Estonian Association of Hydrogen Technologies

Vesinikupäev 2023

Vesinikutehnoloogiate alane koostöö Balti riikides

Seitsmes Vesinikupäev

Tartu 06. Oktoober

Ain Laidoja

BotH2nia

Estonian Association of Hydrogen Technologies

https://www.both2nia.com/en

BaSeH2

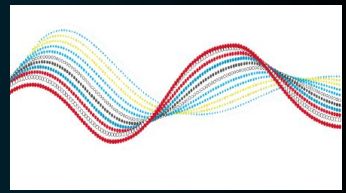
Estonian Association of Hydrogen Technologies

https://h2est.ee/vesinikuuhing/projektides-osalus/baseh2 Vaata ka 2017 https://h2est.ee/baltimereaarsete-riikide-vesinikukonverents/

BaSeH2 – Baltic Sea Region Hydrogen Council

Estonian Association of Hydrogen Technologies

A collaborative project in SI Baltic Sea Neighbourhood Programme **supporting organisations, companies and business associations in Baltic Sea Region** in actions towards reaching their sustainability goals, through further **expansion of regional collaboration**, developing models and methods, providing input to policy and strategy, and sharing knowledge.



Supported by Swedish Institute

FOCUS AREAS IN THE PROJECT:

- Networking
- Competence Development
- Policy Development

Approaches:

- Baltic Sea Region Hydrogen Road Tour
- Mobile workshops
- CEO Alliance platforms
- Launch Baltic Sea Region Hydrogen Council

https://www.both2nia.com/en/news/baltic-sea-region-hydrogen-council-project-launched

Estonian Association of Hydrogen Technologies

Naabrivalve

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Läti

ENERGY IN LATVIA
SNAPSHOT 2022

ELECTRICITY

CONSUMPTION
7.1 TWh

GENERATION
4.8 TWh

GENERATION TYPE
~70% RES
~30% OTHER

NATURAL GAS

CONSUMPTION
9 TWh
(-30% from 2021)

BIOMETHANE POTENTIAL
0,7-1,5 TWh

PHYSICAL FLOWS
~75% LNG
~25% RUS

DIST. HEATING

ENERGY SUPPLIED
5.7 TWh

GENERATORS (>1MW)
100

FUELS
~57% RES
~43% OTHER

*Data from 2021. regulated utilities

Naco

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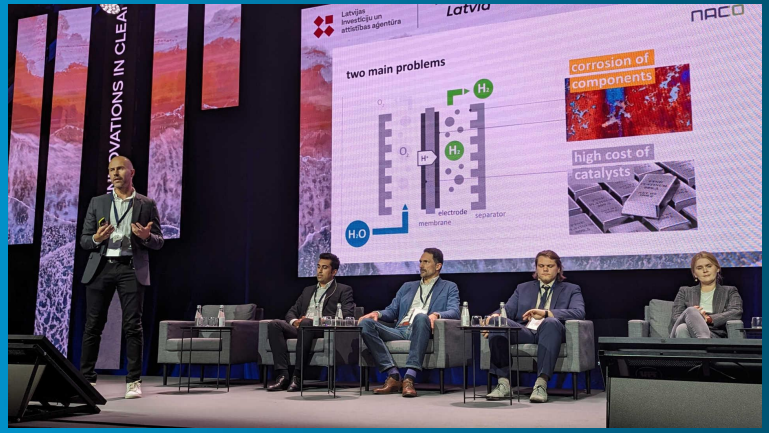
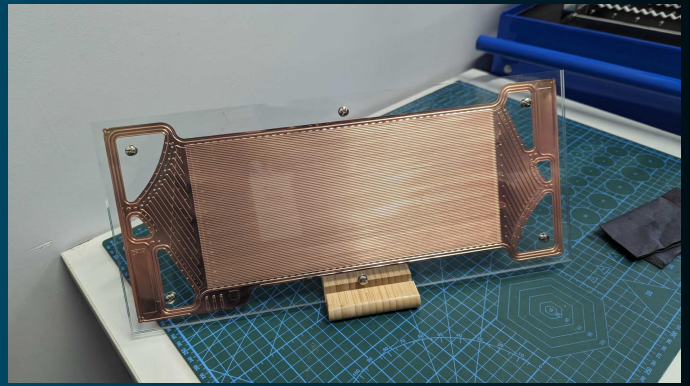
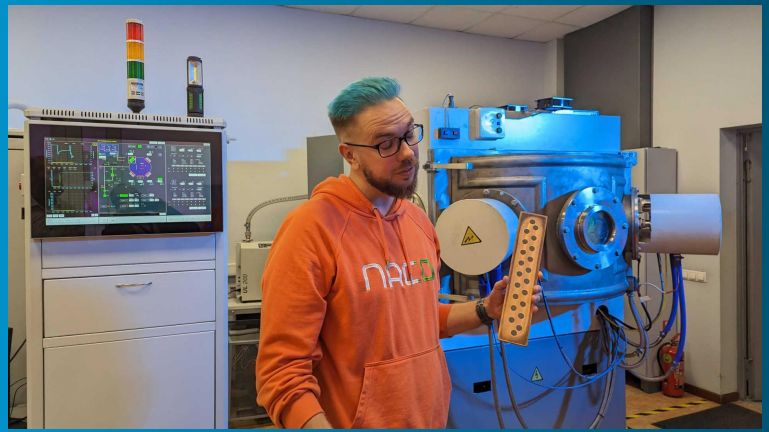
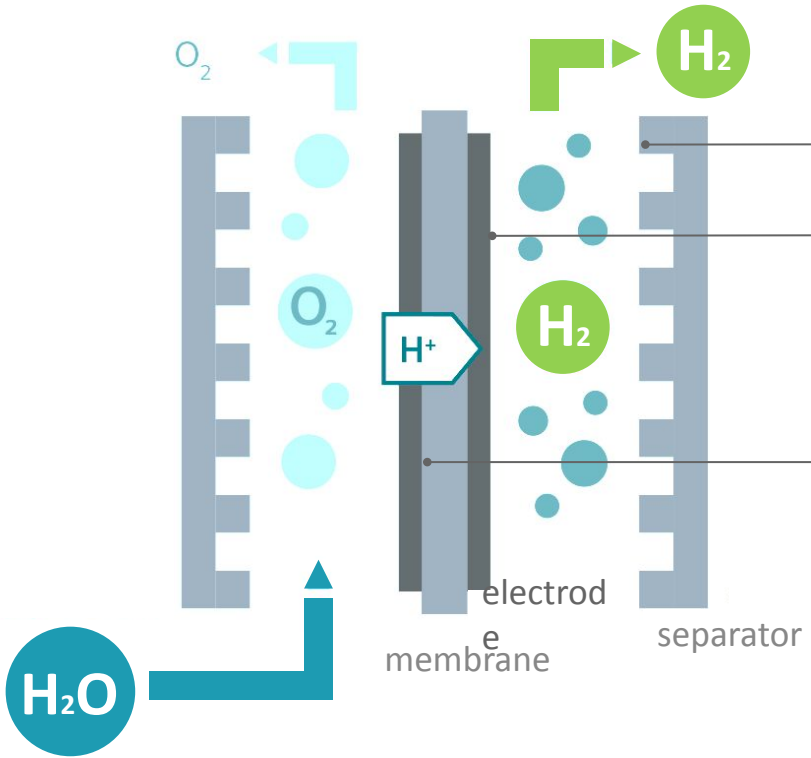






https://www.naco.tech

Problems



corrosion of components

availability and high cost of catalysts (30% of system cost)

https://h2lv.eu/wp-content/uploads/2023/09/11_Raivo_Nikitins_NACO.pdf

Digas

Estonian Association of Hydrogen Technologies

https://digasgroup.com

Conexus

Estonian Association of Hydrogen Technologies

https://www.conexus.lv/en

HySol

Estonian Association of Hydrogen Technologies

HyFuel P

HyFuel P is a simplest mobile refueling solution for, primarily but not restricted, 350 bar(g) fuel cell vehicles (heavy-duty trucks, public transportation, fork lifters etc.). The system needs no electrical connection and is easy transportable.

Caters perfectly to the refueling needs of first stage testing and small vehicle fleets.

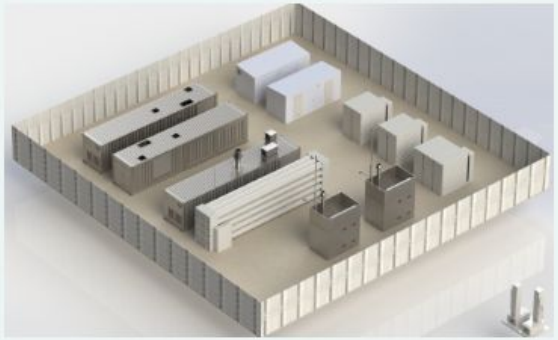
HyFuel C

HyFuel C is a mobile hydrogen refueling station with optional internal storage, that provides hydrogen refueling via cascade and direct boost/compress methods with all fueling control and safety systems. Suitable for both 350 and 700 bar(g) fuel cell vehicles.

Ideal for solutions where multiple refueling per day are necessary.

Full scale station

Hydrogen production and refueling station is a complete and fully automated solution. With variety of options based on systems demands. Equipped with advanced control systems that monitor and regulate the entire refueling process.



The best solution for high refueling demands, such as public transport services.

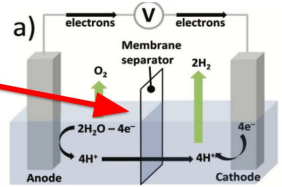
https://hysol.lv/

Hydrogen research at RTU

Estonian Association of Hydrogen Technologies

Disadvantages of conventional membrane type electrolysis equipment

- H_2 and O_2 must not mix
- Membrane is used in commercial electrolysis equipment



https://www.energytech.com/renewables/article/21213512

- High material (membranes) costs;
- High maintenance costs;
- Extra pure water required;
- Safety risks due to H_2/O_2 transport through the membrane
- Expensive pressure maintenance devices on both sides of the membrane are required

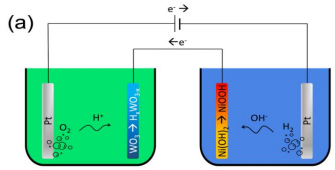
ohmium

Ohmium designs, builds and deploys polymer electrolyte membrane (PEM) electrolyzers which separate the hydrogen out of water- plants with total power 1GW!!!

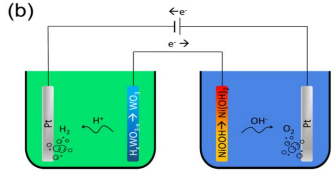
21

Concept created by RTU - decoupled electrolysis (without membrane)

RIGA TECHNICAL UNIVERSITY 1862



1. $2H_2O \rightarrow O_2 + 4e^- + 4H^+$
2. $WO_3 + xe^- + xH^+ \rightarrow H_xWO_3$
3. $Ni(OH)_2 + OH^- \rightarrow NiOOH + e^- + H_2O$
4. $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$



1. $4H^+ + 4e^- \rightarrow 2H_2$
2. $H_xWO_3 \rightarrow WO_3 + xe^- + xH^+$
3. $NiOOH + e^- + H_2O \rightarrow Ni(OH)_2 + OH^-$
4. $4OH^- - 4e^- \rightarrow 2H_2O + O_2$

22

22

https://h2lv.eu/wp-content/uploads/2023/09/4_Gatis_Bezbauers_RTU.pdf

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Leedu

🇱🇹 Leedu Vesinikuplaanid

Estonian Association of Hydrogen Technologies

- 2050, Leedu plaanib toota piisavalt rohelist vesinikku, selleks et katta oma vajadused ja eksportida ülejäävad energiaproduktid teistesse riikidesse.
- Tarvidus 24 TWh (~720 000 tpa) vesiniku järele
- Installeeritud vesinikutootmine 8.5 GW_{el}
- Elektritarve selleks 36 TWh_{el} – 3 korda rohkem kui tänane tarbimine.

Riigi poolsed sammud:


Press release | 4 October 2023 | Brussels

State aid: Commission approves €193 million Lithuanian scheme to support offshore wind farms to foster the transition to a net-zero economy

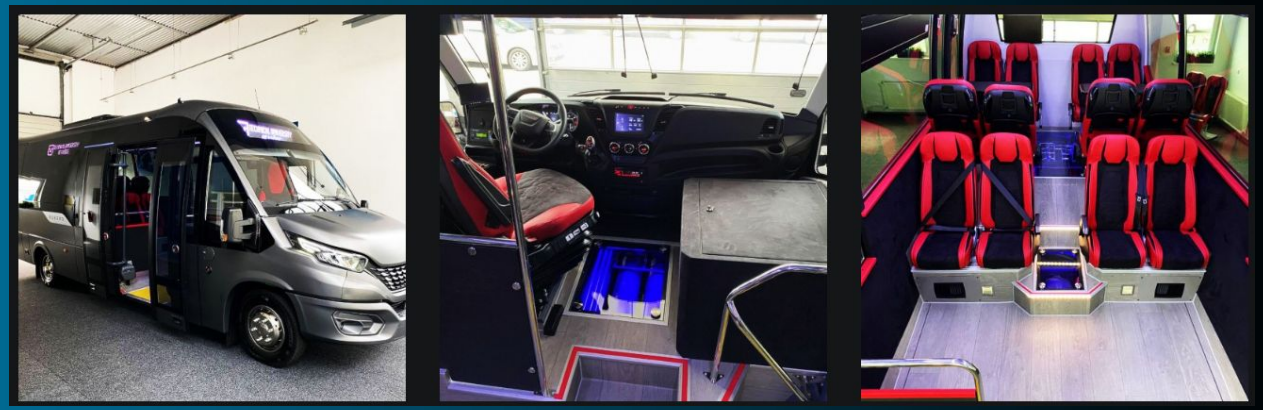
Government's hydrogen development plan, coming soon.

https://enmin.lrv.lt/lt/naujienos/zaliasis-vandenilis

Elinta motors

Estonian Association of Hydrogen Technologies

- Up to 500 km Range
- 8.4 kg Hydrogen Capacity
- 120 kW



- Up to 400-500 km Range
- Unlimited daily operation with fast refueling.
- 150 kW / 1250 Nm

https://elintamotors.com/elinta-motors-home/technology-1/#h2-fuel-cell

Lithuanian Hydrogen Energy Association

Association activities and H_2 energy sector in Lithuania

Dr. Šarūnas Varnagiris

Sarunas.varnagiris@lei.lt

March 2023

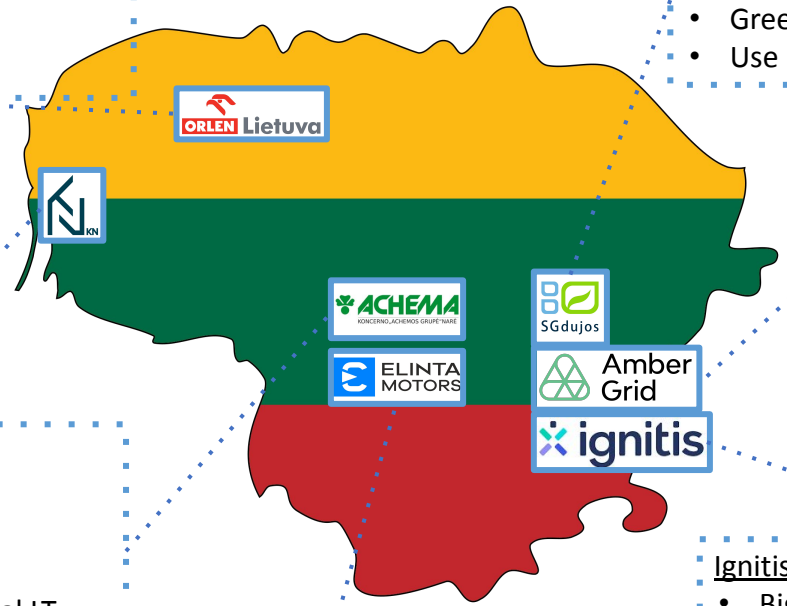
Lithuanian Hydrogen Energy Association

Hydrogen in Lithuania (Industry/some of main players)

<u>ORLEN Lietuva, AB</u>
- Oil producer.
- H_2 annual demand: **50 000 t**
- Application: Refinery.
- Technology: Reforming.

<u>SG Dujos, UAB</u>
- Hydrogen technologies for vehicles.
- Green H_2 producer.
- Use up to 10% of hydrogenated natural gas.

<u>Klaipėdos nafta, AB</u>
- LNG terminal - the energy security of the Baltic Sea Region.
- Plans to be H_2 transportation hub in Baltic region.



<u>Amber Grid, AB</u>
- Lithuanian NG TSO.
- H_2 injection into NG grid system project (up to 10 %).
- Started to operate GIPL pipeline.

<u>Achema, AB</u>
- Fertilizers producer.
- H_2 annual demand: **150 000 t**
- Application: H_2 for ammonia.
- Technology: reforming (18 % of total LT CO_2 emissions).

<u>Elinta Motors, UAB</u>
- Development of H_2 FC vehicles.

<u>Ignitis, UAB</u>
- Biggest electricity supplier in LT.
- 700 MW offshore wind park till 2030.

Lithuanian Hydrogen Energy Association

Some H2-related activities in LT (I)

Government initiatives:

- National Hydrogen Strategy – guidelines presented at 20th September, should be done in short time;
- National calls (supporting schemes) for H2 infrastructure and transport (ended calls)
  - Development of green hydrogen production capacity. Main points: deadline: august 22. Total budget: 50 000 000 €. Max budget per project: 15 000 000 €. Conditions: Max 770 000 Eur per one MW electrolyser, after implementation – H2 production should be not less than 0,168 tonnes of green H2 for every thousand of subsidised euros.
  - HRS installation. Deadline – July 18. Budget - 3 600 000 €.
  - Promoting the purchase of pure electric or hydrogen vehicles for the public sector. Deadline – June 9, budget - 38 000 000 €
  - H2 production and utilization. Deadline – February 1, budget - 20 000 000 €

Lithuanian Hydrogen Energy Association

Some H2-related activities in LT (I)

- **Electricity:**
- 700 MW offshore wind (up to 2 TWh of green electricity per year)
- Harmony Link project – offshore Lithuanian-Polish electricity interconnector (will help to integrate additional 1000 MW offshore wind);
- Installed more than 20 MW batteries for grid stabilisation (foreseen to install more than 200 MW batteries in total).

Gas grids:

- Launched of GIPL (Lithuania-Poland) pipeline (contributes to Baltic Region independence in energy sector).

Transport:

- **4 HRS – till 2026**;

- **25 % of public transport and 1 % of trucks will be H_2FC vehicles till 2030.**
- **Vilnius announced to buy 16 FCEV busses.**

LITHUANIAN ENERGY INSTITUTE

H_2 science projects in Lithuania

Dr. Marius Urbonavičius

Senior Researcher at Center for Hydrogen Energy Technologies

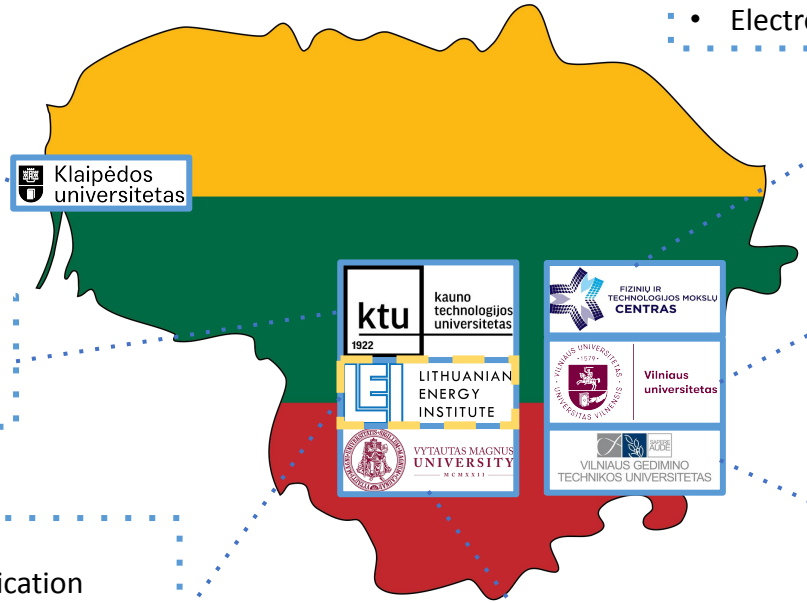
Member of Hydrogen Energy Association

20 September 2023

H_2 research activities in Lithuania

Klaipėda University
- Offshore H_2 application, shipping

Center for Physical Sciences and Technology
- H_2 production via electrolysis
- Photoelectrodes synthesis for hydrogen evolution (photo electrochemistry)
- Electrodes for fuel cells



Kaunas University of Technology
- Synthesis of materials for fuel cells and analysis

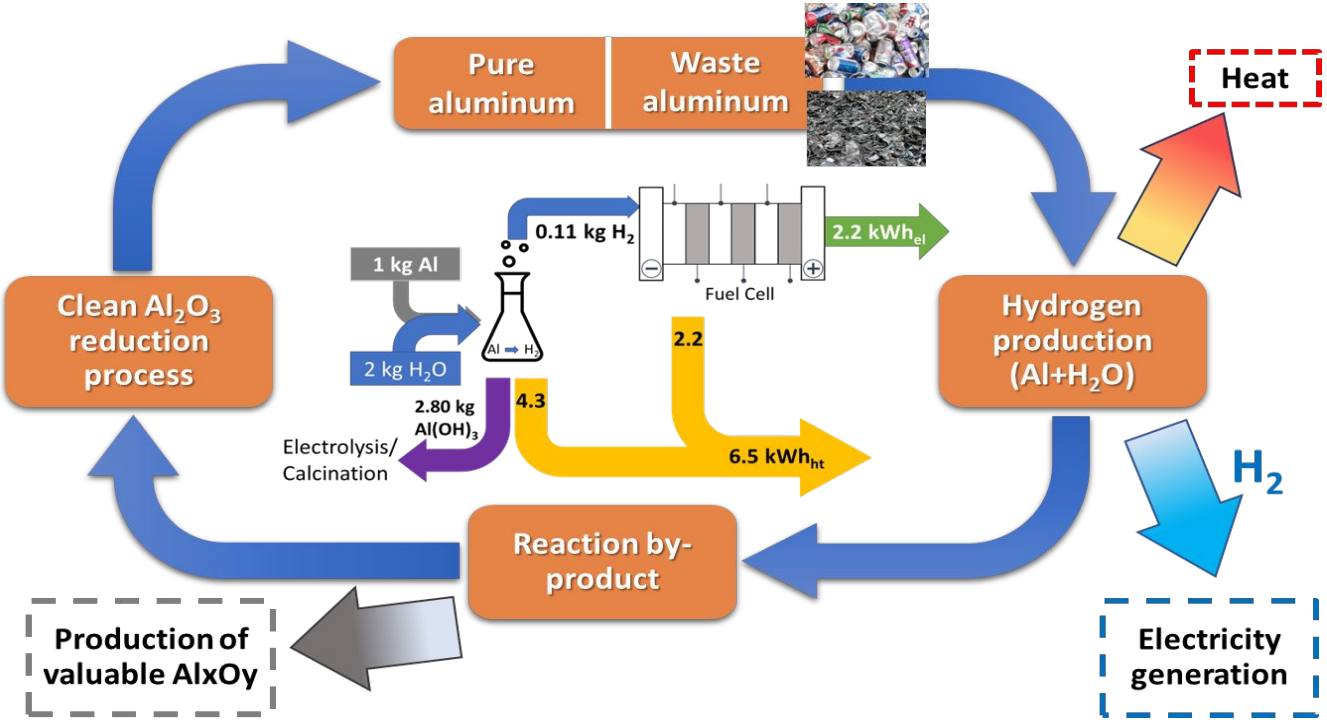
Vilnius University
- Synthesis of solid electrolytes for fuel cells and analysis

Lithuanian energy institute
- H_2 production, storage, application
- Energy balance and management
- Biomethane production and Syngas conversion to biomethane

Vilnius TECH
- H_2 mixture with NG, its application to transport sector

Vytautas Magnus University
- H_2 economy, policy, law and regulations

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 H_2 production and following byproduct reduction to Al oxides

Coordinator

Latvia

LATVIJAS UNIVERSITĀTES CIETVIELU FIZIKAS INSTITŪTS
INSTITUTE OF SOLID STATE PHYSICS UNIVERSITY OF LATVIA

Lithuania

Iceland

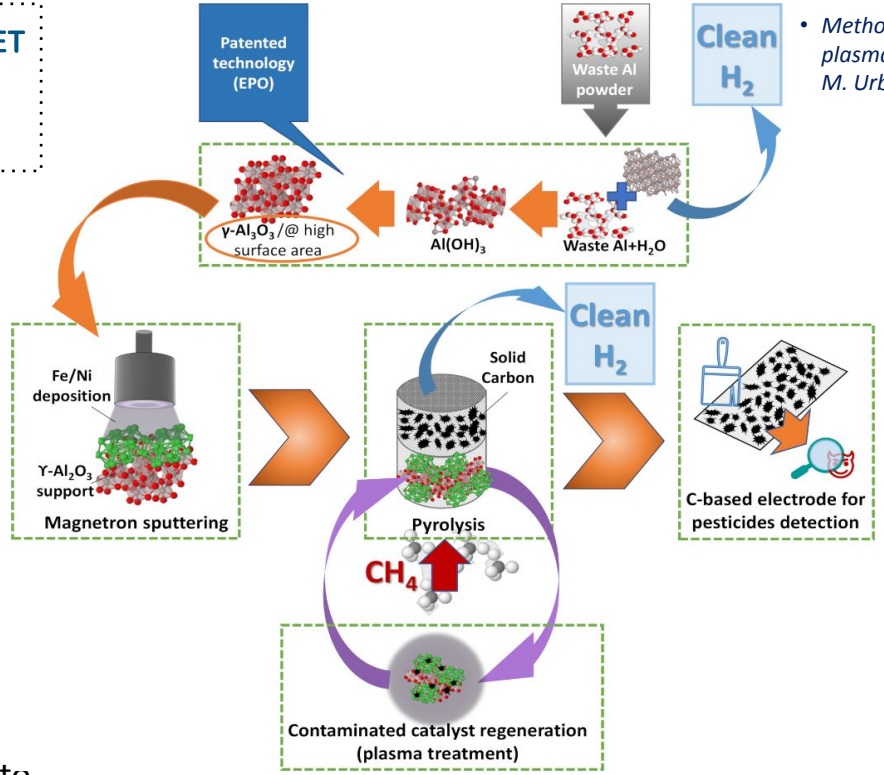
UNIVERSITY OF ICELAND

IceTec

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

M-ERA.NET

Research Council of Lithuania



- *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

Coordinato

Lithuania

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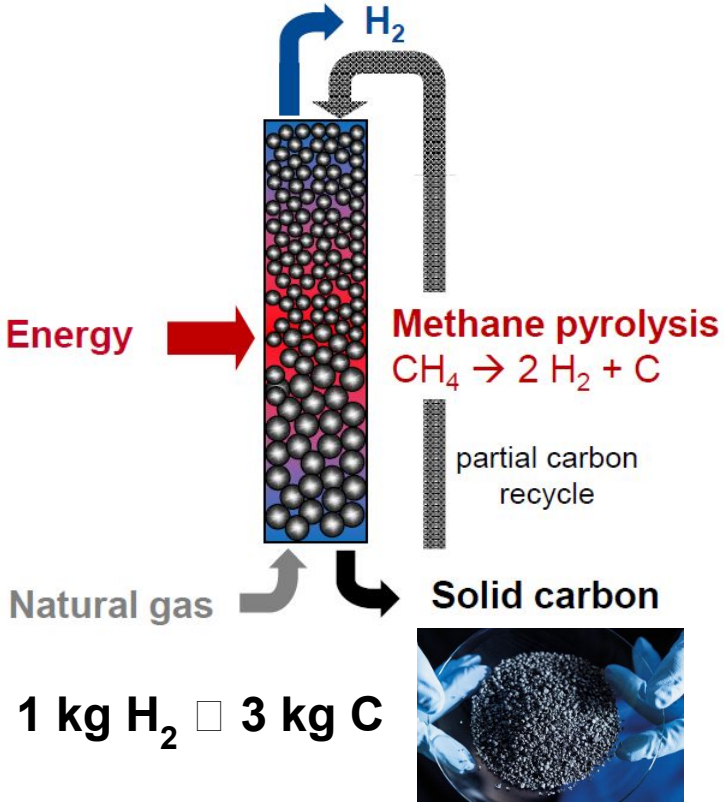
INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA

Slovenia

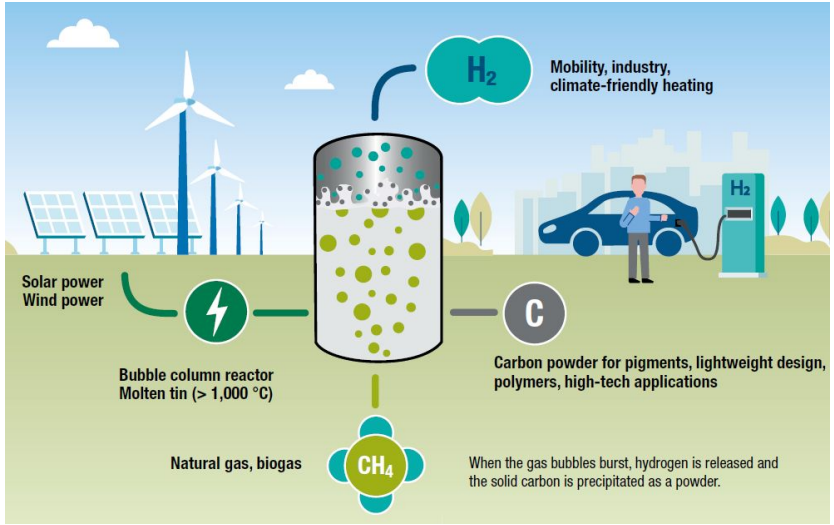
Jožef Stefan Institute

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.



https://hydrogeneurope.eu/he-dvgw-pyrolysis-report/

HYDROGEN ENERGY TECHNOLOGY COURSE FOR BUSINESS

COURSE PROGRAMME

- Hydrogen production and conversion
- Hydrogen technologies
- Hydrogen for industry
- Hydrogen economy
- Hydrogen storage & transportation
- Carbon capture & Storage
- Fuel cells
- Hydrogen for mobility applications & vehicles
- Grid infrastructure
- Case studies
- Power to Hydrogen
- Hydrogen safety

The content may be adjusted based on the participants' requirements

Past participants include AB Amber Grid and AB Achema group

CONTACT
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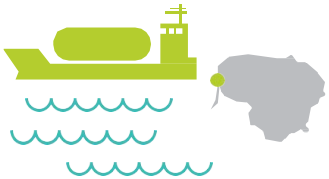
Head of Center for Hydrogen Energy Technologies
Tel: +370 37 401909
Email: darius.milcius@lei.lt

Lithuania‘s plans and goals in the hydrogen economy

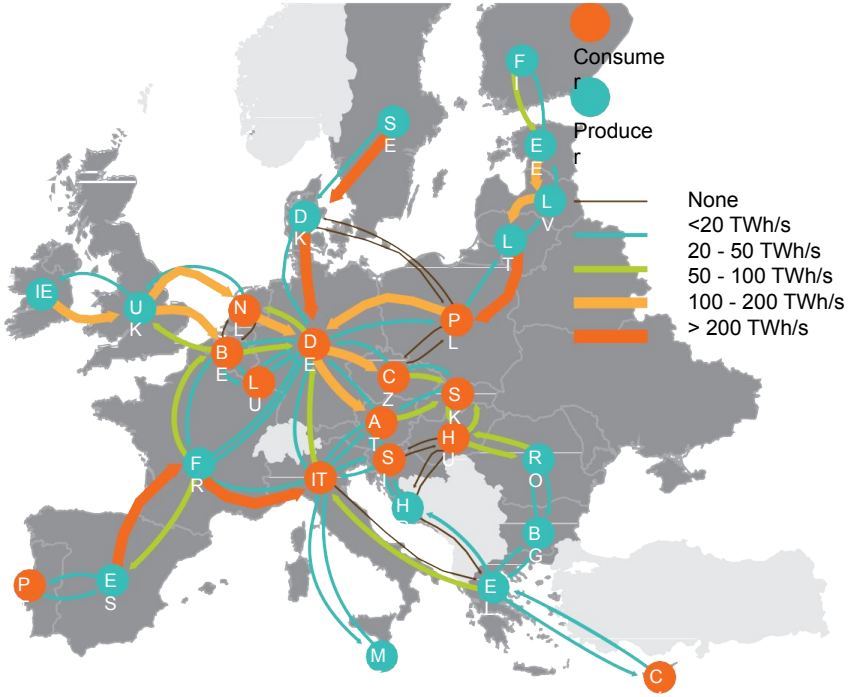
Žilvinas Danys, Head of Innovation Group Ministry of Energy
zilvinas.danys@enmin.lt

MINISTRY OF ENERGY
OF THE REPUBLIC OF LITHUANIA

RES – LITHUANIA FUTURE GREEN HYDROGEN EXPORTER



- Plan – to invest in hydrogen technologies the identical *per capita* amount as Germany and France.
- Hydrogen usage priorities:
  - ✔ in transport and industry
  - ✔ for system balancing
- Pilot project to establish green hydrogen value chain:
  - ✔ 24 MW of electrolysers
  - ✔ 800 tons/yearly and 380 Kt by 2050
  - ✔ 170 hydrogen-powered public buses
  - ✔ 4 filling stations.
- Pilot Power-to-Gas projects initiated.
- Preparation of Draft Lithuania's Hydrogen Roadmap and Action Plan in Q4 2022.



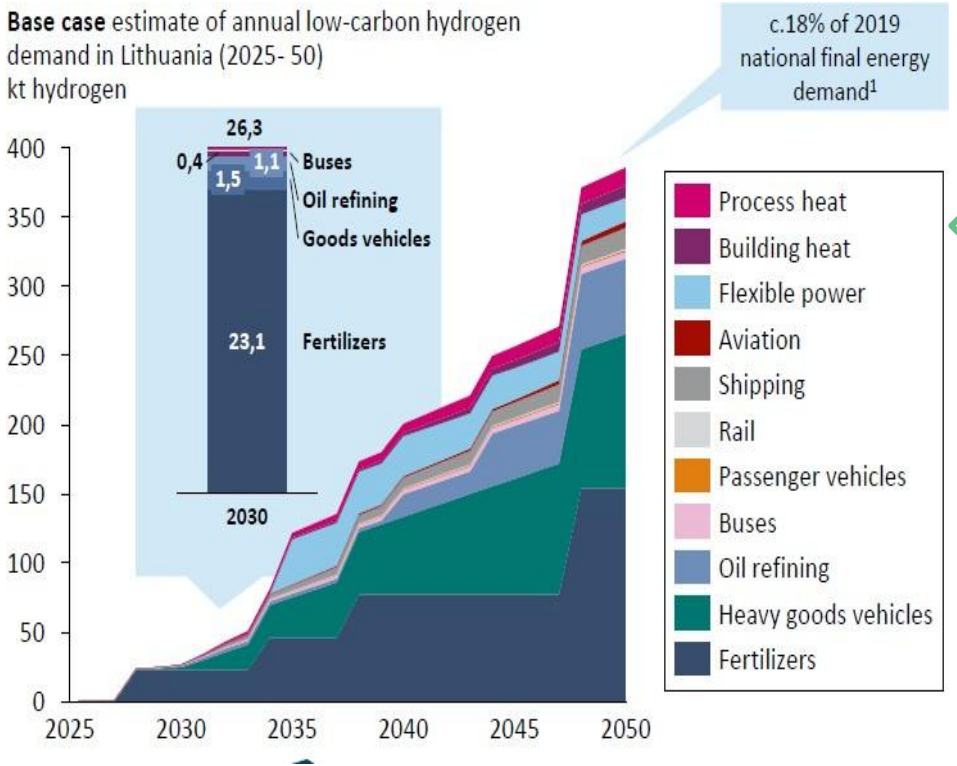
Lithuanian Hydrogen Platform, Nov **2020**

Entry in force of Alternative Fuels Act, Jul **2021**

Lithuanian Hydrogen Development Roadmap to be approved in **2022**

Source: European hydrogen potential scenario (European Commission, 2020)

GREEN AND LOW CARBON H2 DEMAND 2025-2050



Based on the market survey and modelling results, demand for H2 is predicted:

- **26 kt (~1 TWh) by 2030**
- **380 kt (~13 TWh) by 2050**

The most important areas of demand:

Industrial sector (Achema, Orlen)

Transport sector (heavy transport, trains, shipping)

Production of electricity and thermal energy

Estonian Association of Hydrogen Technologies

Soome

Skills

Estonian Association of Hydrogen Technologies

FITech

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Hydrogen economy

Hydrogen plays an important role in the green transition from fossil fuels towards the production and use of renewable energy.

FITech Hydrogen study module brings together the educational offering from all universities of technology in Finland. It consists of 20–40 ECTS of studies. **Scroll down to see courses open for application!**

The study module provides a holistic understanding of the hydrogen economy and its value chain as well as related technical, economic and political questions. It considers hydrogen as a system and as part of the energy system. Hydrogen use is investigated as a part of machines and energy generation and also discussed from the perspective of different chemical products that are derivatives of hydrogen. To complete the picture, the life cycle analysis and the role of hydrogen in energy and geopolitics are also considered.

https://fitech.io/en/hydrogen-economy