FACULTY OF
BIOSCIENCE ENGINEERING

DEPARTMENT OF GREEN CHEMISTRY AND TECHNOLOGY
SUSTAINABLE SYSTEMS ENGINEERING GROUP

STEN

STEN GROUP PRESENTATION

Prof. Jo Dewulf
October 2026

GHENT
UNIVERSITY

GHENT UNIVERSITY

- → Top 100 university
- → Since 1817
- → 11 faculties



BELGIUM





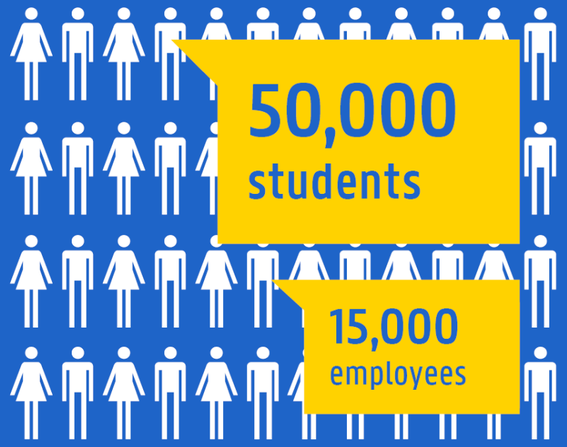
SOUTH KOREA

GHENT UNIVERSITY
GLOBAL CAMPUS

The 1st European university in South Korea.



+200 programmes



68 English-taught master's programmes



2,250
Ghent University students abroad



7,300
International students at Ghent University



DARE TO THINK

Our credo: critical and independent minds.



PLURALISM & PARTICIPATION

Open to everyone irrespective of ideological, political, cultural or social background.



SUSTAINABILITY

For a future that is ecologically, socially and economically sustainable, within a local global context.

WHO ARE WE?

GHENT UNIVERSITY

STEN

SUSTAINABLE SYSTEMS ENGINEERING – STEN

- **Part of the** FACULTY OF BIOSCIENCE ENGINEERING
- Prof. Jo Dewulf
  Prof. Pieter Nachtergaele
  Prof. Sophie Huysveld
- About **30 Pre- and Post-doc** researchers
- About **15 Master thesis** students



STEN website:

STEN LinkedIn:

GHENT UNIVERSITY

STEN PROFESSORS

Since 2003: Jo Dewulf



Full professor: Clean Technology

Context: From clean-up to clean technology

Approach: Resource management:

- Based on thermodynamics
- From process to plant to life cycle

GHENT UNIVERSITY

STEN

KEY FOCUS – PROF. DEWULF



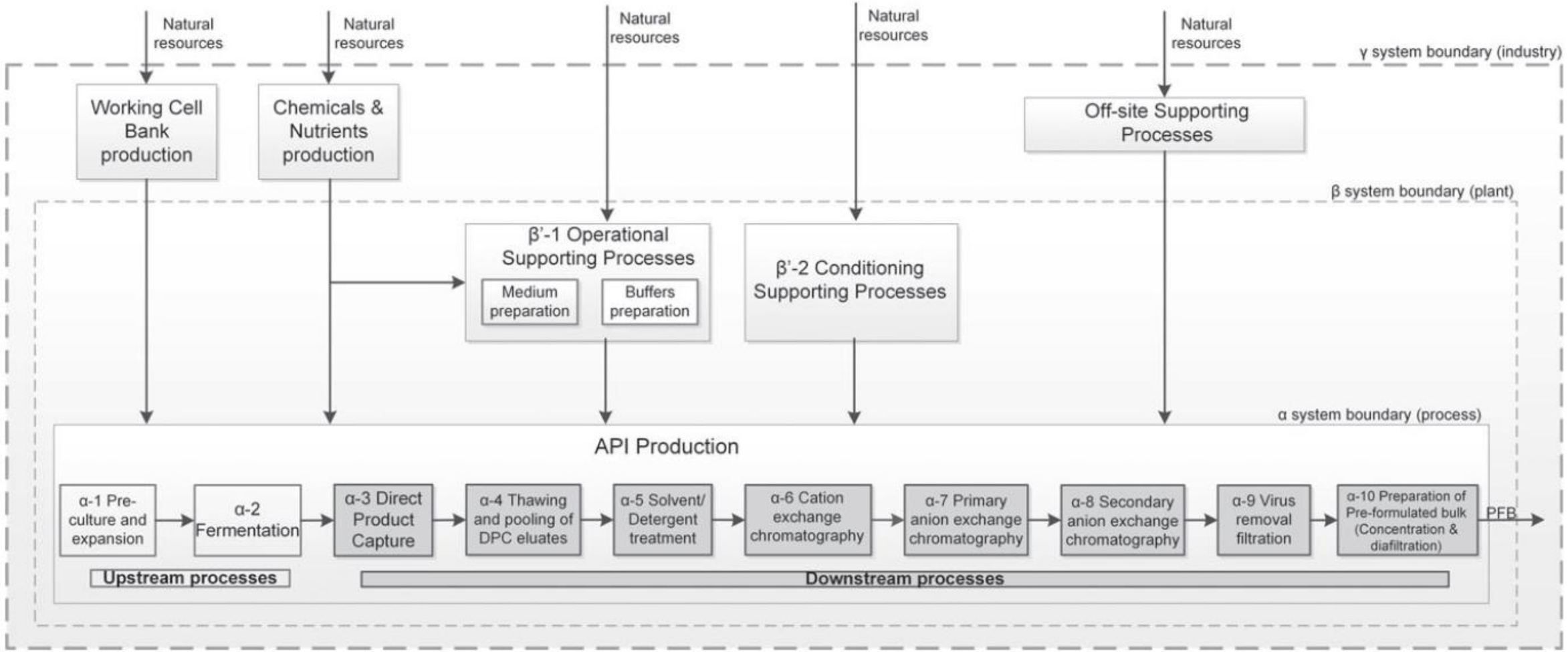
Designing and evaluating production and consumption systems
in a **sustainability** context,
relying on engineering principles.

GHENT UNIVERSITY

PROF. DEWULF

Systematic engineering approach for cleaner production

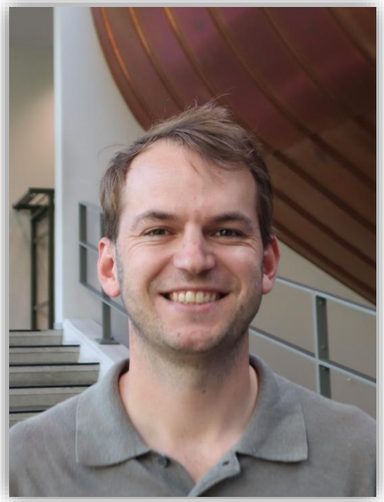
Example: biopharmaceutical production: from processes to plant to life cycle level: from α to β to γ



Renteria et al. 2019

STEN PROFESSORS

Since 2025: Pieter Nachtergaele



Assistant-professor: Process Monitoring & Optimization

Context: Circular and biobased technologies are advancing but face challenges

Approach: Digital & modelling solutions

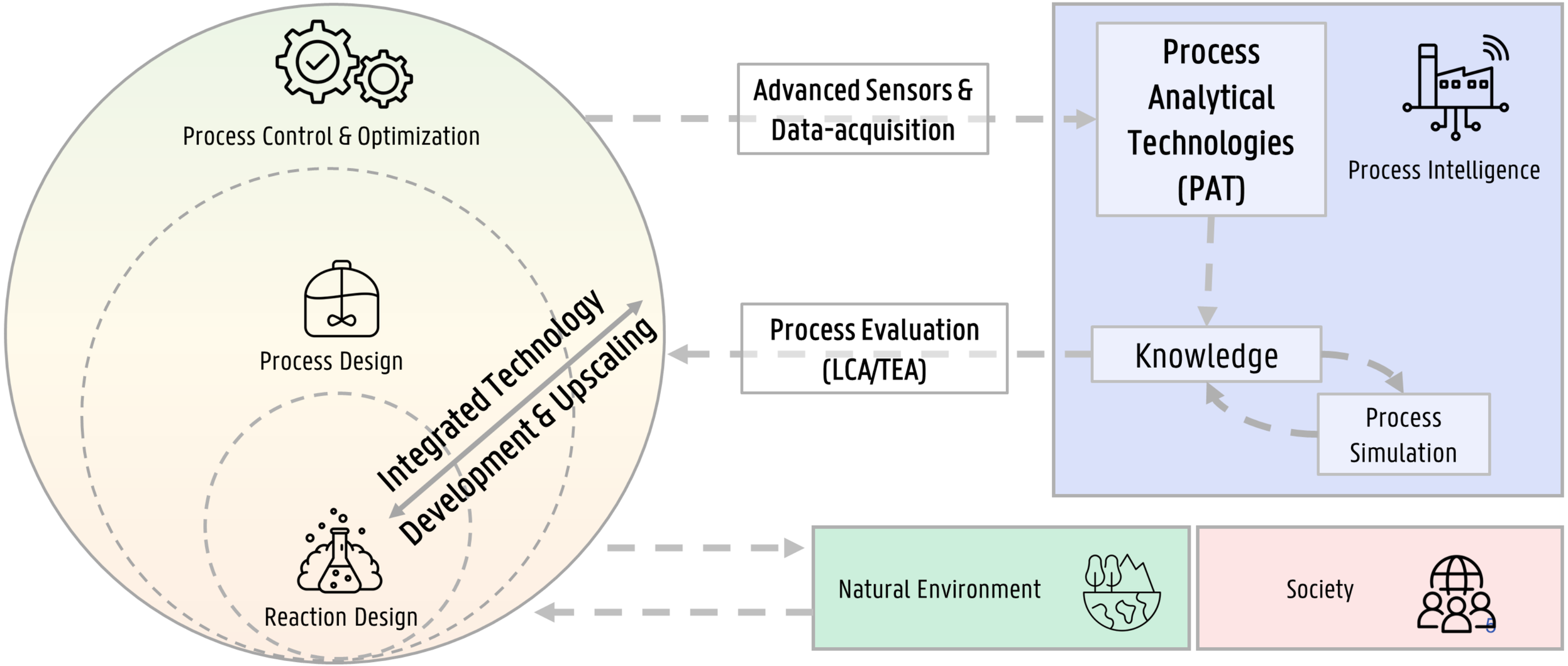
- Increase feedstock flexibility
- Supporting upscaling from lab to industrial scale

GHENT UNIVERSITY

STEN

PROF. NACHTERGAELE

Advanced process monitoring & optimization to support upscaling.



STEN PROFESSORS

Since 2026: Sophie Huysveld



Assistant-professor: Sustainable Circular Technology.

Context: Steering towards sustainable circular systems

Approach: - Prospective life cycle sustainability assessment for emerging circular technologies

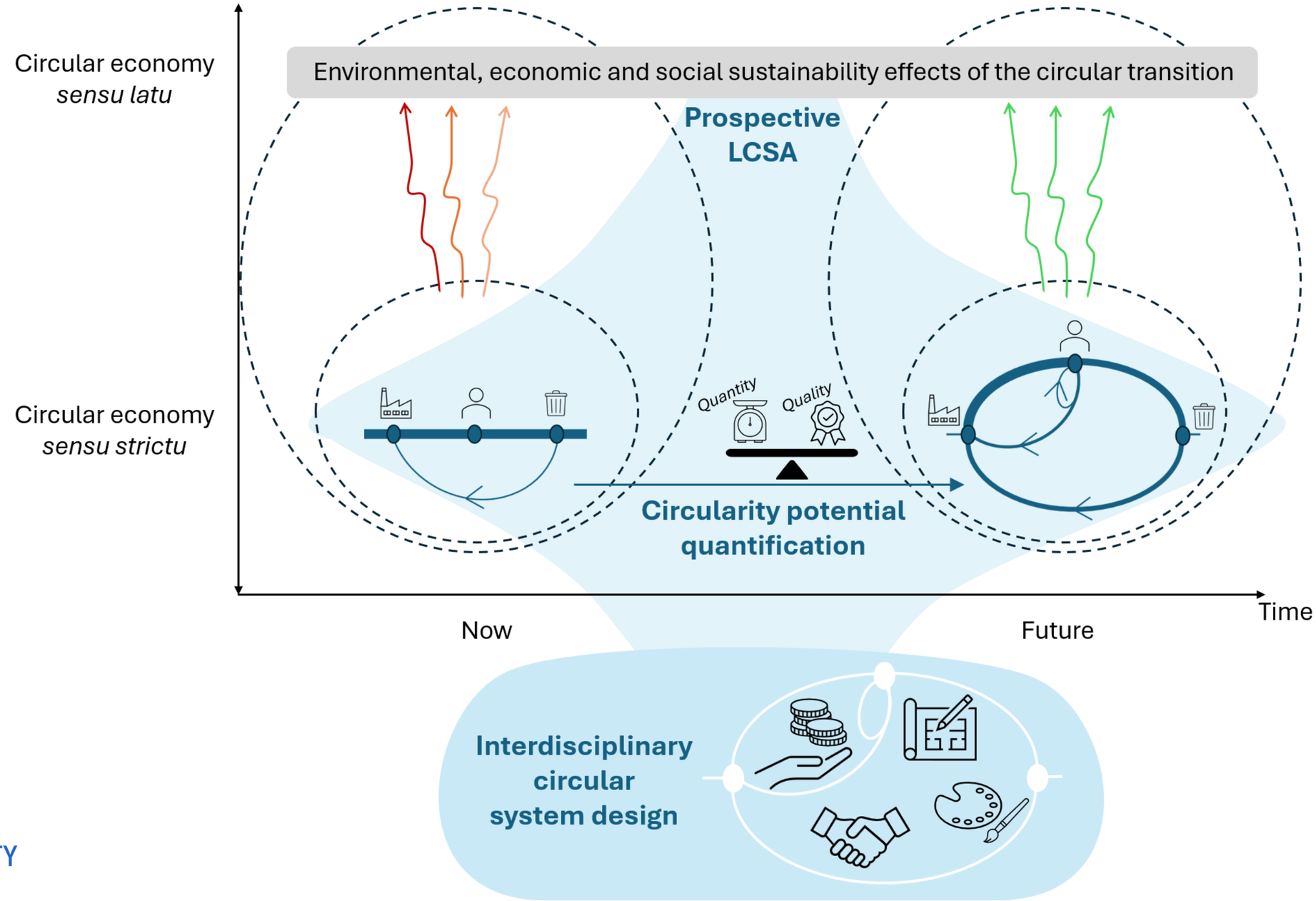
- Assessment of circularity: circular economy indicators
- Interdisciplinary design of circular systems

GHENT UNIVERSITY

STEN

PROF. HUYSVELD

Steering towards sustainable circular systems



GHENT UNIVERSITY

Connect with us on LinkedIn:

GHENT UNIVERSITY

STEN

SOME KEY PAPERS

Resource methods for LCA

Environ. Sci. Technol. **2007**, *41*, 8477–8483

Cumulative Exergy Extraction from the Natural Environment (CEENE): a comprehensive Life Cycle Impact Assessment method for resource accounting

J. DEWULF,*,† M. E. BÖSCH,‡ B. DE MEESTER,† G. VAN DER VORST,† H. VAN LANGENHOVE,† S. HELLWEG,‡ AND M. A. J. HUIJBREGTS§

GHENT UNIVERSITY

ENVIRONMENTAL Science & Technology

ACS AuthorChoice

Policy Analysis

pubs.acs.org/est

Rethinking the Area of Protection "Natural Resources" in Life Cycle Assessment

Jo Dewulf,*,†,‡ Lorenzo Benini,† Lucia Mancini,† Serenella Sala,† Gian Andrea Blengini,†,§ Fulvio Ardente,† Marco Recchioni,† Joachim Maes,† Rana Pant,† and David Pennington†

Resources, Conservation & Recycling 202 (2024) 107363

Contents lists available at ScienceDirect

Resources, Conservation & Recycling

journal homepage: www.elsevier.com/locate/resconrec

ELSEVIER



Full length article

Contribution to inaccessibility as resource impact method: A base for sustainable resource management along the life cycle

J. Dewulf [a,b,*], A. Beylot [a], D. Monfort [a], F. Lai [a], J.Santillan Saldivar [a], Stéphanie Muller [a], F. Mathieux [c]

SOME KEY PAPERS

Resource criticality

Resources Policy 53 (2017) 12–19

Contents lists available at ScienceDirect

Resources Policy

journal homepage: www.elsevier.com/locate/resourpol

EU methodology for critical raw materials assessment: Policy needs and proposed solutions for incremental improvements

Gian Andrea Blengini[a,e,*], Philip Nuss[a], Jo Dewulf[a,d], Viorel Nita[a], Laura Talens Peirò[a], Beatriz Vidal-Legaz[a], Cynthia Latunussa[a], Lucia Mancini[a], Darina Blagoeva[b], David Pennington[a], Mattia Pellegrini[c], Alexis Van Maercke[c], Slavko Solar[c], Milan Grohol[c], Constantin Ciupagea[a]

Resources Policy 50 (2016) 169–176

Contents lists available at ScienceDirect

Resources Policy

journal homepage: www.elsevier.com/locate/resourpol

Criticality on the international scene: Quo vadis?

Jo Dewulf[a,b,*], Gian Andrea Blengini[a,c], David Pennington[a], Philip Nuss[a], Nedal T. Nassar[d]

GHENT UNIVERSITY

The International Journal of Life Cycle Assessment
https://doi.org/10.1007/s11367-025-02439-6

LIFE CYCLE SUSTAINABILITY ASSESSMENT

CriticS: a resource criticality characterization method for life cycle assessment considering stakeholders' perspectives

Isadora C. Hackenhaar[1] · Gustavo Moraga[1,6] · Gwenny Thomassen[1,2,3] · Sue Ellen Taelman[1,4] · Till M. Bachmann[5] · Jo Dewulf[1]

SOME KEY PAPERS

From LCA towards LCSA

Sustainable Production and Consumption 45 (2024) 509–524

Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc



Review article

A comprehensive framework covering Life Cycle Sustainability Assessment, resource circularity and criticality

Isadora C. Hackenhaar [a,*], Gustavo Moraga [a], Gwenny Thomassen [a,b,c], Sue Ellen Taelman [a], Jo Dewulf [a], Till M. Bachmann [d]

Journal of Cleaner Production 467 (2024) 142978

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro



A holistic framework for integrated sustainability assessment of pharmaceuticals

Renewable and Sustainable Energy Reviews 138 (2021) 110666

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: http://www.elsevier.com/locate/rser



The path to sustainable energy supply systems: Proposal of an integrative sustainability assessment framework

A. Buchmayr [a,b,*], E. Verhofstadt [b], L. Van Ootegem [b], D. Sanjuan Delmás [a], G. Thomassen [a,c], J. Dewulf [a]

GHENT UNIVERSITY

SOME KEY PAPERS

Ecosystem services

The International Journal of Life Cycle Assessment
https://doi.org/10.1007/s11367-023-02216-3

REGIONAL TOPICS FROM EUROPE

Integrating ecosystem services and life cycle assessment: a framework accounting for local and global (socio-)environmental impacts

Sue Ellen Taelman[1] · Laura V. De Luca Peña[1] · Nils Préat[1] · Till M. Bachmann[2] · Katrien Van der Biest[3] · Joachim Maes[4] · Jo Dewulf[1]

Handprint

Journal of Cleaner Production 265 (2020) 121743

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

A framework for using the handprint concept in attributional life cycle (sustainability) assessment

R.A.F. Alvarenga [a, *], S. Huysveld [a], S.E. Taelman [a], S. Sfez [a, b], N. Préat [a], M. Cooreman-Algoed [a], D. Sanjuan-Delmás [a], J. Dewulf [a]

Applied Energy 353 (2024) 122123

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

Monetized (socio-)environmental handprint and footprint of an offshore windfarm in the Belgian Continental Shelf: An assessment of local, regional and global impacts

Laura Vittoria De Luca Peña [a, *], Sue Ellen Taelman [a], Bilge Bas [a, b], Jan Staes [c], Jan Mertens [d, e], Julie Clavreul [f], Nils Préat [a], Jo Dewulf [a]

Connect with us on LinkedIn:

GHENT UNIVERSITY

STEN

AGRO-FOOD AND BIO-ECONOMY



GHENT UNIVERSITY

STEN

PROJECT: SUSFOODBEL (2022-2026)

SUSFOODBEL: transitioning to healthy diets from SUStainable FOOD systems in BELgium: Priority policy actions and their multiple sustainability impacts



PhD of Claire Dénos

In Belgium, the food system causes about 20% of greenhouse gas emissions

→ measure the **sustainability impacts** of a shift to **healthy diets**, and how much priority policy actions contribute

Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc

Contribution of ultra-processed food and animal-plant protein intake ratio to the environmental impact of Belgian diets

Claire Dénos [a,b,c,*], Stefanie Vandevijvere [b], Lieselot Boone [a], Margot Cooreman-Algoed [a], Michiel De Bauw [b,d], Wouter M.J. Achten [c], Jo Dewulf [a]

[a] Sustainable Systems Engineering (STEN), Department of Green Chemistry and Technology, Ghent University, Ghent, Belgium
[b] Nutrition and Health Unit, Health Information Service, Scientific Institute of Public Health (Sciensano), Brussels, Belgium
[c] Socio-environmental dynamic research group (SONYA), Université Libre de Bruxelles, Brussels, Belgium
[d] Sustainable Food Economies Research Group (SFERE), Division of Bioeconomics, Department of Earth and Environmental Sciences, KU Leuven, Heverlee, Belgium

PROJECT: ESCIB (2023-2027)

ESCIB: developing Environmental Sustainability and Circularity assessment methodologies for Industrial Bio-based systems

Europe's bio-based economy needs a sound way to assess its sustainability

→ develop one **ready-to-use methodology** to assess **bio-based systems at any TRL**, and help standardise it

Contents lists available at ScienceDirect

Sustainable Production and Consumption

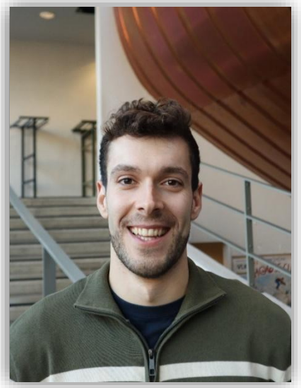
journal homepage: www.elsevier.com/locate/spc

Review Article

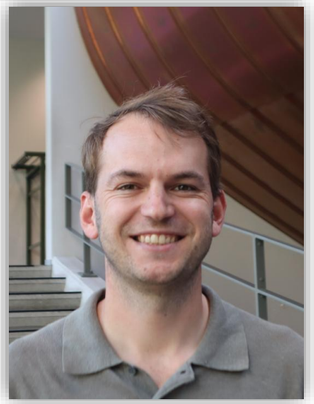
Unravelling circularity assessment for the bio-based economy: A systematic, critical review of indicators and recommendations

C. Pérez-Hernández [a,*], P. Nachtergaele [a], S. Huysveld [a], J. Dewulf [a]

[a] Ghent University, Faculty of Bioscience Engineering, Department of Green Chemistry and Technology, Sustainable Systems Engineering Group (STEN), Coupure Links 653, Ghent, Belgium



PhD of Cristian Pérez Hernández



Prof. Pieter Nachtergaele



Dr. Estefanía Sanabria García

Funding:

PROJECT: **FOODIMAR** (2024-2028)

FOODIMAR: sustainable climate-friendly quality FOOD Ingredients from MARine side-streams



PhD of Iris Joy Abrigo



Dr. Erasmo Cadena

Much of fisheries and aquaculture production, including by-catch and side-streams, is lost, discarded or used for low-value purposes

→ turn white fish and jellyfish side-streams into **collagen and glycosaminoglycans (GAGs)**, reducing waste and **using resources more efficiently**

FOODIMAR

Funding: Sustainable Blue Economy Partnership

PROJECT: **BIOCHROMA (2024-2028)**

BioChroma: exploring the functional potential of bacterial pigments for innovative food and feed applications



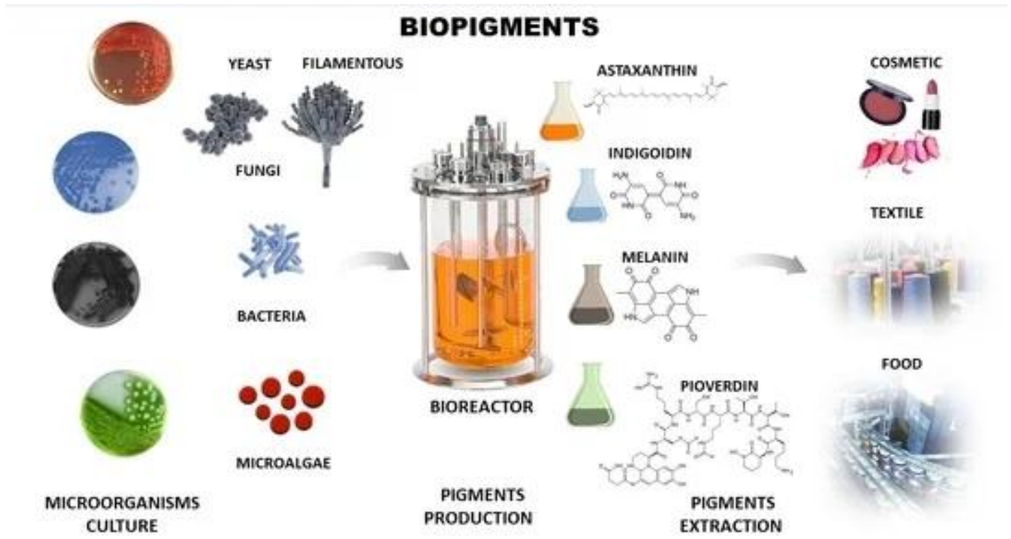
PhD of Laura Teresa Quineche Minaya



Dr. Erasmo Cadena

Synthetic food colourants raise toxicity and environmental concerns, demand for natural pigments is growing

→ expand the range of **microbial pigments** for food and feed, weighing their **environmental benefits and drawbacks**



BioChroma

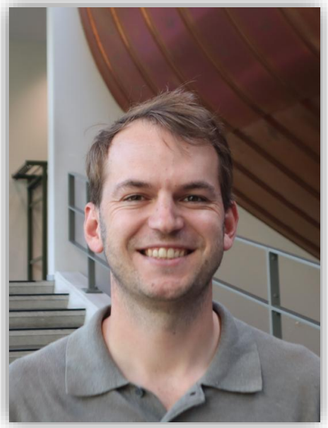
Funding: fwo

PROJECT: **SUPROSEA (2024-2028)**

SUPROSEA: SUstainable PROteins from SEAweed in a cascading manner



PhD of Nora Schelte



Prof. Pieter Nachtergaele

Global demand for sustainable proteins is rising, protein shift

→ assess the **sustainability and profitability** of a **cascading seaweed value chain** for proteins and pigments

Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc

Review Article

Life cycle assessment of seaweed-based proteins – review of status, gaps, and recommendations

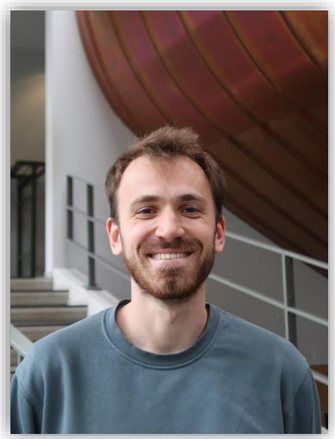
Nora Schelte [a,*], Laura Vittoria De Luca Peña [a], Pieter Nachtergaele [a], Jo Dewulf [a]

[a] Sustainable Systems Engineering (STEN), Department of Green Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000, Ghent, Belgium

Funding:

PROJECT: (2023-2027)

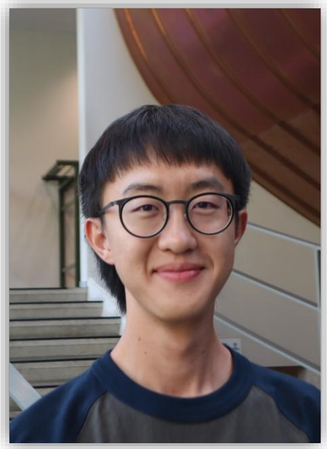
Acquiring production process data for sustainability assessment of microbial biostimulant application



PhD of Robin Dhaenen

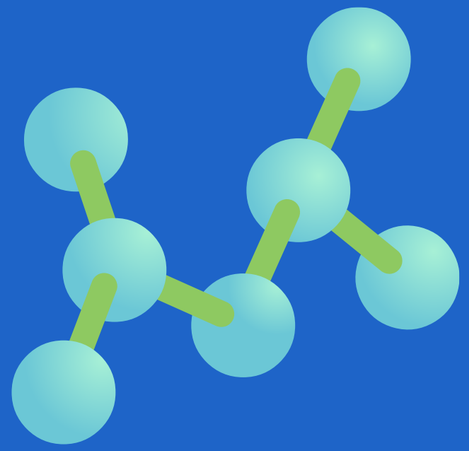
CSC PROJECT (2024-2028)

Life cycle assessment of shrimp aquaculture systems: a comparative assessment of different farming systems



PhD of Zixuan Ma

GHENT
UNIVERSITY



CHEMICAL INDUSTRY



GHENT UNIVERSITY

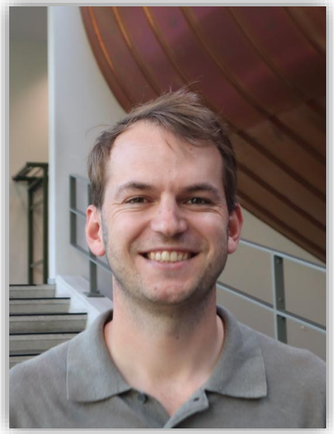
STEN

PROJECT: **CAMELEON** (2024-2028)

Cameleon: Electrified catalytic non-oxidative methane coupling for separated hydrogen and ethylene production



PhD of Mohammad Lahafdoozian



Prof. Pieter Nachtergaele

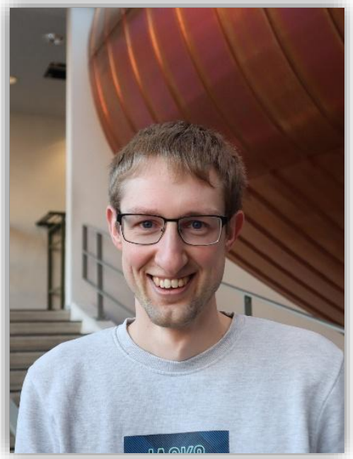
The chemical sector emits large amounts of CO_2 and relies on fossil resources

→ **electrify methane conversion** to produce **hydrogen and ethylene**, with in situ H_2 separation

Funding: VLAIO FLANDERS INDUSTRY INNOVATION MOONSHOT

PROJECT: **RUB-UP** (2026-2030)

Rub-up: Advanced Recycling of Waste Tyres via Devulcanization and Chemical Valorization for Sustainable Material Recovery



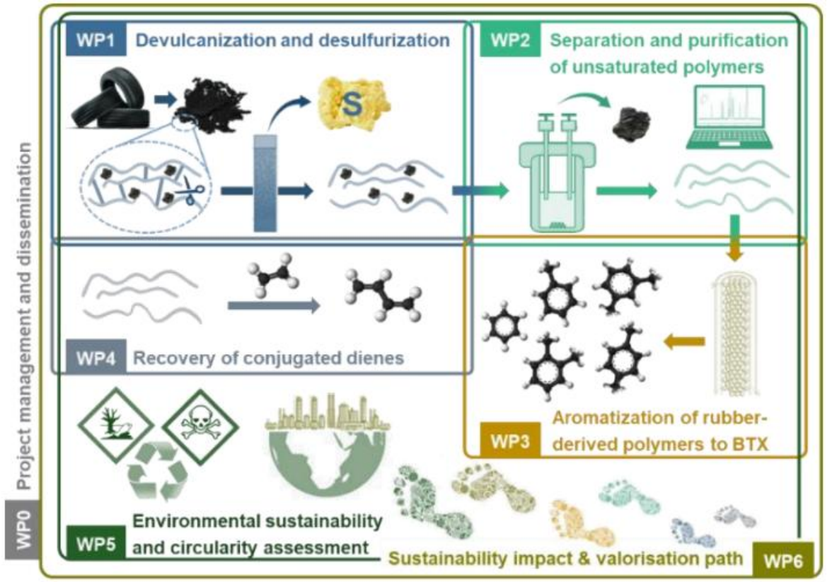
Dr. Jordy Motte



PhD of Sajjad Malekzadeh

Grinding waste tyres into granulate is increasingly restricted by health and regulatory concerns

→ convert **vulcanised rubber waste** into **high-value chemicals and materials**, reducing dependence on fossil carbon

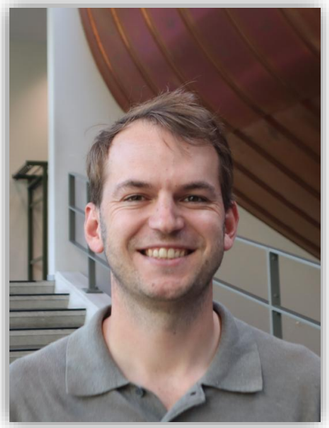


RUB-UP

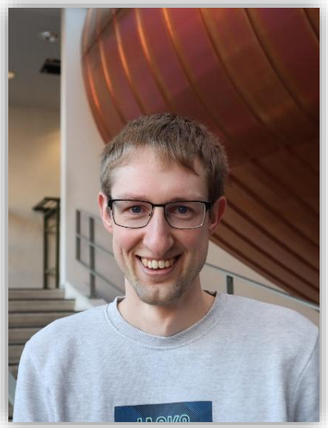
Funding: VLAIO FLANDERS INDUSTRY INNOVATION MOONSHOT

PROJECT: **ATLANTIS** (2025-2029)

Atlantis: Integrated Hydroformation and Oxidative coupling of methane to C2 and C3 base chemicals



Prof. Pieter Nachtergaele



Dr. Jordy Motte

Producing olefins today means burning fuel gas or using expensive renewable electricity

→ use the heat of **methane coupling (OCM)** to drive steam cracking, turning methane into **olefins and C3 chemicals** with less CO_2

ATLANTIS

Funding: VLAIO FLANDERS INDUSTRY INNOVATION MOONSHOT



PLASTICS AND TEXTILES



GHENT UNIVERSITY

STEN

PROJECT: **HIPPROFIB** (2024-2028)

HiPProFib: High Performance Protein Fiber materials



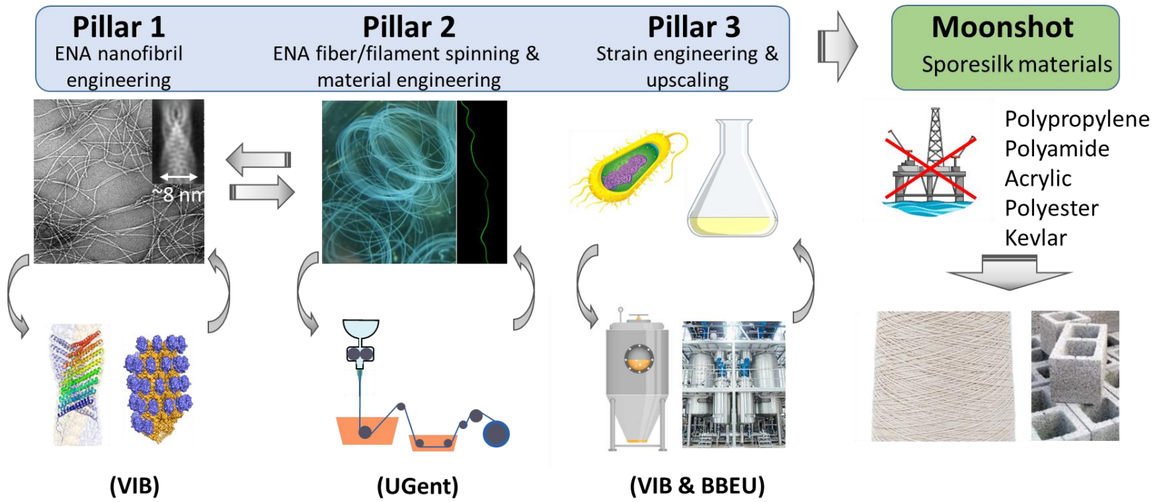
Prof. Sophie Huysveld



Dr. Trang Nhu

62% of textile fibres are man-made and fossil-based

→ scale up the production of **protein-based, silk-like fibres** with tunable mechanical and functional properties

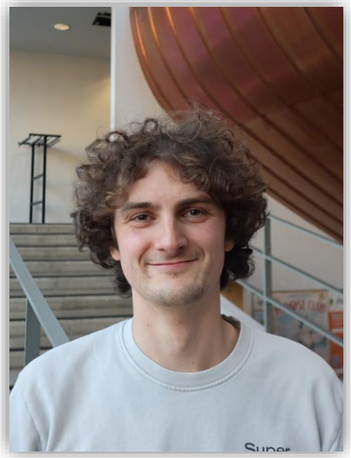


HiPProFib

Funding: VLAIO FLANDERS INDUSTRY INNOVATION MOONSHOT

PROJECT: **MAP4PLASTICS** (2025-2027)

Map4Plastics: Mapping of noncircular EoL plastics and identification of strategies to close circularity gaps



Kobe Vulsteke



Prof. Sophie Huysveld

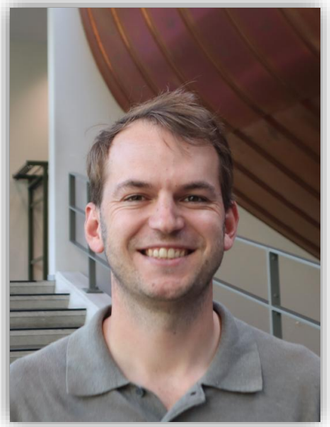
Plastic recycling rates are stagnating, and large streams of end-of-life plastics, mostly beyond packaging, stay unrecycled

→ map these **unrecycled plastics** by centralising data from literature, databases and stakeholder interviews

Map4Plastics Funding: VLAIO CATALISTI

PROJECT: **PACKAHEAD (2024-2028)**

PackAhead: Bringing AI and digitalisation into the circular bioeconomy



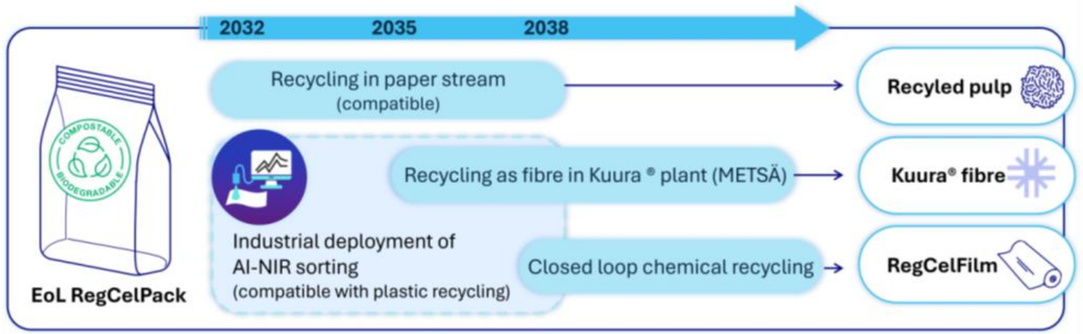
Prof. Pieter Nachtergaele



PhD of Maria Malacek

Food packaging needs sustainable, bio-based alternatives

→ combine **AI and digitalisation** with synthetic biology and bio-based materials to develop the next generation of **sustainable food packaging**

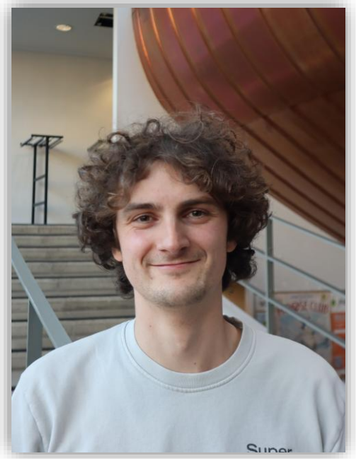


PackAhead

Funding: HORIZON EUROPE

PROJECT: **SWIFT** (2025-2028)

Swift: Sustainable Wet processes hemp and flax Into cottonised Fibre, suitable for Textile and non-woven industry



Kobe Vulsteke

→ develop **sustainable wet pre-treatments** for short hemp and flax fibres to using the fibres in high-quality textile products like clothing and medical non-wovens

GHENT UNIVERSITY

Funding: VLAIO



PHARMA & HEALTHCARE



GHENT UNIVERSITY

STEN

PROJECT: **DICE** (2022-2026)

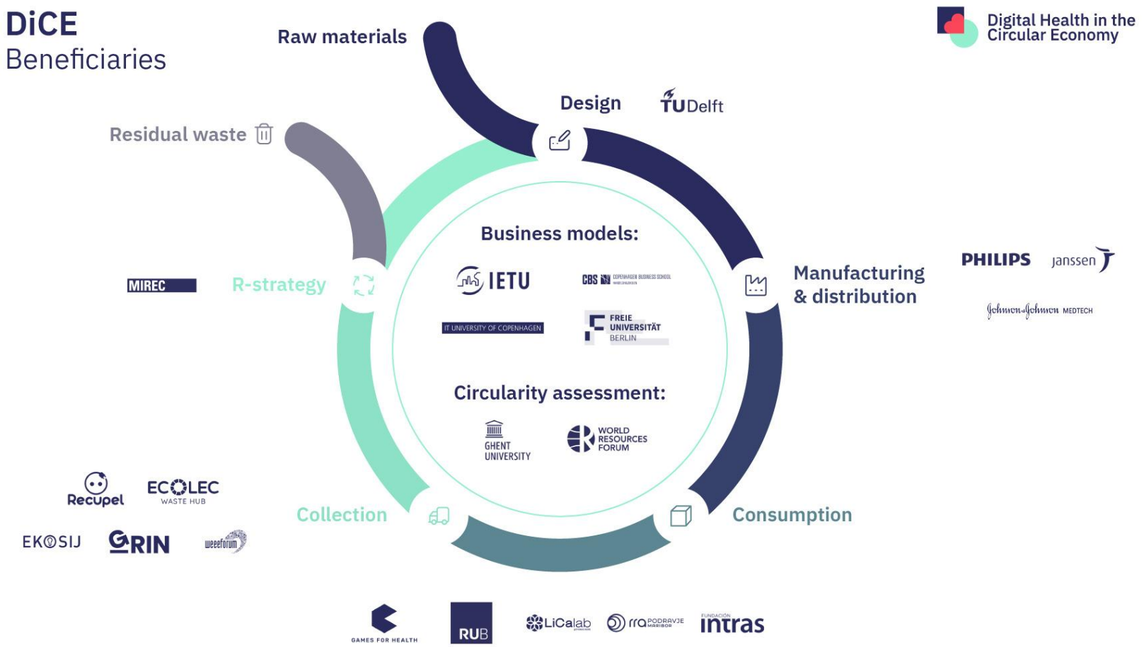
DICE: Digital Health in the Circular Economy



PhD of Naomi Muindi

E-waste from digital health devices is growing, and most of it is incinerated

→ bring stakeholders together for **circular digital healthcare** and less raw material use

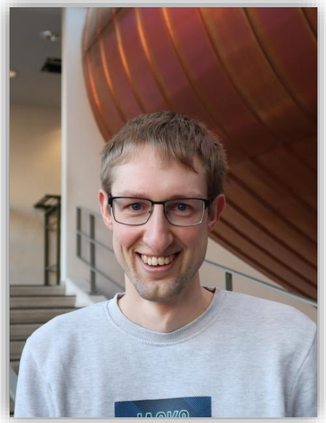


Digital Health in the Circular Economy

Funding: HORIZON EUROPE

PROJECT: **TRANSPHARM (2022-2026)**

TransPharm: Transforming into a sustainable European pharmaceutical sector



Dr. Jordy Motte



Dr. Lisa Van Wilder

Active pharmaceutical ingredients (APIs) deliver health benefits, but they also impact the environment

→ make the European pharmaceutical industry more independent and competitive, delivering **sustainable, green therapeutics** on time

Journal of Cleaner Production 467 (2024) 142978

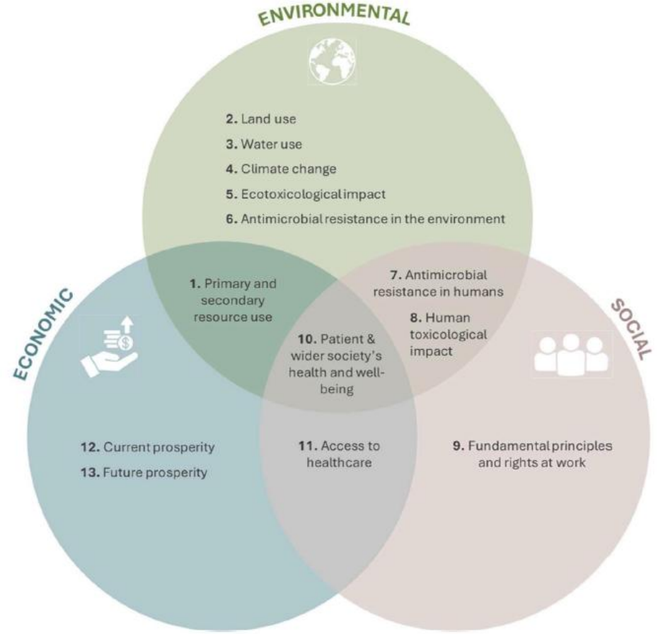
Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

A holistic framework for integrated sustainability assessment of pharmaceuticals

Lisa Van Wilder[a,b,*], Lieselot Boone[a,1], Ad Ragas[c], Caroline Moermond[d], Lowik Pieters[e], Aissa Rechlin[f], Rodrigo Vidaurre[f], Delphine De Smedt[b,2], Jo Dewulf[a,2]



TRANS PHARM

Funding: HORIZON EUROPE

PROJECT: **PHARMECO (2024-2030):**

PHARMECO: Advancing Safe and Sustainable by design practicing in Pharmaceutical manufacturing

The health sector has a significant impact on the environment

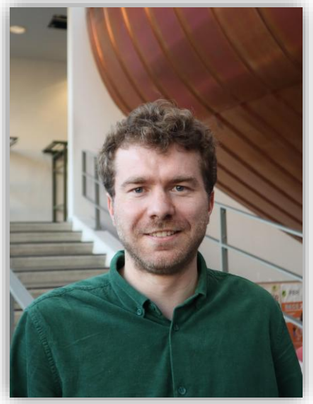
→ accelerate the adoption of **sustainable practices across the pharmaceutical sector**, driving measurable improvements in environmental performance and contributing to global climate goals



Dr. Lieselot Boone



Dr. Lisa Van Wilder



PhD of Jens Forré



PhD of Lotte Neckebroeck



PhD of Aqila Sarastya

PHARMECO

Funding: innovative health initiative

RESEARCH: (2025-2031)

Modelling hospital care pathways for improved environmental performance: integrating healthcare pathways into life cycle assessment



PhD of Camille Masselis

UZ GENT

UNIVERSITEIT GENT

CRITICAL RAW MATERIALS





GHENT UNIVERSITY

STEN

PROJECT: **RESILEX** (2022-2026)

RESILEX: Resilient Enhancement for the Silicon industry Leveraging the European matriX

Europe's solar panel production depends on vulnerable silicon and critical raw material (CRM) value chains

→ develop **silicon reuse, PV module recycling and new products** (e.g. Si-anodes for Li-ion batteries) and cut the environmental impact of solar panel production



Dr. Jordy Motte



Dr. Anna-Sophie Haslinger



Dr. Ricardo Magdalena

ReSilex

Funding: HORIZON EUROPE

PROJECT: **DEER** (2024-2028)

DEER: Demand-side measures to Enhance well-being and foster Environmental footprint Reduction



PhD of Paulien Meese



Dr. Hellen L. De Castro e Silva

Most footprint reduction efforts target the supply side, yet the demand side holds large untapped potential

→ assess **demand-side measures** for thermal comfort and mobility in Flanders: their effect on carbon and material footprints, well-being and consumers' willingness to adapt

DEER

Funding: fwo

PROJECT: **RAWCLIC** (2024-2028)

RAWCLIC: future RAW materials demand, supply and sustainability in the face of CLImate Change

The EU's twin transition needs secure access to raw materials (RMs) from primary and secondary (urban mine) sources

→ model future **RM demand, supply and environmental impacts** to support fact-based industry and policy decisions



PhD of Rhani Bostyn



Dr. Ricardo Magdalena



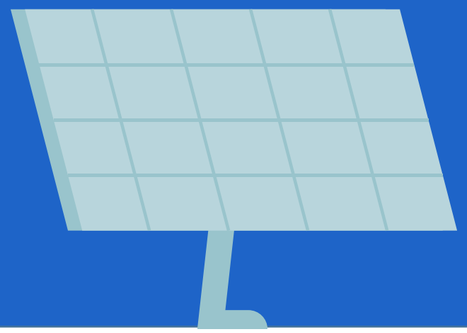
Dr. Hellen L. De Castro e Silva

Rawclic

Funding: HORIZON EUROPE



RENEWABLE ENERGY SECTOR





GHENT UNIVERSITY

STEN

PROJECT: **COMPASS** (2025-2029)

COMPASS: Comprehensive Offshore Management Platform for Assessing SuStainability

Stakeholders need to make decisions about the sustainability of offshore wind farms (OWFs)

→ create an **open, modular decision-support platform** covering all scales and life phases of existing and future OWFs (digital twins, environmental, social and economic assessments)



Dr. Erasmo Cadena



Dr. Anna-Sophie Haslinger



PhD of Lotte Stremersch

COMPASS
COMPREHENSIVE OFFSHORE MANAGEMENT PLATFORM FOR ASSESSING SUSTAINABILITY

Funding: HORIZON EUROPE

PROJECT: **DECOMPASS** (2025-2028)

DECOMPASS: Decommissioning Compass for Offshore Wind



PhD of Célestin Demuytere

First-generation offshore wind farms are reaching end of life: how do we dismantle and process them well?

→ develop a **decision-support compass** for decommissioning in the **Belgian North Sea** (removal techniques, logistics, LCA/circularity, ecological impacts)

DECOMPASS
Decommissioning Compass for Offshore Wind

Funding: BLAUWE CLUSTER

PROJECT: **ORESA** (2025-2028)

ORESA: Offshore Renewable Energy Sustainability Alliance



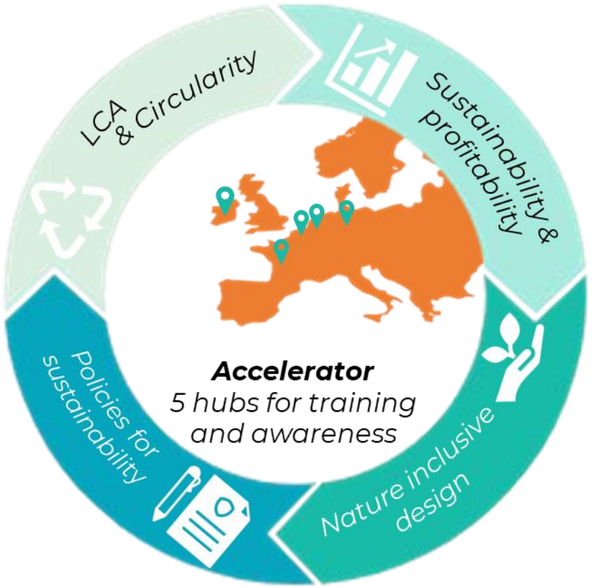
Dr. Erasmo Cadena



PhD of Célestin Demuytere

Sustainability and profitability are considered conflicting values in blue economy

→ build and pilot a **sustainability accelerator** (LCA & Circularity, Profitability, Nature-inclusive Design, Policy)



Funding:

PROJECT: **HEAT PUMPS** (2024-2028)

Circular Desing and Circular Business Models for Heat pumps



PhD of Lana Hutse



Dr. Ligia da Silva Lima

Sustainable heating needs more than new technology

→ **circular design** and **circular business strategies**

Next-generation heat pumps: sustainability assessment and business innovation for more circular systems

DAIKIN