

The 11th NEDO-CDTI Joint Workshop

“Technologies for Hydrogen Valley in Spain and Japan – Regional H2 Value Chain”

Hydrogen



水素が
次世代エネルギー
社会を切り拓く!

Ammonia as a green hydrogen carrier: ARENHA PROJECT

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Presentation: Centro Nacional del Hidrógeno (CNH2)

- ✓ *Centro Nacional del Hidrógeno* (CNH2), is a Spanish National Researching Centre located in Puertollano (SPAIN), that was established in 2007 as a **Public Consortium**.
- ✓ The main activity of the CNH2 is the **technological and scientific investigation on hydrogen and fuel cells**, providing services to the all the scientific and industrial community to national and international level.
- ✓ CNH2 covers all the **hydrogen value** and it is equipped with **13 laboratories** to R&D activities.



Ref.: Resume of CNH2 laboratories and capabilities. [CNH2]



Expertise: CNH2 activities in hydrogen distribution area

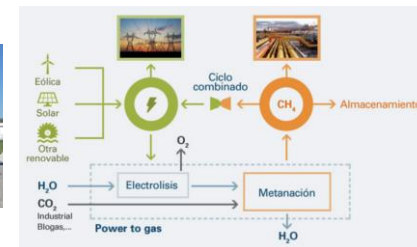
✓ Power to Gas (PtG):



Renewable natural gas production process

COLLABORATIVE CHALLENGES 2013

Development of a synthetic natural gas production plant from electrolytic hydrogen produced from renewable energies and its methanation with CO₂ obtained from biogas.



RCT-2014-2975-3 2014-2016

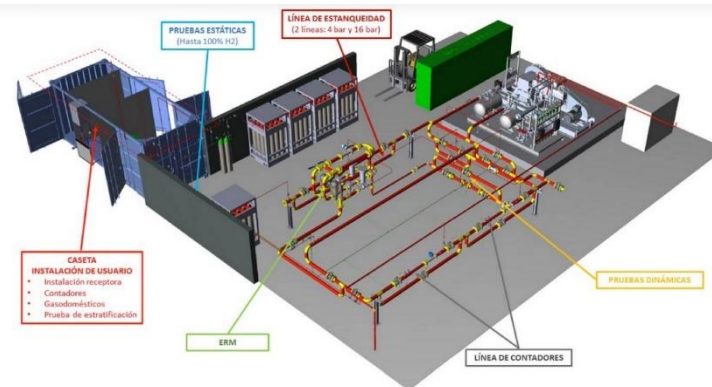
✓ Blending and grid injection:



H2SAREA HI-LOOP

HAZITEK – EMPRESA I+G BULTZATZEKO LAGUNTZA

To know and have the necessary technological solutions for the eventual progressive transformation of the gas network. Development of a testbench for testing the operation of the natural gas infrastructure in varied blending percentages until 100% hydrogen is obtained.



ZE-2021/00001- H2SAREA 2021-2023





CNH2 activities in hydrogen distribution field

✓ Blending and grid injection:

GREENH2PIPES

GREENH2PIPES
PROGRAMA MISIONES CIENCIA E INNOVACIÓN

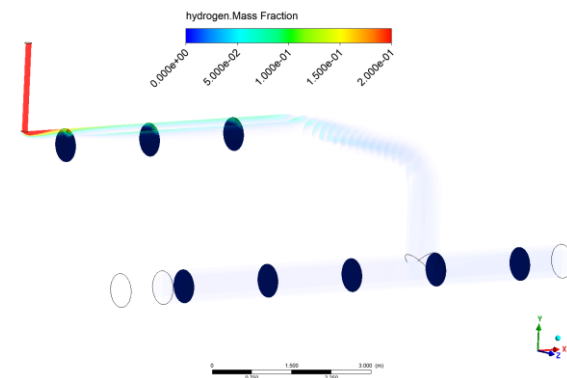
Foster the research and technological development required to promote hydrogen production, transport via the gas network, and storage through liquid organic carriers (LOH)



MIG-20211014



2021-2024



✓ Offshore transport:

OCEANH2

OCEAN-H2
PROGRAMA MISIONES CIENCIA E INNOVACIÓN

Industrial Research project for a modular, flexible and intelligent plant for the generation, storage and distribution of offshore green hydrogen using offshore renewable electricity generation, hybridizing technology floating wind and photovoltaic technologies..



MIG- 20201001



2020-2023





CNH2 activities in hydrogen distribution field

✓ Hydrogen Valley:

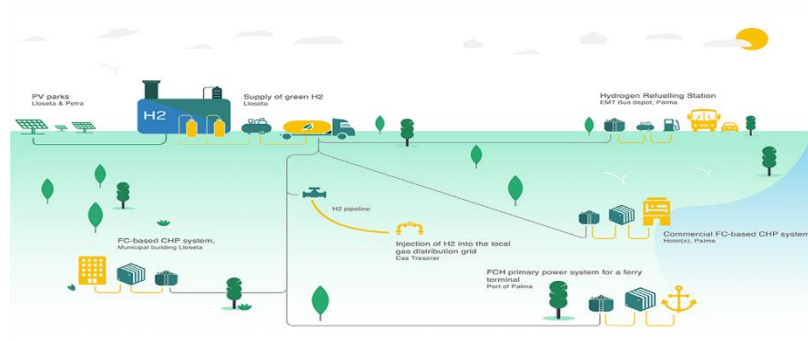
GREEN HYSLAND – Deployment of a H2 Ecosystem on the Island of Mallorca

FUEL CELL AND HYDROGEN JOINT UNDERTAKING (FCH2 JU) 2020

GREEN HYSLAND aims to deploy a fully-functioning Hydrogen (H2) ecosystem in the island of Mallorca, Spain, turning the island into the first H2 hub in Southern Europe. This will be achieved by producing green hydrogen from solar energy and delivering it to the end users, such as the island's tourism, transport, industry and energy sectors, including gas grid injection for green heat and power local end-use.

<https://greenhysland.eu/>

101007201  2021 -2025



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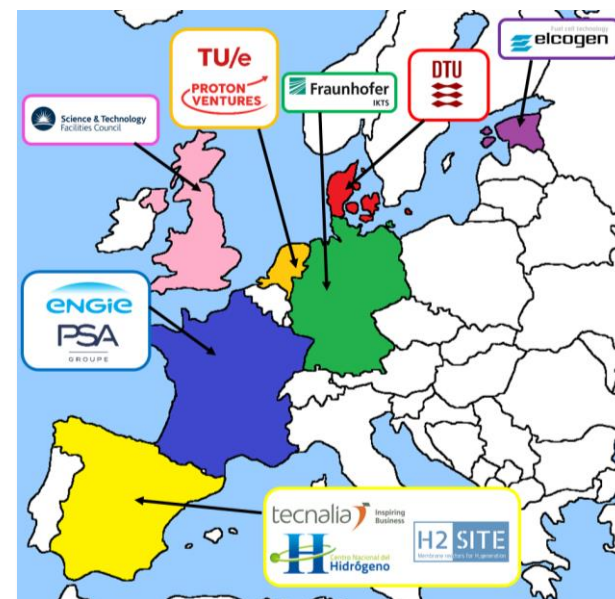
ARENHA PROJECT



areNH₃a

Advanced materials and Reactors for ENergy storage tHrough Ammonia

- ✓ The ARENHA project aims at **using ammonia as a green hydrogen carrier** and for that purpose it develops its main activities around the green hydrogen production, ammonia synthesis, ammonia storage and ammonia dehydrogenation.
- ✓ ARENHA **main goal is to develop, integrate and demonstrate key material solutions** enabling the flexible, secure and profitable storage and utilization of energy under form of green ammonia.
- ✓ ARENHA will **demonstrate the full power-to-ammonia-to-usage value chain at TRL 5** and the outstanding potential of green ammonia to address the issue of large-scale energy storage.



Duration: 4 years (2020 – 2024)
H2020 funding 5,7 M€ approx.



Horizon 2020
European Union funding
for Research & Innovation

Grant Agreement No 862482



PARTNERSHIP

Coordinator



Universities



Research institutions



Industries



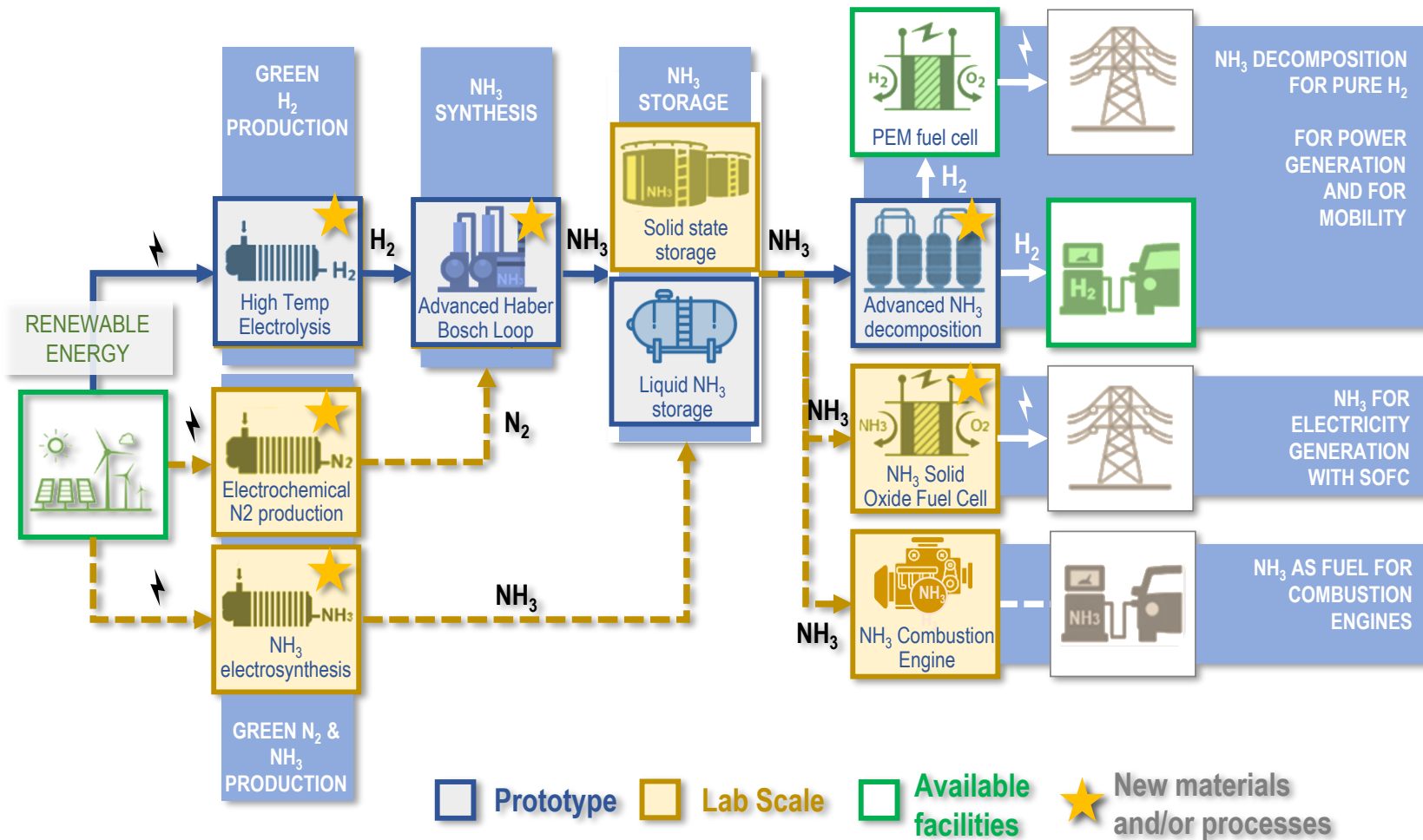


OBJETIVES

- ✓ **1st:** Develop and integrate **innovative solid oxide cell materials** into a flexible high temperature electrolysis demonstration unit.
- ✓ **2nd:** Develop and integrate **innovative materials into a synthesis loop** enabling to operate a flexible Haber Bosch production unit.
- ✓ **3rd:** Develop and integrate **innovative materials into a decomposition reactor** able to generate of pure hydrogen from green ammonia
- ✓ **4th:** Develop and test innovative materials and solutions for the **alternative direct synthesis and utilization** of next-generation green ammonia.
- ✓ **5th:** Demonstrate ammonia as a **flexible energy carrier** through the development of a fully integrated prototype.
- ✓ **6th:** Assess the **social acceptance, techno-economic-environmental** feasibility, and **replication** potential of the developed **value chains**.

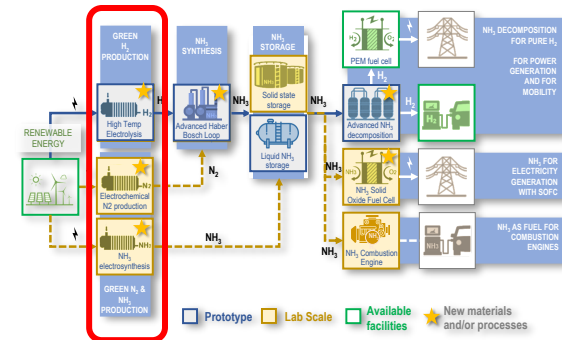
POWER-TO AMMONIA -TO USAGE VALUE CHAIN

✓ Power-to-ammonia-to-usage value chain in ARENHA














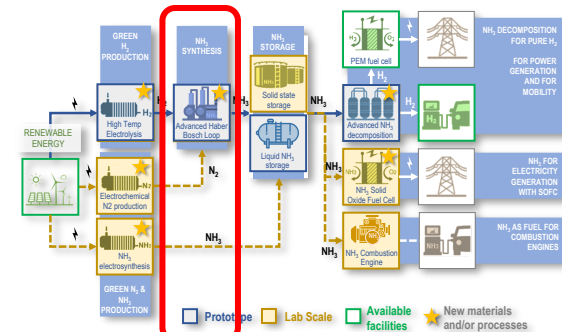
OVERALL APPROACH



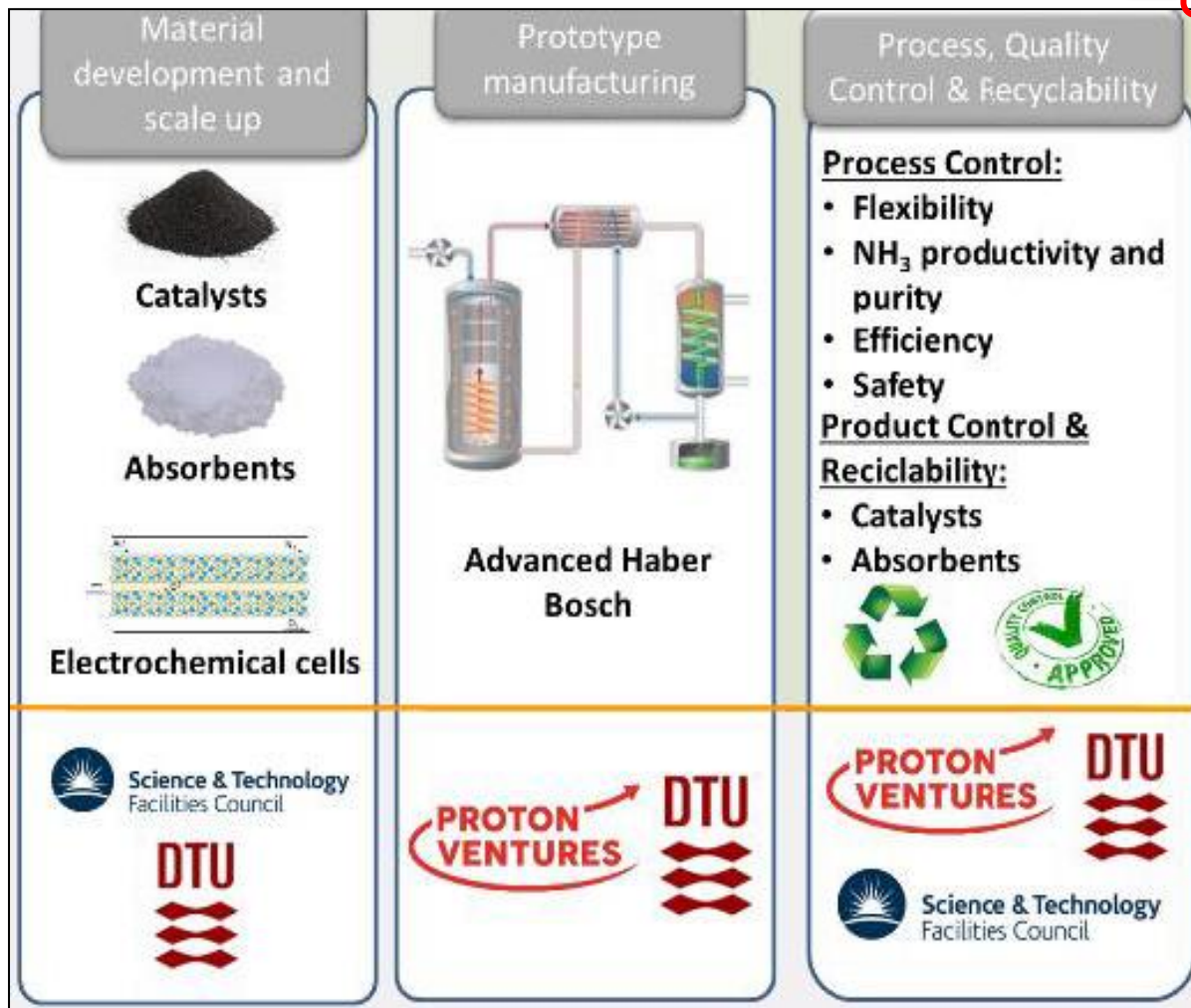
✓ PHASE 1: GREEN HYDROGEN PRODUCTION

development and scale up	manufacturing	Process, Quality Control & Recyclability	Benchmarking of novel technologies
 SOEC cells and stacks	 SOEC stack modules and BoP	<p>Process Control:</p> <ul style="list-style-type: none"> Flexibility H₂ productivity and purity Efficiency Safety <p>Product Control & Recyclability:</p> <ul style="list-style-type: none"> Cell materials Stacks & stack modules  	 Battolyzer
			

OVERALL APPROACH

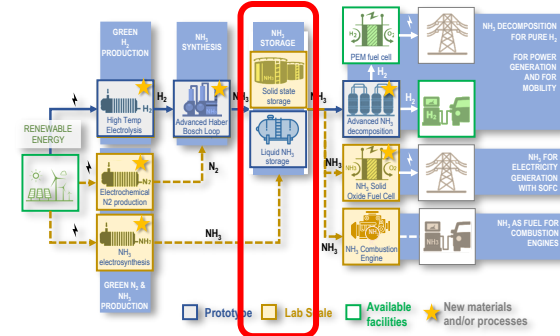


✓ PHASE 2: AMMONIA SYNTHESIS

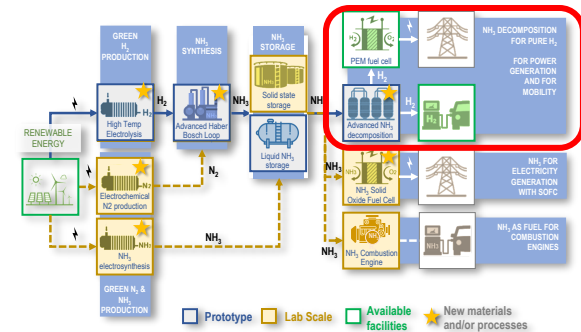


OVERALL APPROACH

✓ PHASE 3: AMMONIA STORAGE



OVERALL APPROACH



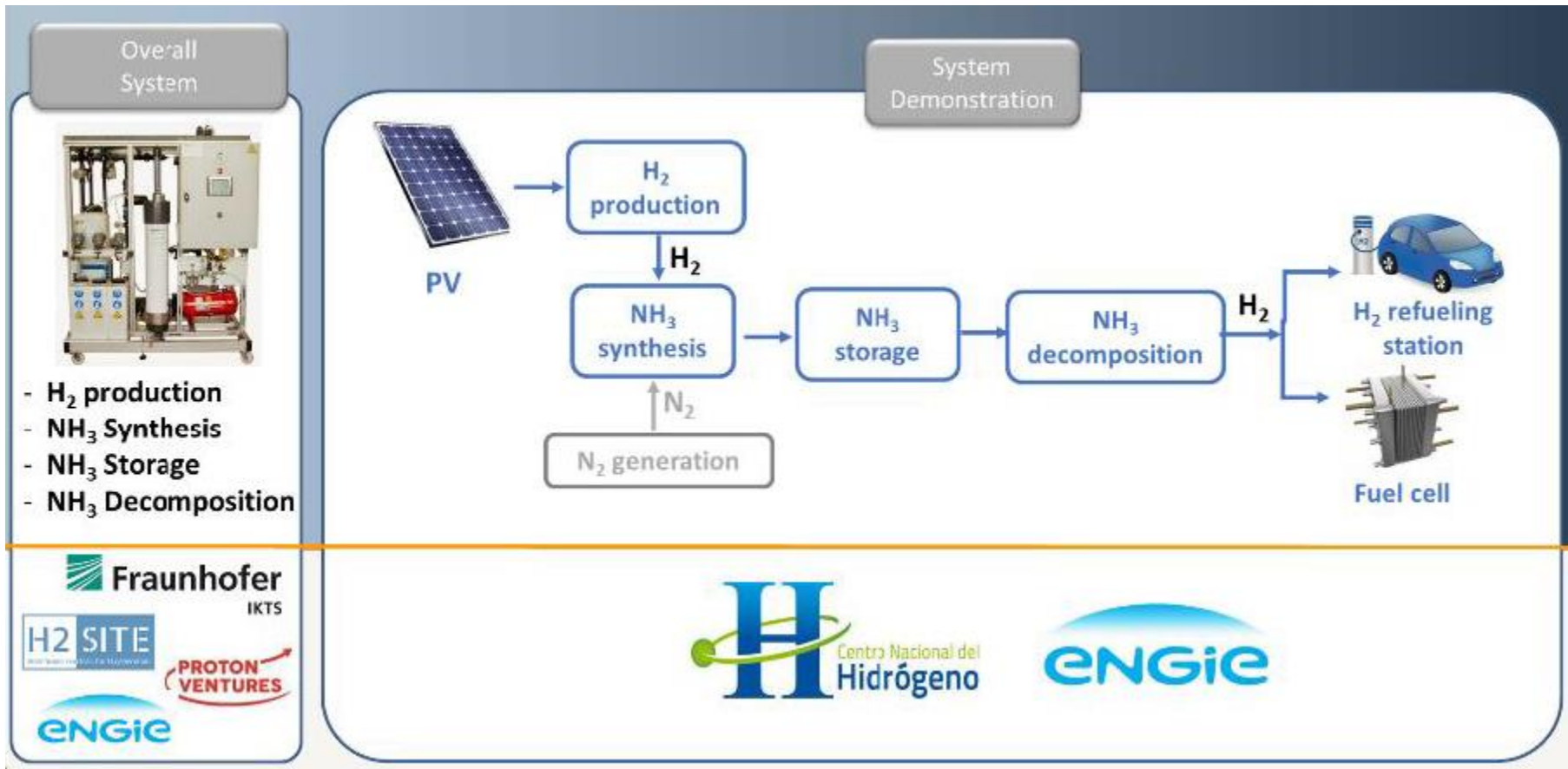
✓ PHASE 4: AMMONIA DECOMPOSITION

Material development and scale up	Prototype manufacturing	Process, Quality Control & Recyclability
<p>Catalysts</p> <p>Advanced Membranes</p>	<p>Membrane reactor</p>	<p>Process Control:</p> <ul style="list-style-type: none"> • H₂ productivity and purity • Efficiency • Safety <p>Product Control & Recyclability:</p> <ul style="list-style-type: none"> • Catalysts • Membranes
<p>Science & Technology Facilities Council</p>	<p>H2 SITE Membrane reactors for H₂ generation</p>	<p>H2 SITE Membrane reactors for H₂ generation</p>



OVERALL APPROACH

✓ SYSTEM INTEGRATION AND DEMONSTRATION



Demonstrate the full power-to-ammonia-to-usage value chain at TRL 5.

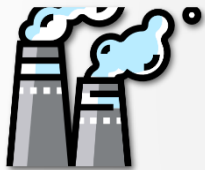
IMPACT



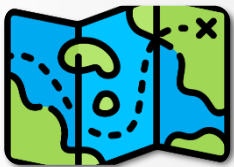
Decrease energy **import** dependency



Promote the **integration of offshore renewables**



Integration of **renewable with large scale energy storage**



Ammonia to **diversify energy supply** from third countries



Strategic European in energy storage.



IDEAS FOR A JAPAN – SPAIN COLLABORATION

- ✓ **Share experiences and knowledges** about hydrogen transportation and distribution for long distances.
- ✓ Bilateral contributions and info sharing to **normative development**.
- ✓ Study **markets barriers in EU and Japan** to import/export hydrogen developments.

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Thanks for your attention !

ありがとう



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