4TU.Energy

4TU.Energy: Energy Community Day

Pitch Session

TU Delft Delft University of Technology

TU/e Eindhoven University of Technology

University of Twente.

Wageningen University & Research

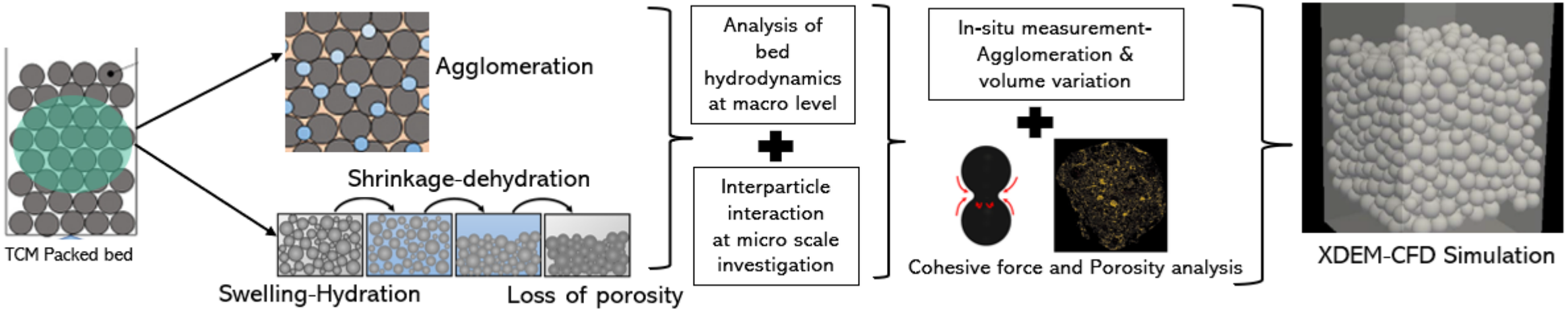
Cyclability analysis of thermochemical material

Aastha (University of Twente)

Research objectives

- Agglomeration and Volume variation analysis of TCM
- Particle scale- experimental study
- Particle scale-modeling study

DESCRIPTION AND METHODS



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Design Anthropology for Energy Transition

Abhigyan Singh (Industrial Design Engineering, TU Delft, a.singh@tudelft.nl)

Research Goal: to investigate social, cultural, and economic possibilities of emerging neighbourhood-level energy systems in the global north and global south

Energy Exchanges
(P2P Energy, Energy Sharing,…)

Social Relations

Modes of Exchanges
(reciprocity, redistribution, market,…)

Values Flows

Justice

(Social) Power

Research Themes: Social Theories & Perspectives

Research Methodologies

Design Methods
(Co-creation, Visualizations, Living Labs, Prototyping,…

Ethnography

Computational Social Science

Thermal Engineering

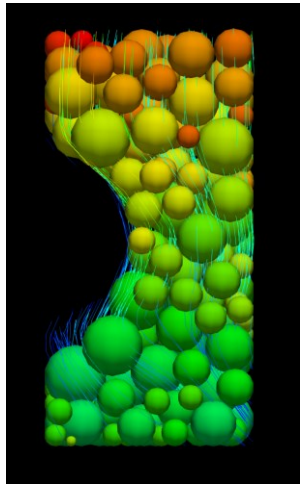
Bram Kieskamp (University of Twente)

Goals / Research topics

- Long term heat storage using salt hydrates
- Transport phenomena in porous media
- Vacuum reactor design

Methods and Techniques

Leliveld (2022)



➢ Methods

- Numerical modelling
  - Computational fluid dynamics
  - Discrete element method
- Experimental work
  - Material characterization
  - In-situ measurements of the vacuum system
  - Model validation

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Integrated Hydrogen Energy Systems

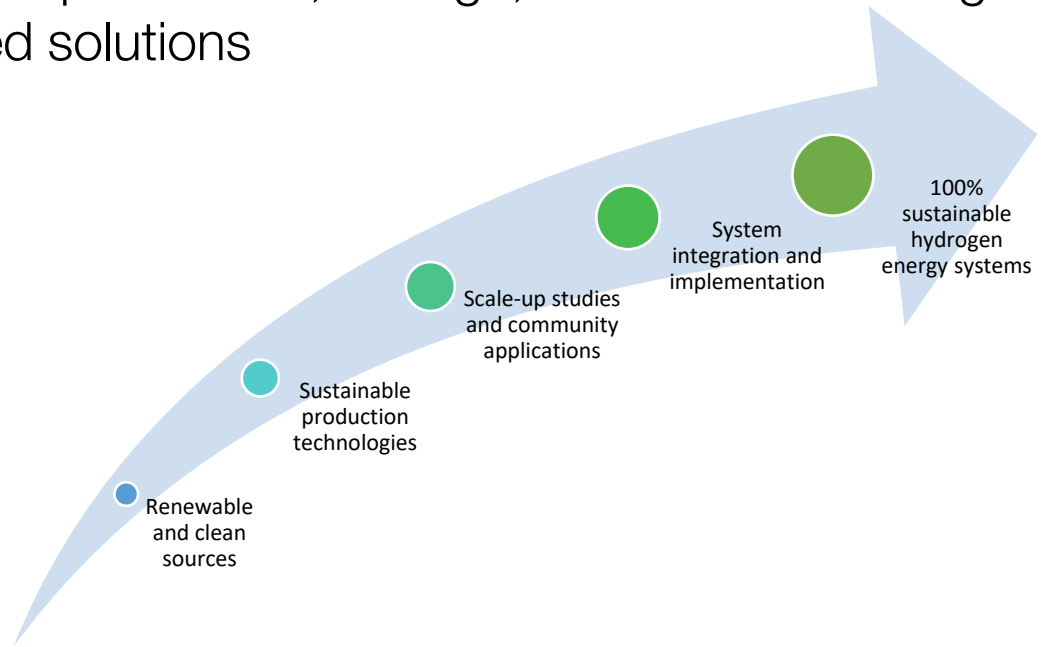
Canan Acar (University of Twente)

Profile at a glance

- *Research focus*: integrated hydrogen energy systems for decarbonization
- *Goal*: design, develop, model, and test systems with optimum performance
- *Unique expertise*: inclusion of the second law of thermodynamics
- *Research topics*: hydrogen production, storage, and end-use for high-performance decarbonized solutions

UNIVERSITY OF TWENTE.

ROADMAP

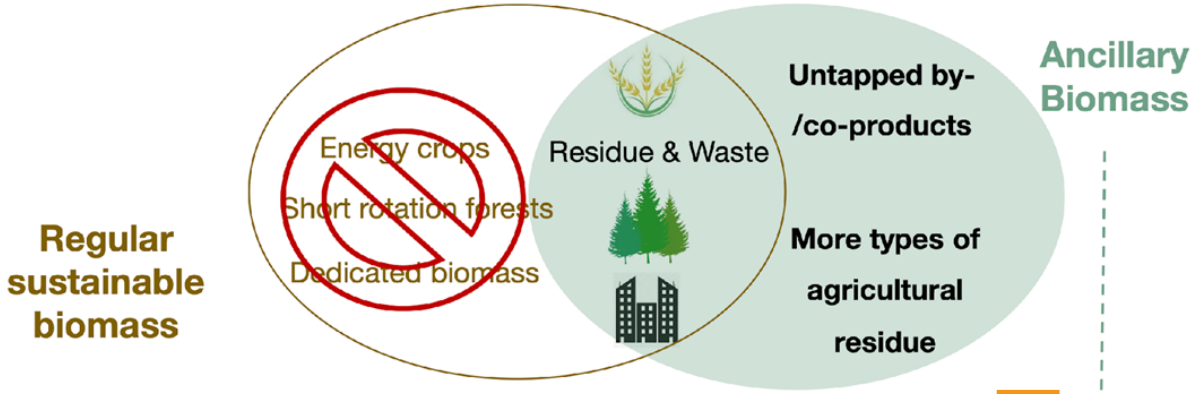


Modelling the Sustainable Role of Land-free Bioenergy

Fei Wu (fei.wu@usys.ethz.ch)

What is land-free *Ancillary Bioenergy*?

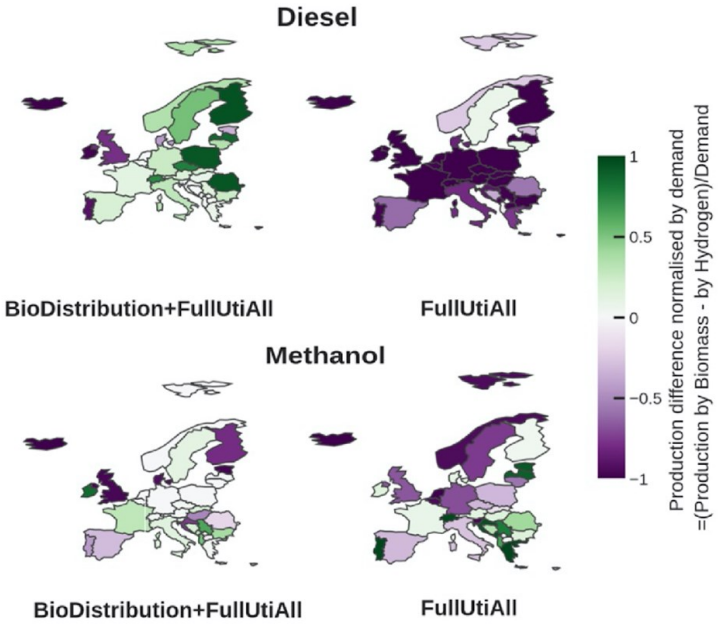
Energy from non-dedicated biomass, i.e., residues and by/coproducts of little or no value, without land-use conflicts or food competition!



Food system model SOLm → Calliope Energy system optimization model

Example: Where to strategically use what?

Country-wise (when competing with hydrogen)



Looking for future sustainable and land-free biomass data for your research?

Free data https://github.com/wwwuFei/AB-Euro-Calliope

Open model 10.5281/zenodo.6854684

Wu et al. (2022). Environmental Research Letters. 10.1088/1748-9326/aca9e1

Wu and Pfenninger. (2022) Preprint. https://doi.org/10.48550/arXiv.2212.08513

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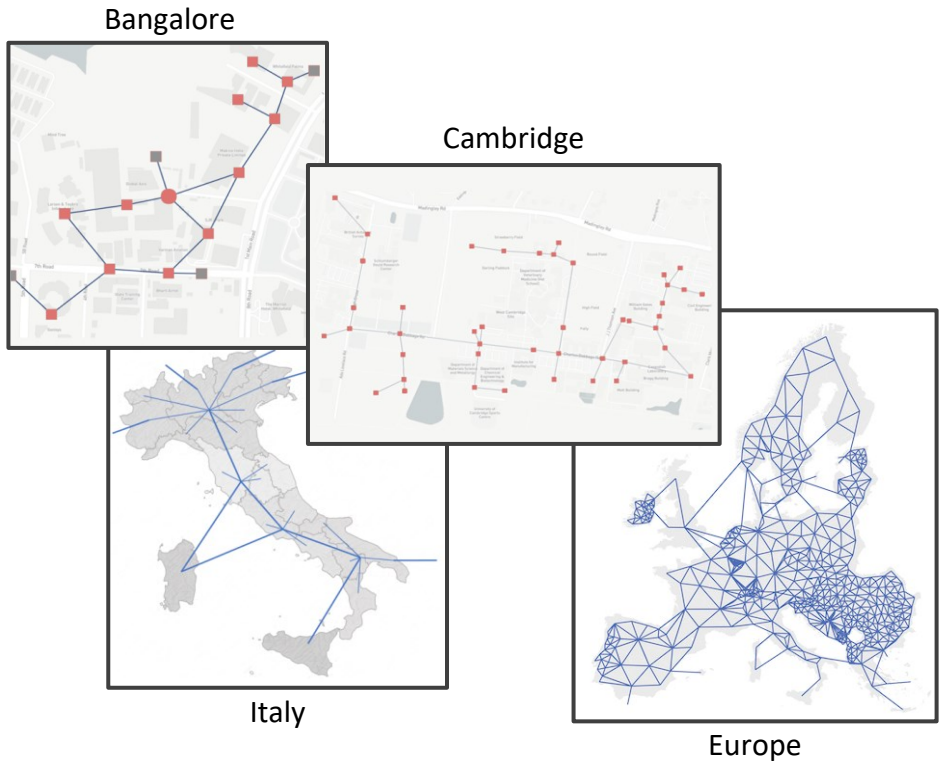
Designing carbon-neutral, resilient energy systems

Francesco Lombardi (TU Delft)

Calliope www.callio.pe



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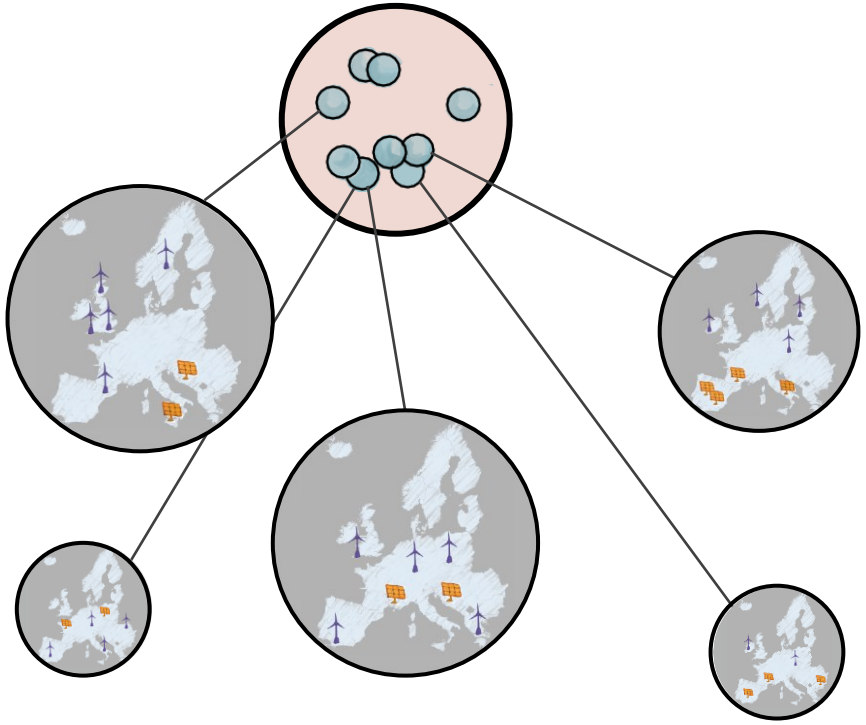
SPORES



Want to know more?
Get in touch!

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FrLomb
Francesco Lombardi

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Computational Catalysis & Materials Design

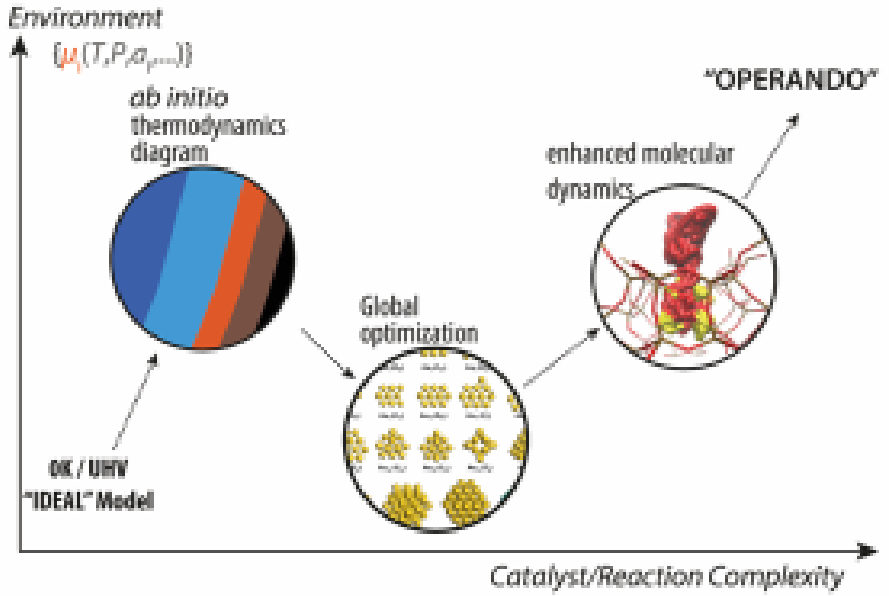
Guanna Li (Wageningen University and Research)

Goals / Research topics

- Computational chemistry
- Biomass conversion & CO_2 utilization
- High throughput in silico catalytic materials design

METHODS AND TECHNIQUES

- **Operando modeling** towards **real reaction environment**
- **Material screening** by high throughput computational modeling
- **Evolutionary** methodology – identify **reaction dynamics**
- **Structure-activity** relationship – multidimensional **descriptors**
- **Theory – Experiment Cross-Talk**



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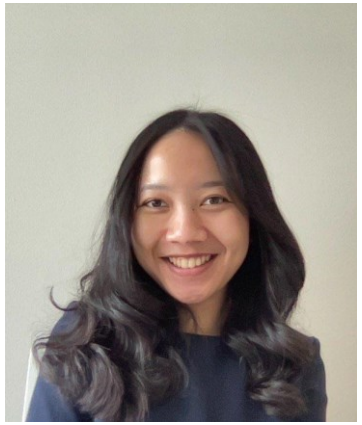
Optical Hydrogen Sensors for Aircrafts

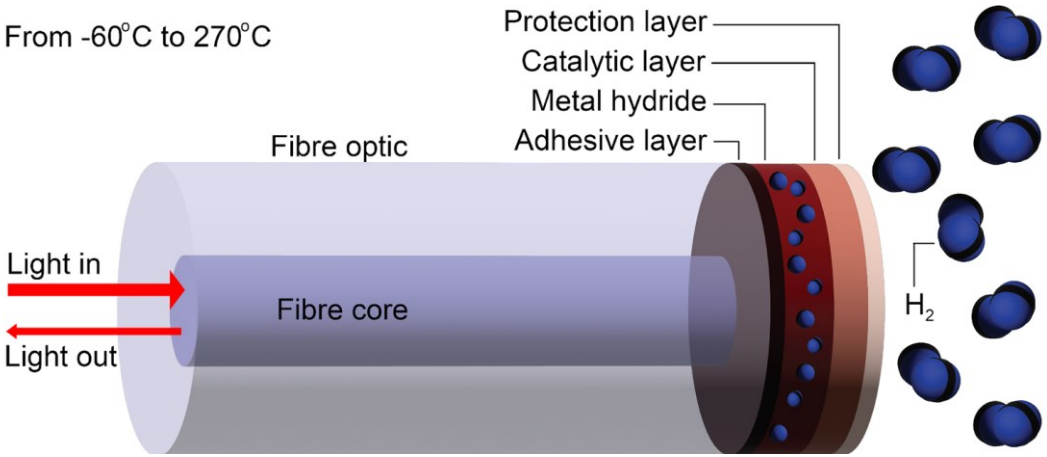
Sandra Dewi (Delft University of Technology)

Goals / Research topics

- Hydrogen detection at extreme temperatures
- Metal hydride-based sensing materials
- A collaboration between Dr. Lars Bannenberg and Dr. Roger Groves



Methods and Techniques



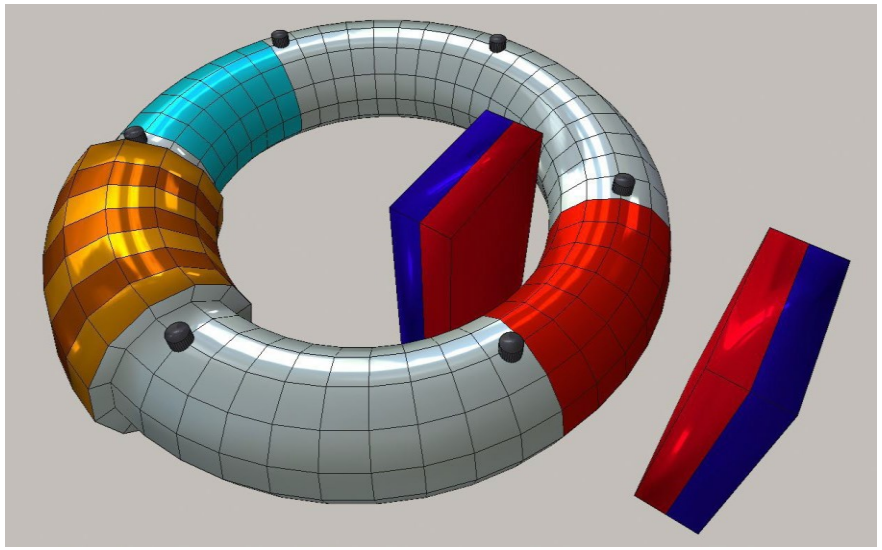
Optical properties of the sensing materials change upon contact with hydrogen. This results in altered intensity of the propagated light inside the fibre optic. Such interaction between sensing materials, fibre optic and hydrogen is the fundamental principle of this sensor.

Magnetic Heat Pumps

Keerthivasan Rajamani (University of Twente)

Research topics

- Magnetic refrigeration
- Liquid metals
- Ferrofluids



Schematic of a magnetocaloric heat pump

Techno-economic, environmental and social assessment of emerging technologies

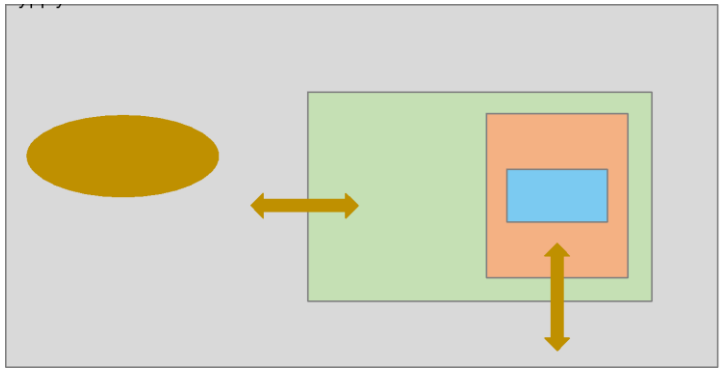
Mar Pérez-Fortes (Delft University of Technology)

Goals / Research topics

- Bridging modelling scales in CO_2 electrolysis: device, plant, supply chain and system scales
- Defossilisation of the industrial sector: alternative raw materials and impact propagation

Methods and Techniques

➢ **Multidisciplinary approach**



Process modelling, supply chain optimisation, life cycle assessment, agent-based modelling, interviews

Different methods to analyse the different “problem-scales” for emergent technologies.

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Environmental Technology

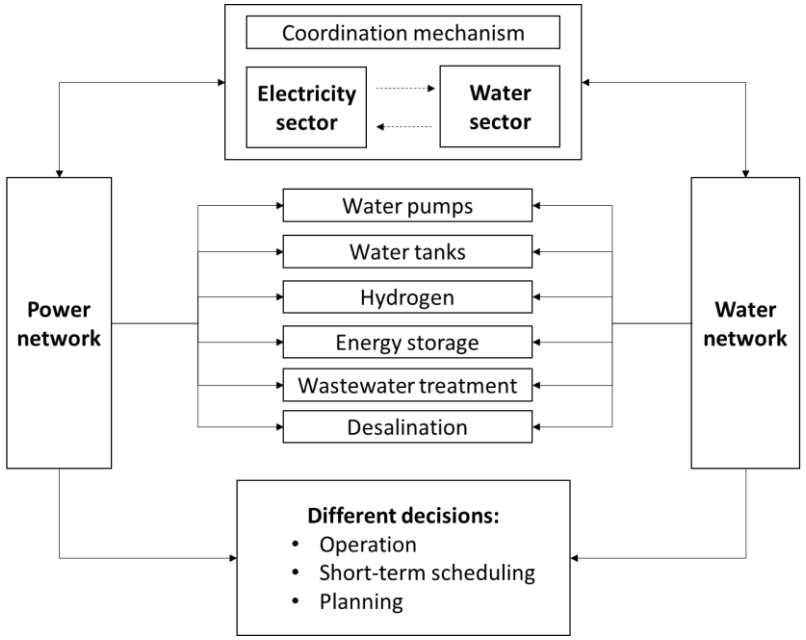
Alessio Belmondo Bianchi (Wageningen University and Research)

Research topics

- Integrated power and water coordination (**WatErCo**)
- Mathematical programming
- Convex optimization
- Decomposition techniques
- Algorithmic implementation

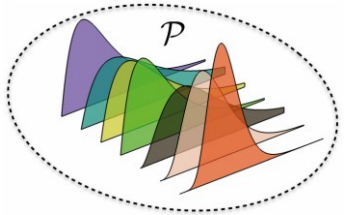
julia

python



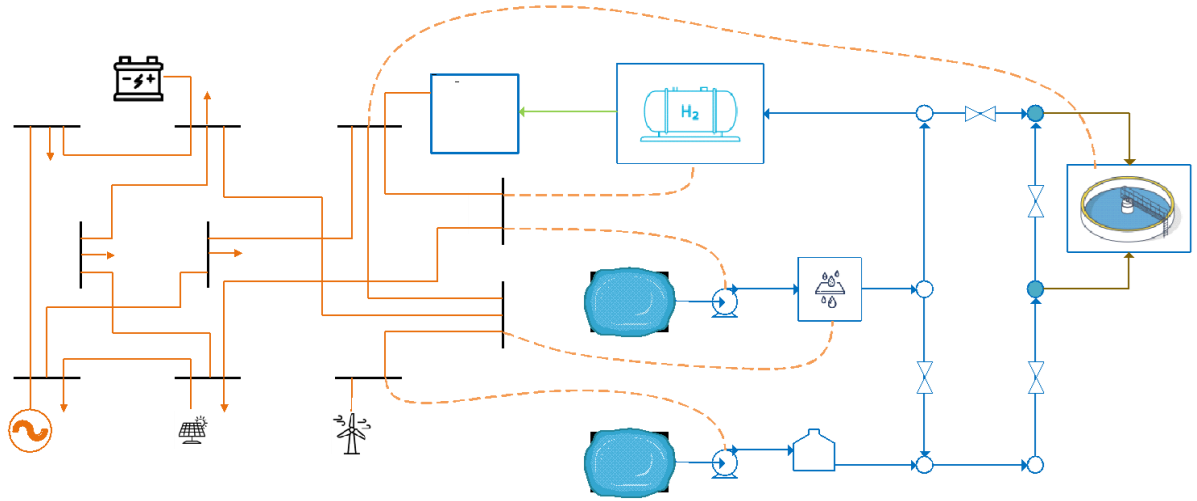
Mathematical programming under uncertainty

- Uncertainties on supply and demand side
- Chance-constrained optimization
- Distributionally robust optimization



$$\min_{\mathbb{P}\in\Pi} \mathbb{P}[p^G_{e,t} + (\phi^T \Delta\omega_t)\breve{p}^G_{e,t} \geq \underline{P}^G_e] \geq (1-\epsilon)$$

Optimal power and water flow (OPWF)



Benefits

- Economic efficiency
- Higher Flexibility
- System resilience
- Environmental gain

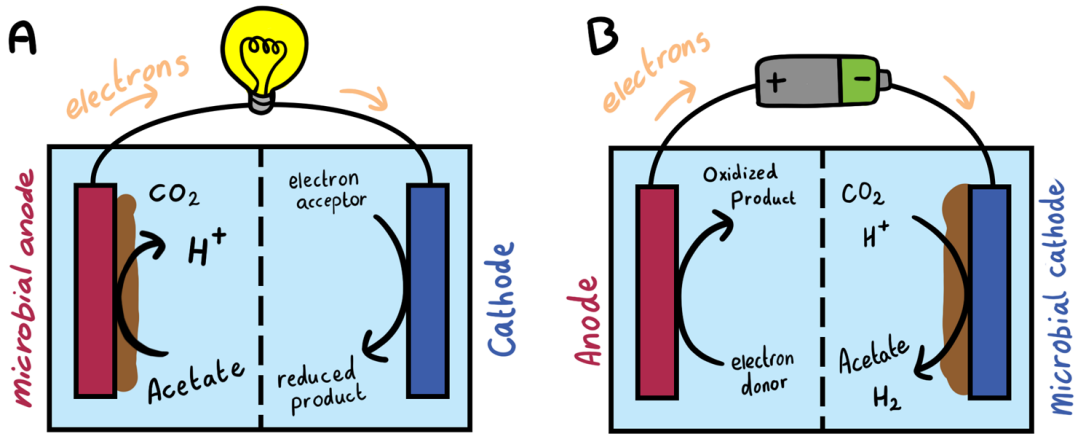
Barriers

- Political
- Technological
- Infrastructural

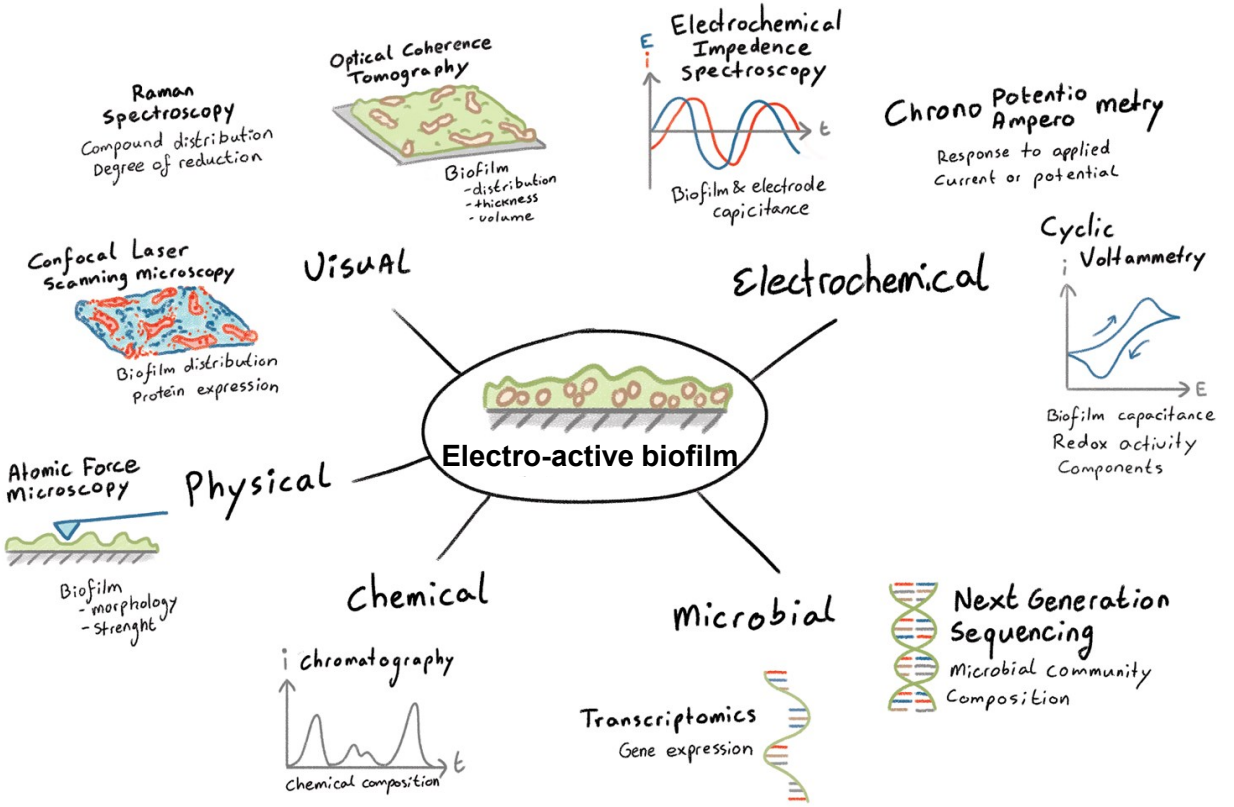
Annemiek ter Heijne (Wageningen University and Research)

Goals / Research topics

Understanding and developing electrochemical technologies for resource recovery



Electro-active biofilms as renewable catalyst



Applications

Recovery of nutrients (N,P,S) and energy

Power-to-X (methane, acetate, VFAs)

Removal of pollutants

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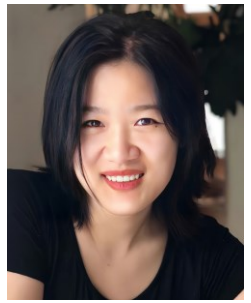
Environmental Technology

Anran Li (Wageningen University and Research)



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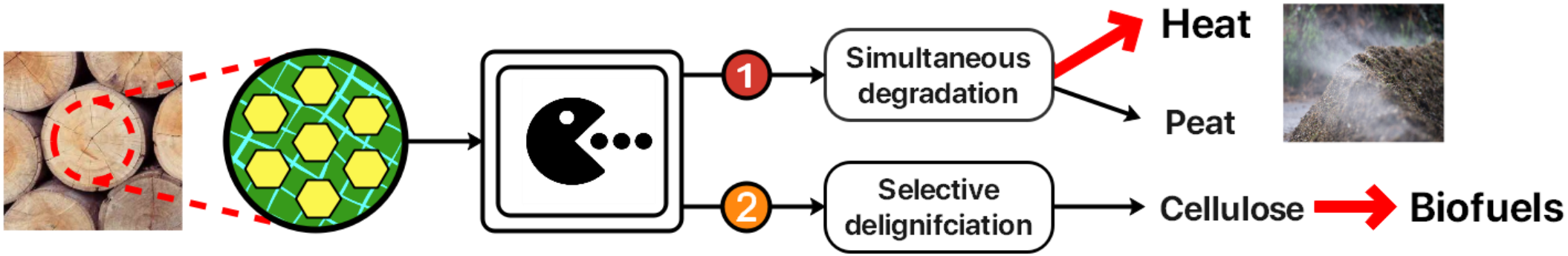
Research subjects

- Bioenergy from woody biomass
- Microbial degradation of lignocellulose

Main challenges

- Understanding of mechanisms
- Regulation of microbial activity

Process schematic



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Neutron Reflectometry and Optical Hydrogen Sensors

Lars Bannenberg (Delft University of Technology)

Goals / Research topics

- Neutron and X-ray Reflectometry
- Neutron and X-ray Scattering
- Metal Hydride Optical Hydrogen Sensors

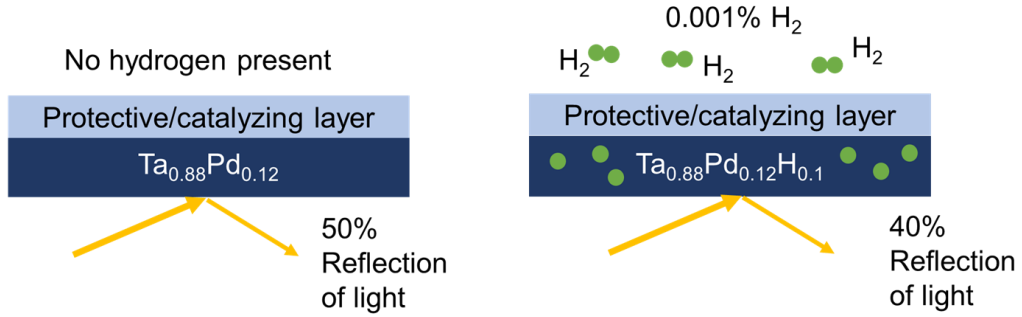
Methods and Techniques

Neutron Reflectometry

Neutron and X-ray reflectometry are techniques to study the thickness and composition of thin films with length scales between 1 – 200 nm.

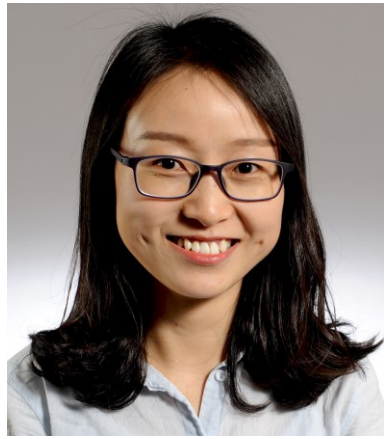
Apart from applying this technique in my own research on optical hydrogen sensors, we have successfully applied it to study superconductors, solar cells, dental implant coatings, polymers, corrosion, and battery materials

Optical Hydrogen Sensors



Thermal and Fluid Engineering

Tingting Zhu (University of Twente)



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Goals / Research topics

- Mixture refrigerant based heat pump technologies
- Solar thermal energy technologies
- Thermal energy storage systems