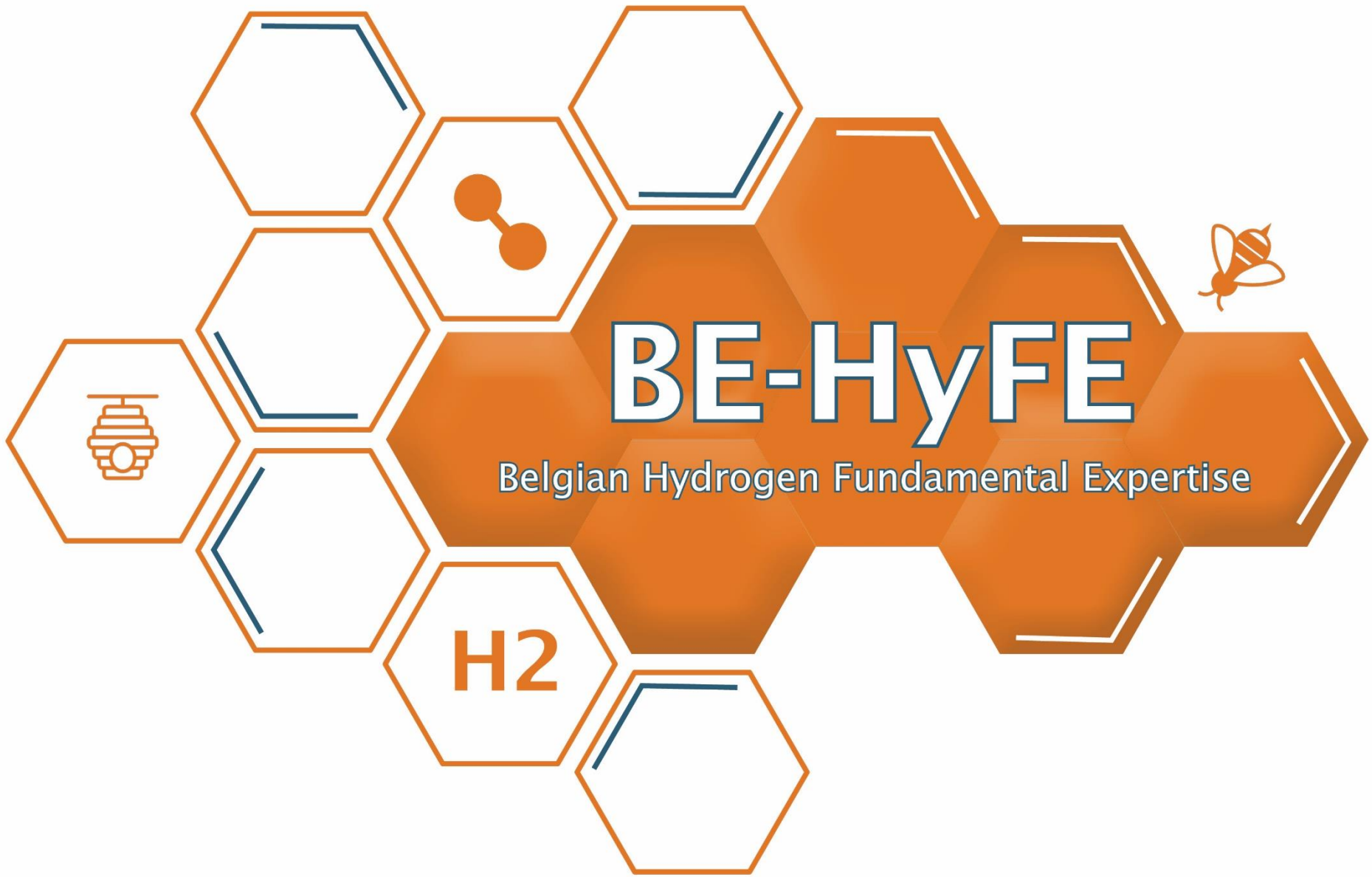

BE-HyFE
Belgian Hydrogen Fundamental Expertise
H2

wifi

login: TheLab
password: Experiment

BE-HyFE project

A first look at the BE-HyFE project for the Industrial Advisory Board

05.10.21 – The Lab (Ghent) – Marijke Mahieu & Louis Sileghem

BE-HyFE – IAB

Who’s who?

Project coördination team – UGent

Prof. Michel De Paepe
Project Supervisor

Marijke Mahieu
Project Coordinator
& Community Builder

SPOC

Louis Sileghem
Scientific coordinator

Judith Ooms
BD EnerGhentIC

BE-HyFE IAB

Project introduction

Project type

- Energy Transition Fund
- Within the federal energy competences the Energy Transition Fund aims to encourage and support research, development and innovation in the field of energy
- Call 13/11/2020 → 14 approved projects
- BE-HyFE → thematical axes 1&3
  - Renewable energy sources in North Sea & biofuels
  - Security of supply & grid balancing

economie
FOD Economie, K.M.O., Middenstand en Energie

Project in numbers

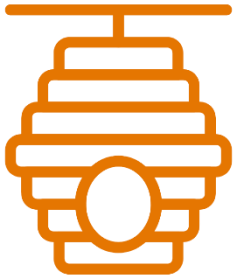
- 14 academic partners
- 16 PhD topics
- 31 Letters of support
- 3 pillars
- 4,5 years
- 4,5 mio euro
- 1 backbone/community

Project goal

The aim of the project is to create a **Belgian homebase** for **academic hydrogen expertise** by establishing a **core group of 16 broadly trained and highly networked early-stage researchers** who can, together with their extended academic peer-network, **support the Belgian industry** in finding both technological and societal solutions to essential hydrogen challenges. They will achieve this by pursuing **excellence in their fundamental research**, obtaining specialized skills through **extensive training** and **exchanging knowledge** between peers and within the **academic-industrial network**.

What's in a name?

BE-HyFE



Belgian **Hydrogen** **Fundamental** **Expertise**

Organised structure

Common goal

Gathering expertise

Cross-pollinate

collective responsibility

Why this project?

- Hydrogen is hot!
- Hydrogen is needed
- Belgian expertise
- Still, more fundamental research is crucial
- BE academic expertise: highly specialised and outstanding
  - BUT: fragmented & limited collaboration

BE-HyFE = interdisciplinary approach to create an academic hydrogen backbone for the industry

BE-HyFE IAB

Project goals | pillars | expectations

Project goals

What do we want to achieve after 4,5 project years?

- 16 graduated PhDs
- Multidisciplinary team of hydrogen experts = backbone
- Highly trained ESRs – communication, approaching industry, network skills, collaborative mindset, agility, etc.
- A BE academic network
- An academic – industrial network
- New (structural) collaboration & opportunities
- Foundation for more BE industrial innovation
- Stronger BE position in EU and worldwide
- Increase of hydrogen knowledge = accelerate the energy transition

How? → project methodology = hollistic approach, 3 pillars, ITN

Our 3 pillars

Research

- 16 ≠topics
- Whole value chain
- Promotor + co-promoter host
- Exchange program
- Mapping academic expertise & industrial needs

Training

- Training agenda
- workshops – technical or topic specific
- Tranferrable & overall skills
- Network events
- Agile training
- HydrogenWeeks
- Alumni framework

Community & mobility

- Academic network
- Academic-industrial network
- Secondments
- Site/company visits
- H2 EU networks
- IEA
- Academic community platform

Cluster partners WaterstofNet – Tweed in tandem

Our cluster partners will act as in-betweens for the ESRs and the companies involved, will provide access to companies through their large network and will facilitate knowledge transfer via webinars, workshops and other events.

Tasks:

- **Secondments**: guide ESRs/promoters with linking them to right companies, together with IAB
- Organisation of **company/site visits**: organise site or company visits for the team
- **Mapping Belgian research activities** and **industrial needs**: overview of current research activities in BE KI & opportunities/needs industry
- Identify and promote possible **collaborations with foreign companies and knowledge institutions**, or with **similar hydrogen networks** that exist abroad

WaterstofNet

Cluster TWEED

Kick-off meeting

Interaction with industry

Interaction with industry

What can we offer our industrial partners? How can you get involved?

- **IAB** → 2x/year, advise on network opportunities, discuss secondment options, provide feedback/reflection moments for ESRs, support site visits, knowledge exchange

- **Secondments** → where relevant and compliant with rules the ESR will spend several months of their PhD at one of the companies: hands-on experience, better outline of bigger context, increased market potential after graduation

- **Academic-Industrial network** → networking opportunities (2-way), knowledge transfer via webinars, workshops & events, site visits

Interaction with industry

Ensure maximum interlinkage, knowledge exchange and collaboration with industry

BUT

- ESRs must remain independent in the fundamental aspect of the research
- Industry cannot pilot the research (no control or influence by private party)
- Secondments: only when fits in frame of fundamental research; no commercial activity whatsoever

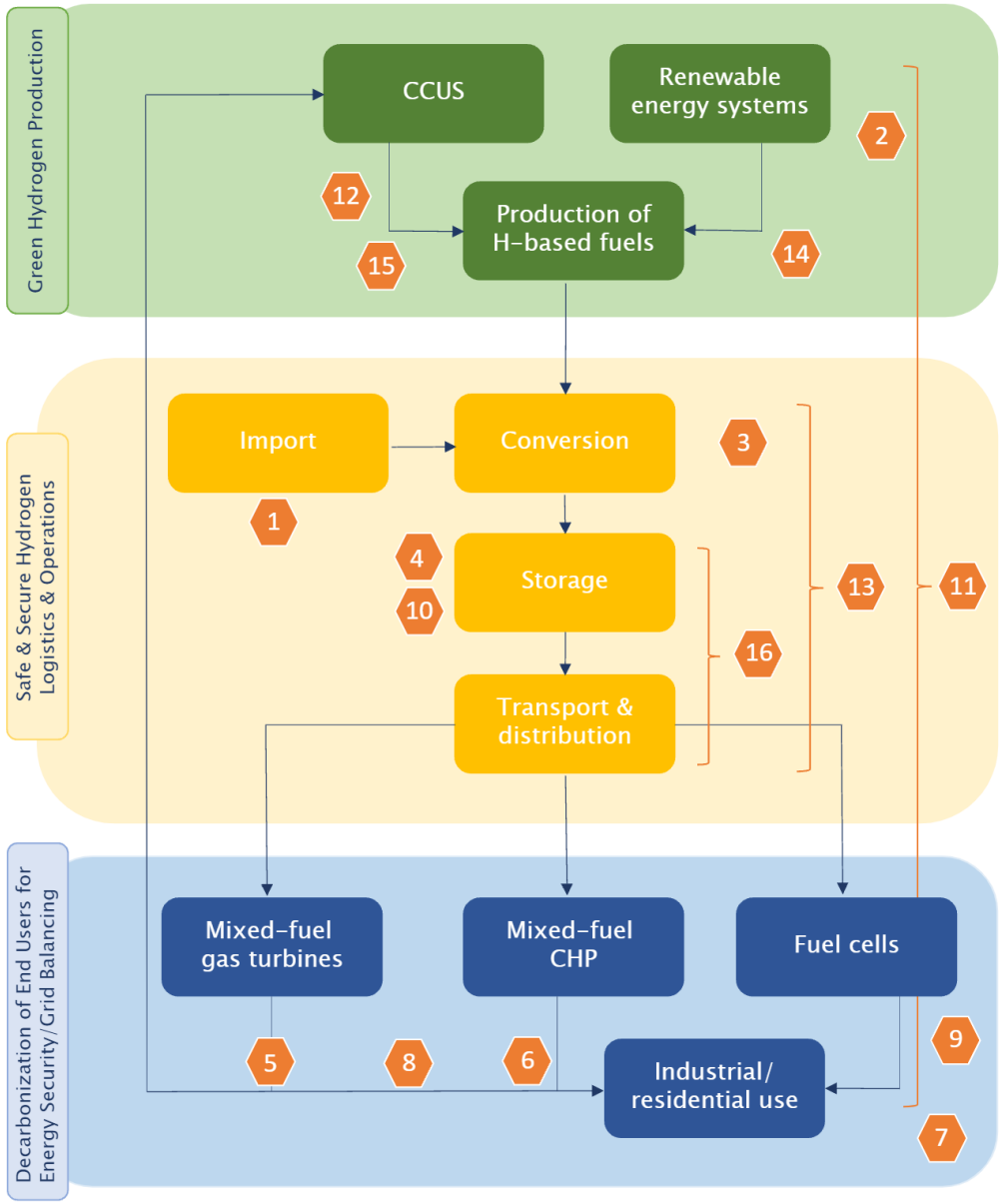
Interaction with industry: next steps

- **Survey** will be send to ask about:
  - Your possible participation in the IAB
  - Your expectations about the project and the research topics
  - Your suggestions for the industrial–academic network
  - Your willingness to offer site visits to your facilities
- **Secondments**:
  - Will only start in second half of project
  - Always in consultation with promoter, coordination team, cluster organisations and IAB

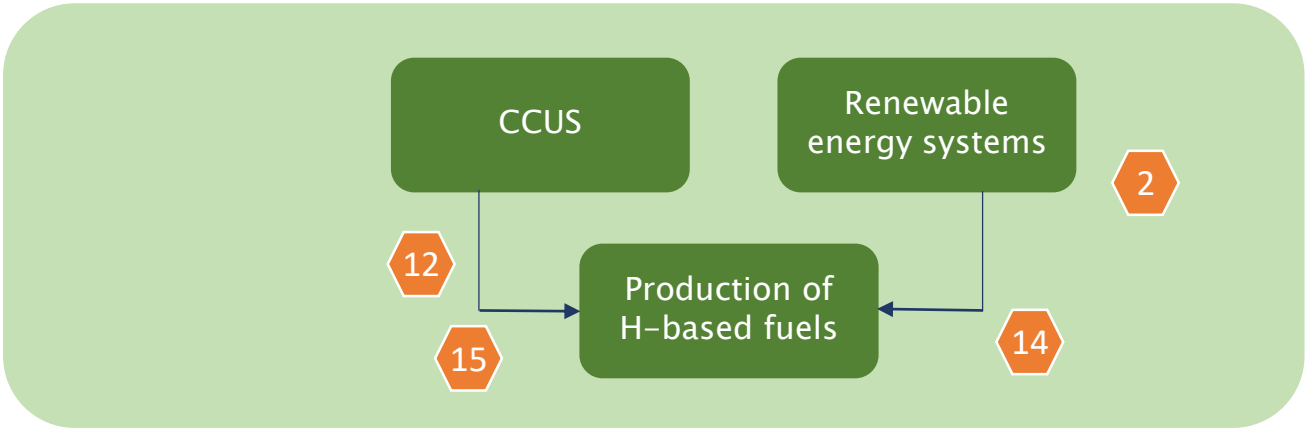
Kick-off meeting

16 PhD topics - overview

Value Chain for Hydrogen & our 16 topics

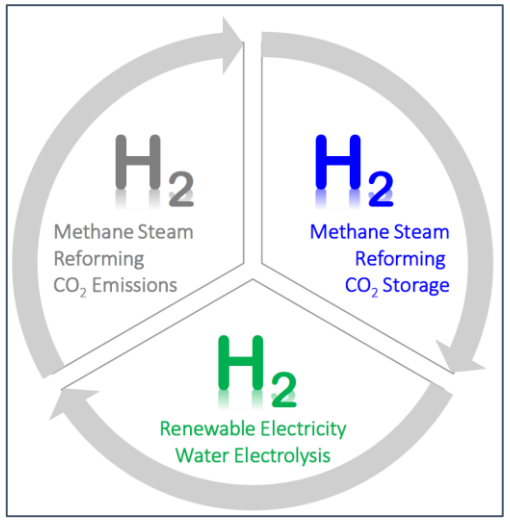


Green Hydrogen Production



2 Green vs. Blue Hydrogen: more molecules or deep electrification of Belgium's energy system by 2050?

We will fundamentally address the question for which end users **high-purity** and low-T electrolytic H2 can have a **significant added value** on the process level, thereby justifying the replacement of SMR H2 strictly on a performance basis.



Host institution

UCLouvain

Academic promotor
Prof. Joris Proost

Co-promoter
Prof. Kevin Van Geem (UGent)

12 Next generation of conductive and stable electrocatalysts for CO2/H2 conversion and H2 production

We will investigate how to improve **stability** over long term for CO2 conversion by electrocatalysis. Our focus will be on novel **conductive and stable electrocatalyst** based on doped graphitic materials combined with metal / metal oxides doped with S/N

Host institution

UHASSELT
KNOWLEDGE IN ACTION

Academic promotor
Prof. An Hardy

Co-promoter
Dr. Deepak Pant (VITO)

14 Photo-electrochemical (PEC) water splitting for hydrogen generation

Green hydrogen production is key to CO2 conversion into CH4, CH3OH etc. Low-cost production of H2 is possible by the **photelectrochemical route** but how to improve the production rate needs further investigation. Our focus will be on **photoelectrode materials, PEC mechanisms and the PEC cell**

Host institutions

UHASSELT KNOWLEDGE IN ACTION

Universiteit Antwerpen

Joint PhD

Academic promotors

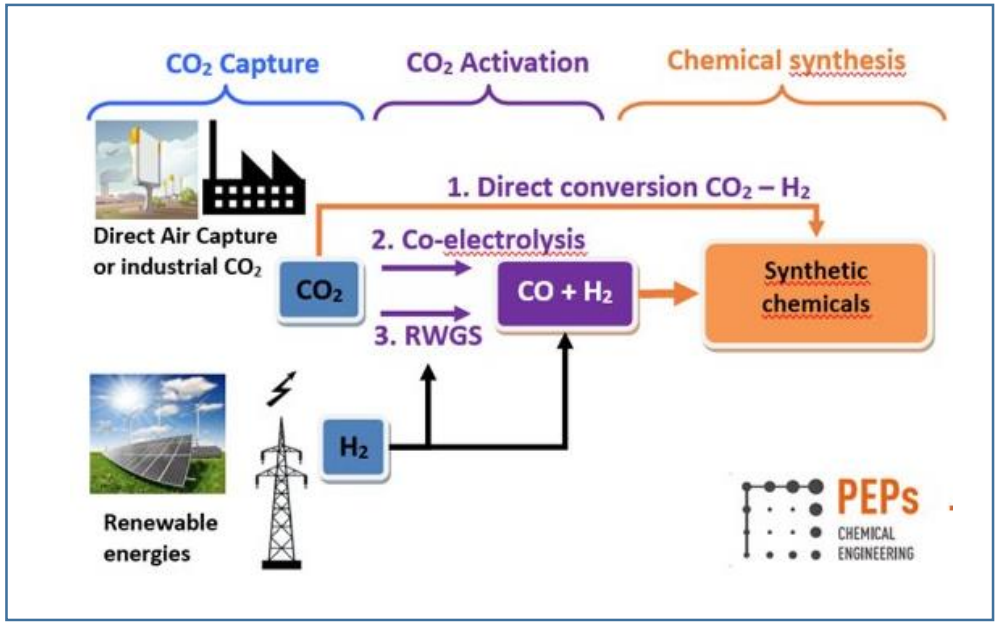
Prof. An Hardy (UHasselt)

Prof. Tom Breugelmans (UA)

15

CCU routes: Experimental study of catalysts and process designs for chemical synthesis using H2 and CO2

Hydrogen is needed to produce synthetic fuels based on captured CO2, and they can react in different ways. This PhD will focus on **developing catalysts and processes for the direct reaction of CO2 and H2**



Host institutions

LIÈGE université

KU LEUVEN

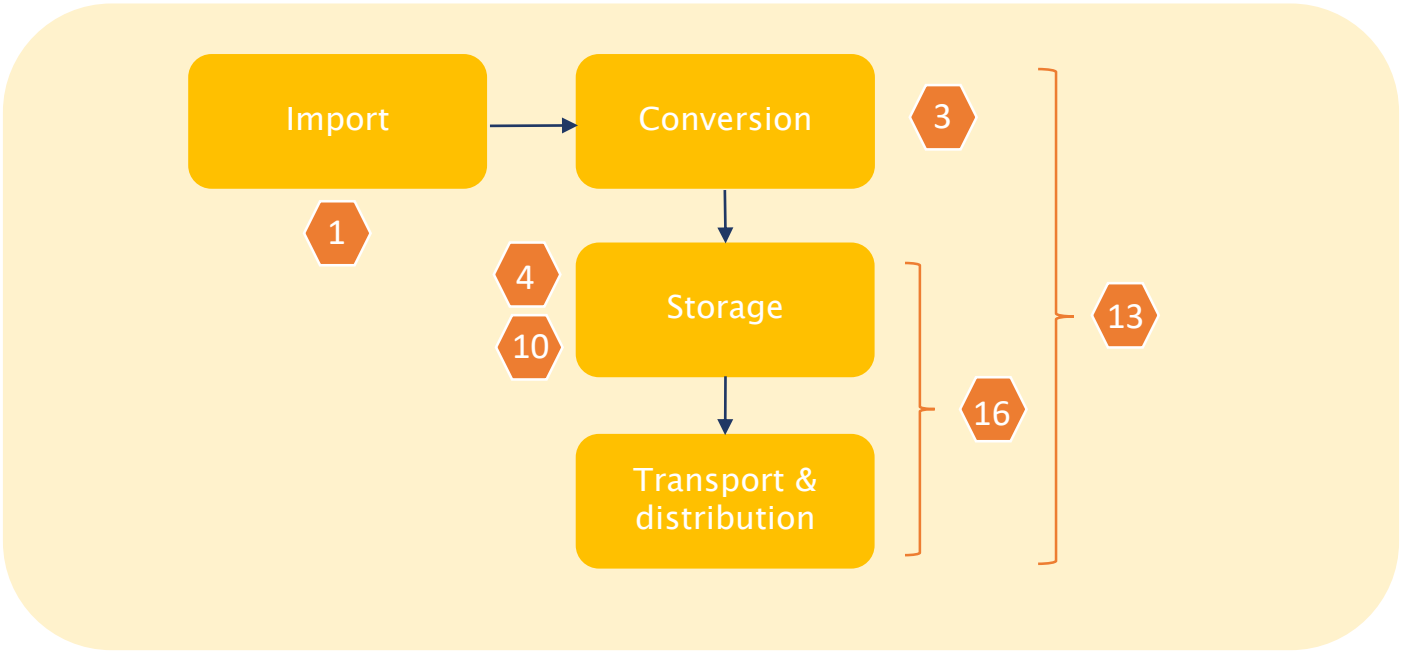
Joint PhD

Academic promotors

Prof. Grégoire Leonard (ULiège)

Prof. Michiel Dusselier (KUL)

Distribution



1 Security of supply implications of large-Scale imports of zero-carbon fuels

With this research, we want to map the **scope for sustainable fuel imports** and identify **potential supplier countries and trade routes.** We will also assess the **energy security risks** of trade and discuss **regulatory options** to govern hydrogen trade and associated risks

Host institution

GHENT UNIVERSITY

Academic promotor
Prof. Thijs Van de Graaf

Co-promoter
Prof. Ronnie Belmans
(KUL/Energyville)

3 Study of low cost compressors for GH2 storage at high pressure

The objective of this research is to define and implement a techn(ic)o-economic **Model and Assessment Tool** for the selection of the technology and the characteristics (design, working and performance parameters) for **compression systems of GH2 for transport and storage**

Host institution

ULB UNIVERSITÉ LIBRE DE BRUXELLES

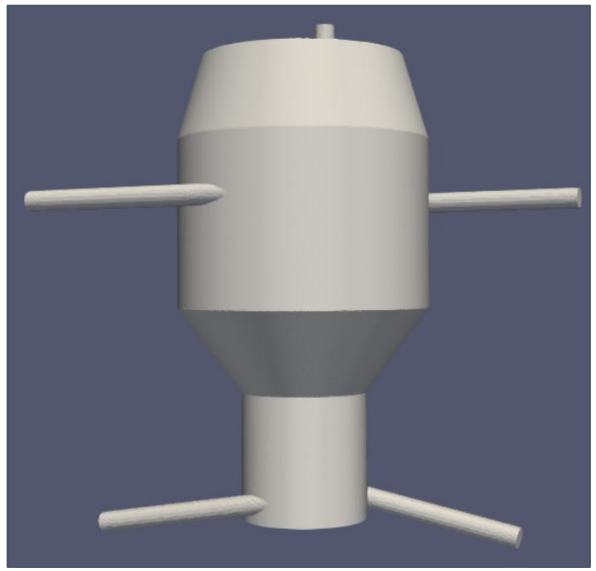
ECOLE POLYTECHNIQUE DE BRUXELLES

Academic promotor
Prof. Patrick Hendrick

Co-promoter
Prof. Jeroen Van Beeck &
Frank Eulitz
(VKI)

4 Design of an energy efficient intensified and electrified H2 release unit from Liquid Organic Hydrogen Carrier (LOHC)

This PhD will do a **CFD study** on the design of a new reactor type for **H2-release from a Liquid Organic Hydrogen Carrier** (LOHC) with automated shape optimization procedures



Host institution

Universiteit Antwerpen

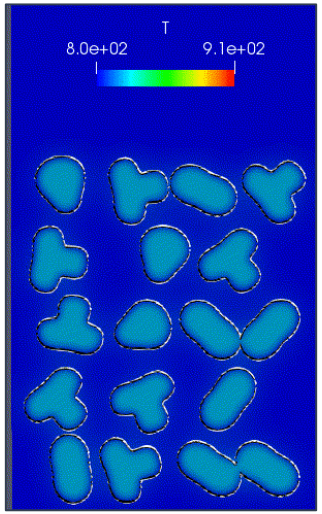
BlueApp
Powered by UAntwerp

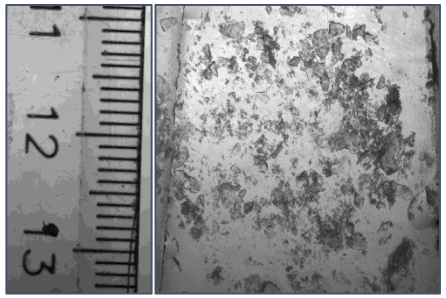
Academic promotor
Prof. Patrice Perreault

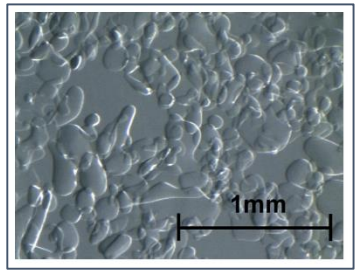
Co-promoter
Prof. Francesco Contino
(UCLouvain)

10 Advanced Characterization of Densified Cryogenic Hydrogen

Slush hydrogen is promising to increase the volumetric energy density for storage capabilities. This PhD will dive deeper in the **advanced characterization** of thermodynamic slush properties in storage conditions







Host institution

The von Karman Institute for Fluid Dynamics

Academic promotor
Prof. Michel De Paepe (UGent)

Co-promoter
Prof. Miguel Alfonso Mendez (VKI)
Prof. Delphine Laboureur (VKI)

13

Safety of operations and logistics using GH2 and LH2

We aim to deliver **a potential less restrictive and easier-to-apply Safety Standard specific for H2**, based on in-the-field experience for indoor and outdoor applications.

This research will use a 3D model simulation tool and efficient instrumentation for leak detection.

Host institutions

ULB UNIVERSITÉ LIBRE DE BRUXELLES | VUB

Joint PhD

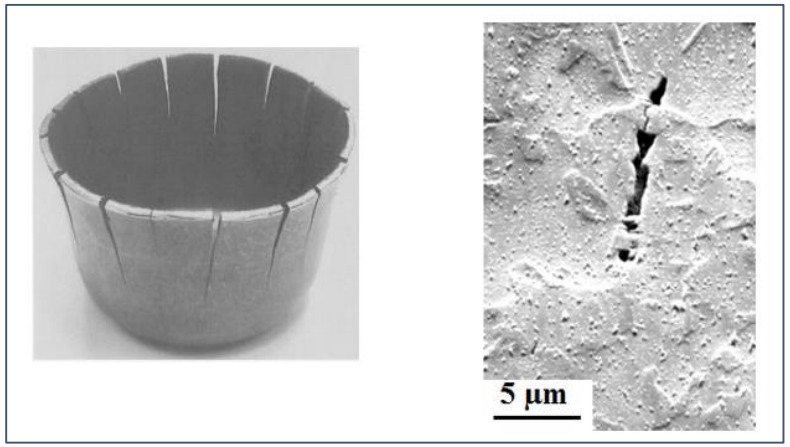
Academic promotors

Prof. Patrick Hendrick (ULB)

Prof. Julien Blondeau (VUB)

16 Developing hydrogen-resistant materials by innovative alloy design

In-depth characterization and theory-based assessment of **hydrogen-microstructure interaction** allows identifying active deformation mechanisms and how they are impacted by hydrogen. This research will further develop strategies to make **metal alloys more hydrogen-resistant**



Host institutions

GHENT UNIVERSITY

UCLouvain

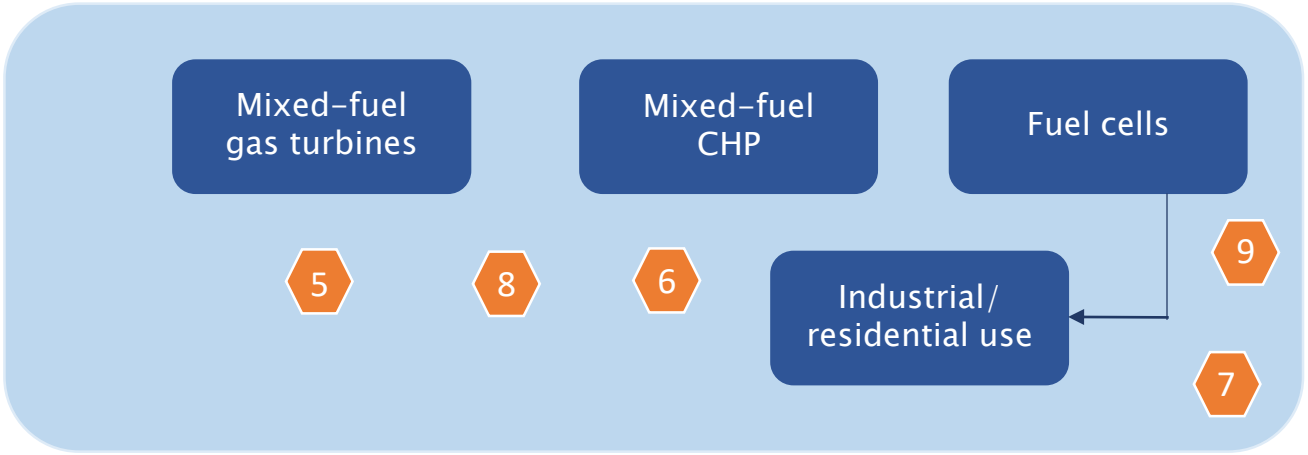
Joint PhD

Academic promotors

Prof. Kim Verbeken (UGent)

Prof. Pascal Jacques (UCLouvain)

Decarbonization of End Users for Energy Security/Grid Balancing



5 Impact of H2 on the Thermodynamic Performances of Gas Turbines of Different Size

This research will investigate what the impact is of green H2 and H2-based fuels on **gas turbine cycle performance**. This will be done for small and large scale turbines using **steady-state and transient simulations**

Host institution

UMONS
Université de Mons

Academic promotor
Prof. Ward De Paepe

Co-promoter
Prof. Julien Blondeau
(VUB)

6 Oxy fuel combustion of CO2-dilute, natural gas/hydrogen burners in a decarbonized gas transmission network

This project will undertake numerical modeling of renewably-generated hydrogen concentrations in a **gas transmission network** with power-to-gas capability and experimental characterizations of advanced combustor units that can make use of **natural gas/hydrogen mixtures** in such a network.

Host institution

KU LEUVEN

Academic promotor
Prof. Joshua Lacey

Co-promoter
Prof. Francesco Contino
(UCLouvain)

8 Numerical simulations of H2 and H2 -derived fuels combustion

The scope of this research is the accurate modeling of the combustion process of **H2, H2-derived fuels and their mixtures** in industrial applications (gas turbines) using **Large Eddy Simulations (LES).** The goal is to predict **combustion efficiencies and pollutant emissions**

Host institution

VRIJE UNIVERSITEIT BRUSSEL

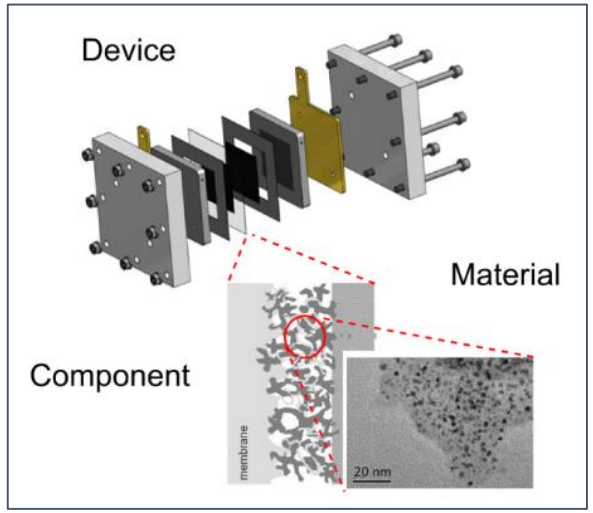
Academic promotor
Prof. Julien Blondeau

Co-promoter
Prof. Laurent Bricteux (UMons)

7

Optimized carbon supports for PEMFC electrodes

The goal of this research is to develop **optimized carbon structures** to be used as catalyst supports for Proton Exchange Membrane fuel cells and **their corresponding catalytic layers** in Membrane-Electrode Assembly (MEA) configuration



Host institution

LIÈGE université

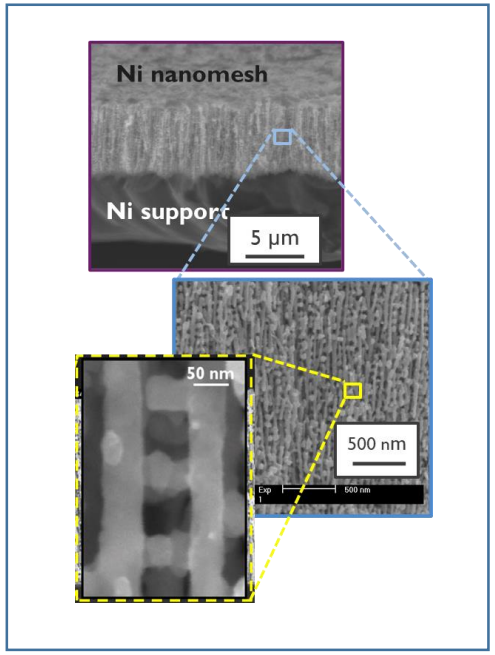
Academic promotor
Prof. Nathalie Job

Co-promoter
Prof. Philippe Vereecken (KUL/imec)

9

Deterministic control of nanostructured electrode architecture for efficient and high energy-density Fuel Cells

We will use a **nanomesh electrode**, thin-film catalyst and thin-film nanocomposite electrolyte technologies to fabricate Gas-Diffusion-Electrodes for hydrogen fuel cells. Secondly, we will investigate **mass transport and intrinsic catalytic effects.**



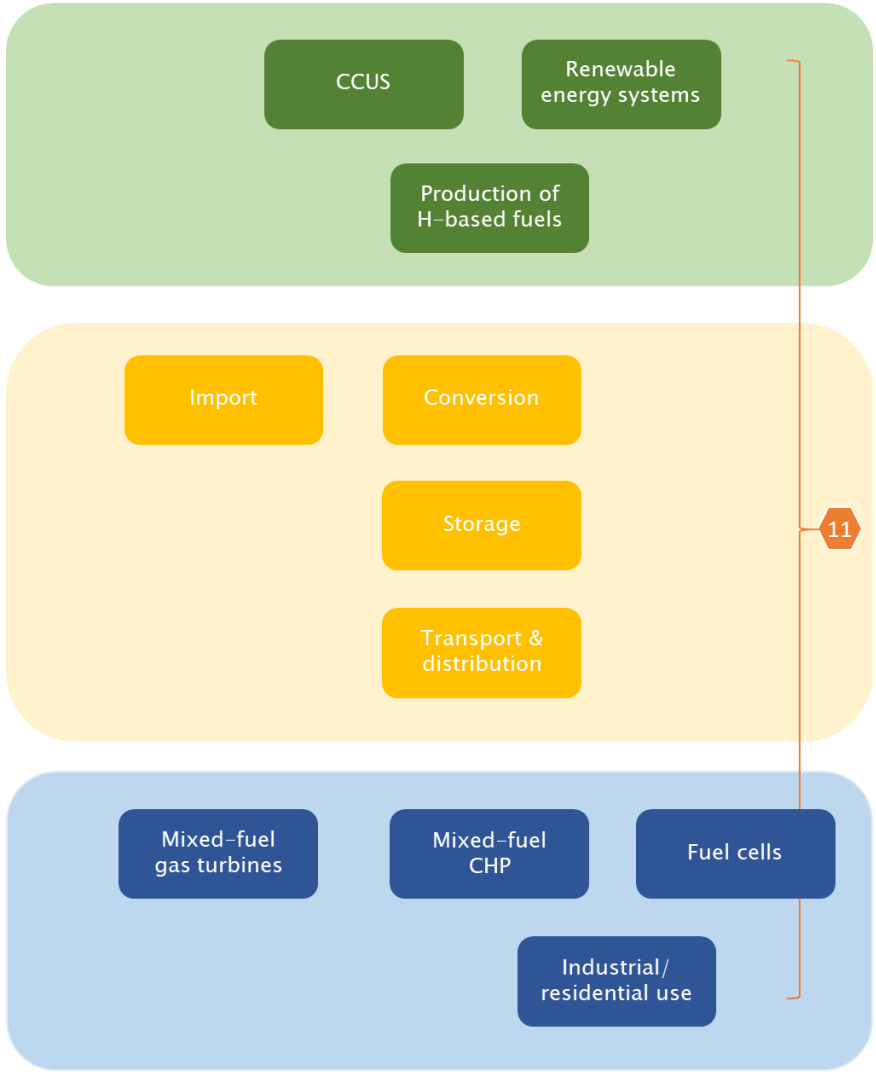
Host institution

imec

Academic promotor
Prof. Philippe Vereecken

Co-promoter
Prof. Nathalie Job
(ULiège)

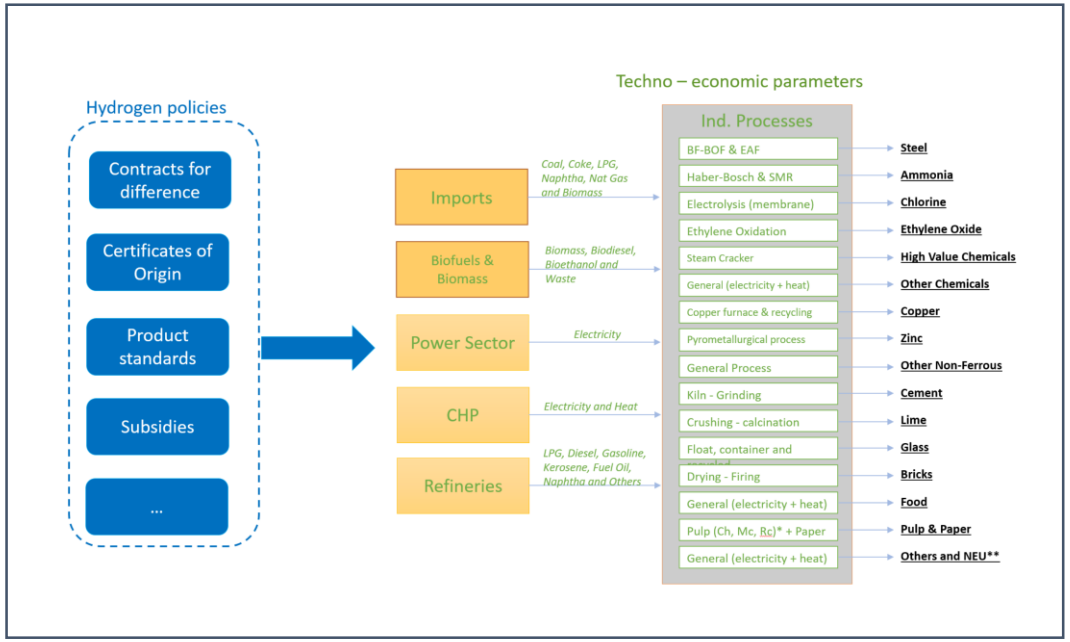
Overall – the entire value chain



11

Hydrogen policy modelling for industrial systems

We aim to build a model to fill the gap between **techno-economic models** and **policy impact models** including industrial decision making



Host institution

vito

Academic promotor
Prof. Erik Delarue (KUL)

Co-promoter
Tomas Wyns (VUB)
Pieter Vingerhoets(Vito)

BE-HyFE consortium

With the support of
Energy Transition Fund

economie