



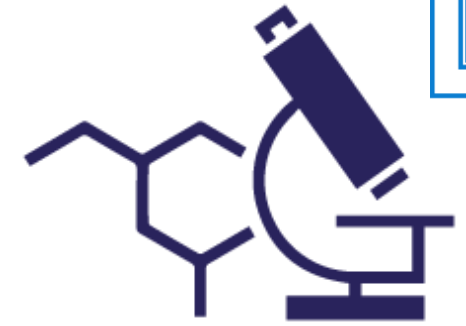
LITHUANIAN
ENERGY
INSTITUTE

Hydrogen research: a key element in green transformation

Dr. Marius Urbonavicius

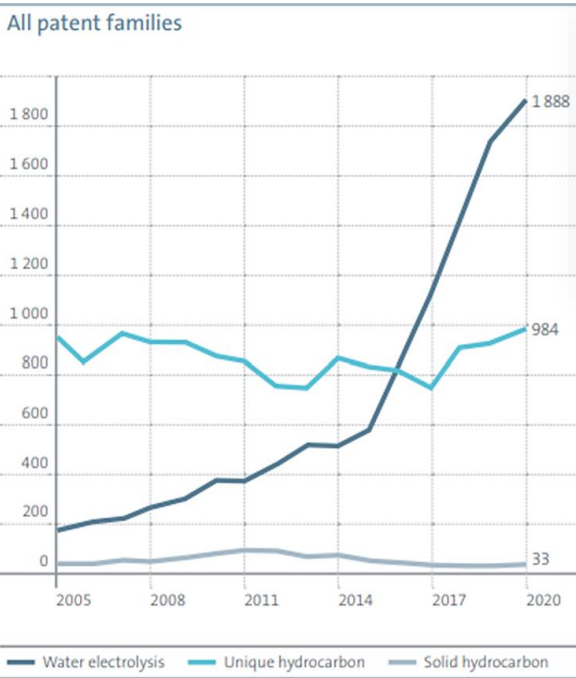
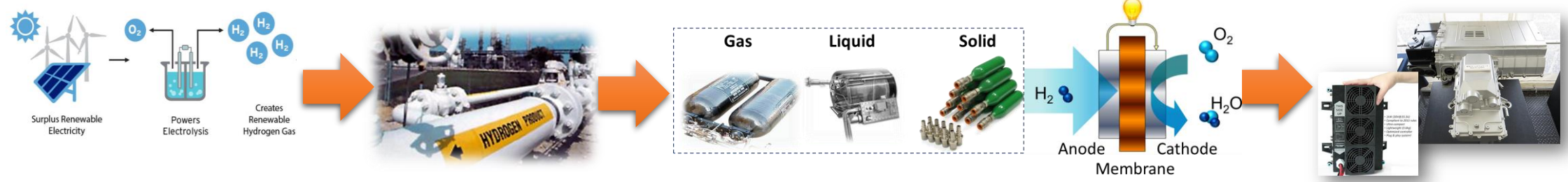
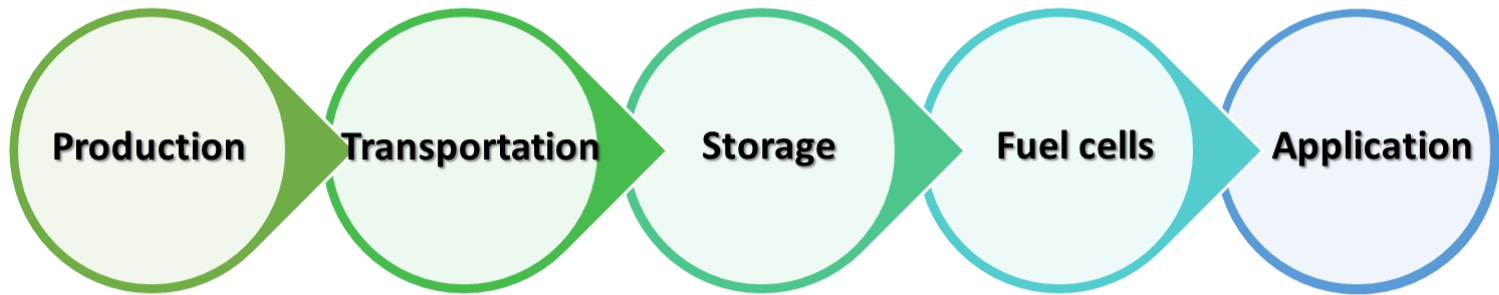
Senior Researcher at Center for Hydrogen Energy Technologies

Center for Hydrogen Energy Technologies

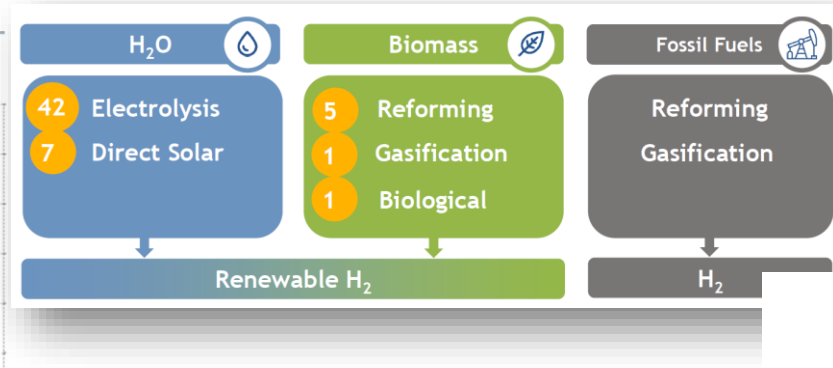


Areas of research

- Research in the field of **hydrogen energy technologies**.
- Synthesis of hydrogen separation **membranes** and analysis of their properties.
- **Hydrogen production** using water reactions with metals and nanoparticles of their alloys.
- **Synthesis of metals and their alloy hydrides** designed for hydrogen storage: analysis of their properties.
- Synthesis of hydrogen **fuel cell components** (anodes/electrolytes/cathodes) applying physical vapour deposition methods.
- **Analysis** of battery material properties.
- Synthesis and analysis of **photocatalytic materials**.
- Application of **physical vapor deposition** methods for **thin films** formation and **surface modification**.
- **Improvement** of various **surfaces characteristics** by application of **glow discharge plasma**.
- H₂ energy **training courses** for industry



Trend of all patent families

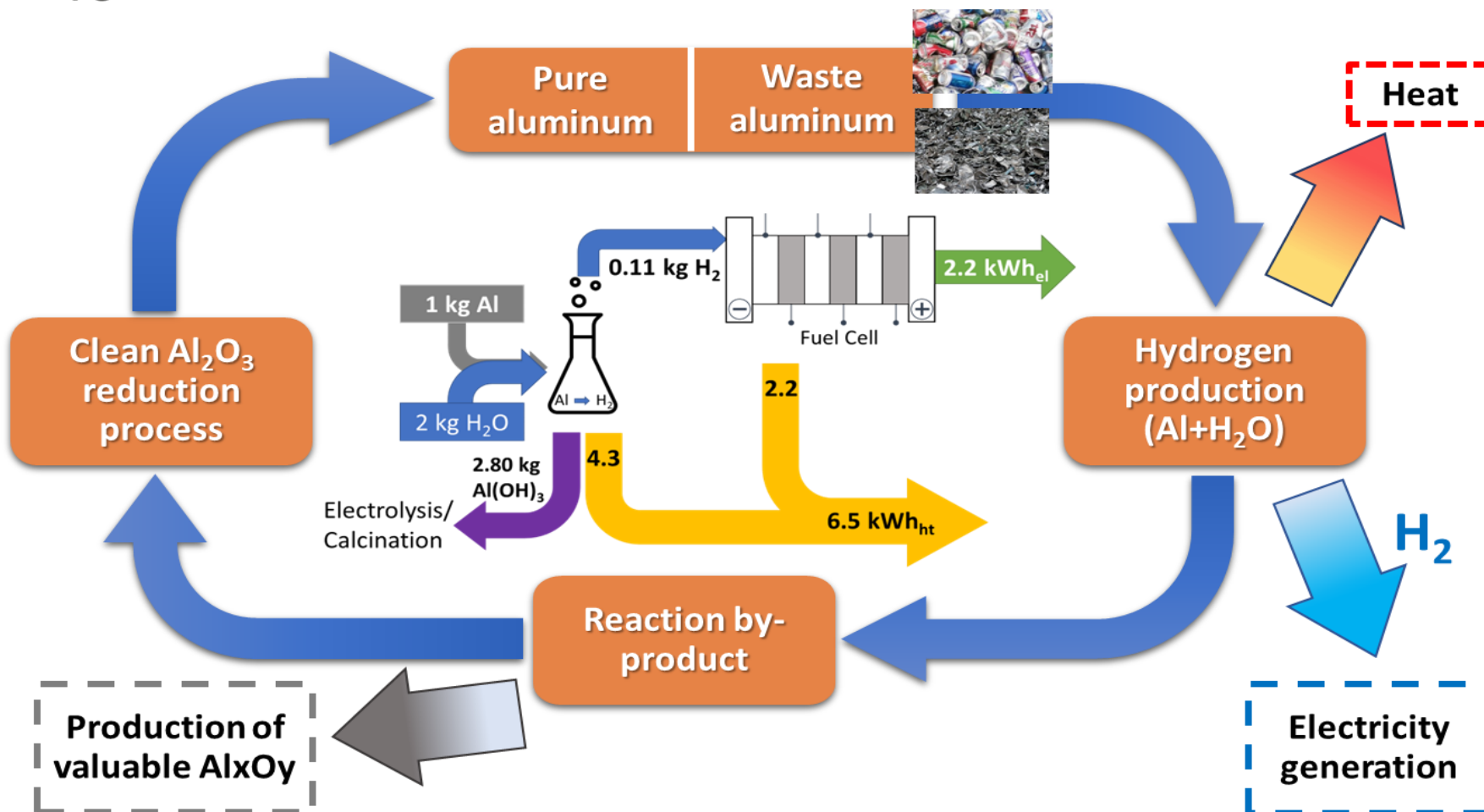


56 projects, 180 M Eur, 16.7 % of Clean H₂ JU support

In 11 years electrolyser capacity increased 500x and funding per MW installed reduced 100x

Increased financial contribution from industry

Project – ALICE-WHY (Aluminum in circle economy - from waste through hydrogen energy to alumina)



The main goal of the project is to investigate the Al reaction with water and design a prototype for scrap Al use in H₂ production and following byproduct reduction to Al oxides

Coordinator

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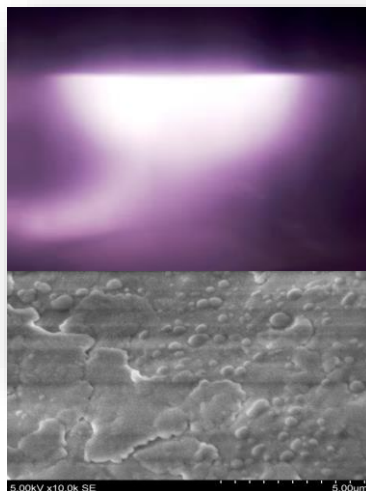
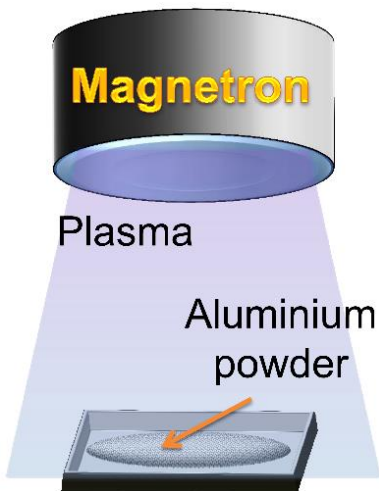
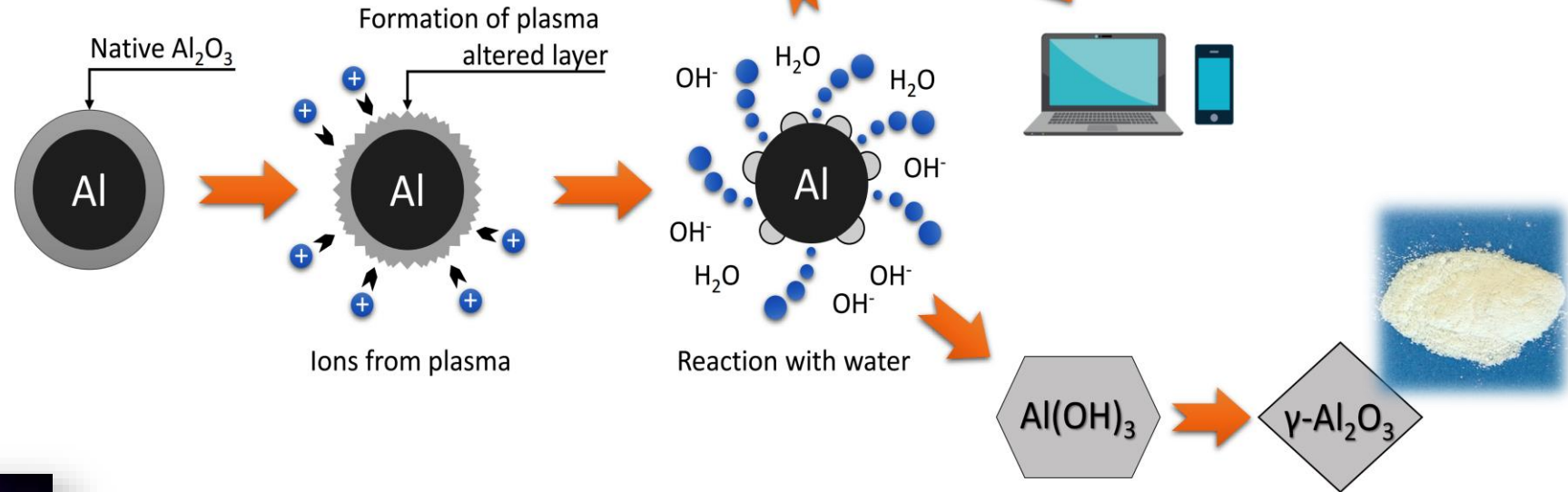
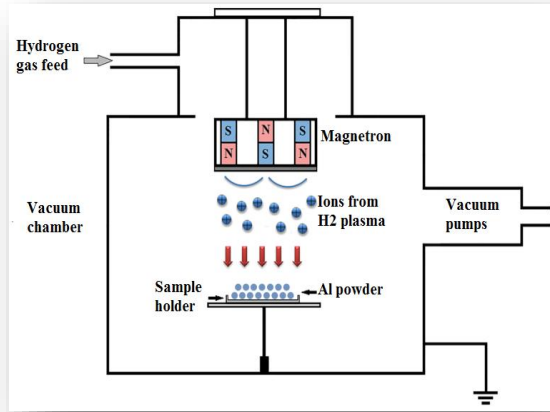
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Iceland


 UNIVERSITY OF ICELAND


Plasma treatment



Unmodified Al powder



Plasma modified Al powder



Surface area > 200 m²/g

- as catalyst carrier
- petroleum industry
- optoelectronics
- water treatment
- membranes
- as an absorbent
- and etc.

Al source

Industrial byproducts



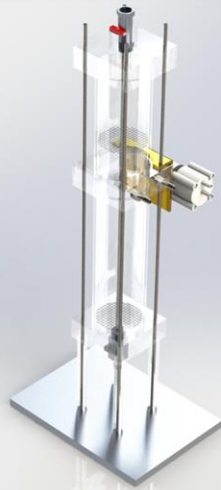
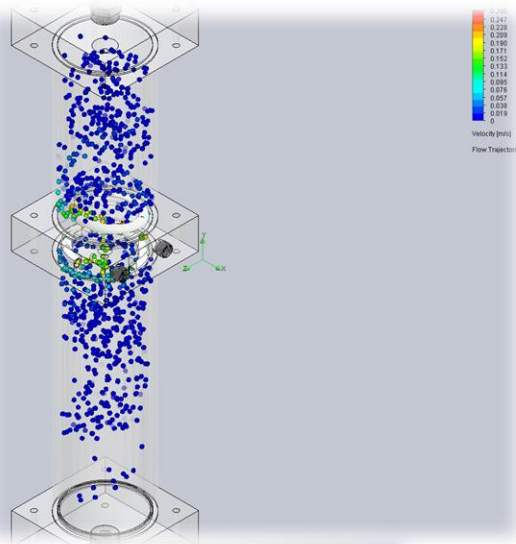
Industrial scrap/leftovers



Scrap – aluminium packaging, cans etc.



Reactor Design



H₂ purity – 99.5 %

Upscaling:



ALICE-WHY



Project – InnoHyppy (INNOvative catalyst and its regeneration for clean HYdrogen Production via methane Pyrolysis)



- Method for synthesis of gamma aluminium oxide using plasma - modified aluminium and water reaction. D. Milčius, M. Urbonavičius, M. Lelis. EPO, EP3768640B1

The present project aims at the fundamental and practical investigation of Fe/Ni materials by development of novel catalyst for cleaner and more efficient **clean hydrogen production via methane pyrolysis** technique as well as their regeneration in order to increase its durability, where all the residues will be used as secondary raw materials for further application

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Slovenia



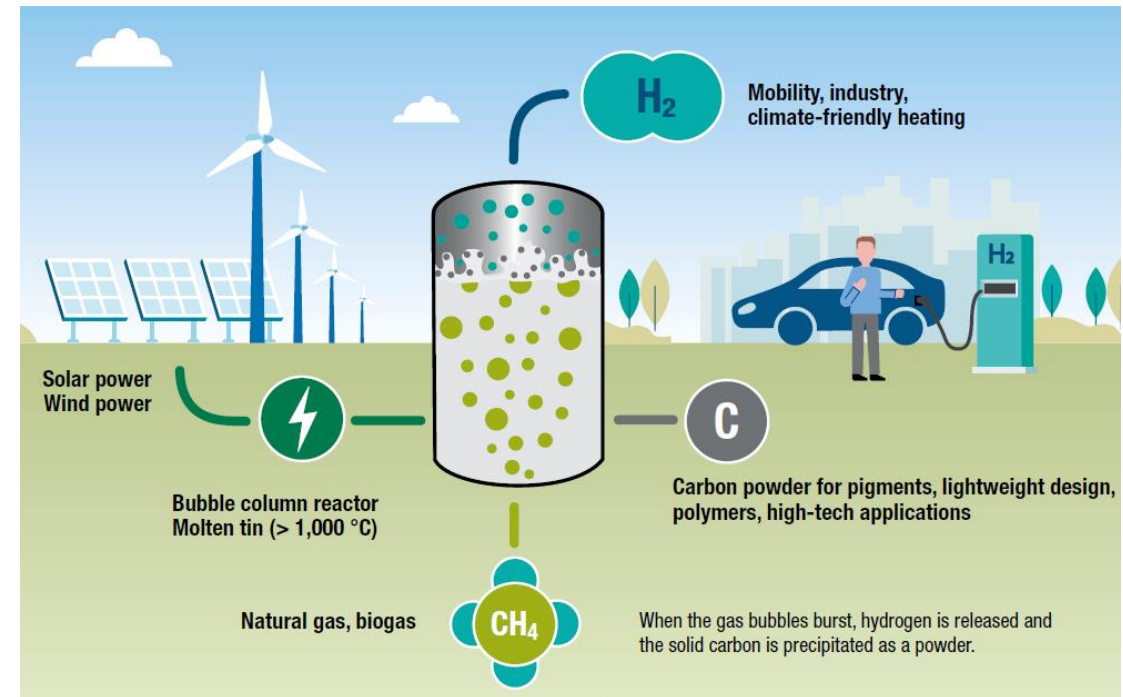
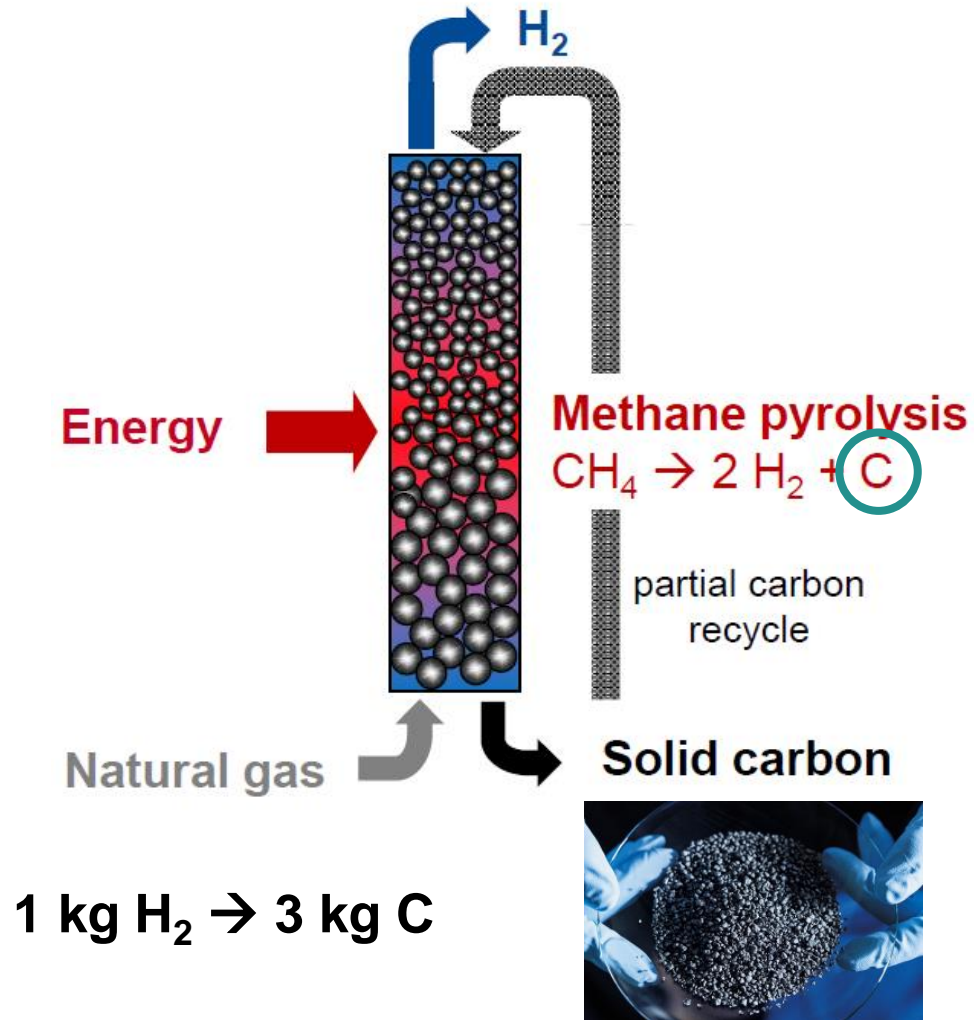
Jožef Stefan Institute

Methane Pyrolysis - Turquoise hydrogen

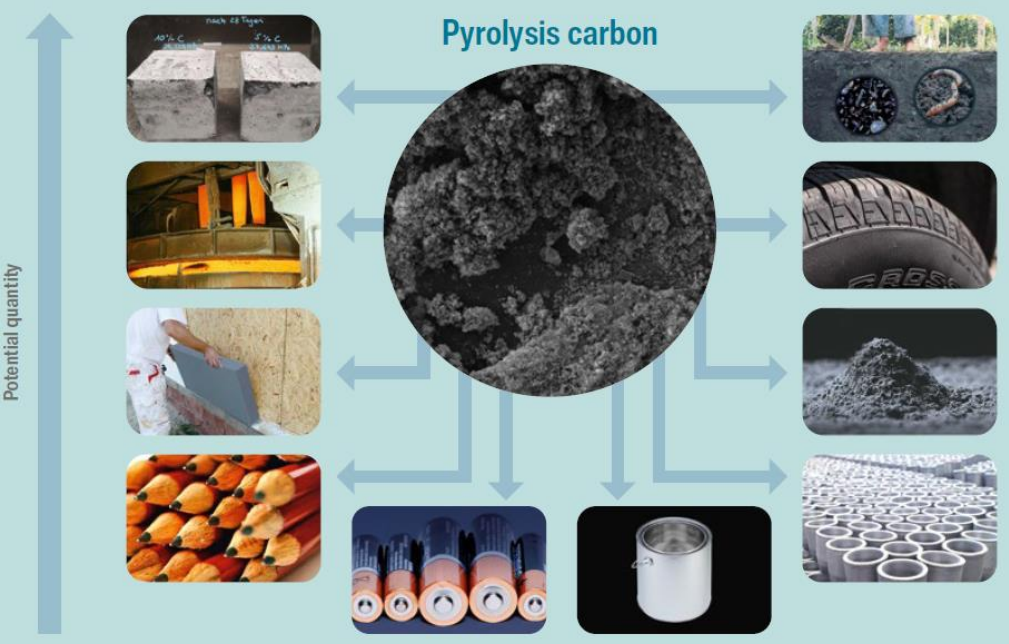


Stephen Jackson,
Chief Market & technology Officer at Hydrogen Europe:

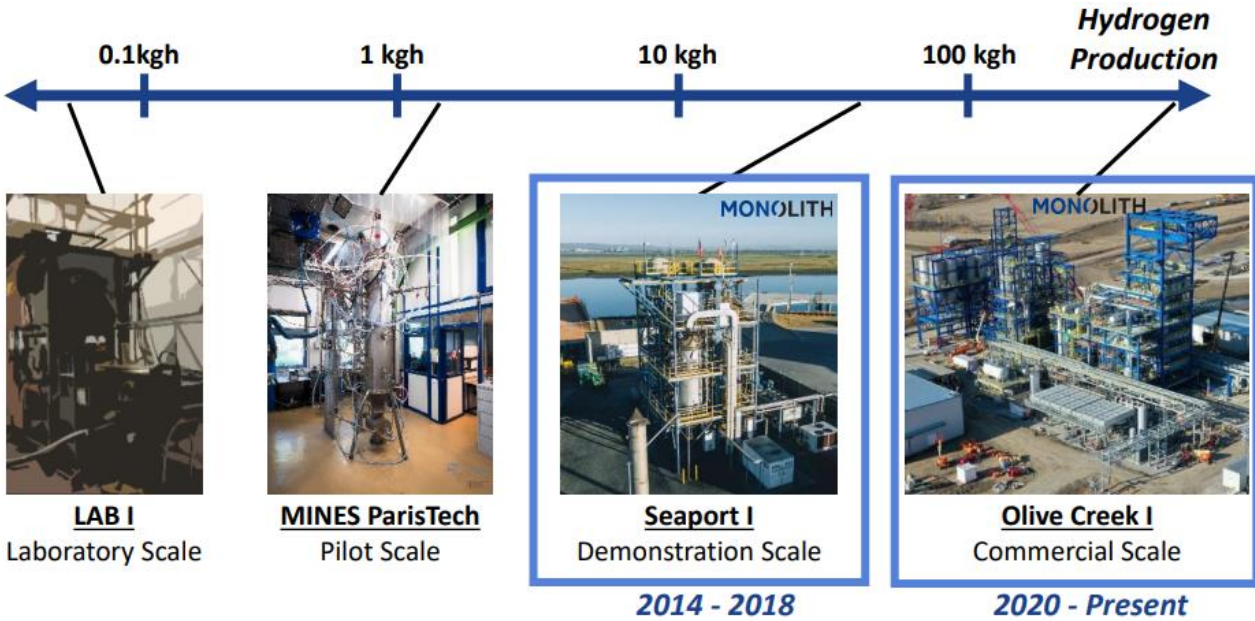
» *Turquoise hydrogen made from pyrolysis is a clean and cost-effective production method that, if properly exploited, can play an important role in growing the hydrogen market and achieving our energy-transition goals.* «



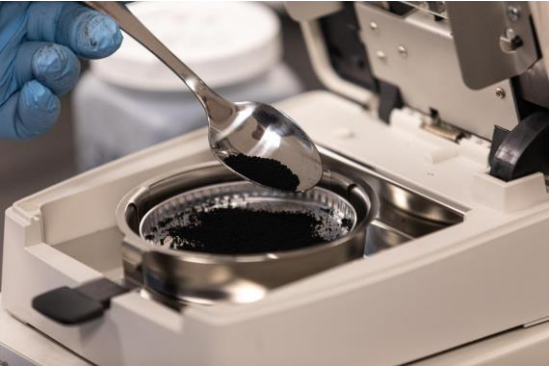
Carbon application



monolith



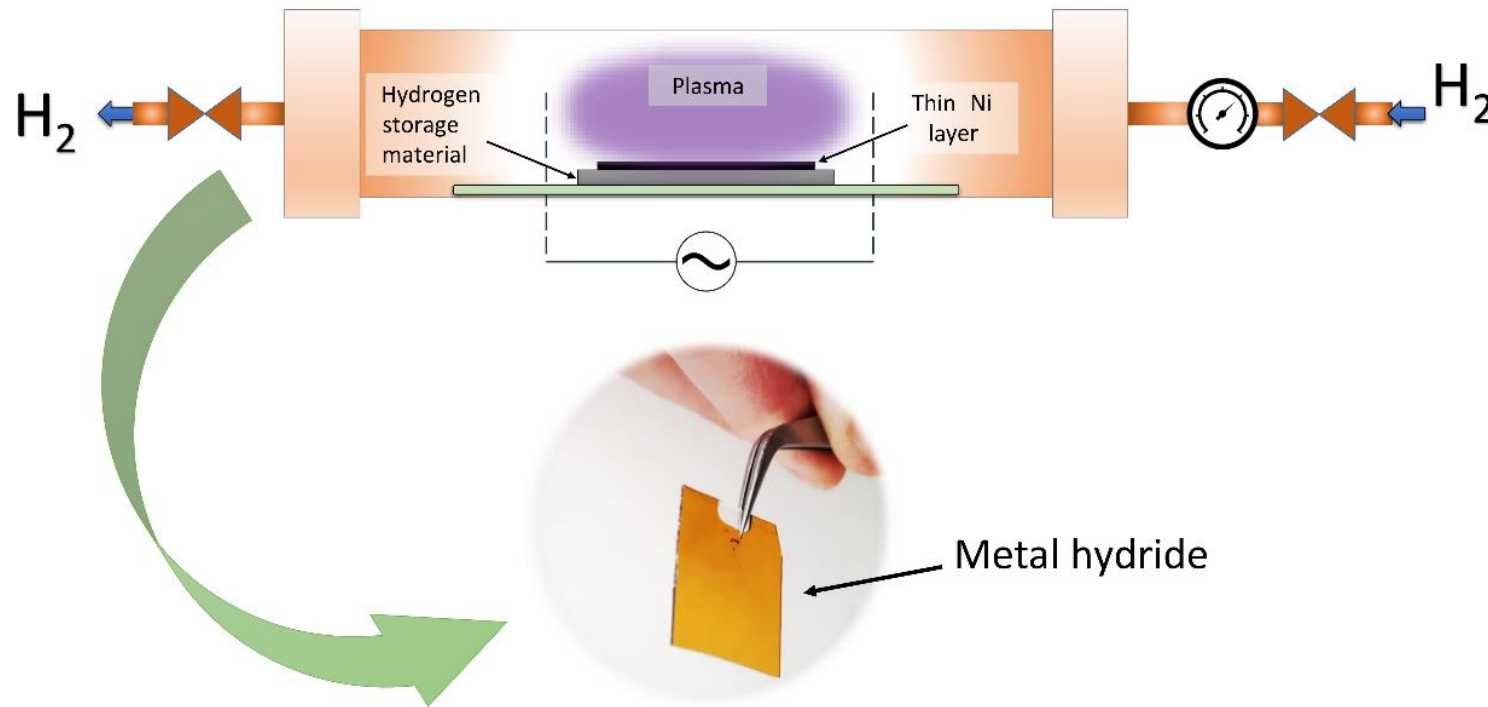
Cooperation with **GOODYEAR**



Synthesis of metal hydrides



MgH_2 and Mg_2NiH_4 metal hydrides could be used as a hydrogen source for fuel cell application in mobile devices. The objective of this invention is novel technology for hydrogenation of metals and their alloys which allows avoiding the usage of expensive catalysts such as Pt and Pd.



European patent: Method of hydrogenation of metals and their alloys, EP 2338834 B1.

The use of metal hydrides in production of synthetic fuels



Mg₂NiH₄ – as Sabatier reaction catalyst and hydrogen source

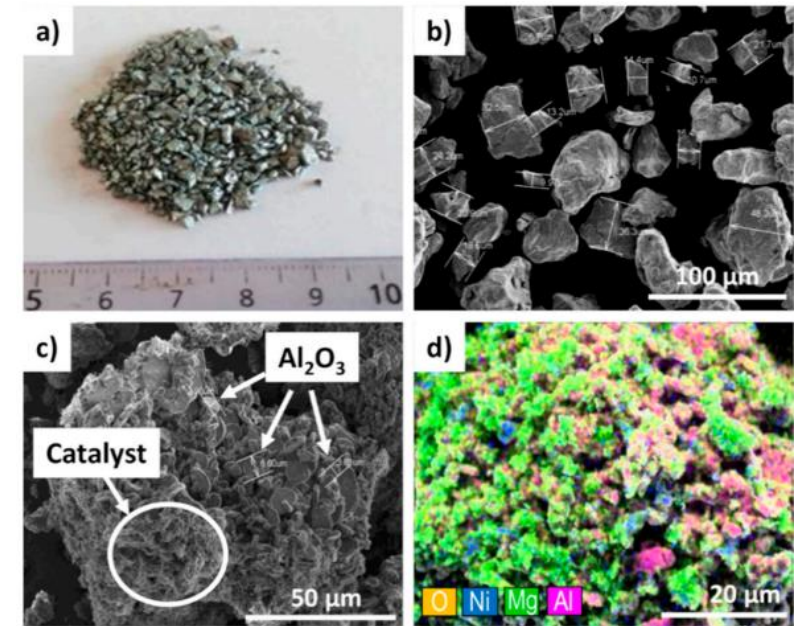
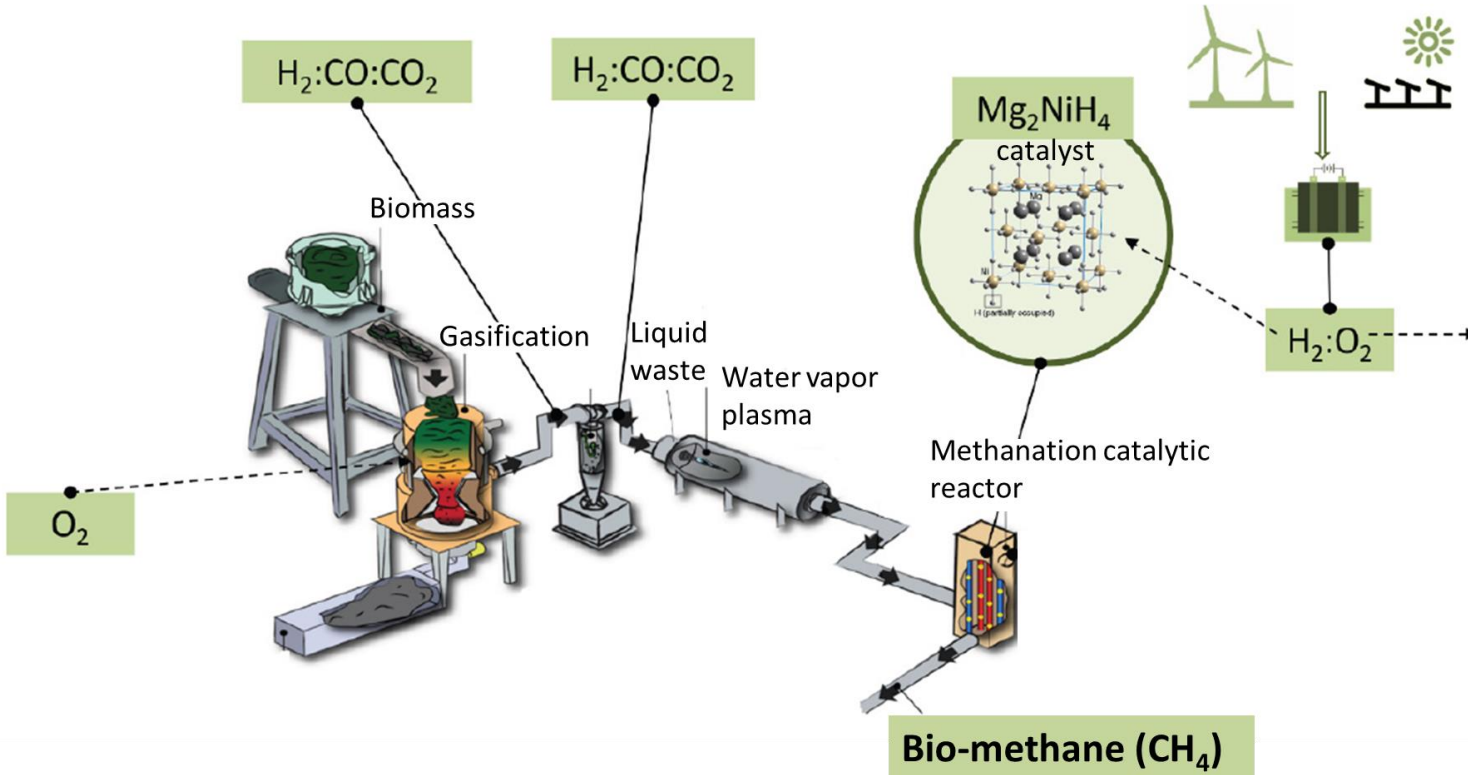
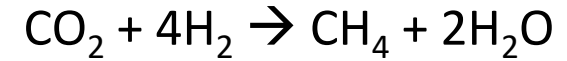


Figure 8. Optical and SEM images: (a) as received Mg₂Ni alloy grains, (b) Mg₂Ni grains after grinding, (c) catalyst-Al₂O₃ mixture after methanation test, and (d) EDS elemental mapping of catalyst-Al₂O₃ mixture after methanation test.

Project: Development of innovative biomethane production technology using the catalytic thermochemical conversion method (01.2.2-LMT-K-718-01-0005)

Lelis M. [LEI], Varnagiris Š. [LEI], Urbonavičius M. [LEI], Zakarauskas K. [LEI]. Investigation of Catalyst Development from Mg₂NiH₄ Hydride and Its Application for the CO₂ Methanation Reaction In: Coatings. Basel: MDPI, 2020, vol. 10 (12), 1178, p. 1-15. ISSN 2079-6412.

BalticSeaH2



Demonstrating hydrogen economy with the largest cross-border Hydrogen Valley in Europe



The Role of Hydrogen energy association:

- Communication and dissemination;
- Social awareness and acceptance activities;
- Collection and sharing of information;
- Cooperation and networking;
- Contributing to the development of Valley Replication Toolkit.

Follow the project!



BalticSeaH2valley.eu



[BalticSeaH2](https://www.linkedin.com/company/BalticSeaH2)



[@BalticSeaH2](https://twitter.com/BalticSeaH2)

The project is supported by the Clean Hydrogen Partnership and its members.



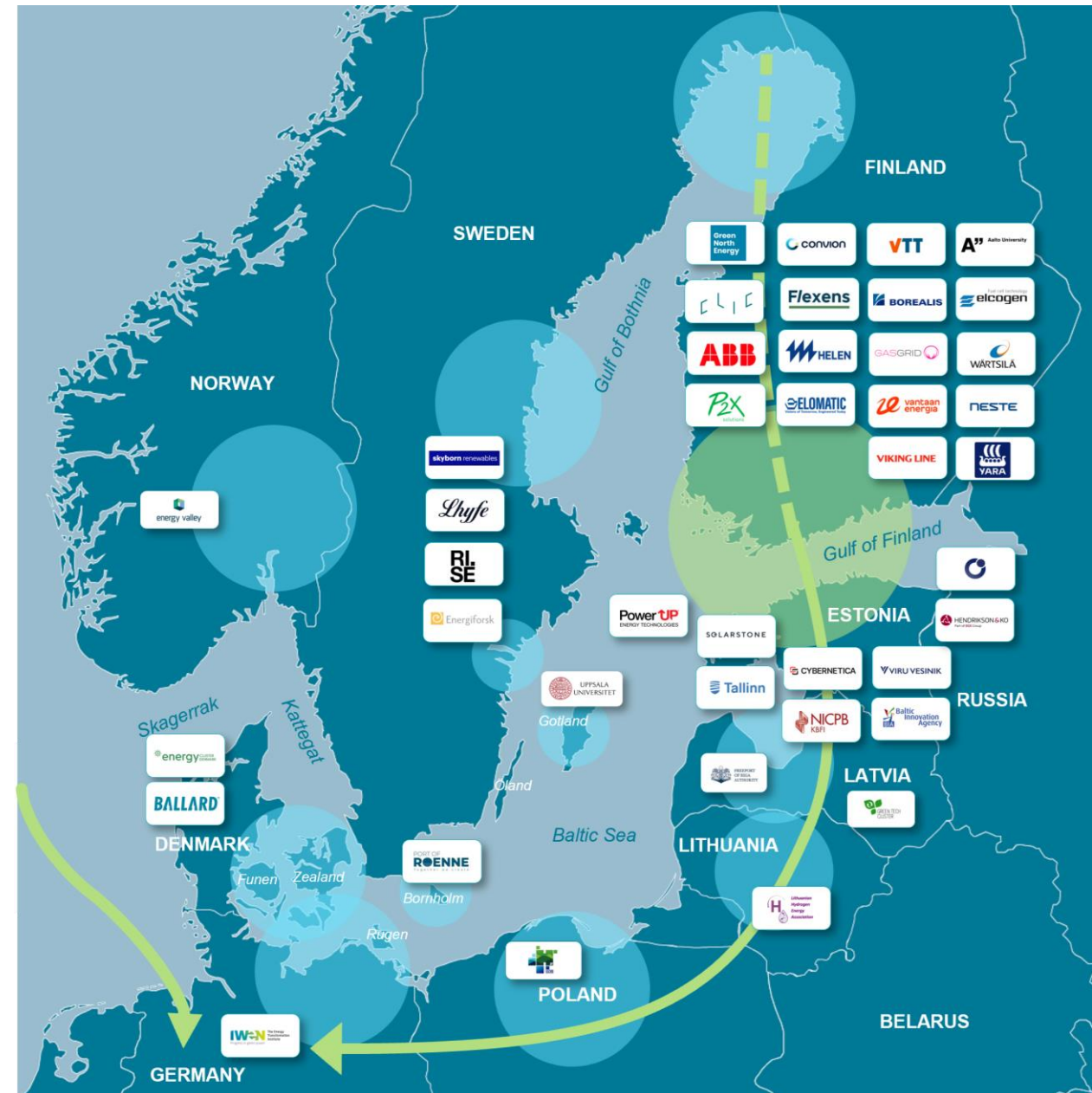
**Clean Hydrogen
Partnership**



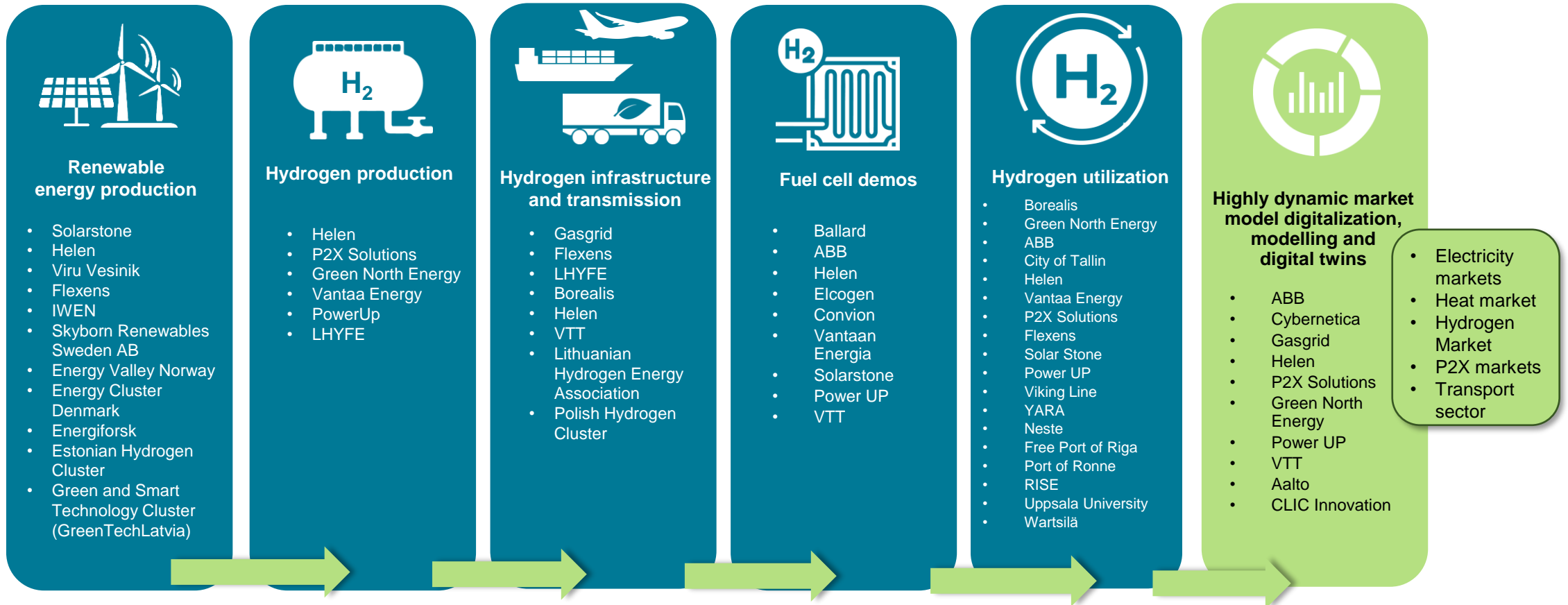
Co-funded by
the European Union

About BalticSeaH2

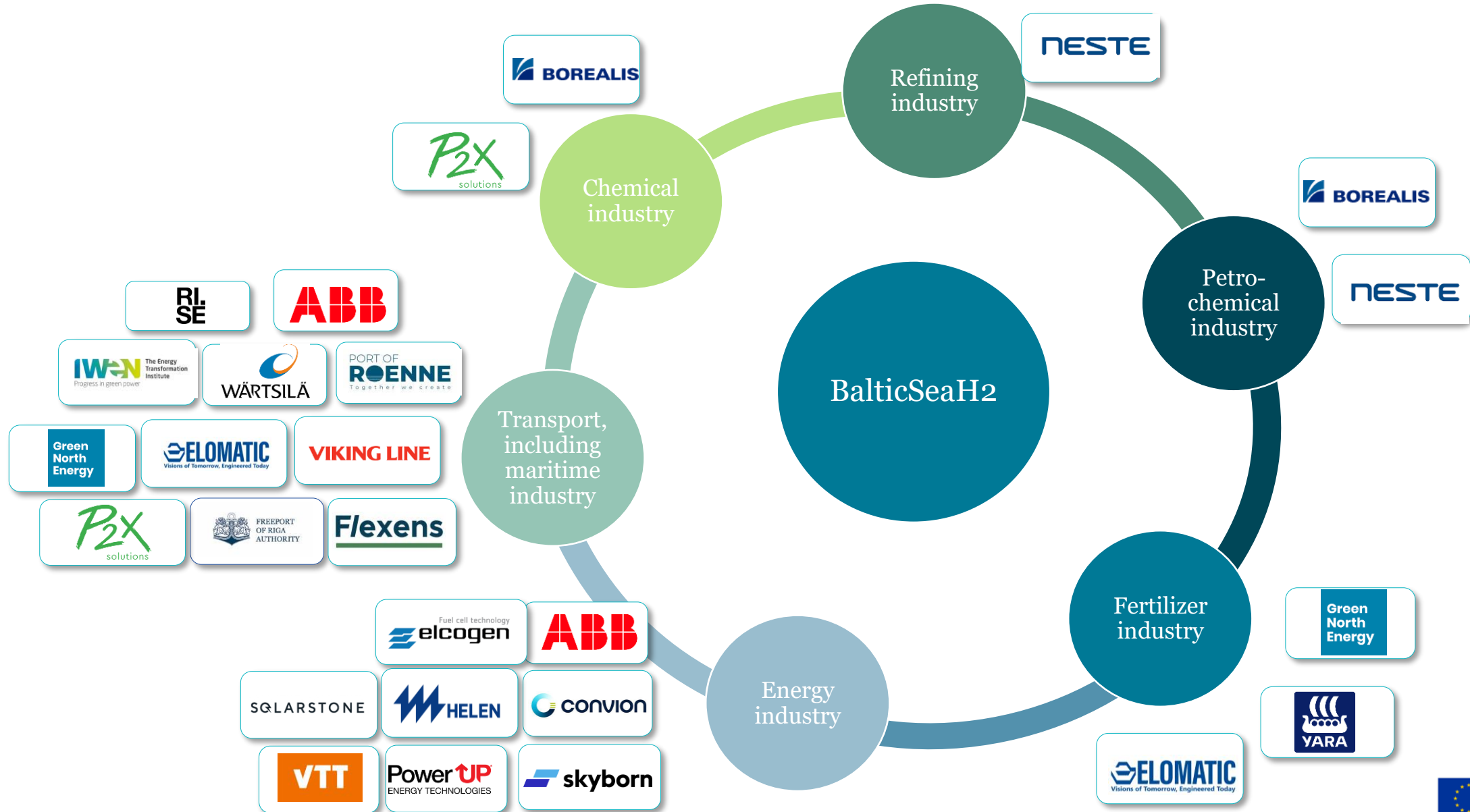
- 40 partners in 9 countries
- Coordinated by CLIC Innovation and Gasgrid Finland
- Main valley between Finland and Estonia: replication valleys in Norway, Sweden, Denmark, Latvia, Lithuania, Poland and Northern Germany
- 25 demonstration cases under preparation
- Total budget 33 M€, EU funding for 25 M€



Hydrogen value chain and infrastructure

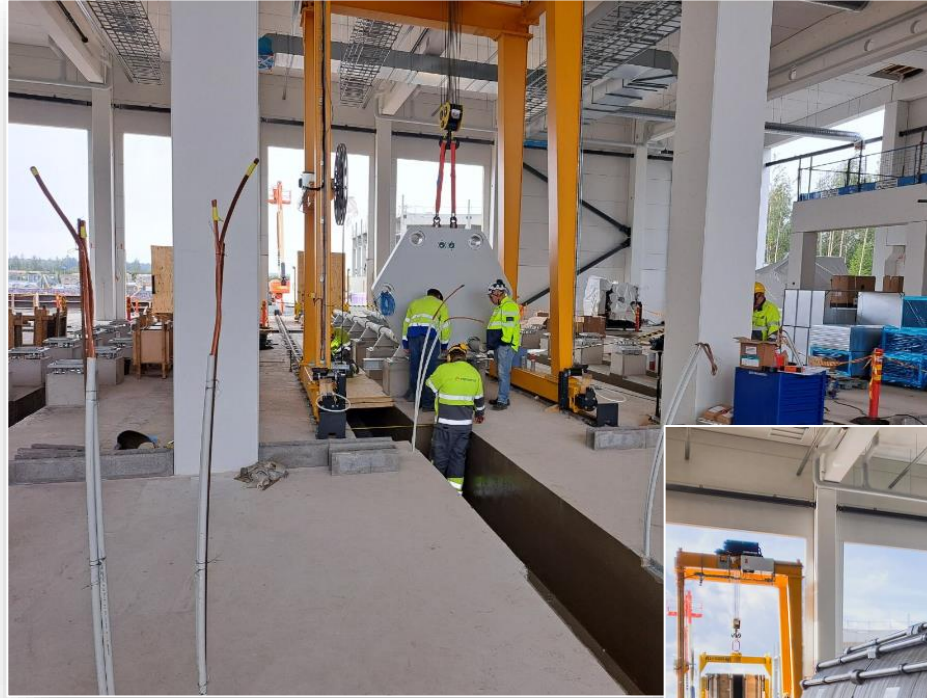


Use cases and industries involved in BalticSeaH2



P2X Solutions Oy demonstration case: Green H₂ production in Harjavalta

- The four stacks have 20 MW of capacity
- 3000 t/a H₂
- Plant is stated to be completed in 2024
- The plant is also to include methanation capacity for the production of renewable synthetic methane from hydrogen and captured CO₂ from industrial processes
- Also develops the ICT integration of H₂ plant. *Effective data handling will play an increasingly crucial role in the future energy market: as the markets become more tightly integrated, real-time data becomes the lifeblood of operations.*





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Thank You.

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