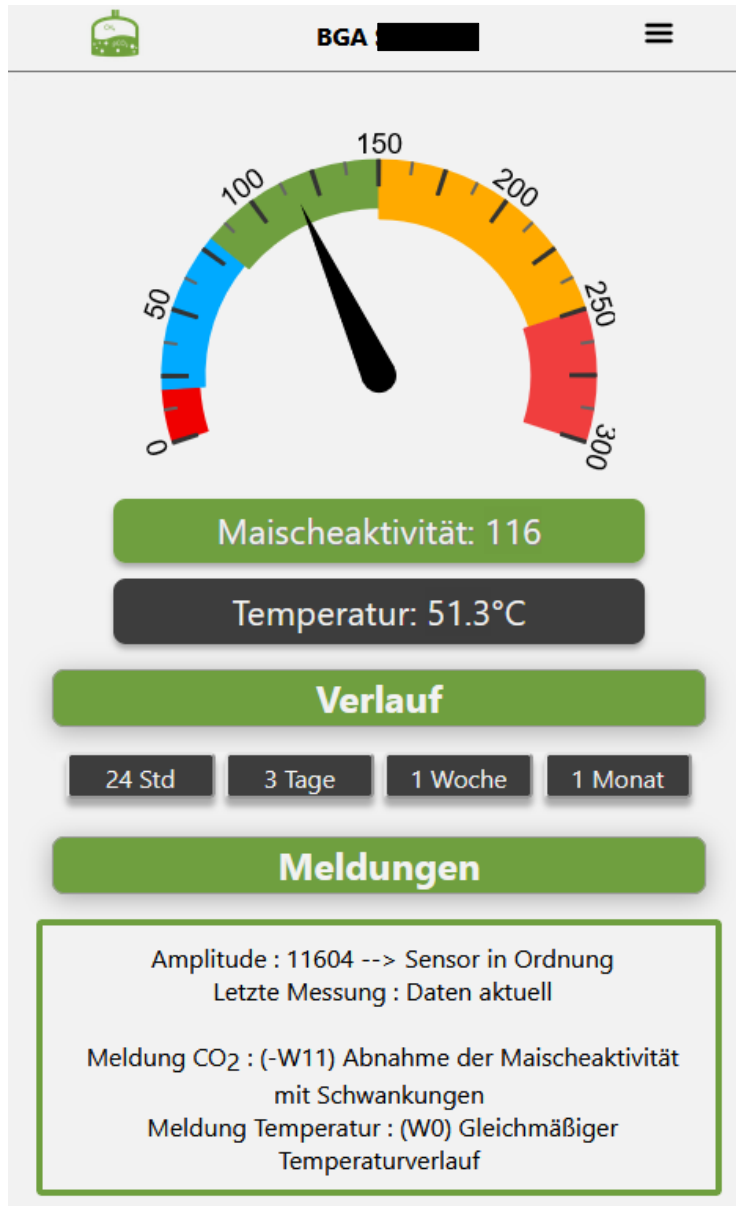


End-user interface



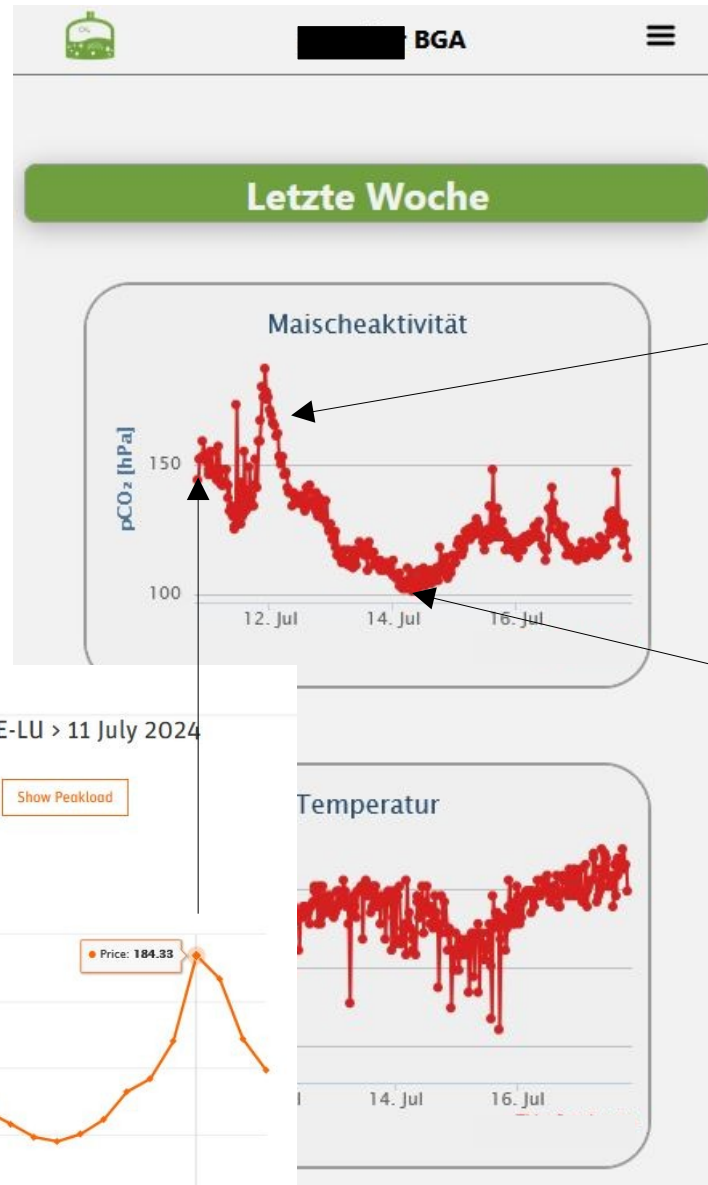
- 1 Process load / slurry activity (pCO₂)
- 2 Slurry temperature
- 3 Submenu „Trend“
last 24 h, 3 days, 1 week, 1 month
- 4 Messages
 - 4a Signal intensity / sensor replacement
 - 4b Data transfer
 - 4c Messages process load
 - 4d Messages temperature

End-user interface



Application in biogas plants with on-demand operating scheme

Agricultural biogas plant
Rated electricity output: 750 kW
Installed production capacity: 3.500 kW



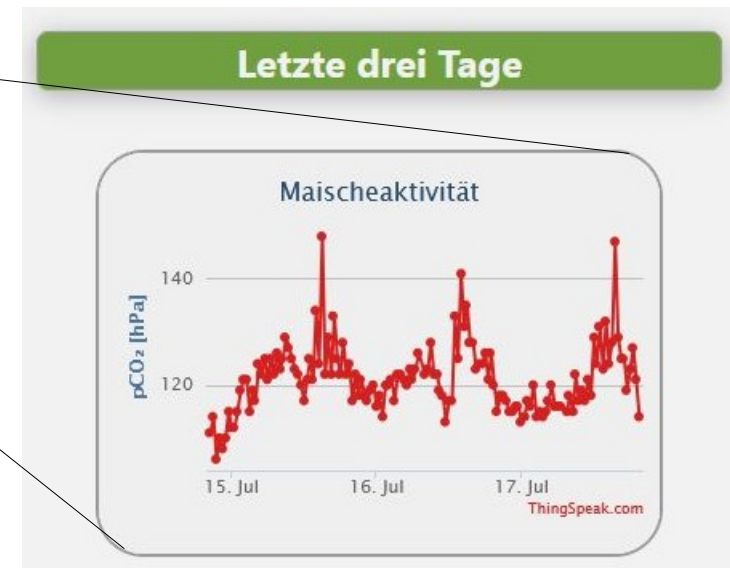
Exceptional peak
through grain input to meet
high Friday night prices

Decreased substrate input
due to low weekend prices



Application in biogas plants with on-demand operating scheme

Agricultural biogas plant
Rated electricity output: 750 kW
Installed production capacity: 3.500 kW



Regular feeding scheme
for high gas production
during afternoon and evening



Background evaluations and alerts

Messages for process temperature evaluating the range and variability from recent and previous data

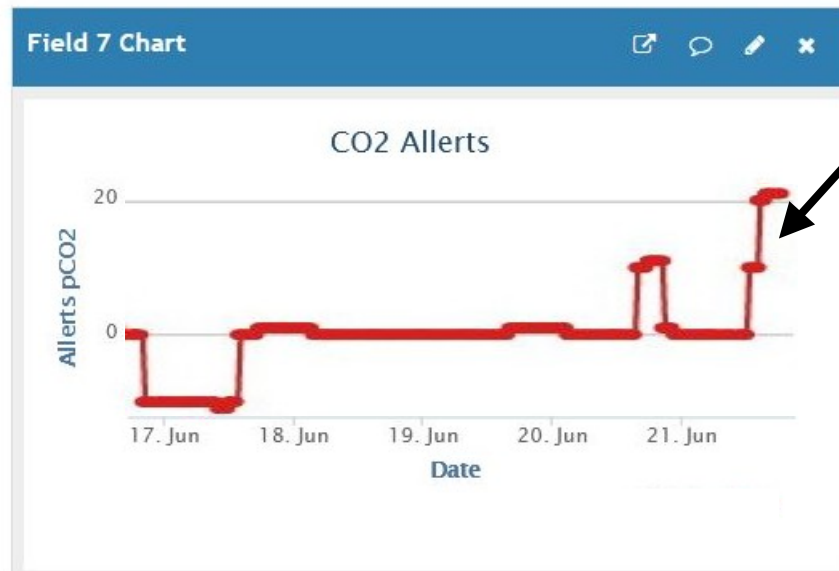
Code	Message
W22	Highly variable process temperature strongly above the range
W21	Variable process temperature strongly above the range
W20	Process temperature strongly above the range
W12	Highly variable process temperature above the range
W11	Variable process temperature above the range
W10	Process temperature above the range
W2	Highly variable process temperature
W1	Variable process temperature
W0	Regular temperature range
-W10	Process temperature below the range
-W11	Variable process temperature below the range
-W12	Highly variable process temperature below the range
-W20	Process temperature strongly below the range
-W21	Variable process temperature strongly below the range
-W22	Highly variable process temperature strongly below the range

Messages for process load evaluating the range and variability from recent and previous data

Code	Message
W22	CO ₂ strongly above the range at high variability, process overload
W21	Variable CO ₂ strongly above the range, process overload
W20	CO ₂ strongly above the range, process overload
W12	CO ₂ above the range at high variability
W11	Variable CO ₂ above the range
W10	CO ₂ above the range
W2	High variability of CO ₂ in the process
W1	Variability of CO ₂ in the process
W0	Regular process range
-W10	CO ₂ below the previous range
-W11	Variable CO ₂ below the previous range
-W12	CO ₂ below the previous range at high variability
-W20	CO ₂ strongly below the range, process underperformance
-W21	Variable CO ₂ strongly below the range, process underperformance
-W22	CO ₂ strongly below the range at high variability, process underperformance

Data evaluation every **30 minutes** assessing **15 states**
for process load and temperature displayed on end-user interface

Background evaluations and alerts



Alerts when process load exceeds the previous range

OptProC – Real time process control ^{*)}

Conclusions

- Control of process load and temperature through real-time data, background evaluations and alerts prevent process failure
- Plug-and-play installation, high sustainability
- Optimization of substrate use and feeding management
- Improves flexible plant operation through trend analysis and retrospective data evaluation
- Trend analysis allows to forecast substrate input for demand-driven electricity production

^{*)} European patent EP 3 867 349

OptProC – Real time process control ^{*)}

Conclusions

