NGHRI
Namibia Green Hydrogen Research Institute

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Green Hydrogen Uses

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Outline

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Introduction

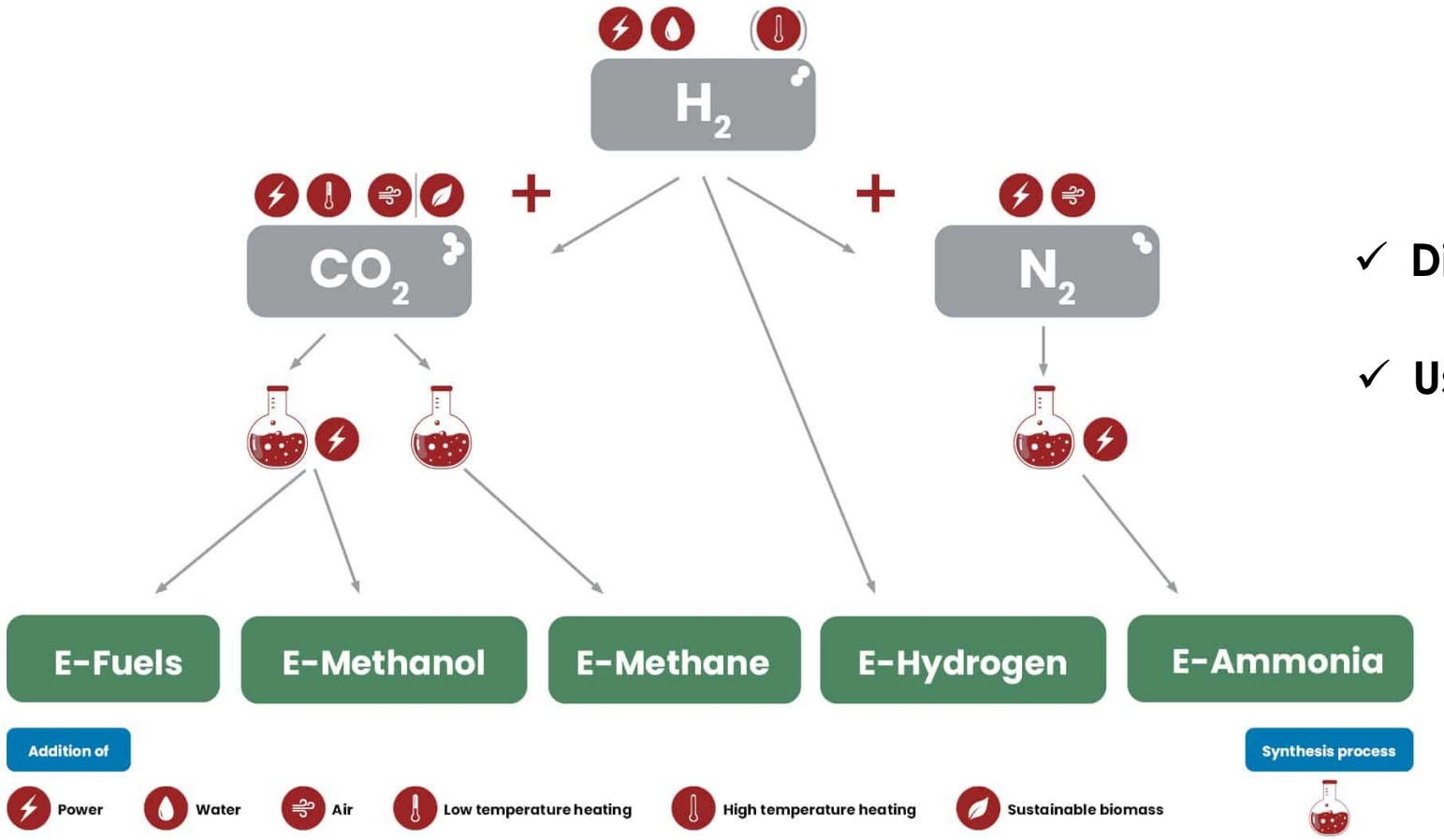
Hydrogen Use Case

Green Hydrogen research at UNAM on use case

Conclusion

Introduction

Power-to-X (PtX): Power-to-X converts renewable electricity, from wind, solar, hydro, and geothermal power plants, into a wide variety of end products (X).



- ✓ **Direct Use of Hydrogen**
- ✓ **Use Hydrogen in its Derivatives**

Hydrogen use: Iron and Steen Industry

By reacting hydrogen directly with iron ore, iron and water are produced in place of iron and CO_2.

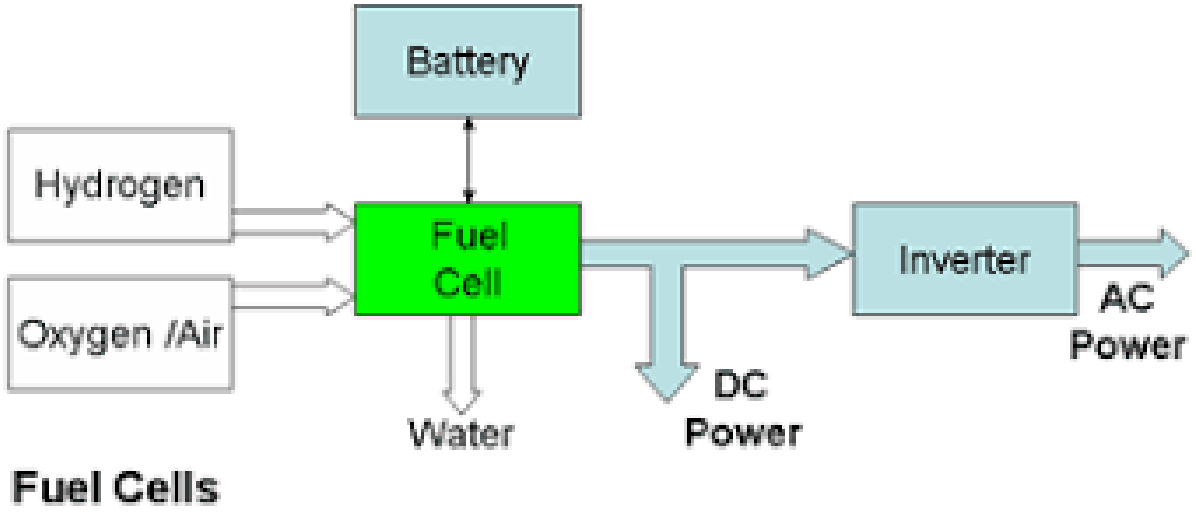
process is called Direct Reduced Iron (DRI) and is already being used with natural gas instead of hydrogen

Hydrogen use in green Iron making

Local benefit

Hydrogen use in Power stations

Energy Production: Hydrogen is used as a fuel for power generation through hydrogen fuel cells and can be used to produce electricity and heat with zero emissions



Fuel Cells

Hydrogen power station

Example: HDF Power plant to be constructed in Swakopmund for local electricity generation

Hydrogen use in Transportation

Transportation: Hydrogen fuel cell vehicles use hydrogen as a clean alternative to gasoline or diesel for powering vehicles.

Large Haulage trucks, Ships

Anglo American miming trucks

Energy Observer

Jet Fuel

Aerospace: Liquid hydrogen is used as rocket fuel in the space industry.

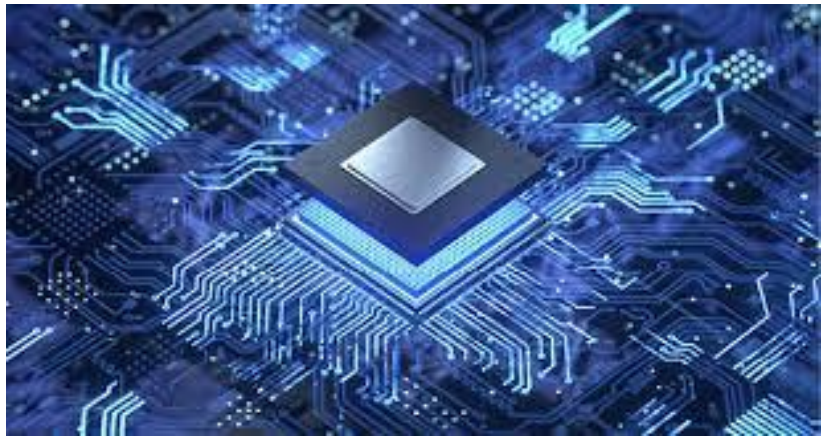
Kerosene made from Hydrogen and Carbon is a Jet Fuel

Hydrogen powered Jet

Hydrogen powered Rocket

Electronic Industry

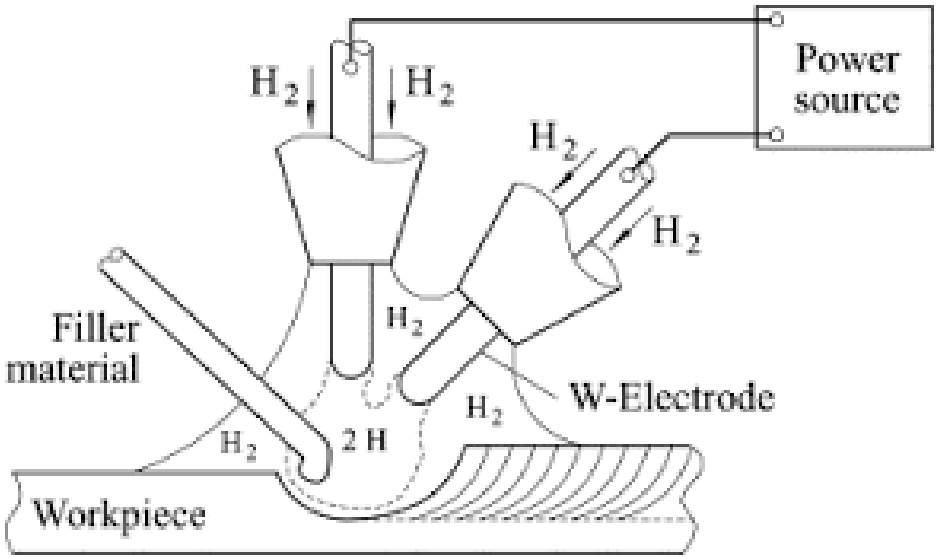
Electronics: Hydrogen is used in the production of semiconductors and flat-panel displays.



Hydrogen is used in semiconductor manufacturing for processes like plasma cleaning and etching, surface passivation, and reducing oxide layers.

It plays a critical role in maintaining clean and controlled environments during semiconductor fabrication, ensuring high-quality device performance.

Welding Industry



Welding: Hydrogen is used as a shielding gas in welding processes.

Hydrogen is one of the gases you are actually trying to get out of your weld pool.

Still, you can use it as a shielding gas in high-temperature applications to increase arc stability and weld bead performance.

There is even a specific welding process that utilizes pure hydrogen shielding called Atomic Hydrogen Welding.

Food Industry and Drug synthesis

Food Industry: It's used for hydrogenation of oils and fats, which is important in food processing.

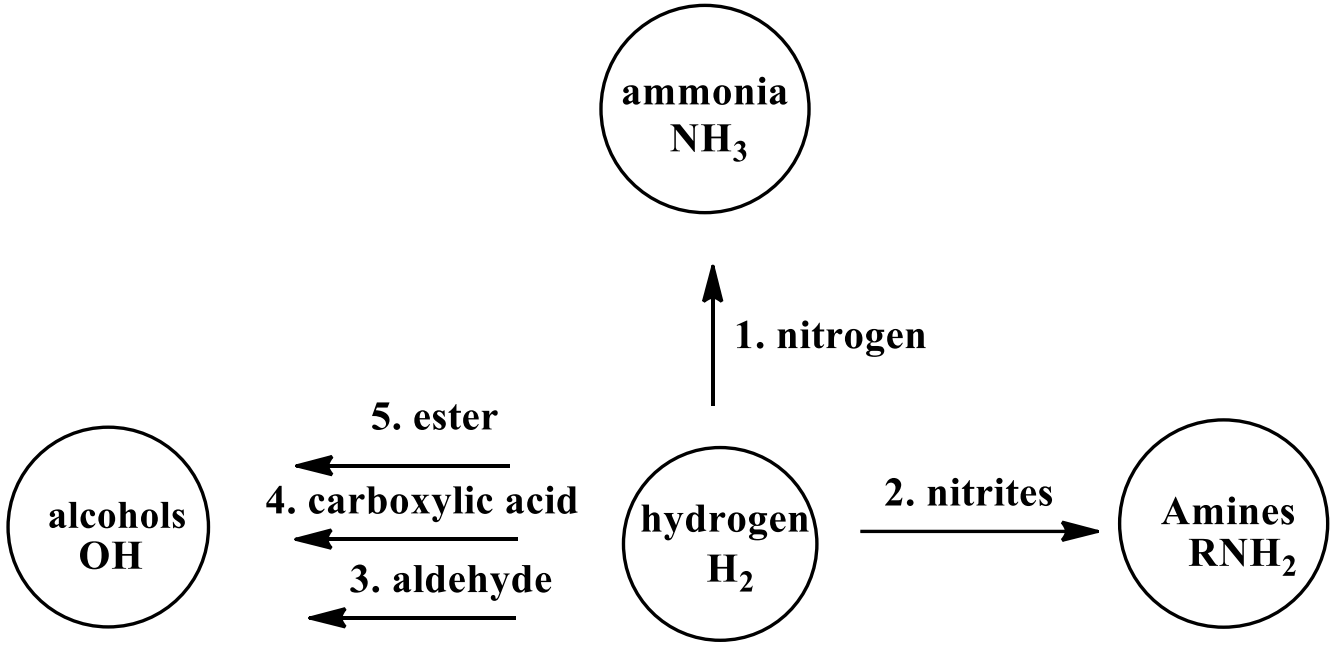
Manufacturers favour hydrogenation as a way to prevent oxidation of oils and ensure longer shelf life.

Partially hydrogenated vegetable oils are used in the fast food and processed food industries because they impart the desired texture and crispness to baked and fried foods.

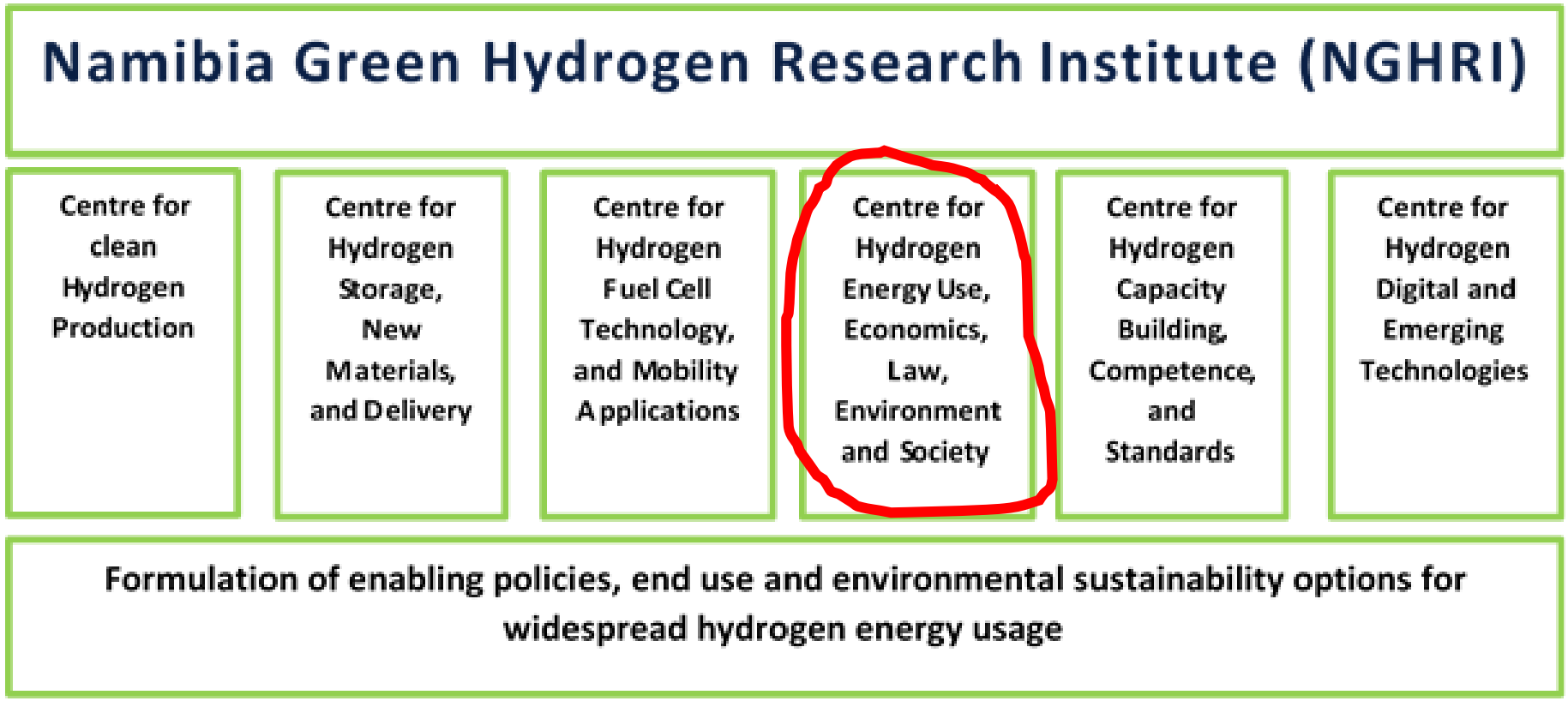
Pharmaceuticals: It's used in the synthesis of certain drugs and medications.

Chemical Industry

Reaction scheme of hydrogen and other molecules to give useful chemicals and reagents.



Research at NGHRI



Hydrogen use in Fertilizer potentials

Namibia has about eleven green scheme projects such as the Orange River, Hardap, Etunda, Musese, Sikondo, Uvungu-Vungu, Ndonga-Linena, Mashare, Shadikongoro, Kalimbeza, and Shitemo green scheme farms.

The Government has spent N$5.4 billion to set up the dam that has a holding capacity of 800 million cubic metres, making it the biggest dam in the country with the view of collecting water and being used for irrigation and farming purposes

Namibia Imports of Fertilizers was US$80.52 Million during 2022, according to the United Nations COMTRADE database on international trade.

Research activity at UNAM on fertilizers

Green ammonia is reacted with locally available sulfuric acid (to be sourced from Dundee Precious Metal) to produce Green Ammonium Sulfate-based fertilizers.

DAURES GREEN HYDROGEN CONSORTIUM

DAURES GREEN HYDROGEN VILLAGE

$$3H_2 \text{ (green hydrogen)} + N_2 \text{ (nitrogen)} \longrightarrow 2NH_3 \text{ (green ammonia)} \quad \text{.....Eq.1}$$

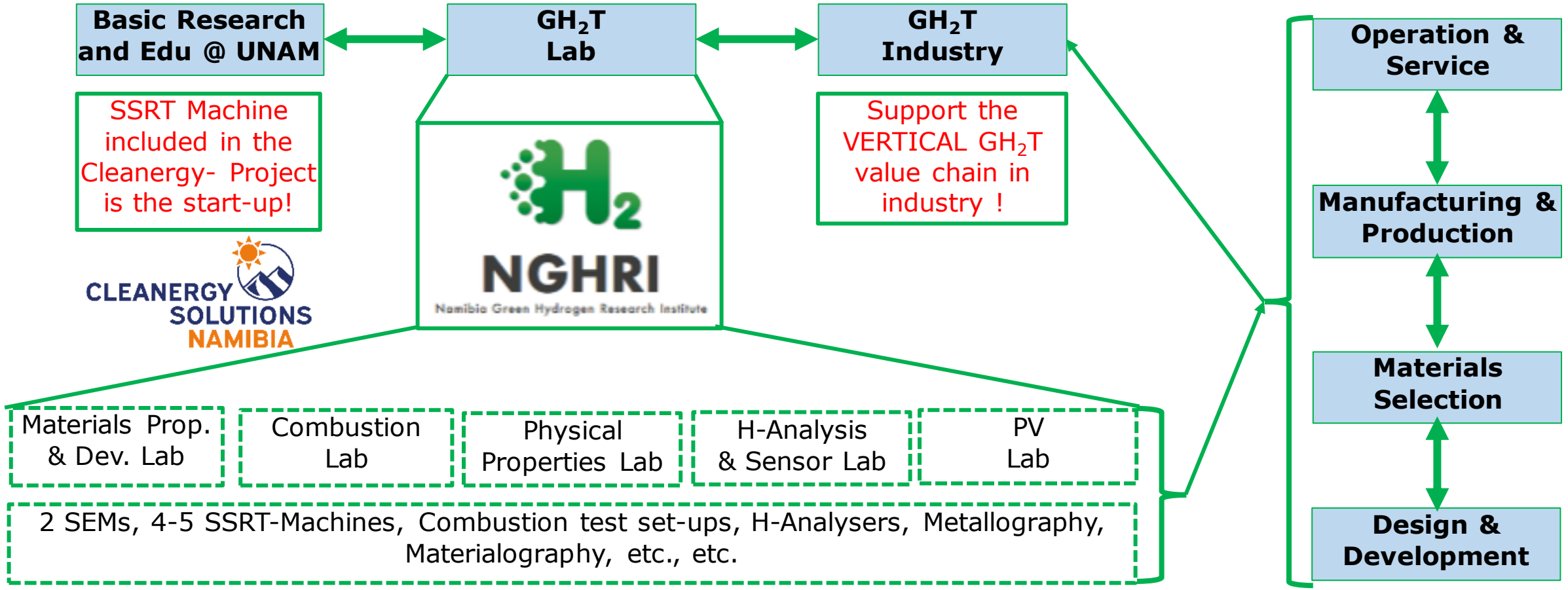
$$2NH_3 \text{ (green ammonia)} + H_2SO_4 \text{ (sulphuric acid)} \longrightarrow (NH_4)_2SO_4 \text{ (green ammonium sulphate)} \quad \text{.....Eq. 2}$$

These fertilizers will undergo testing and research at the Daures Greenhouse Nursery planned to produce tomatoes at a commercial scale.

This initiative holds potential not only for the production of green fertilizers at a larger scale but also for improving food production not just at Daures but throughout the entire country.

Material Testing for Hydrogen Compatibility

Rough concept to emerge NGHRI into a research and testing lab for GH_2T in Namibia



Concluding remarks

Decarbonization Champion: Hydrogen stands as a powerful ally in the quest for decarbonization.

Versatility and Cross-Sectoral Integration: One of the key strengths of the hydrogen economy lies in its versatility. Hydrogen can be utilized across diverse sectors, from powering fuel cells in vehicles to acting as a feedstock for industrial processes.

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Energy Storage Game-Changer: Hydrogen's role in energy storage is pivotal. It serves as a means to store excess energy generated from intermittent renewable sources, helping to address the challenges of grid stability and reliability.

Technological Innovation: The realization of a hydrogen economy relies heavily on ongoing technological innovation. Continued research and development efforts are essential to improve the efficiency and cost-effectiveness of hydrogen production, storage, and utilization technologies.

Global Collaboration and Policy Support: The success of the hydrogen economy hinges on global collaboration and supportive policy frameworks.

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THANK YOU