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Advanced materials and Reactors for Energy storage tHrough Ammonia

ARENHA

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https://arenha.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862482

Duration: 4 years. Starting date: 01 April 2020

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1. Introduction

Nowadays, mankind is facing two of the most difficult challenges in its life:

- global warming and associated climate changes

- local pollution of urban areas.

1. Introduction

Energy production 21st Century

- Majority from fossil fuel derivatives (carbon based): Currently, more than 80% of global primary energy use is fossil based. Over the last decade, 85% of the increase in global use of energy was fossil based.
- CO_2 production

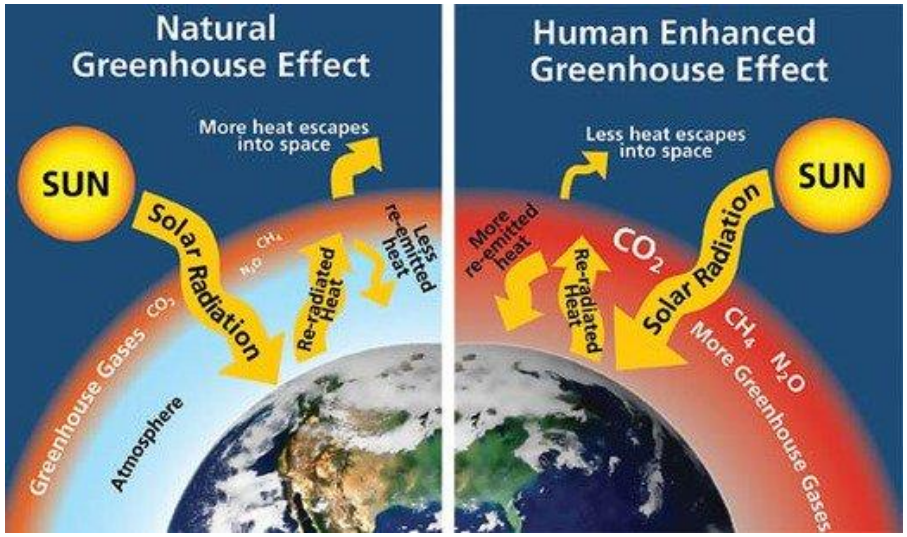
Greenhouse gasses

- **Effect**

  Trap IR-radiation (heat)

- **Emission CO_2**

  Natural & human activity



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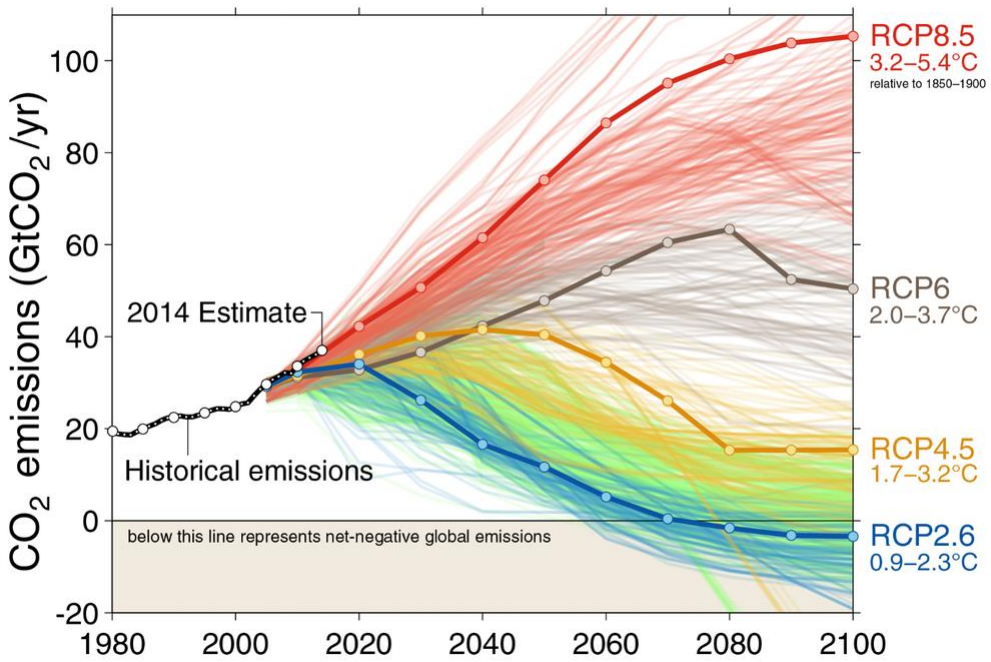
1. Introduction



Global carbon dioxide emissions from human activity, compared to four different possible futures as depicted in IPCC scenarios. Fuss et al. 2014

The EU Commission's Low Carbon Roadmap (and the world climate contract) suggest a reduction of >80% of CO_2 emissions by 2050 compared to levels at the beginning of the 21st century.

2018: 37,1 $GtCO_2$ (www.globalcarbonproject.org)

Transition process requires a new energy system without C at the end with radical technical solutions and infrastructure investments.

Climate Action in the UN's Sustainable Development Goals (SDGs): Limiting global warming to 1.5°C (https://www.ipcc.ch/sr15/)

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1. Introduction

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.

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1. Introduction

- Renewable energy is playing an important role in addressing some of the key challenges facing today's global society, such as the cost of energy, energy security and climate change.
- Energy storage is crucial for overcoming the inherent intermittency of renewable resources and increasing their share of generation capacity.
- 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.
- Batteries may not be the best solution to face all energy storage needs, due to cost, safety and environmental issues.
- Pumped hydro and methods such as compressed gas energy storage suffer from geological constraints to their deployment.

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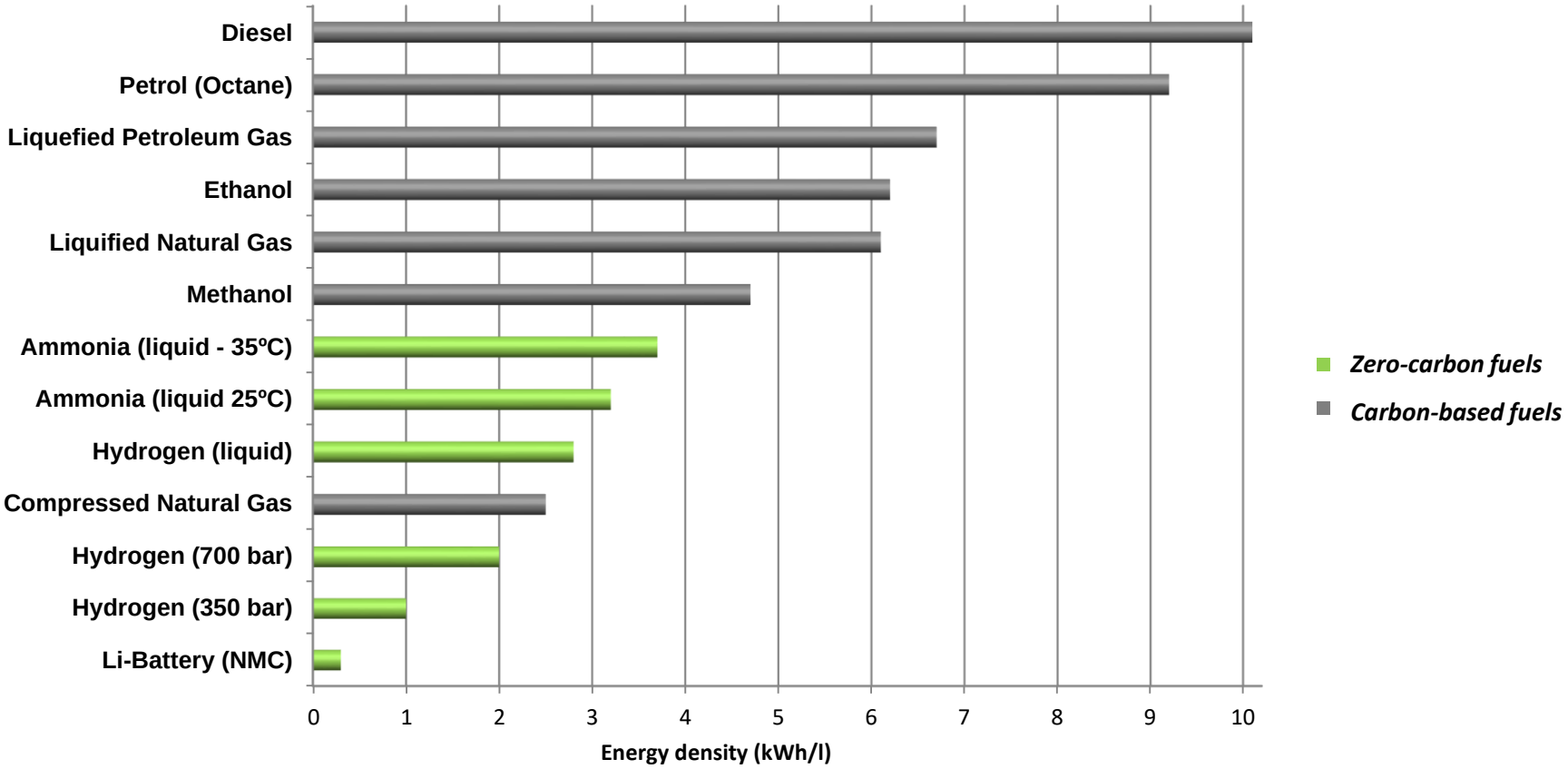
1. Introduction

- Non battery-based storage technology, such as Power-to-X technologies (Power-to-Gas, Power-to-Chemicals, Power-to-Liquids) that allows transforming renewable electricity into synthetic gases (hydrogen, methane or other gases) and chemicals/liquids, can be suitable solutions for different energy storage needs.
- 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

1. Introduction

The volumetric energy density of a range of fuel options.



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2. Objective

- 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.

Duration: 4 years
H2020 funding 5,7 M€ approx.

- 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.

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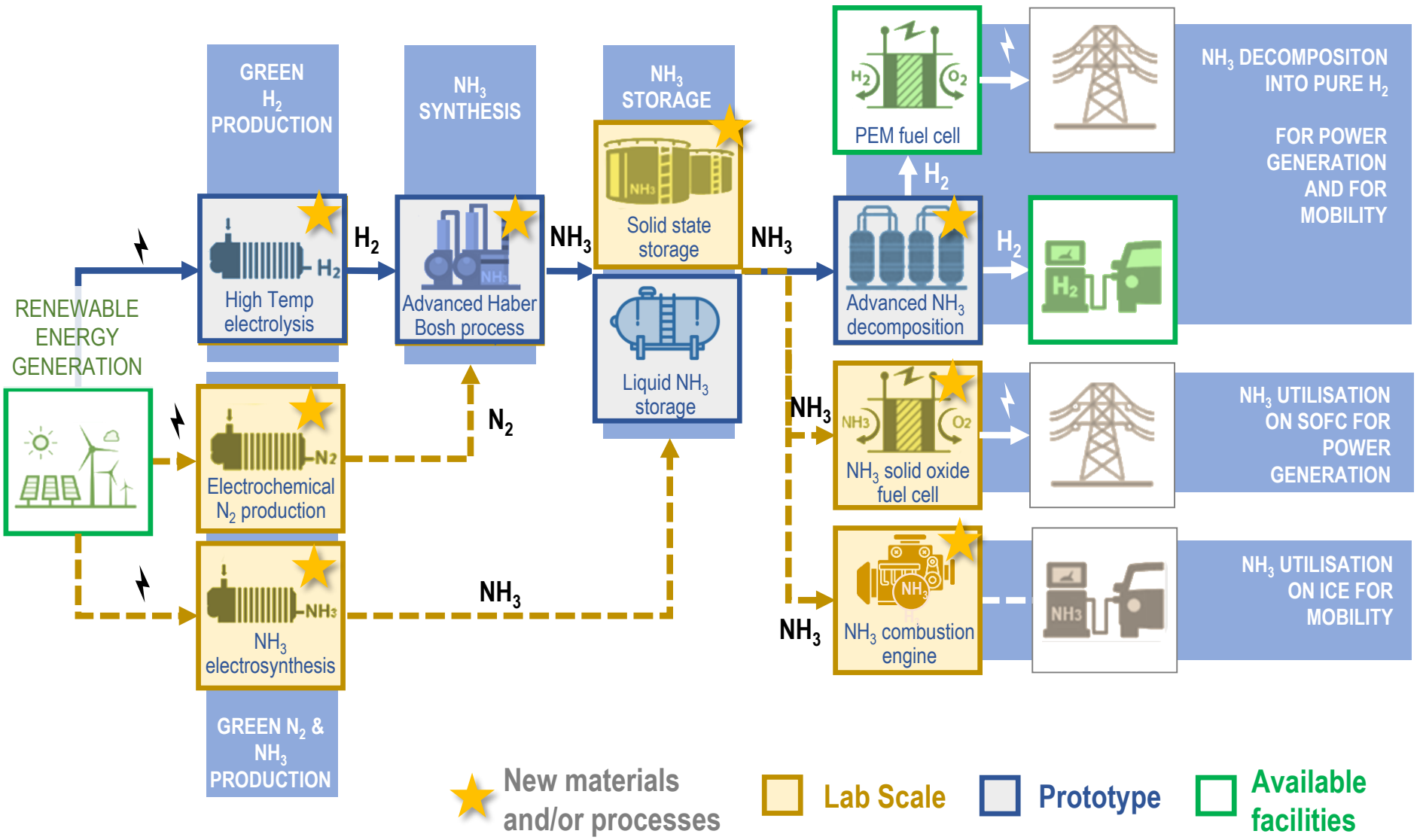
2. Objective

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



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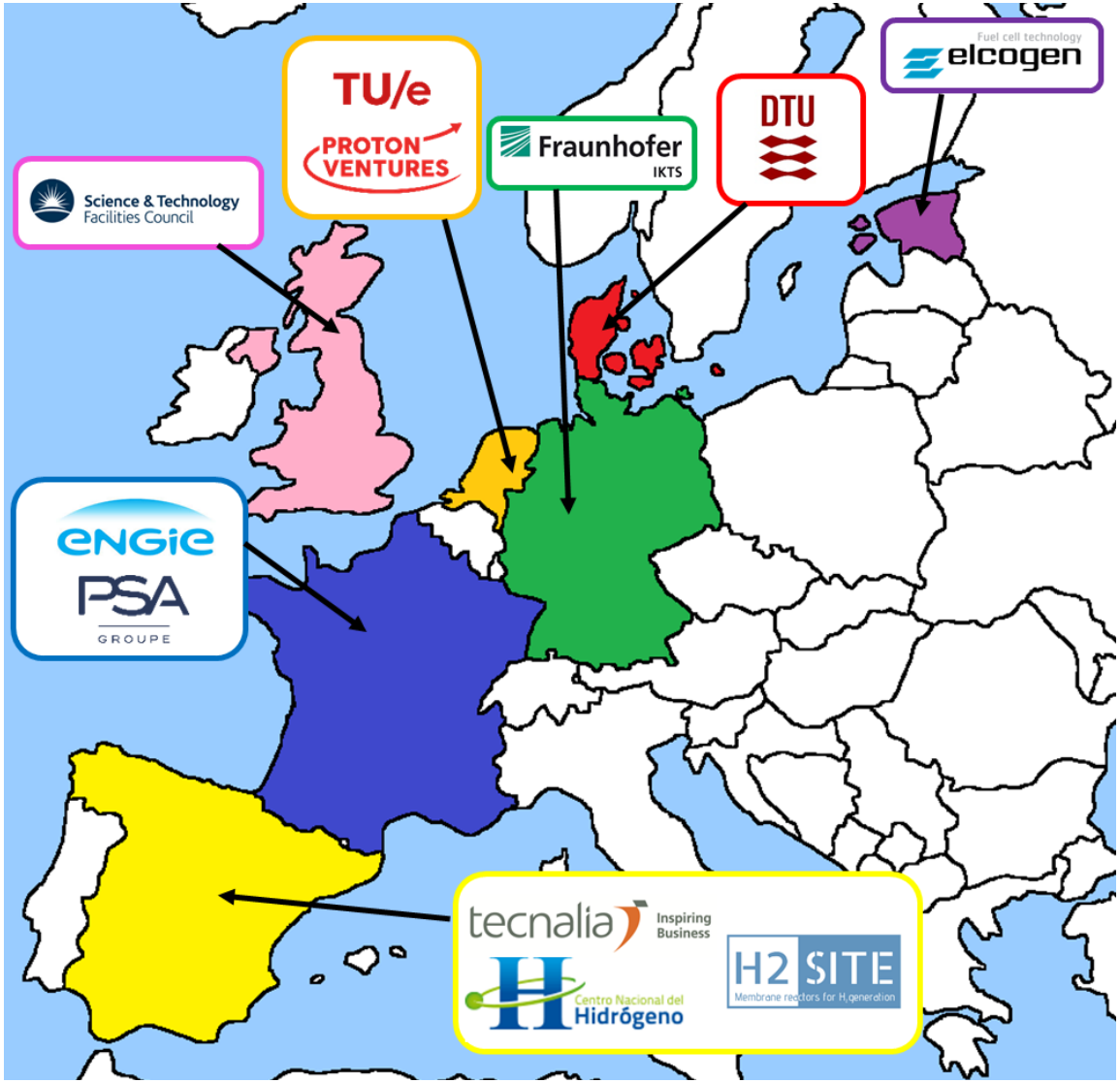
3. Partnership



- Multidisciplinary and complementary team.
- 11 partners in 7 countries.
- Industrial oriented (45%):
  5 SME/IND + 6 RTO/HES
- 3 SMEs & 2 IND

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3. Partnership

Coordinator

tecnalia Inspiring Business

Universities

TU/e

DTU

Research institutions

tecnalia Inspiring Business

Centro Nacional del Hidrógeno

Fraunhofer IKTS

Science & Technology Facilities Council

Industries

PROTON VENTURES

Fuel cell technology elcogen

H2 SITE Membrane reactors for H_2 generation

PSA GROUPE

ENGIE

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4. Overall approach

GREEN HYDROGEN PRODUCTION

Material development and scale up	Prototype manufacturing	Process, Quality Control & Recyclability	Benchmarking of novel technologies
		**Process Control:** • Flexibility • H2 productivity and purity • Efficiency • Safety **Product Control & Reciclability:** • Cell materials • Stacks & stack modules	
SOEC cells and stacks	SOEC stack modules and BoP		Battolyzer
Fraunhofer IKTS elcogen	Fraunhofer IKTS elcogen Centro Nacional del Hidrógeno	Fraunhofer IKTS elcogen Centro Nacional del Hidrógeno	PROTON VENTURES

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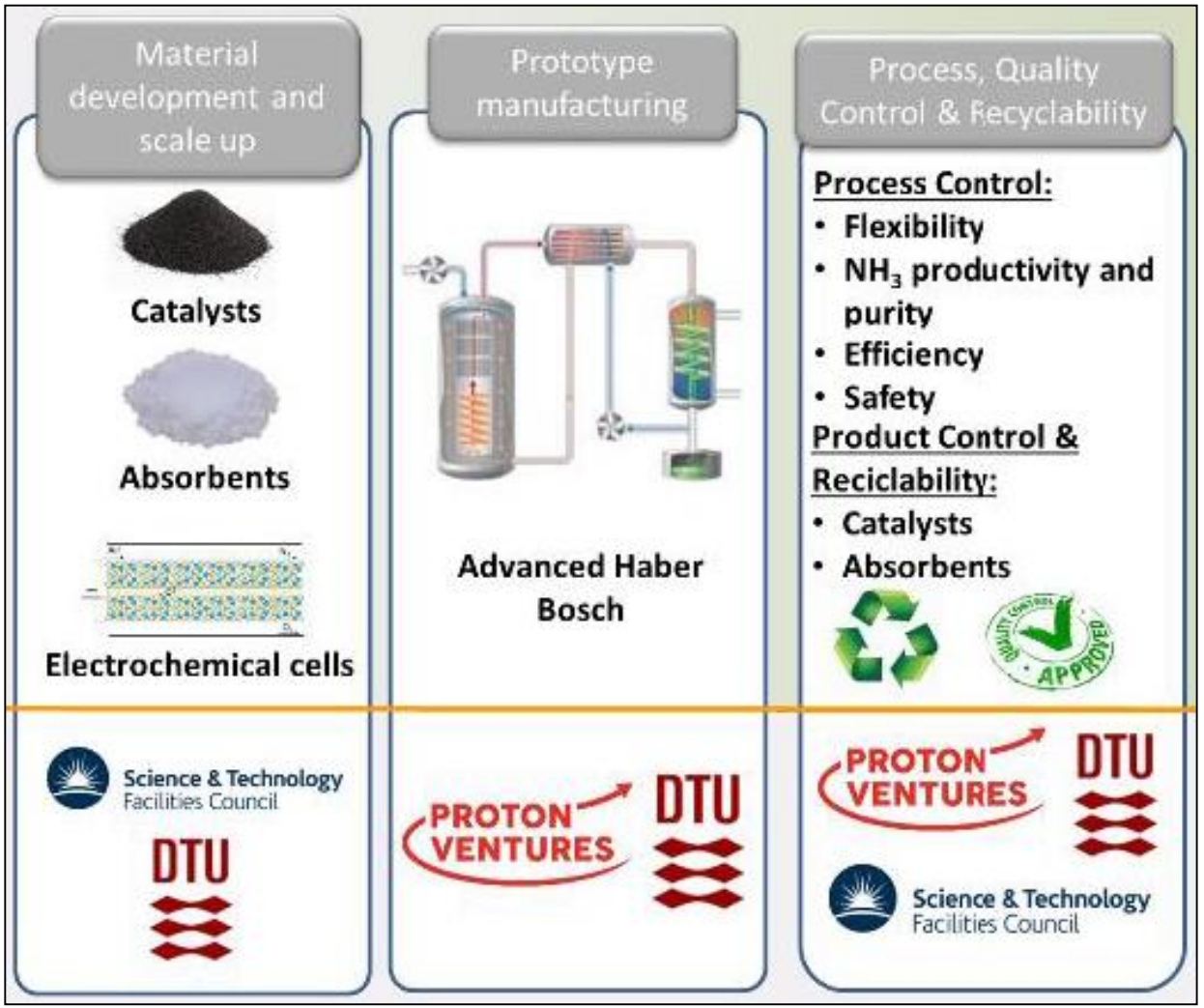
4. Overall approach

AMMONIA SYNTHESIS



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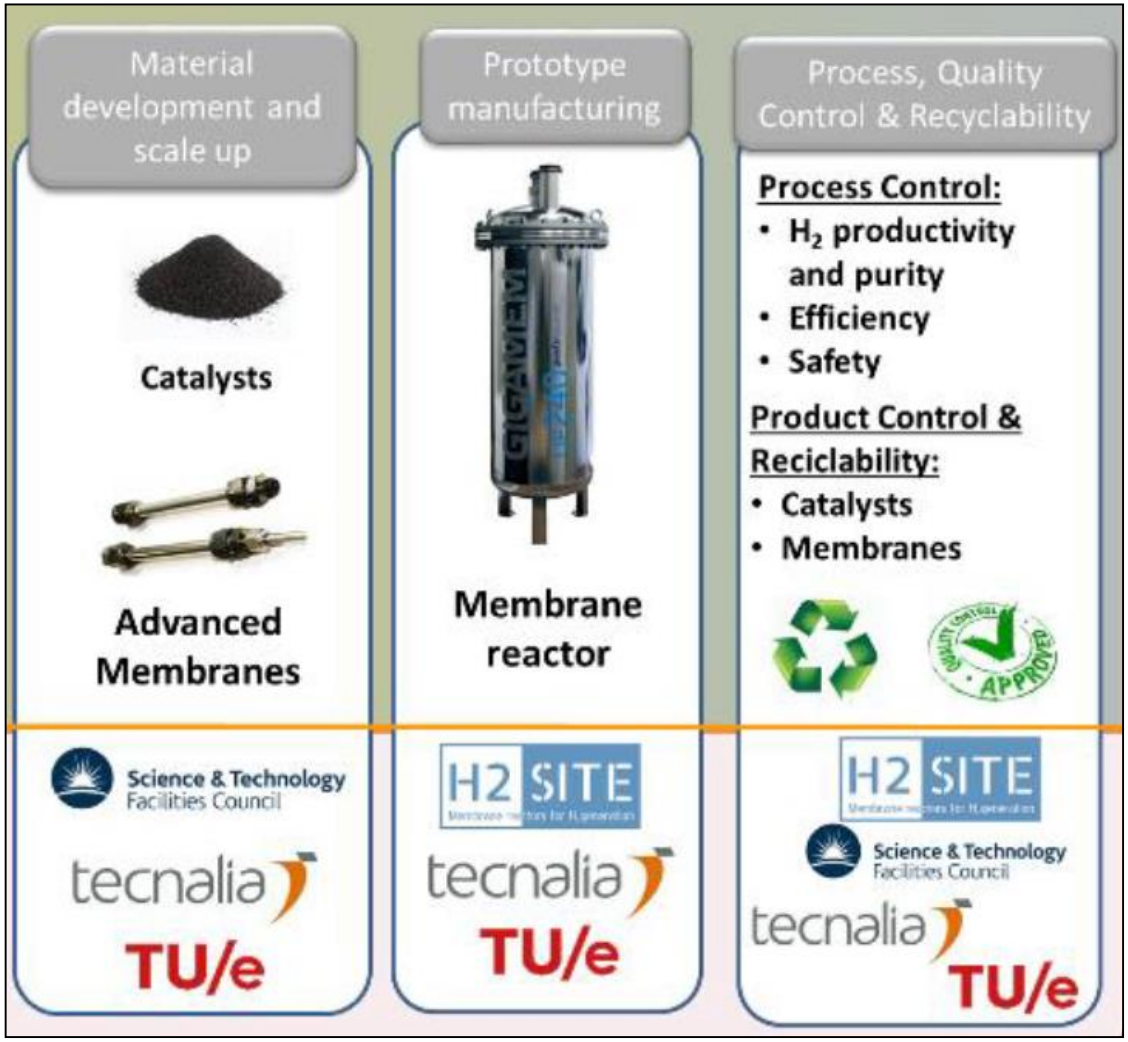
4. Overall approach

AMMONIA STORAGE

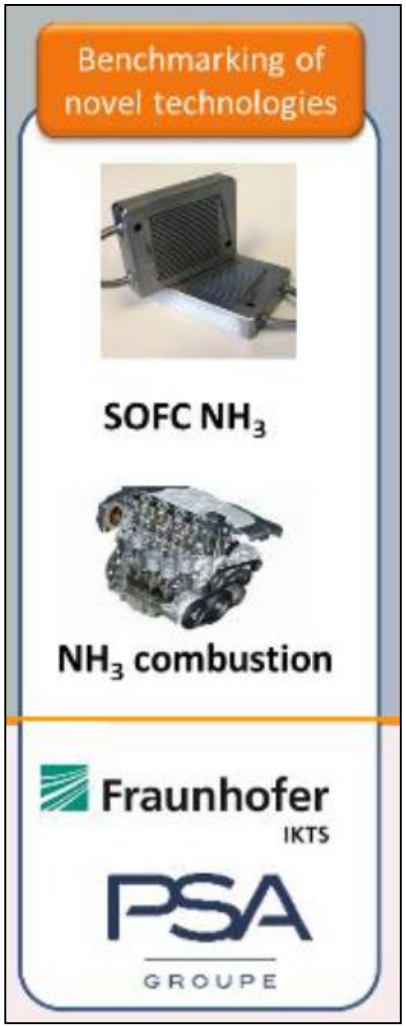
4. Overall approach

AMMONIA DECOMPOSITION

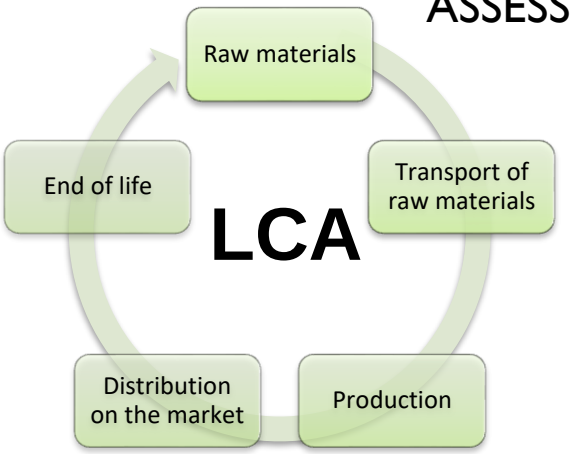


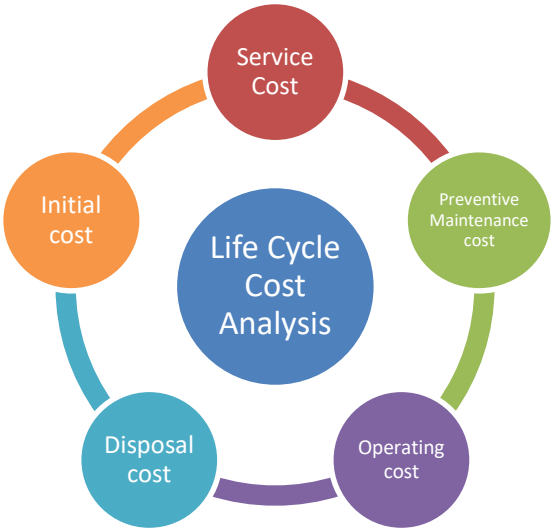
4. Overall approach

AMMONIA USAGE



ENVIRONMENTAL LCA, ECONOMY AND SAFETY ASSESSMENT





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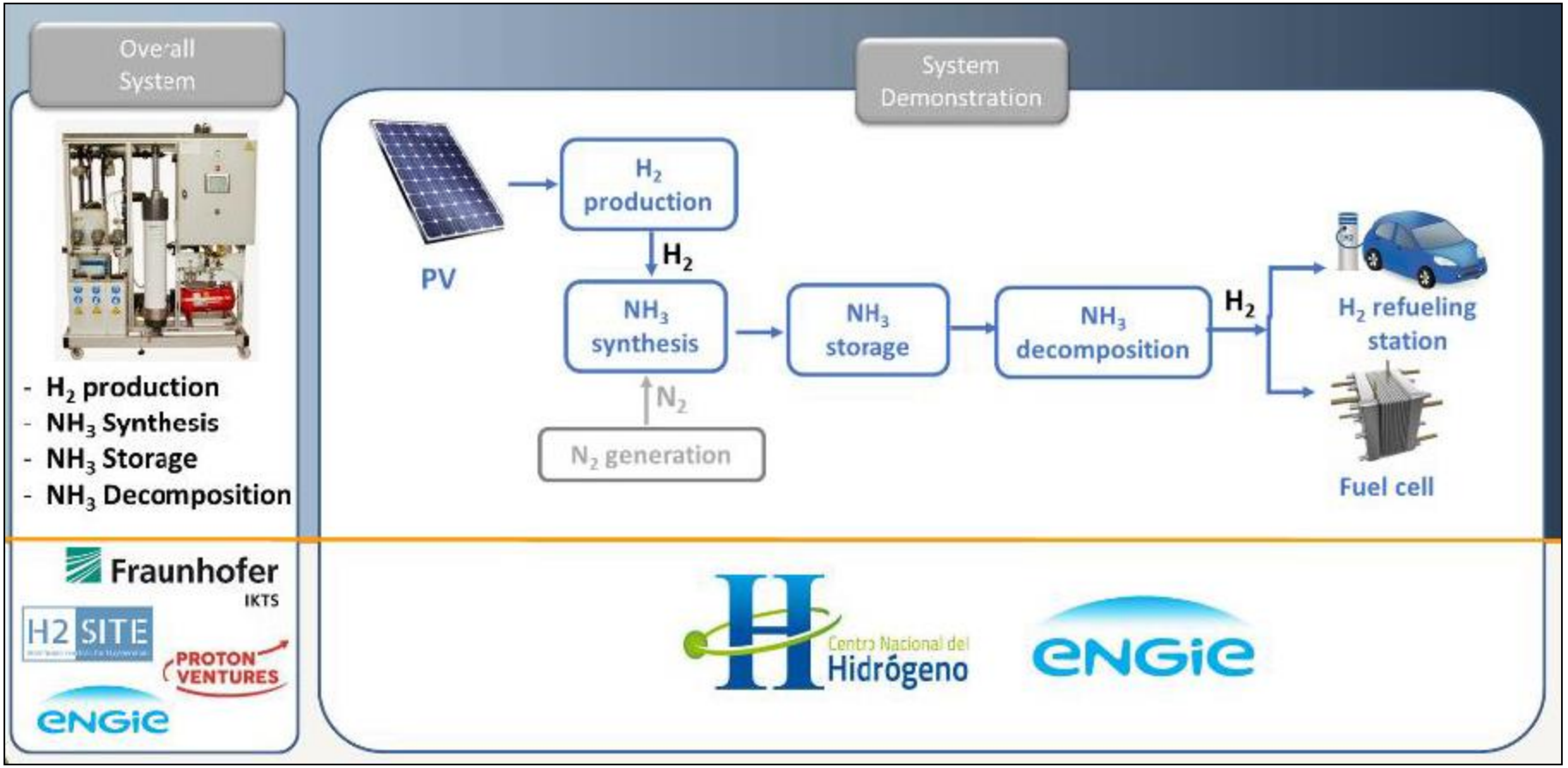
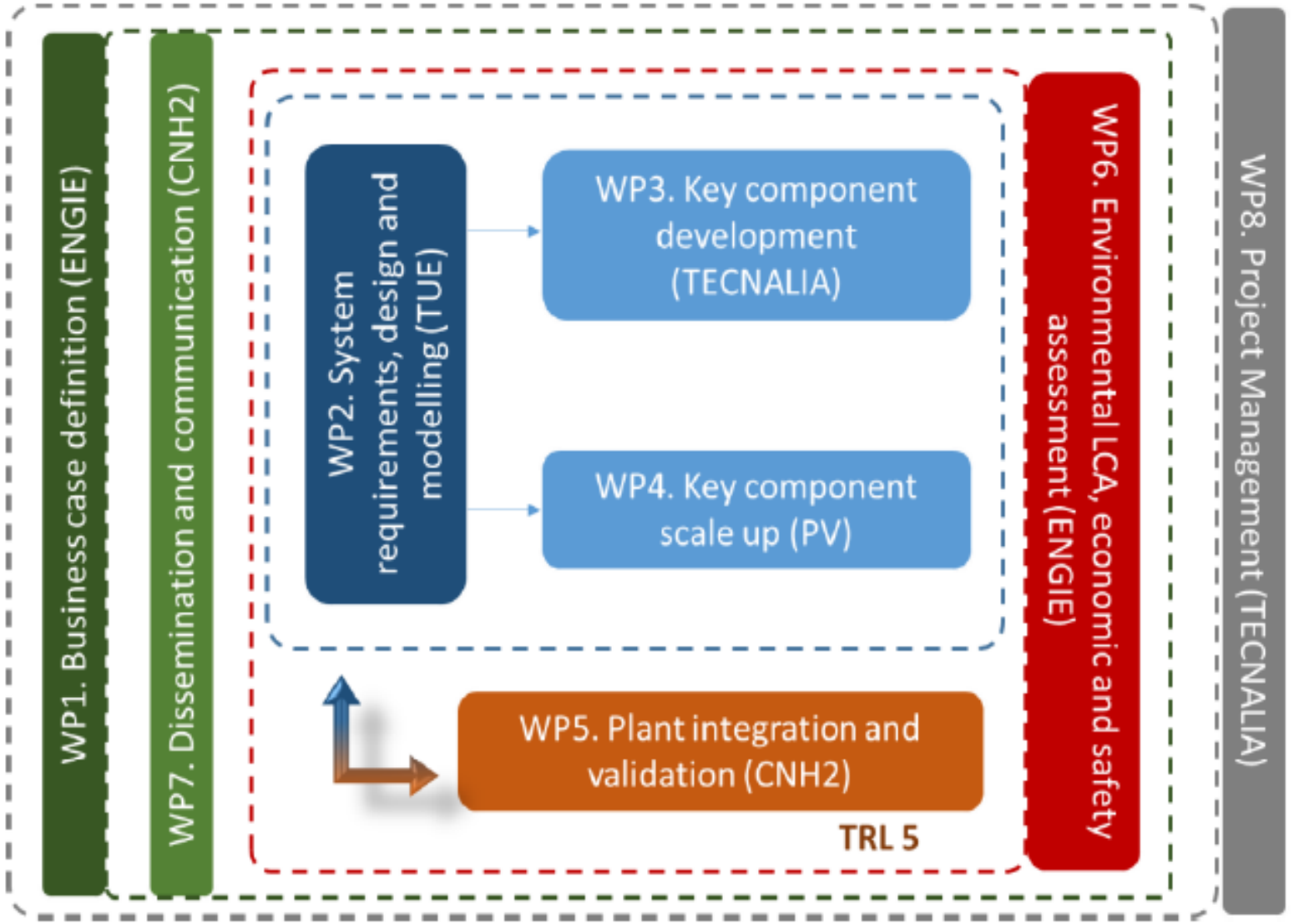
4. Overall approach

SYSTEM INTEGRATION AND DEMONSTRATION



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

5. Project Structure and planning



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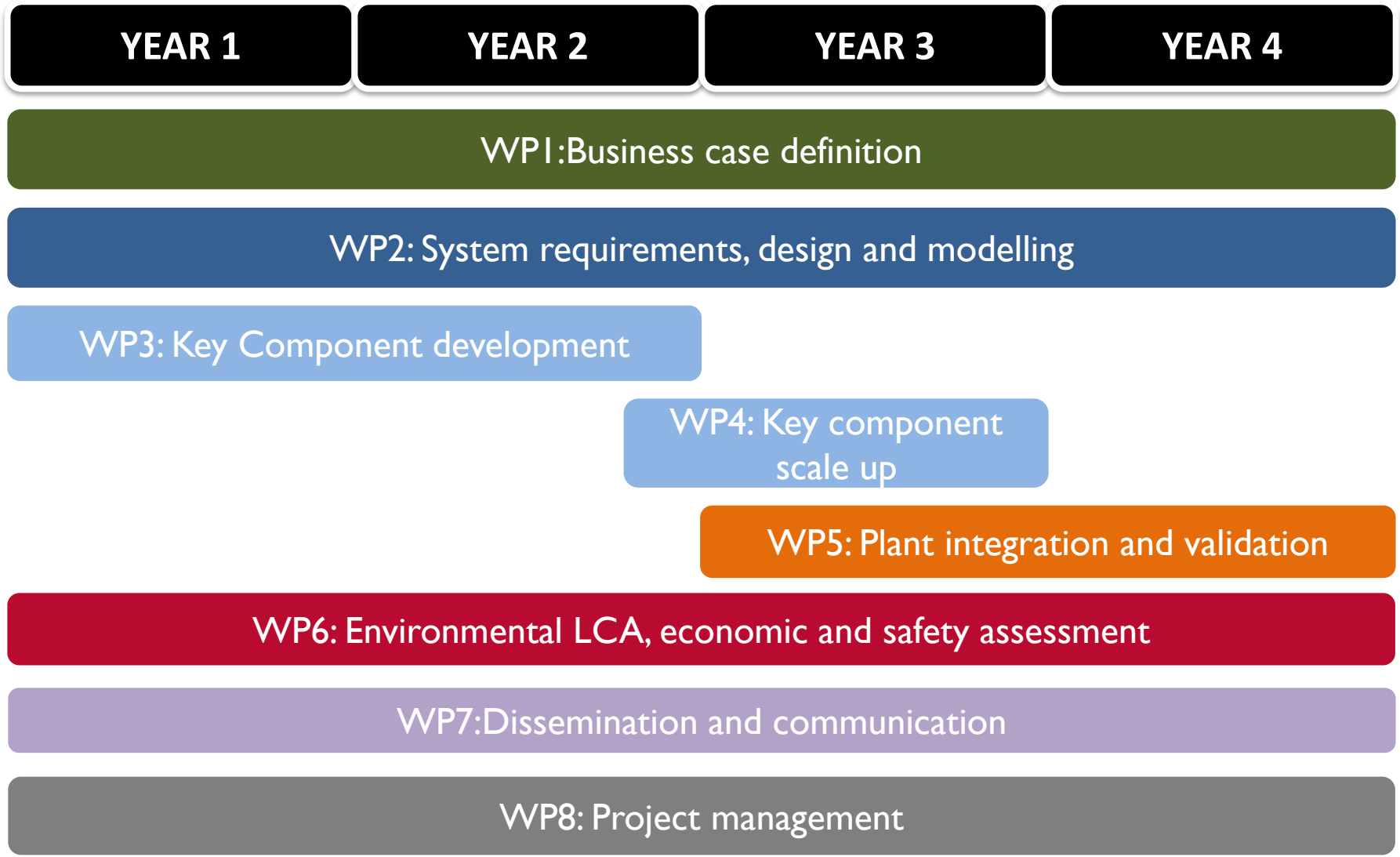

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6. Impact

Decrease energy import dependency.

Promote the integration of offshore renewables for energy dependency.

Integration of renewable in power systems with large scale energy storage.

Strategic European leadership in energy storage.

Ammonia to diversify energy supply from third countries

Alternative energy import through renewable electricity storage and long distance transportation.

-  > $2.5 trillion per year
-  > 5000 future jobs
- Reduction of NOx-emission = Increase quality of life
- Avoid 20 million barrels of oil per day

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Thank you for your attention

Website: arenha.eu/