Funded by the European Union

Introduction to AMBHER and ANDREAH

www.ambherproject.eu

www.andreahproject.eu

Contact: José Luis Viviente
joseluis.viviente@tecnalia.com

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Funded by the European Union

1. Introduction

- Society is facing today key **challenges** such us climate change, local pollution of urban areas, cost of energy and energy security….

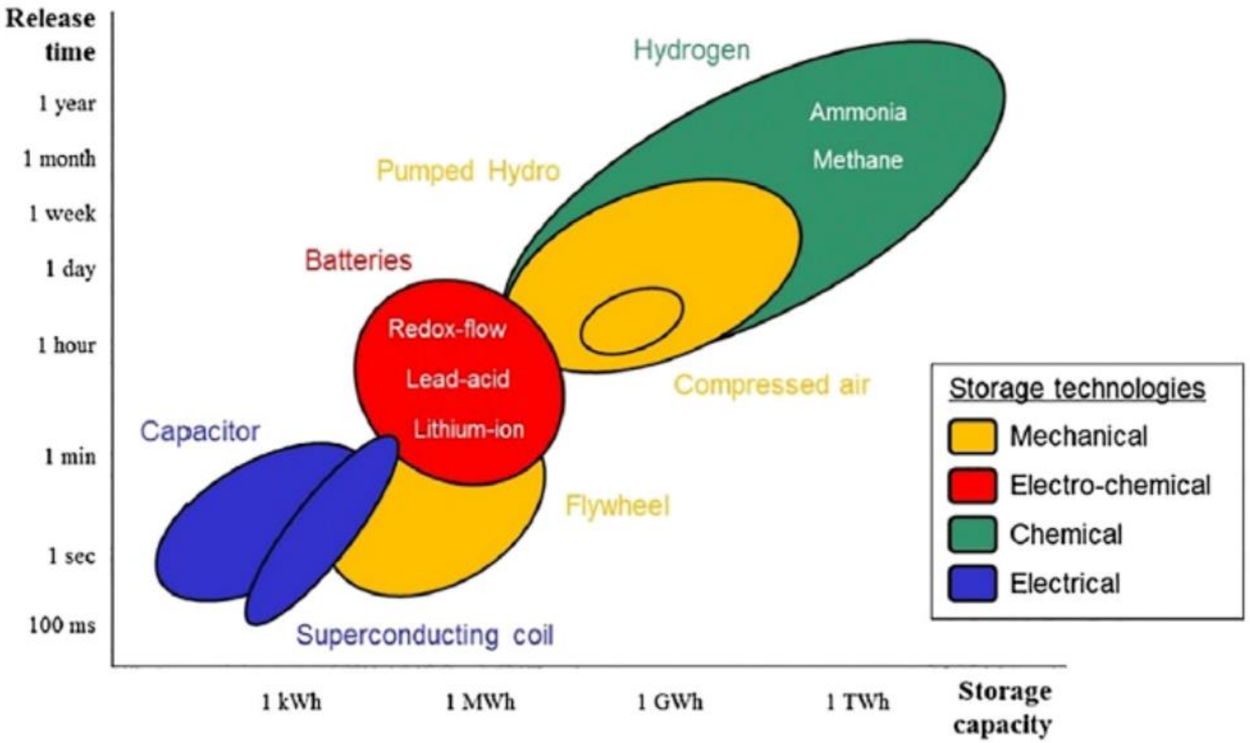



- Energy production 21st Century
  - Majority from fossil fuel derivatives (carbon based): more than 80% of global primary energy use is fossil based.
  - CO_2 production
- Greenhouse gases. Reduce emissions to environment
  - Increasing Energy efficiency;
  - Carbon Capture, Utilizations and Storage
  - Low carbon processes
  - Net-negative global emission
  - Search for renewable energy carrier: Hydrogen,……
  - …..
- European Green Deal: Set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral in 2050.
  - Maximise the deployment of renewables and the use of electricity to fully decarbonize Europe's energy supply.
  - Increase renewable energy to at least 32% of the EU's final energy consumption by 2030
  - By 2050, more than 80% of electricity will be coming from renewable energy sources.

Funded by the European Union

1. Introduction

Energy storage technologies



L.Ye et al. Reaction: "Green" Ammonia Production. Catalysis Vol. 3, Issue 5, p712-714, 2017
DOI: https://doi.org/10.1016/j.chempr.2017.10.016

- Sustainable energy production can only work well when the specific different energy storage challenges are solved: provide the required capacity for grid-scale energy storage.
- Overcoming the inherent intermittency of renewable resources and increasing their share of generation capacity (i.e. integration of renewable energy in the grid).
- The only sufficiently flexible mechanism allowing large quantities of energy to be stored over long time periods at any location is chemical energy storage: via hydrogen or carbon-neutral derivatives.
- H_2 has gained considerable attention as an ideal and clean energy carrier:
  - H_2 combustion produced only water as by-product
  - High efficiencies for energy conversion are achieved when it is employed as feedstock for power production.

Funded by the European Union

1. Introduction

Why ammonia as a H_2 carrier?

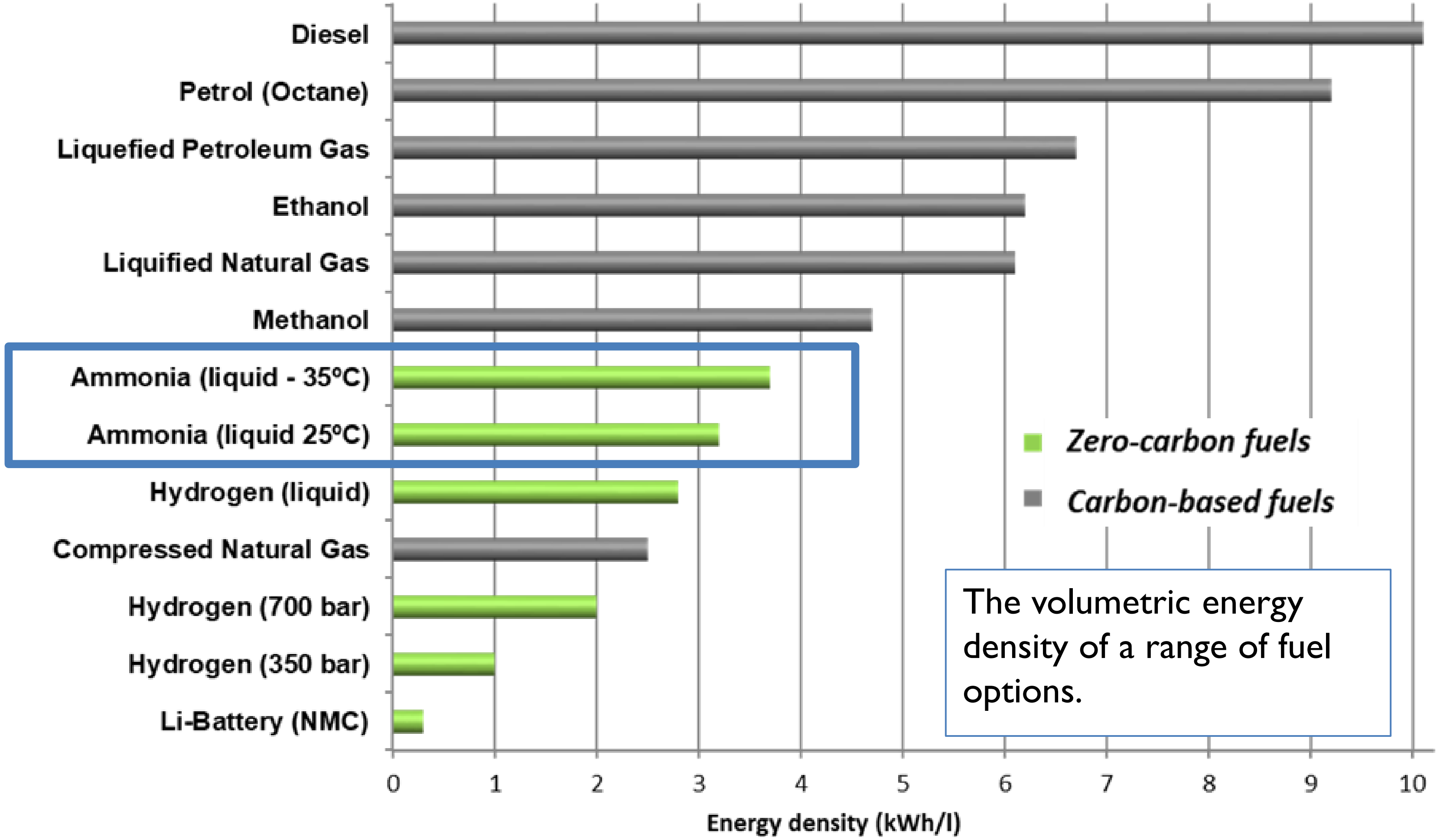
High volumetric energy density

Relatively low cost

Easy to liquefy

Easy to store and transport

Carbon free



The volumetric energy density of a range of fuel options.

2. Impact

More efficiently and cheaper long-term energy storage in form of green ammonia

Hydrogen carrier:
Mobility, transport and industry decarbonisation

Increasing renewable shares in the grid with large scale energy storage.

Strategic European leadership in energy storage.

Decrease energy import dependency by using ammonia to diversify energy supply (i.e. H_2) from third countries

- Alternative energy import through renewable electricity storage and long-distance transportation.
- Secure and clean supply of renewable energy

Support to the clean energy transition / European Green Deal.

- Low carbon society using hydrogen.
- Replace natural gas, coal and oil in hard-to-decarbonise industries and transport sectors (i.e.; maritime).
- Reducing the amount of CO_2 emissions.

Funded by the European Union

The projects

1. AMBHER: Ammonia and MOF Based Hydrogen storage for euRope

Topic: HORIZON-CL4-2021-RESILIENCE-01-17 - Advanced materials for hydrogen storage

www.ambherproject.eu

2. ANDREAH: AmmoNia baseD membRane rEActor for green Hydrogen production

Topic: HORIZON-JTI-CLEANH2-2022-02-04

andreahproject.eu

MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

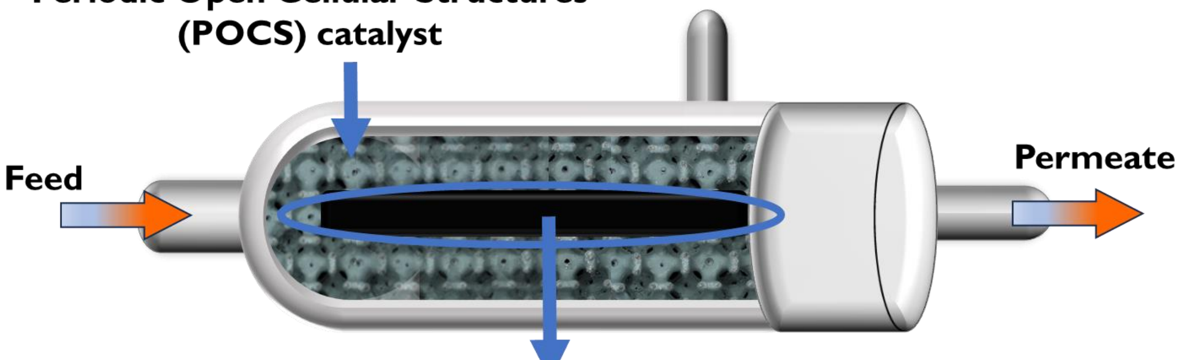
Funded by the European Union

The projects

AMBHER

Ammonia and MOF Based Hydrogen storagE for euRope.

$N_2 + 3H_2 \longleftrightarrow 2NH_3$



Catalytic Membrane Reactor

AndreaH

Clean Hydrogen Partnership

AmmoNia baseD membRane rEActor for green Hydrogen production

$2NH_3 \longleftrightarrow N_2 + 3H_2$

- integration of both the catalytic reaction and the separation of the product into one single step: to lower both the size and number of the required process equipment for separation, ultimately reducing the costs associated to them. More compact design.
- In equilibrium limited reaction systems, the selective separation of one of the reaction products from the reaction zone through the membrane will shifts the thermodynamic equilibrium towards the reaction products: higher achievable conversions as well as in the possibility to achieve conversions comparable to those obtained in conventional systems at lower temperatures, ultimately reducing the energy requirements of the reaction unit and thus leading to substantial benefits in terms of process efficiency.

Funded by the European Union

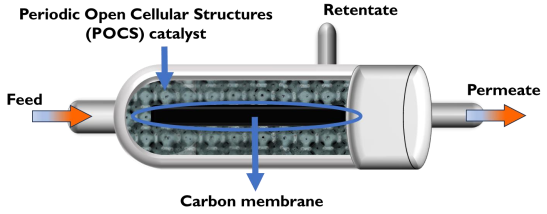
The projects

AMBHER

Ammonia and MOF Based Hydrogen storagE for euRope.

$N_2 + 3H_2 \longleftrightarrow 2NH_3$

- produce green ammonia, with higher production rate at lower pressures and temperatures (20 bar, 250 °C) compared to conventional system (150-250 bar and > 450 °C): Lower energy footprint and expected CAPEX.
- innovative environmentally friendly catalyst materials (4 different families).
- POCS to optimised heat and mass transfer compared to conventional packed-bed reactors. Less amount of catalyst.
- Carbon membranes.



Catalytic Membrane Reactor

AndreaH

AmmoNia baseD membRane rEActor for green Hydrogen production

$2NH_3 \longleftrightarrow N_2 + 3H_2$

- Ammonia decomposition membrane reactor working at lower temperatures of at least 100 °C) compared to conventional reformers (>500 °C, up to 900 °C)
  - Lower energy footprint.
  - Reducing CAPEX and OPEX compared to Pd-based membrane reactor.
- Reducing CRM: catalysts without or with low (<1wt%) Ru content (using not critical Ni).
- POCS to optimised heat and mass transfer compared to conventional packed-bed reactors. Less amount of catalyst.
- Carbon membranes instead of Pd membranes.

Funded by the European Union

AMBHER
AndreaH
Clean Hydrogen Partnership

Thank you for your attention

www.ambherproject.eu

www.andreahproject.eu

AMBHER
AndreaH
Clean Hydrogen Partnership

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Health and Digital Executive Agency.
Neither the European Union nor the granting authority can be held responsible for them.

The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research.
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CHJU. Neither the European Union nor the granting authority can be held responsible for them.

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE