Industrial Symbiosis^2 Hubs 4 Circularity

Funded by the European Union

This project has received funding from the European Union's HORIZON Research and Innovation Actions programme under grant agreement number 101138473

FEATURING IS2H4C

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Sustainable Circular Economy Transition: From Industrial Symbiosis to Hubs for Circularity

Topic: HORIZON-CL4-2023-TWIN-TRANSITION-01-37 - Hubs for circularity for near zero emissions regions applying industrial symbiosis and cooperative approach to heavy industrialized clusters and surrounding ecosystems (Processes4Planet partnership) (IA)

PROJECT SCALE: 23.5 MILLION EUROS

EU GRANT: 20 MILLION EUROS

34 PARTNERS, 9 COUNTRIES

PROJECT DURATION: 49 MONTHS

PROJECT START-END DATES: JANUARY 2024 – JANUARY 2028

IS2H4C Objectives

IS2H4C's biggest ambition is to promote H4C as Europe's future sustainable regional development models

Objective 1. Deploy and demonstrate near commercial scale industrial symbiosis through innovative technologies

Objective 2: Ensure resilience and sustainability of H4Cs considering planet, people, and profit

Objective 3: Facilitate the market penetration of H4C through novel financial schemes and social innovation approaches unlocking public and private investment

Objective 4: Develop a digital collaboration platform for information-sharing and smart decision-support

Objective 5: Achieve a standardized top-down H4C design methodology, applicable as a reference regional development model

Objective 6: Maximize wider uptake of IS2H4C's results during and after the project's execution

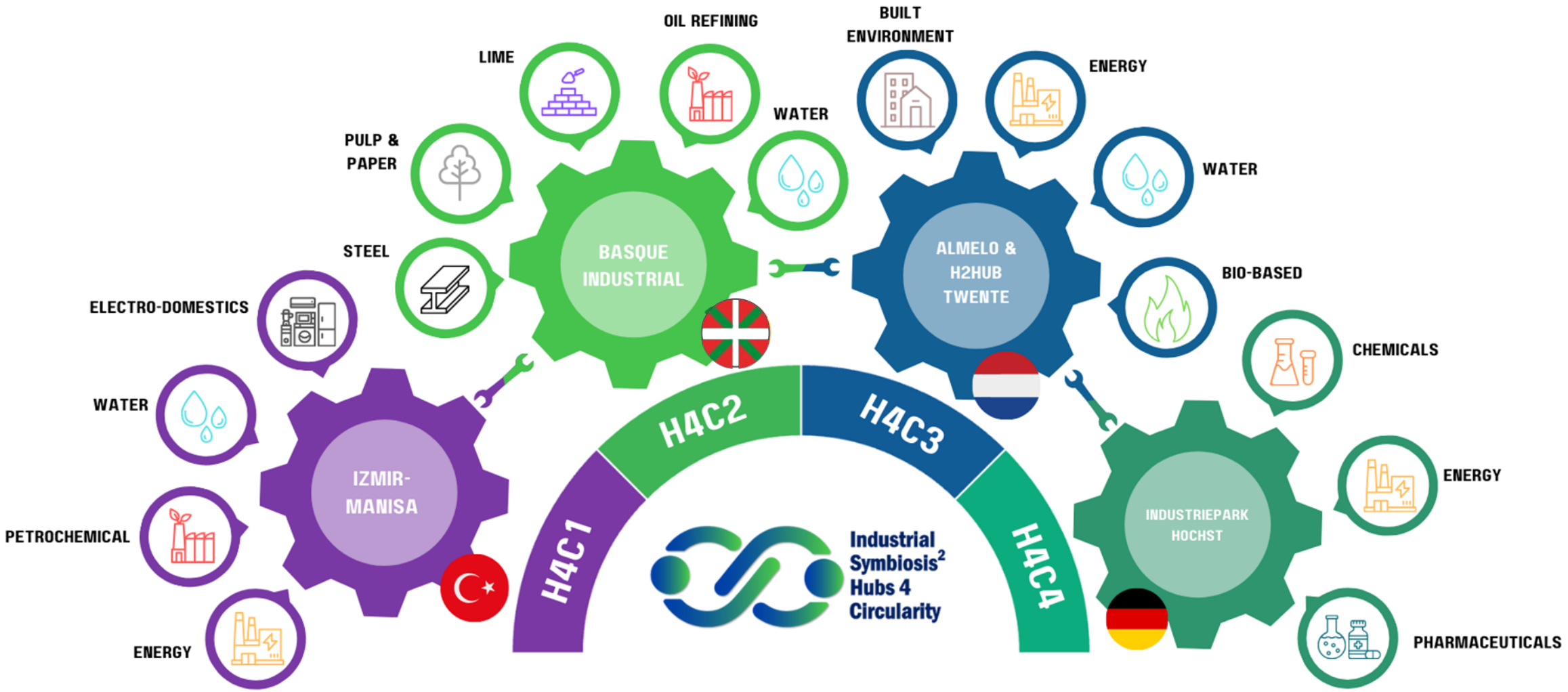
Technology Deployment & Development

17 symbiotic synergies to be demonstrated (scale up from TRL3-6 to TRL 7-9 or directly apply TRL7-9)

24 hub expansion synergies to be researched

11 technologies to be deployed: green H_2, carbon capture and utilization, e-fuels, oxycombustion, wastewater treatment, waste heat recovery, sensing technology

Four Hubs in IS2H4C

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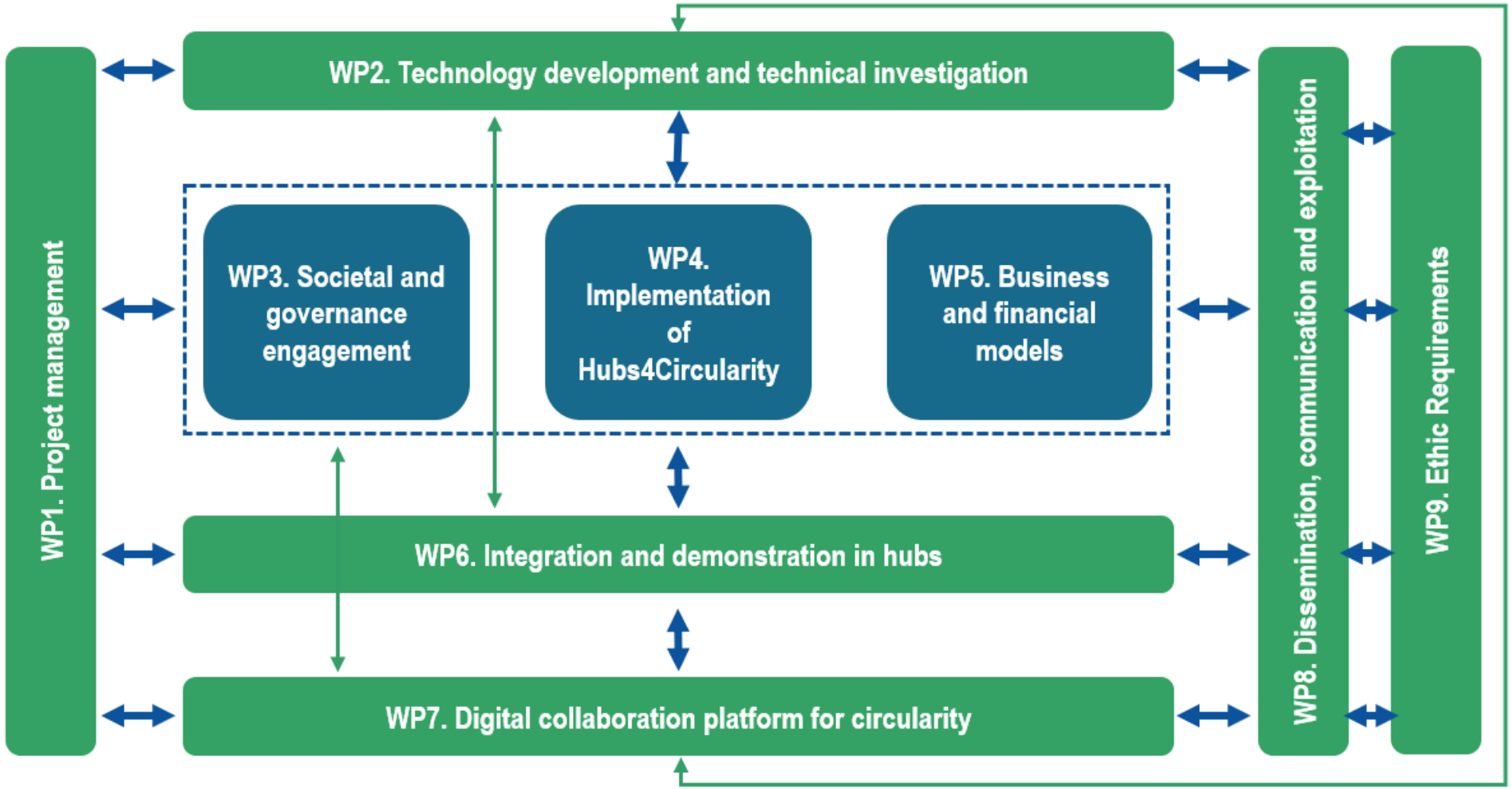
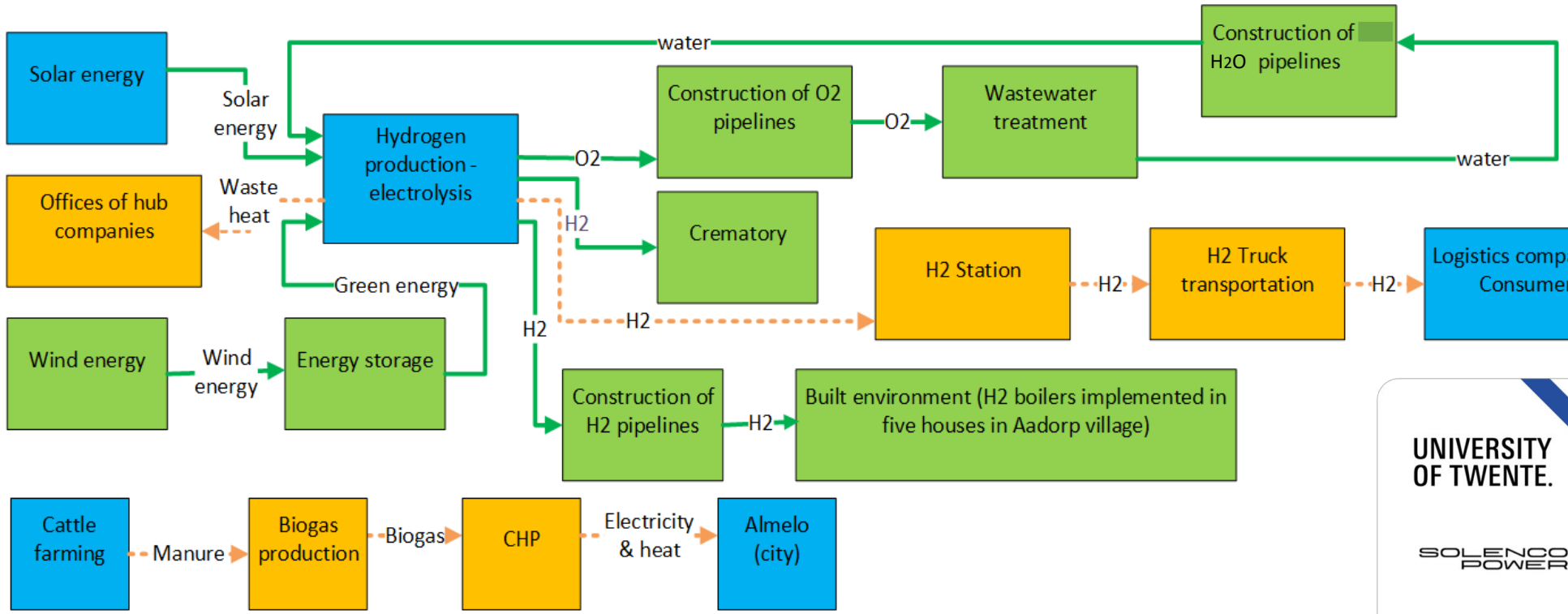
Workplan in IS2H4C



Dutch Hub



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DUURZAAM AADORP | om

H2 Hub Twente
Waterstof Platform

WP2 – Technology Development

Objectives

- Develop, analyse, and optimise key technologies to maximise industrial synergies (e.g., energy conversion, waste recovery and utilisation, carbon capture and utilization).
- Forecast system behavior and optimize the circularity pathways on a technical level.
- Crucial inputs from desk research/lab work to integration of advanced technologies in the field (in WP6).

WP 3 - Societal Engagement and Governance

Objectives

- Identify relevant stakeholders and their connection process to H4C.
- Investigate non-technical (regulatory, ethical, societal) challenges and barriers for establishing the hub
- Define stakeholder needs and best stakeholder engagement strategies to ensure sustainable development of the H4C
- Establish living labs from the beginning of the project to beyond project's end
- Measure socio-economic regional development impacts of H4C

WP4 - Modelling and optimisation for H4C development

UTwente

WP4 ensures H4Cs operate efficiently and sustainably.

H4C analysis: Characterization of resources, processes, energy flows, and industrial symbioses

H4C optimization: Quantitative methods for **matchmaking** and **optimizing** logistics, material and energy flows

H4C development: Models for bottom-up and top-down hub development

H4C impact assessment: Long-term environmental impact and economic effects

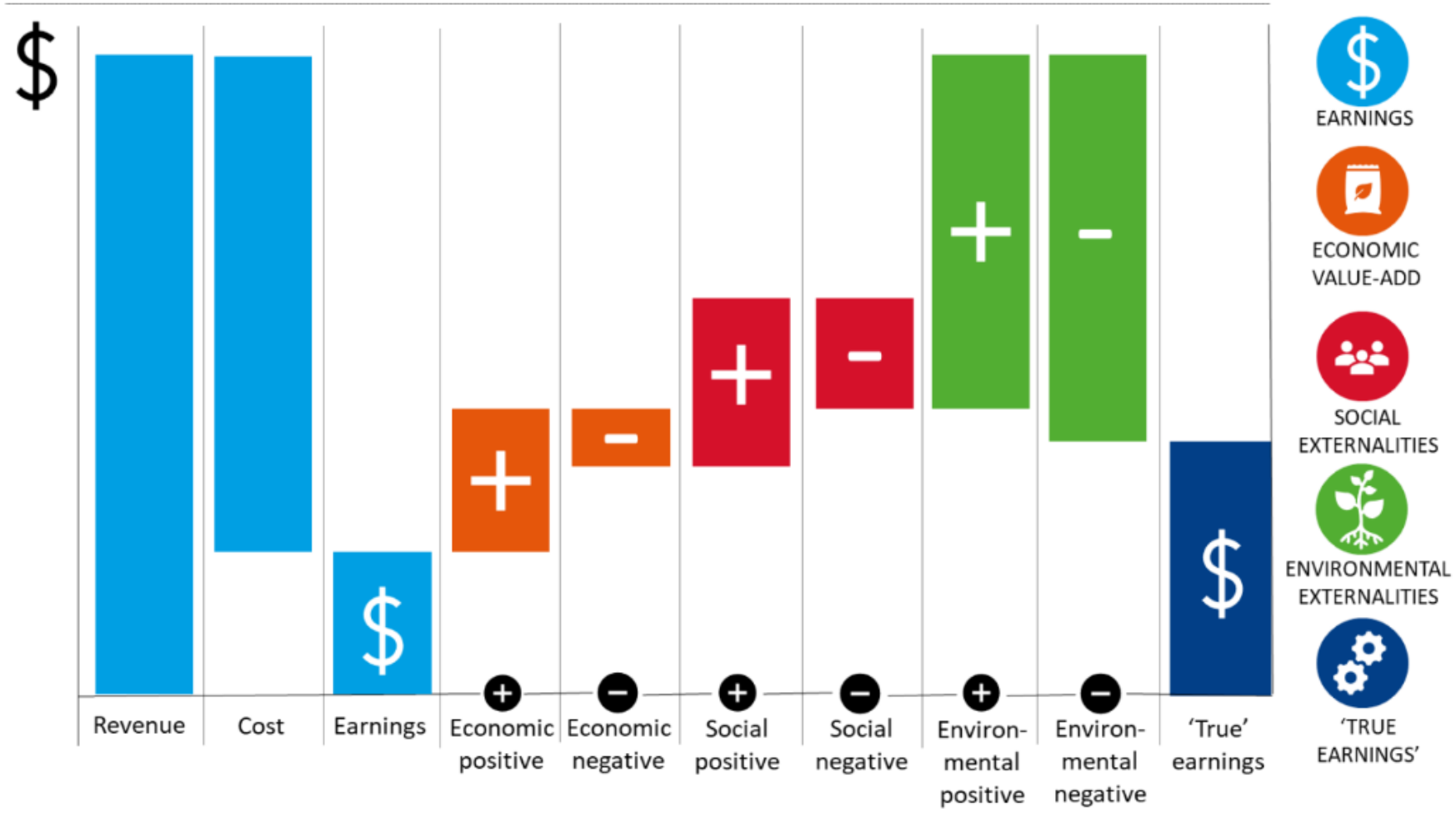
WP5 - Business and financial models

Objectives

- Design and develop **impact valuation model**, using the “True Value Methodology”
- Assess and monetise the social and environmental externalities as a project screening tool
- Develop business cases for synergies planned in four hubs
- Project further business opportunities within hubs

WP5 - Business and financial models

True Value Model developed by KPMG



WP6 - Integration and demonstration in hubs

Objectives

- Field work takes place in WP6 to deploy the a-priori decided technologies in the hubs.
- WP6 aims at advancing the industrial zones into H4C via applying the technologies in the operational environment under the principals of circularity and IS and integrating the existing and new infrastructure.
- Project’s practical impact occurs in the WP6.

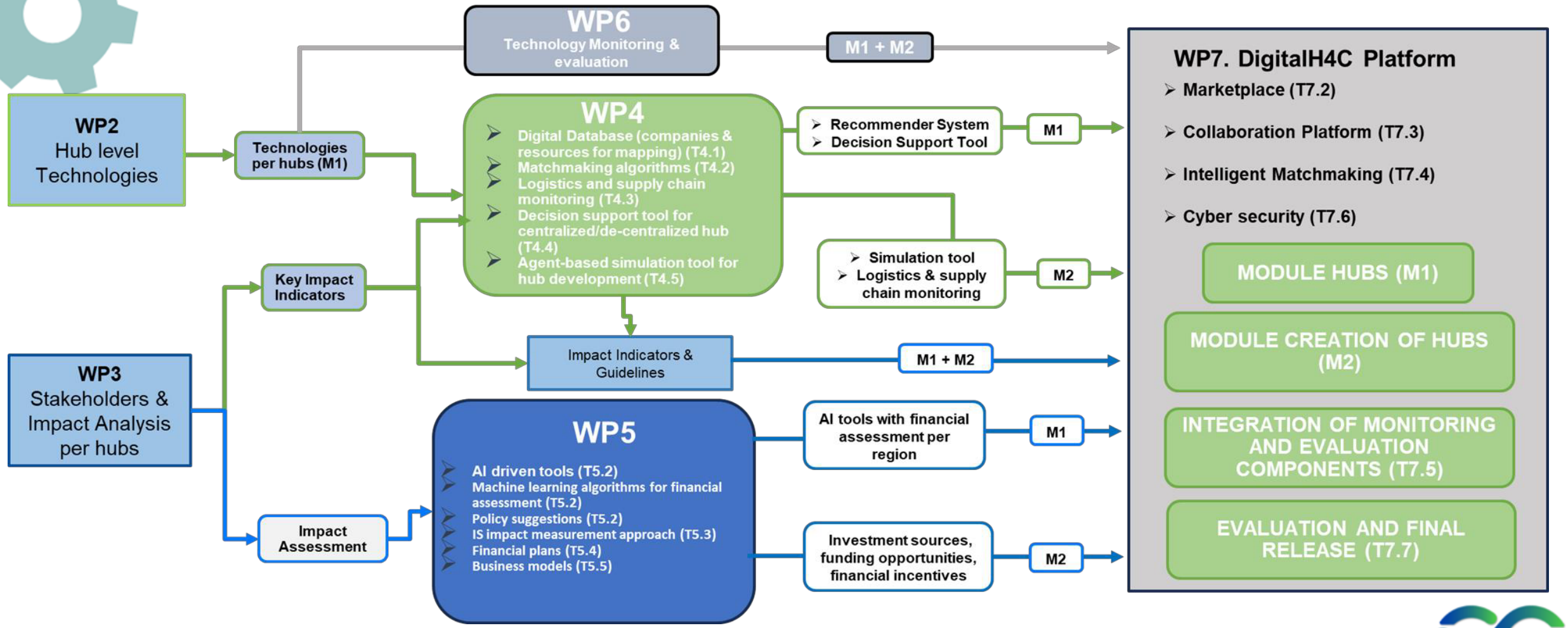
WP6 – Status of Dutch hub

WP7 - Digital Collaboration Platform for H4C

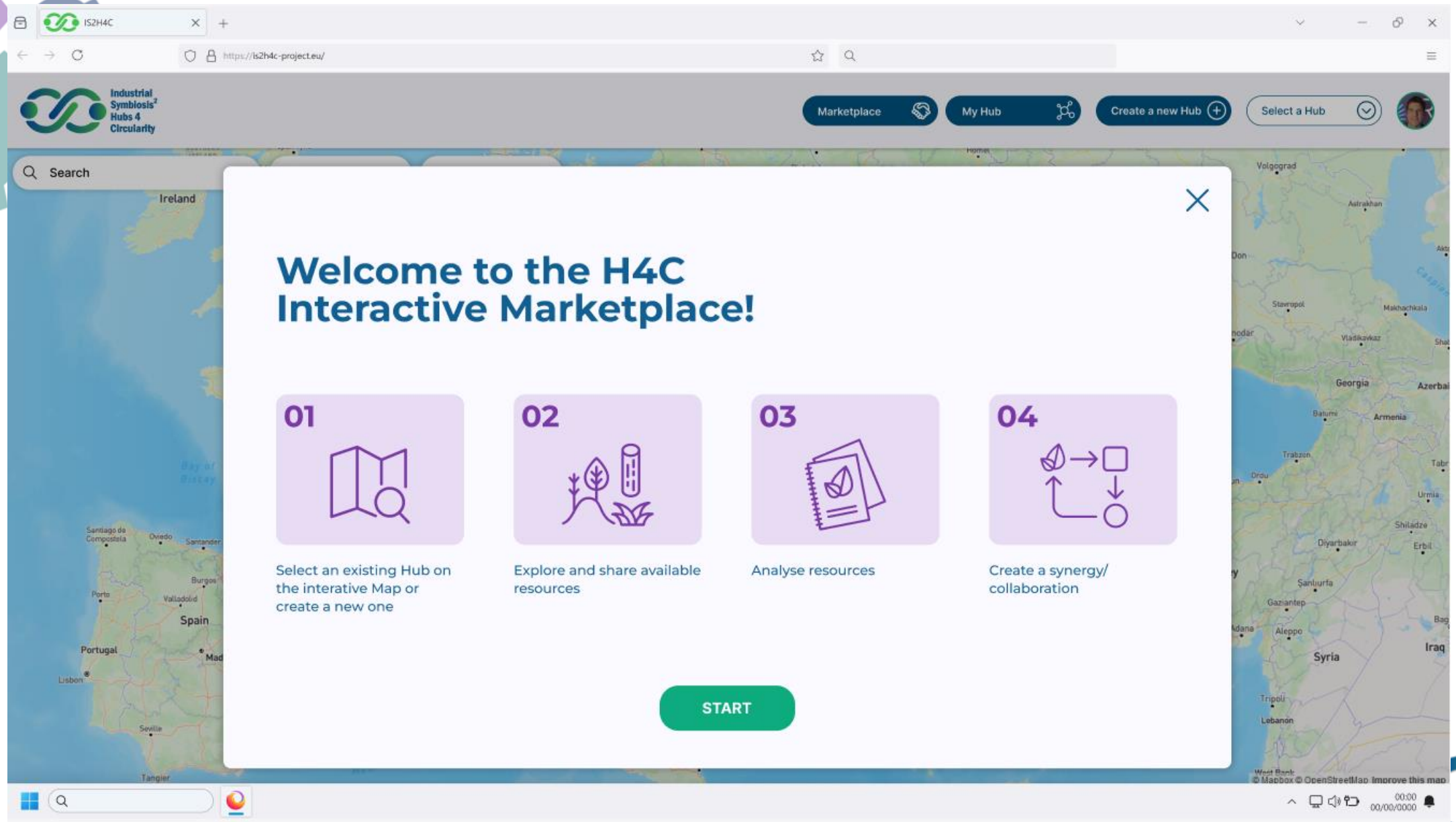
Objective:

Develop a user-friendly, scalable, and adaptable **digital collaboration platform for H4C (DigitalH4C).** The platform consists of a modular suite of tools, features, and data analytics to facilitate IS identification, assessment, implementation, and monitoring.

WP7 - Digital Collaboration Platform for H4C



H4C platform: Landing Page



Newsletter

1st Edition has published

Subscribe to receive our biannual newsletter through our webpage!

is2h4c-project.eu

Dear Readers,

Welcome to the biannual newsletter of the IS2H4C project! Since our kickoff, we've made remarkable progress in advancing industrial symbiosis and sustainability across Europe. Join us as we recap the key milestones and events that have shaped our journey over the past months.

Industrial Symbiosis^2 Hubs 4 Circularity

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SBS
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H$_2$ Hub Twente
Waterstof Platform

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KPMG

Calcinor

Industrial Symbiosis^2 Hubs 4 Circularity

Thank you

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Introductie

Wie ben ik?

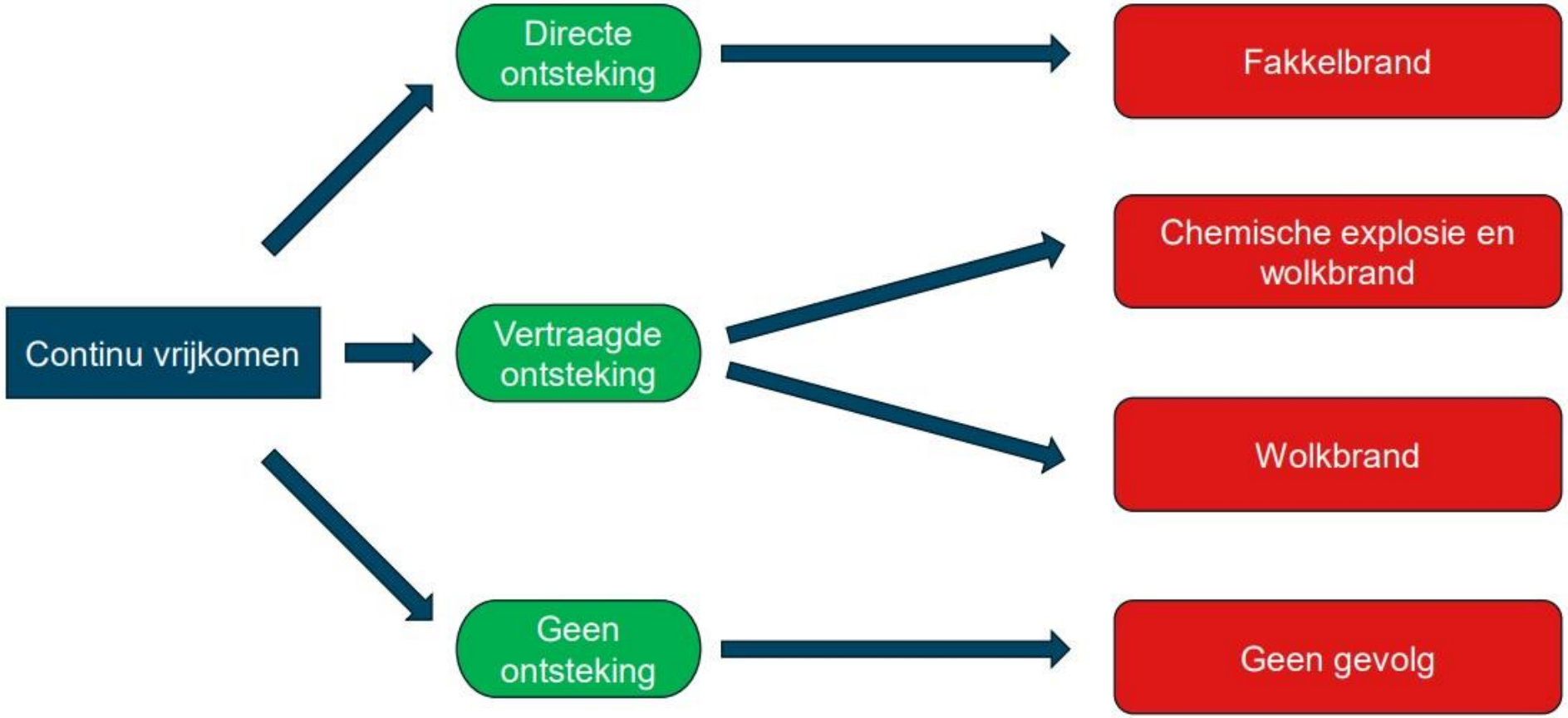
Waarom waterstof?

- Belangrijk onderdeel van de energietransitie
- Steeds meer toepassingen: mobiliteit, industrie & opslag
- Veiligheid cruciaal, en dan komt de brandweer in beeld!

Gevaren H_2

- Geurloos, kleurloos
- Hoge difussiecoëfficiënt
- Verbrossing
- Lichter dan lucht (ophoping kan ook!)
- Hoge ontstekingskans
- Nauwelijks zichtbare vlam
- Opslag specifiek: gasvorming vs. vloeibaar (cryogeen)
- Weglekken H_2 naar atmosfeer (11x schadelijker dan CO_2)

Gevolgen vrijkomen H_2



bron: gevaren van waterstof NIPV

Waterstoftankstation (PGS 35)

Waterstoftankstation, Kjørbo

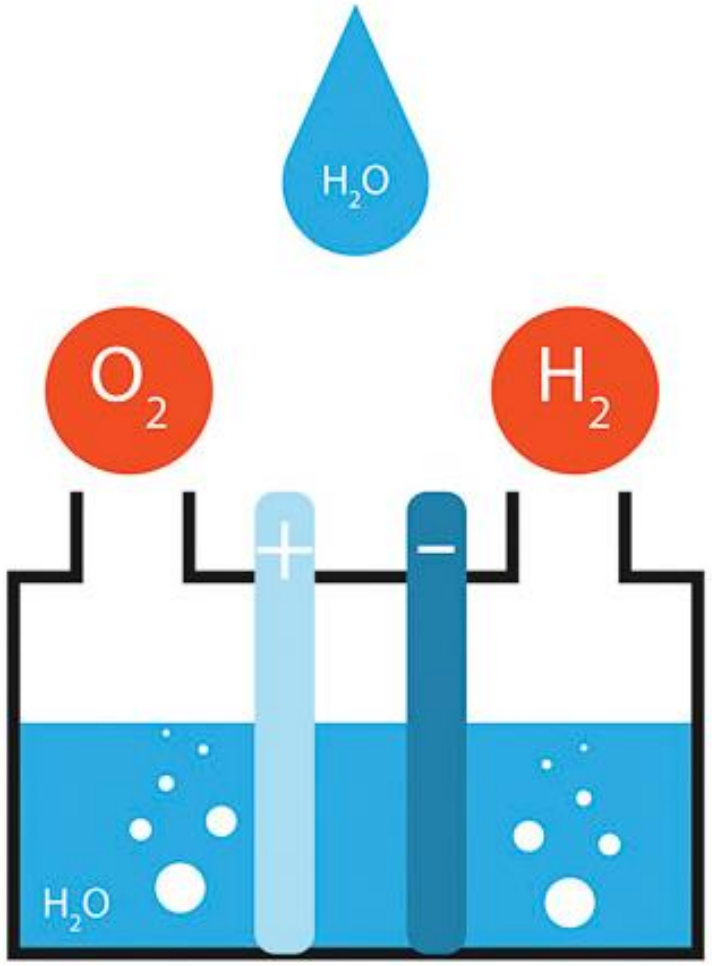
Maandag 10 juni 2019, 17:30 uur
Waterstof Explosie (≈ 3,0 – 3,5 kg. H_2)
Ruitschade op 60 – 70 meter

Kantoorlocatie op 70 meter
Woningen op 225 meter

Installaties productie H_2 door elektrolyse (PGS 40)

Scenario's → Doelen → Maatregelen

- Explosiegevaar
- Onzichtbare vlam
- Hoge druk
- Thermisch gevaar
- Gevaarlijke stoffen
- Gehoorschade

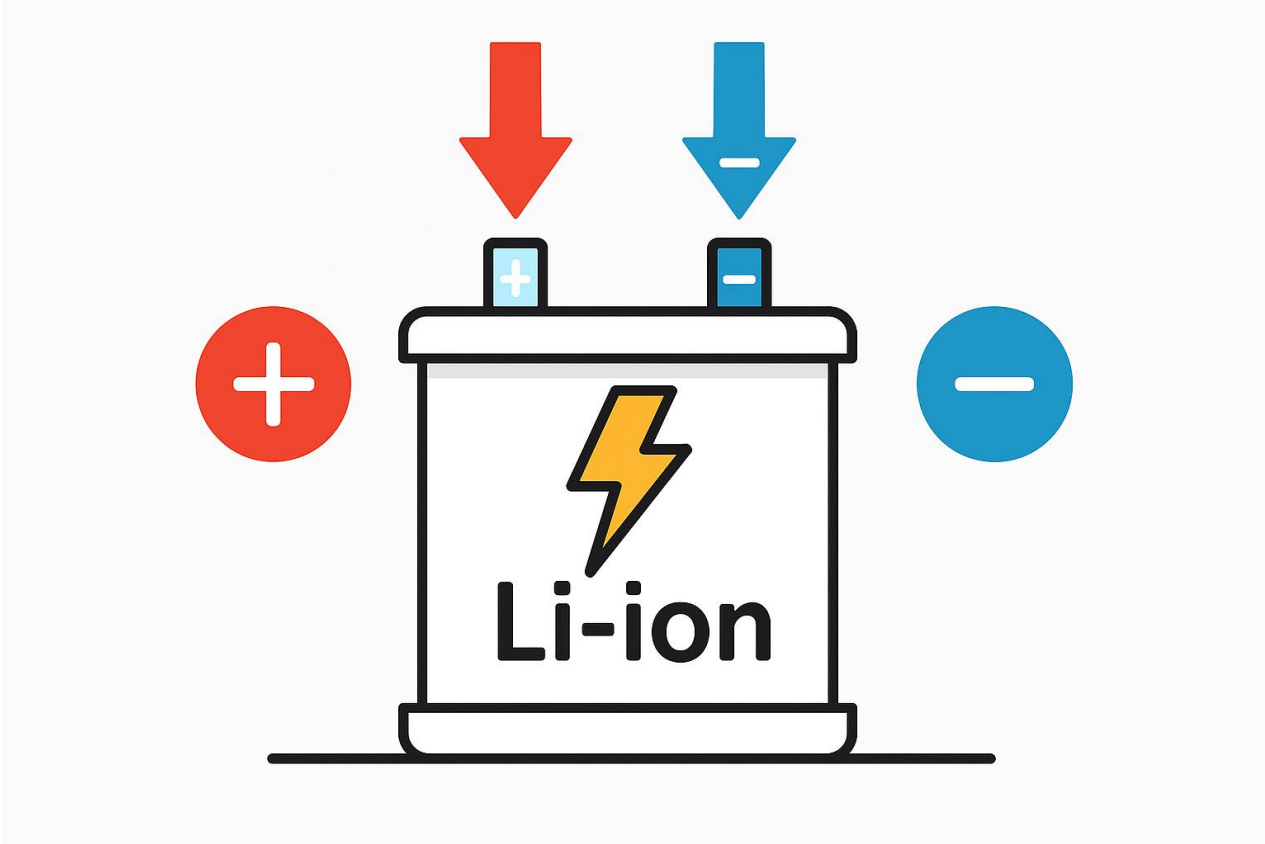


Synergie met duurzame energie (EOS)

Lithium-houdende-energiedragers

- Brandgevaar
- Explosiegevaar (!)
- Gevaar toxische wolk

- Weinig blusmogelijkheden
- Electrocutiegevaar
- Vervuild bluswater

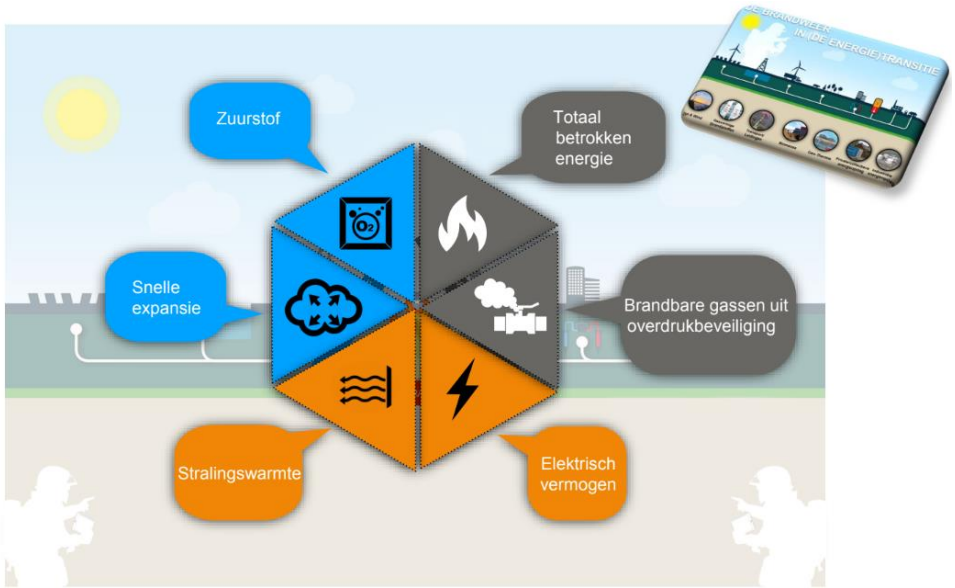


Incident EOS 215 kWh LiFePO4 [4-aug 2025]

Toekomst

- Incidentbestrijding: kennisbehoefte hoe te handelen

- Investeren in voorspellend vermogen (best-real-worst scenario's)




Waterstof is
onzichtbaar,
onvoorbereid
zijn niet

BOOST

cross-border hydrogen in industry, research and education

Euregional H2 Business Event @ H2Hub Twente 2025
02/10/2025

Faeze Khalighi

Thermal and Fluid Engineering Department

Interreg Deutschland – Nederland
(Ko-)finanziert von der Europäischen Union (Mede) gefinancierd door de Europese Unie

Project Motivation

- Support the growing hydrogen industry
- Enhance industrial decision-making
- Educational and research value

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Key features for a hydrogen BoP toolbox?

dynamic, use friendly, …

https://www.menti.com/

Use code: 3188 9705

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Key components of a hydrogen BoP?

heat exchanger, pump, …

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Development Methodology

- Requirements of the industrial partners
- Integrated physics-based and data-driven model
- Validation with real-world use cases
- Development in Python
- User interface and visualization layer

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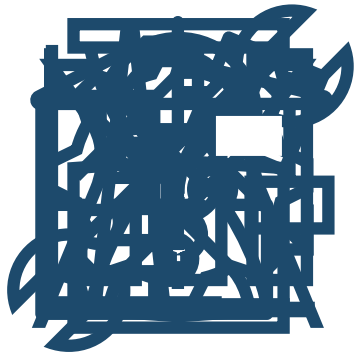
Takeaways from Industry Interviews …

Features

- Scenario analysis for early decision-making
- Techno-economic modeling with operations
- Flexible configuration
- Parameterized components
- Expandable architecture
- Degradation model
- Dynamic system modelling
- Optimization and control
- Open-source software



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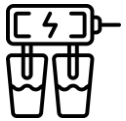
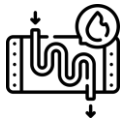
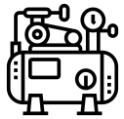
Components



Low temperature electrolyzers (PEM, AWE, AEM)



Heat exchanger



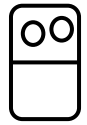
Compressor

Pump system

Water purifier

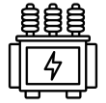
DeOxo

Dryer



Gas-liquid separator

Rectifier

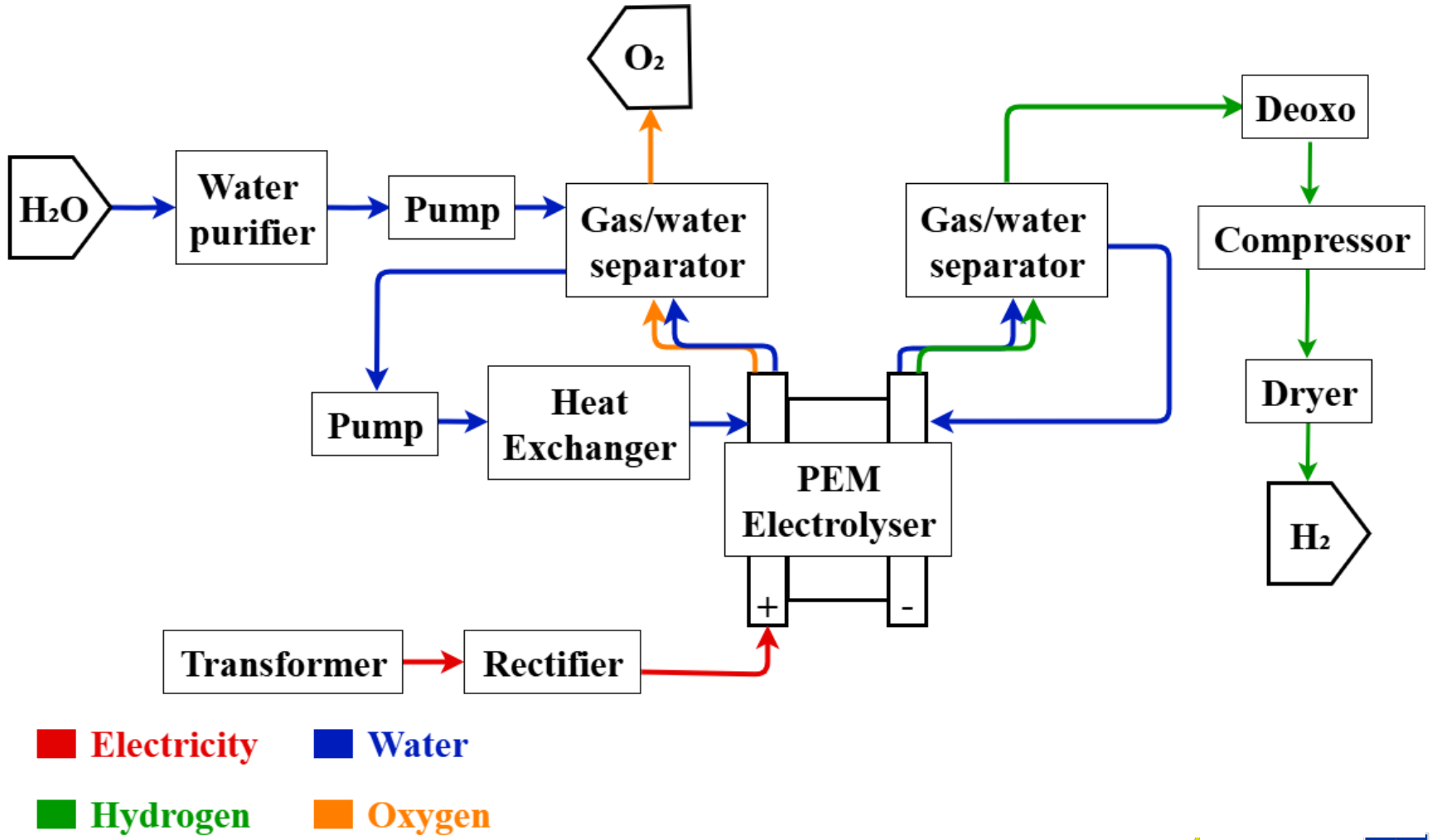


Transformers

Converter

This slide has been designed using resources from Flaticon.com

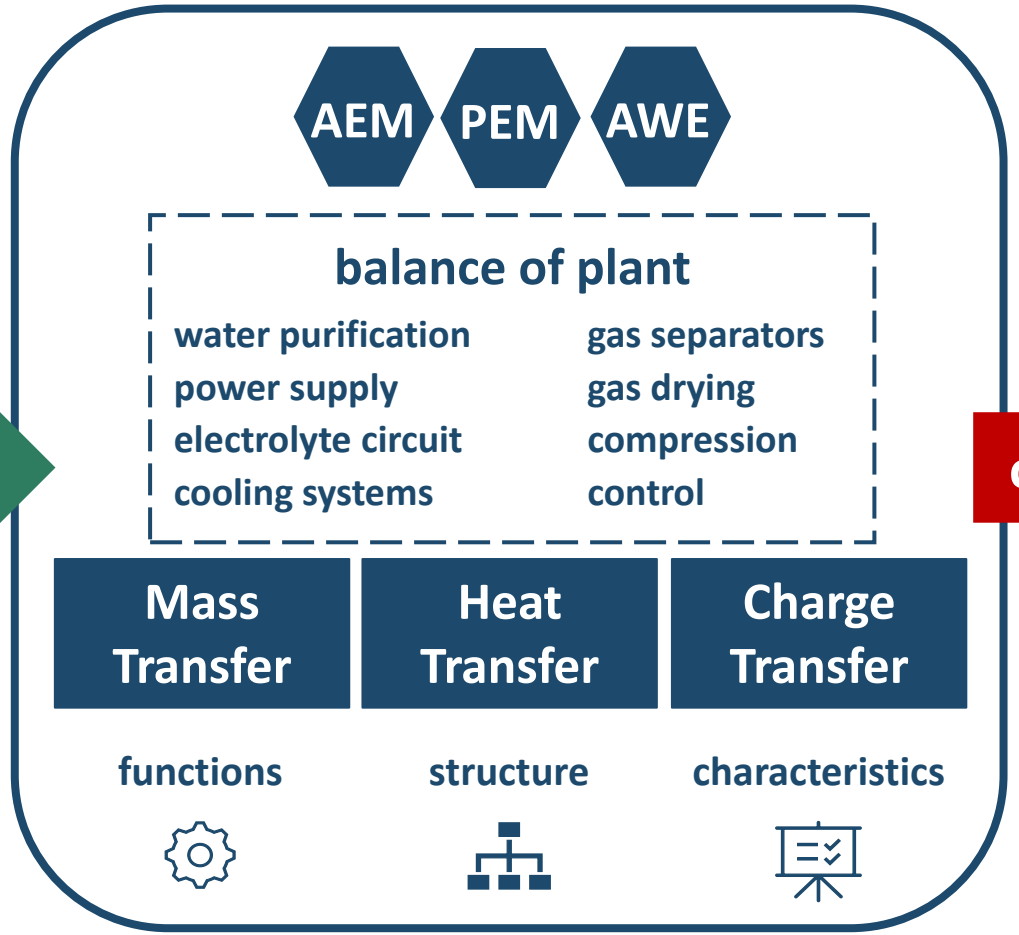
Balance of Plant (PEM)



BOOST toolbox

Temperature,
Pressure,
Power,
Mass (H2O), …

inputs



Toolbox

outputs

Temperature,
Pressure,
Mass
(H2,O2, H2O),
Price, Size, …

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Target Users

Planning and engineering consultants

Energy system integrators

Academic and research institutions

Regional development agencies

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Potential Outcomes

- Fast-tracked hydrogen hub development
- Facilitates cross-border cooperation
- Optimized hybrid energy setups
- Reusable digital prototypes
- Reduced techno-economic risks
- Enhanced roadmap and policy alignment
- Flexible product for industry and education

Thank you !!!

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Ministerium für Wirtschaft, Energie, Industrie, Mittelstand und Handwerk des Landes Nordrhein-Westfalen

Niedersächsische Staatskanzlei

provincie Gelderland

provincie Overijssel

Ministerie van Economische Zaken en Klimaat

This project received funding from the European Union and the Interreg partners within the framework of the German-Dutch Interreg program.