



The dairy biorefinery: Integrating treatment processes for cheese whey valorisation

Paolo Dessì

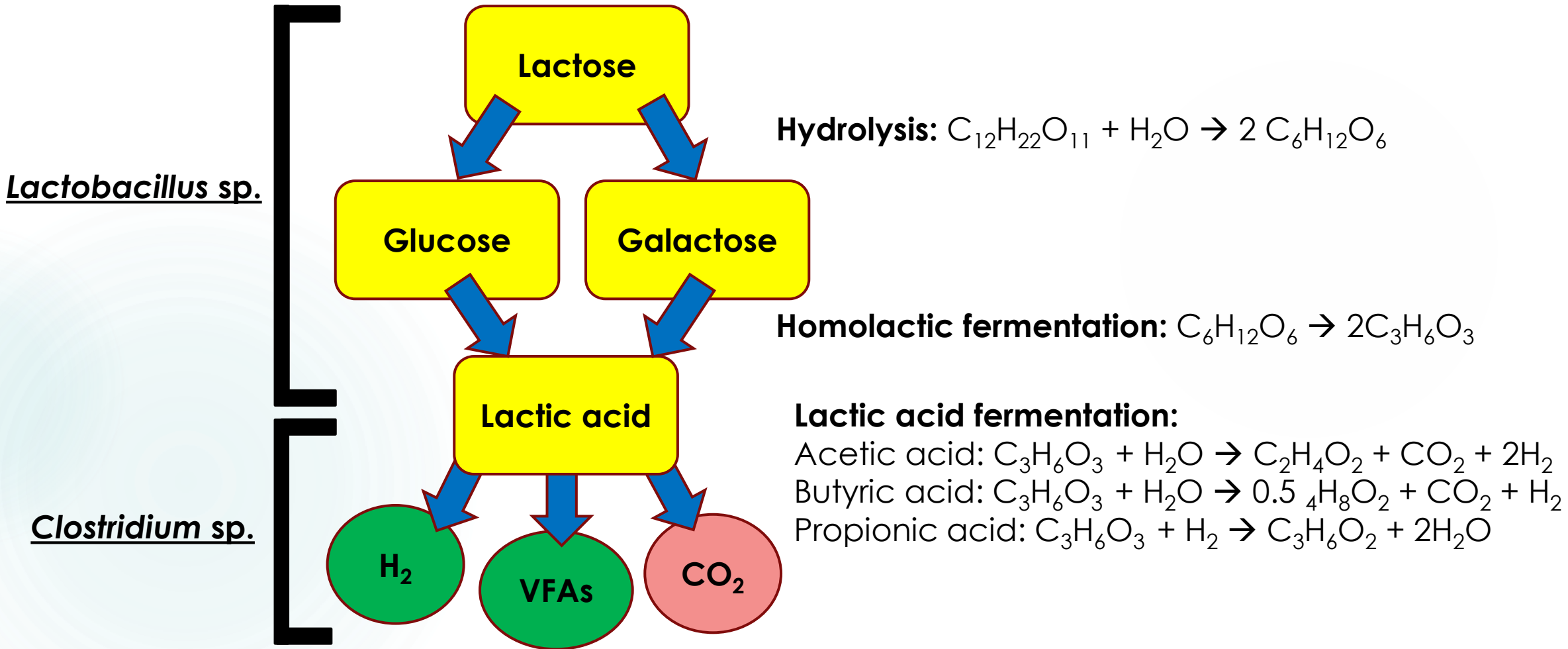
Cheese whey

8-10 L per kg of cheese produced

190 billion kg per year worldwide

High organic load (50-100 g/L COD, 90% of which is lactose)

Cheese whey fermentation



Fermentation

UASB reactors

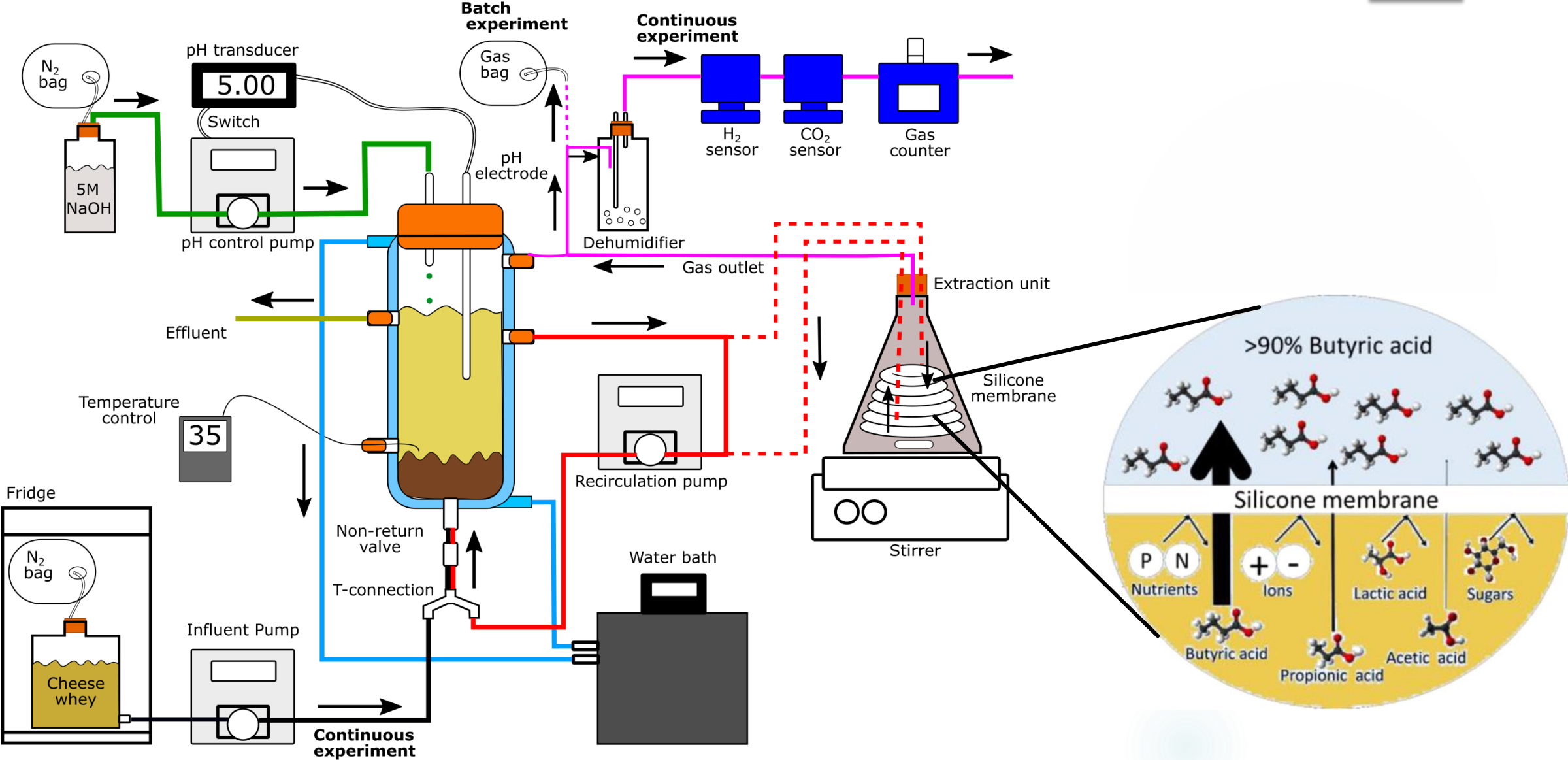
On-line gas monitoring (H_2 , CO_2)

In-line VFA extraction unit

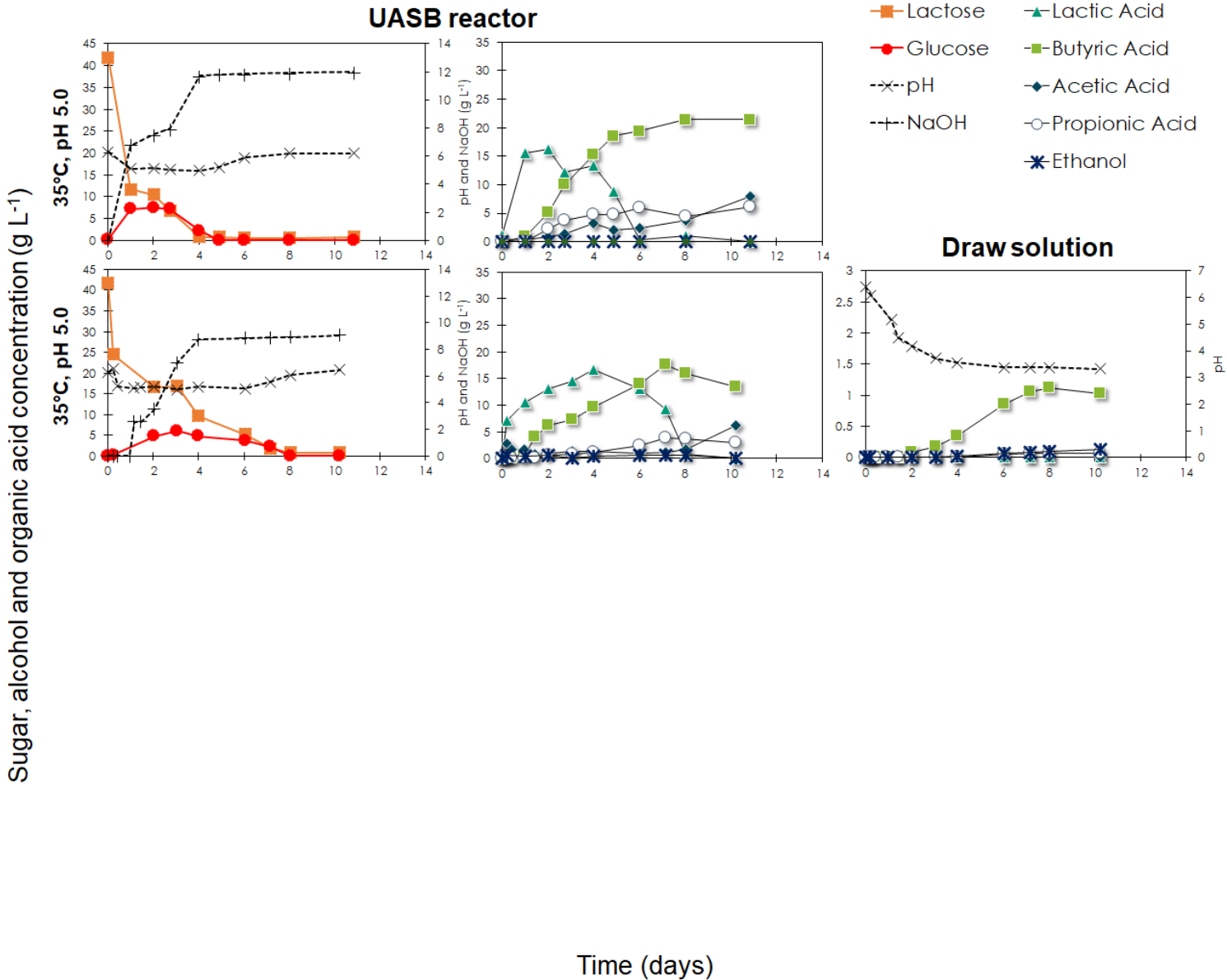
Inoculated with autoctonous anaerobic sludge (heat treated)



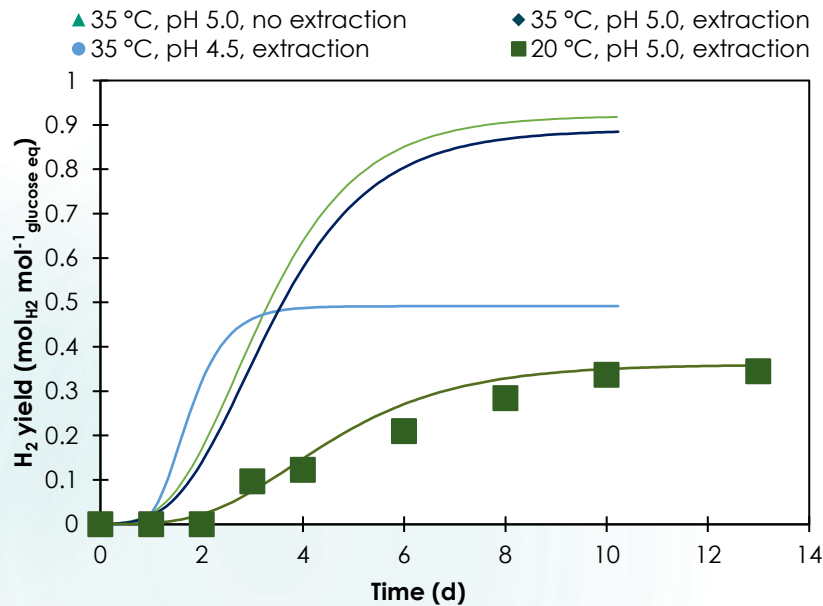
Fermentation



Fermentation



Fermentation



Take-home message

The extraction system did not affect H₂ yield

Butyric acid can be selectively extracted

Low pH increases VFA recovery, but decreased H₂ yield

Low temperature can cause a shift to ethanol production

Bioplastics

Can be produced from fermented CW

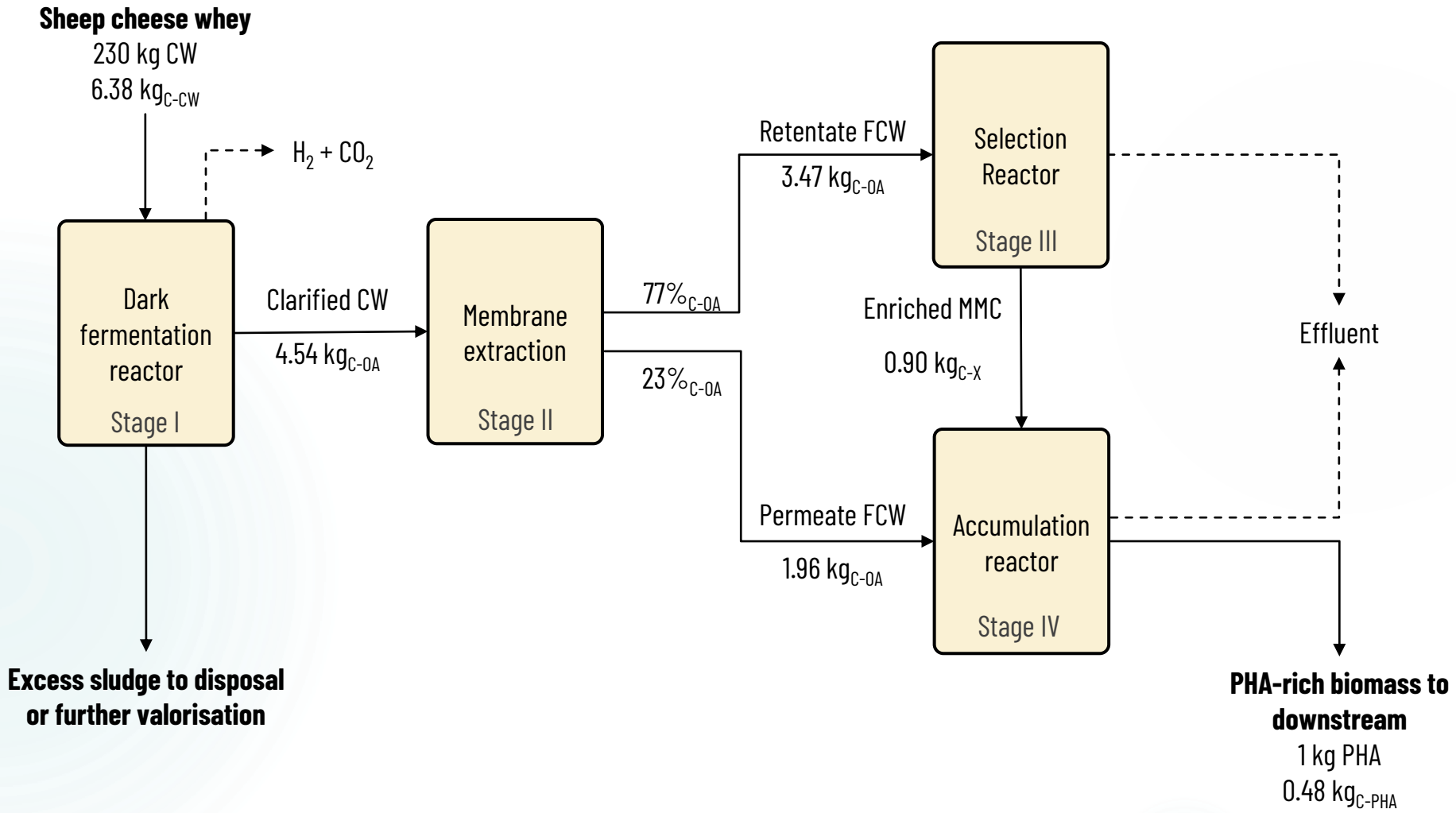
4 g PHA / kg CW (7.5% carbon conversion)

Bio-based, bio-degradable polymers

Several applications: Packaging, cosmetics, medicals, 3D printing



Bioplastics



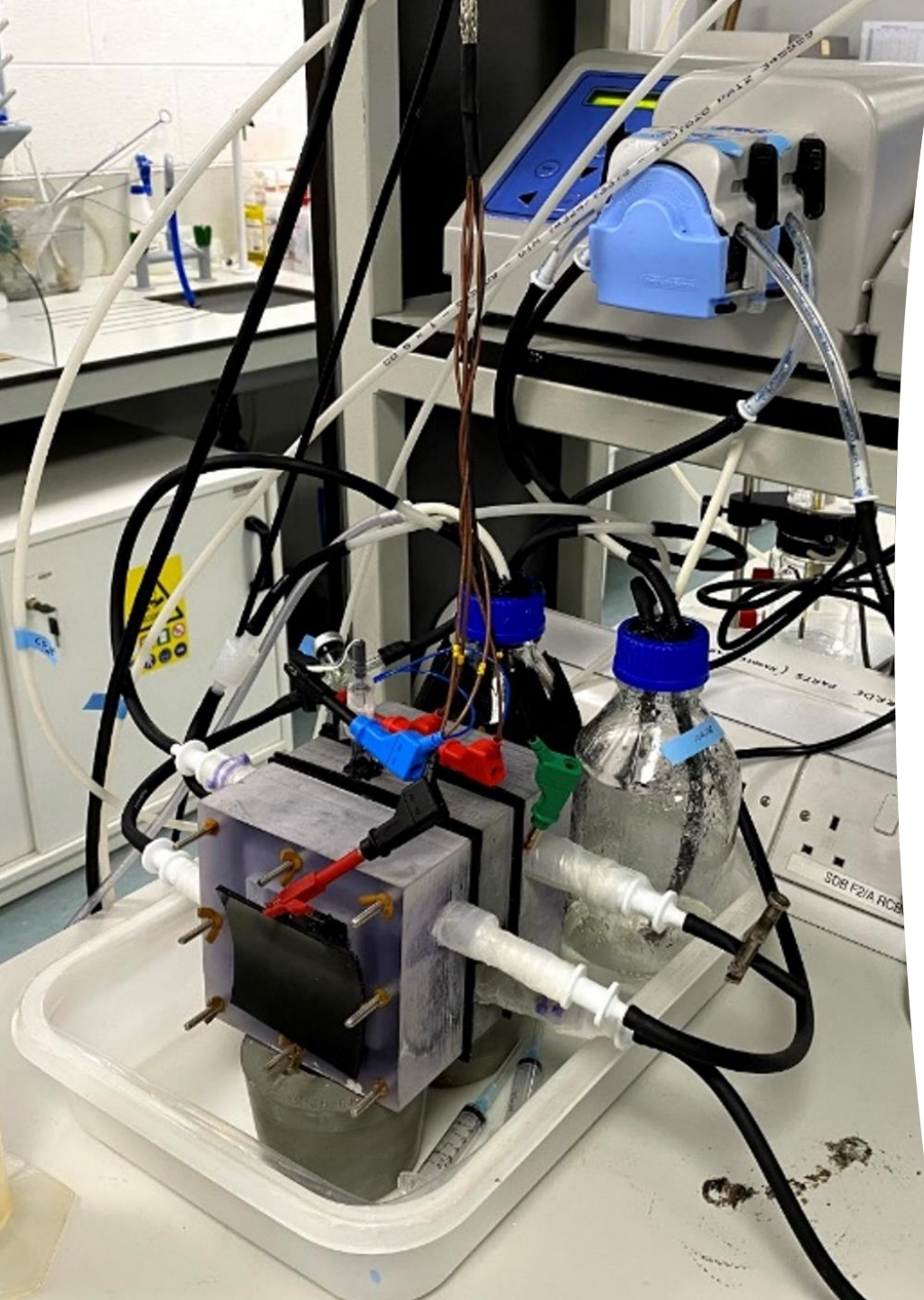
CO₂ recycling

Microbial electrochemical process

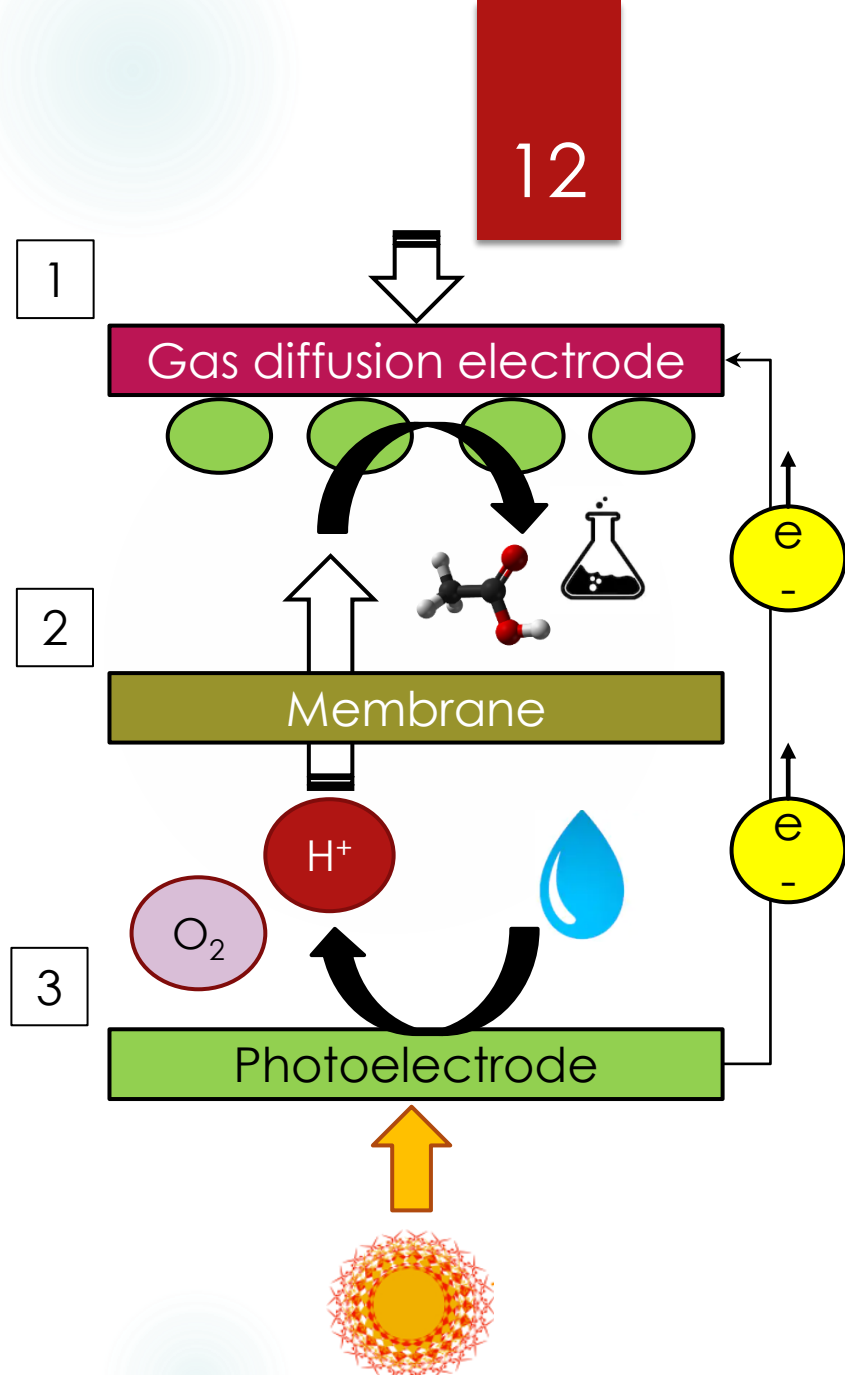
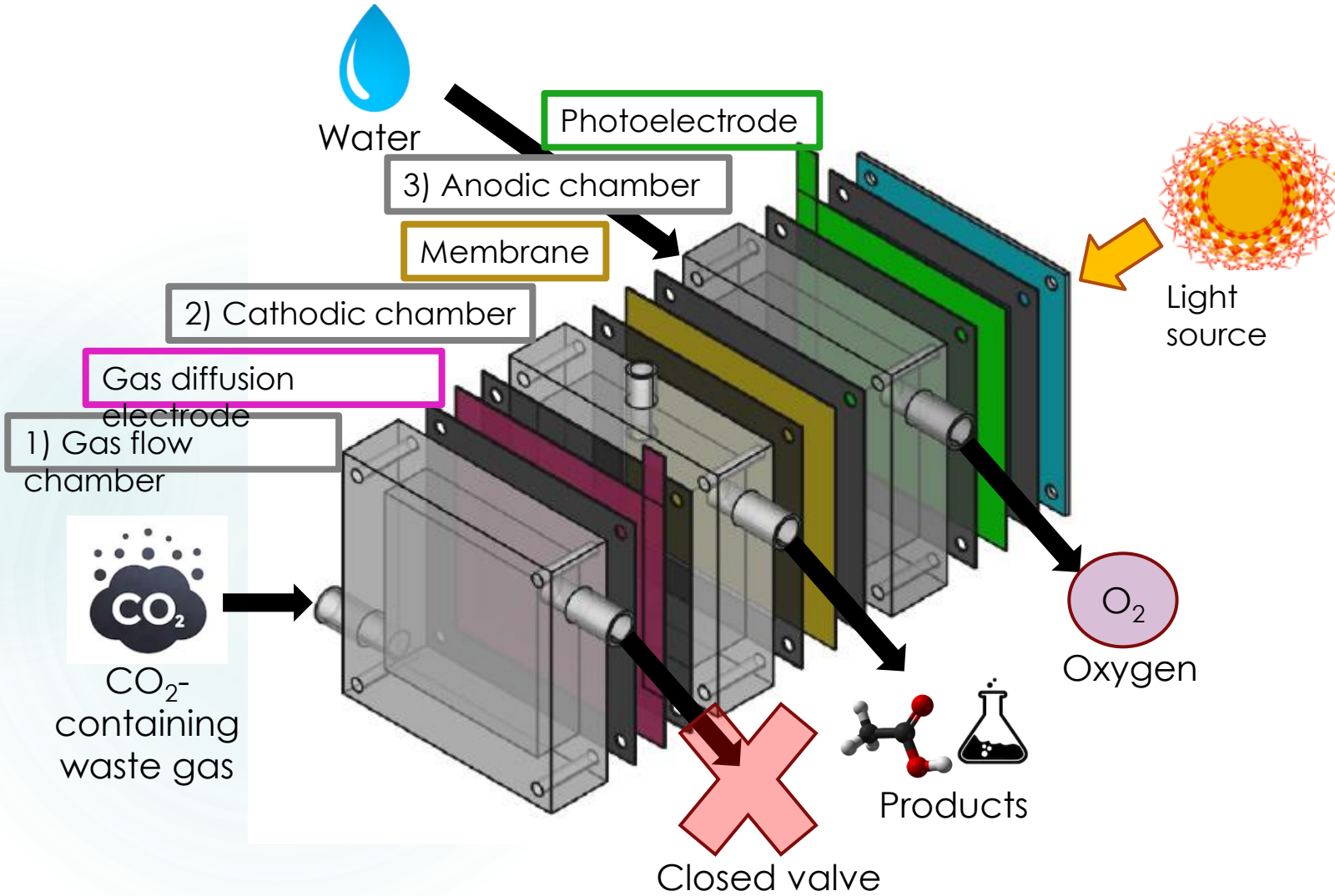
Carbon-negative technology

CO₂ conversion to green chemicals

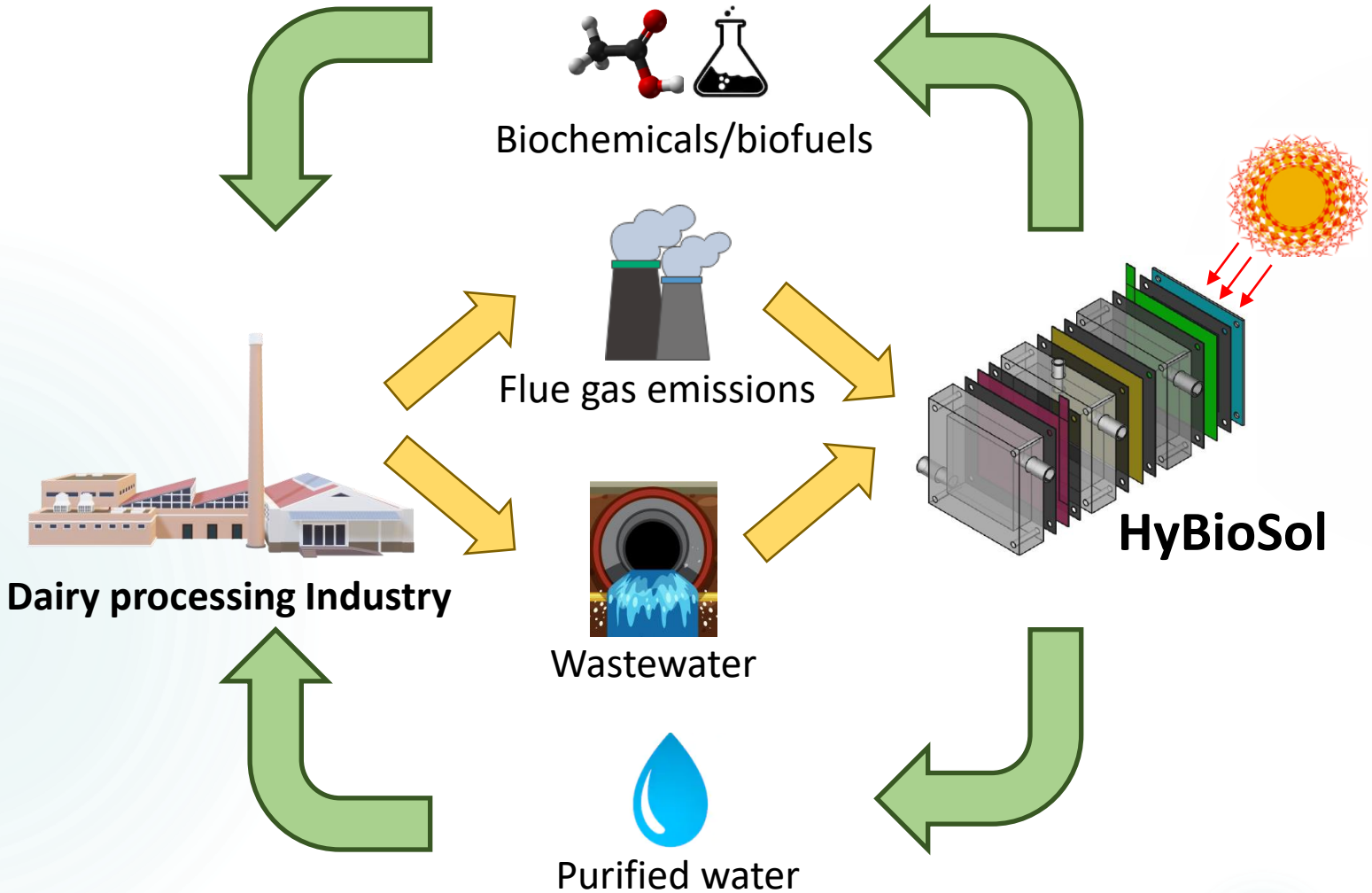
50-60 kg product (acetic acid) / MWh



CO₂ recycling



CO₂ recycling



References

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Review

The dairy biorefinery: Integrating treatment processes for cheese whey valorisation

Fabiano Asunis^{a,b}, Giorgia De Gioannis^{a,c}, Paolo Dessì^{b,*}, Marco Isipato^{a,b}, Piet N.L. Lens^b, Aldo Muntoni^{a,c}, Alessandra Polettini^d, Raffaella Pomi^d, Andreina Rossi^d, Daniela Spiga^a



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Research review paper

Microbial electrosynthesis: Towards sustainable biorefineries for production of green chemicals from CO₂ emissions

Paolo Dessì^{a,*}, Laura Rovira-Alsina^b, Carlos Sánchez^c, G. Kumaravel Dinesh^a, Wenming Tong^a, Pritha Chatterjee^d, Michele Tedesco^e, Pau Farràs^a, Hubertus M.V. Hamelers^e, Sebastià Puig^b



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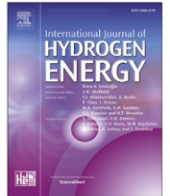


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Fermentative hydrogen production from cheese whey with *in-line*, concentration gradient-driven butyric acid extraction

Paolo Dessì^{a,1}, Fabiano Asunis^{a,b,*}, Harish Ravishankar^a, Francesco Giuseppe Cocco^{a,b}, Giorgia De Gioannis^b, Aldo Muntoni^b, Piet N.L. Lens^a



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Students & researchers

Fermentation & VFA extraction: Fabiano Asunis, Lisa Guiney, Harish Ravishankar, Patrick Maxwell, Stefano Trudu

CO₂ recycling: Francesco Cocco, Marco Isipato, Dinesh Kumaravel, Tong Wenming



A top-down view of a stainless steel pot containing a pale yellow liquid. A metal strainer is positioned in the center, holding a mound of small, white, irregularly shaped cheese curds. The text "Thank you!" is overlaid in the center of the image.

Thank you!