


This resource was developed as part of the HyAcademy.eu project.

Hydrogen Infrastructure



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 Schweizerische Eidgenossenschaft
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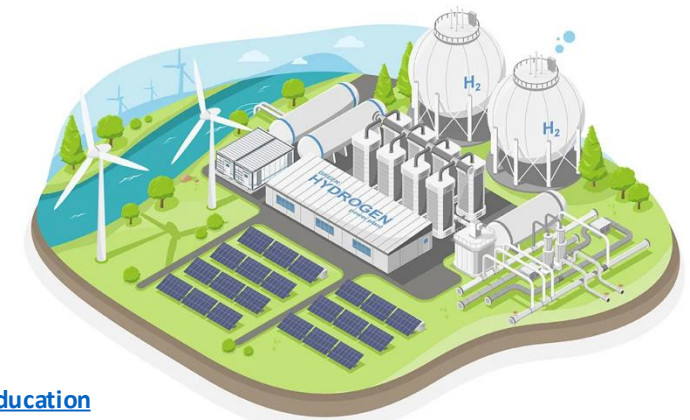
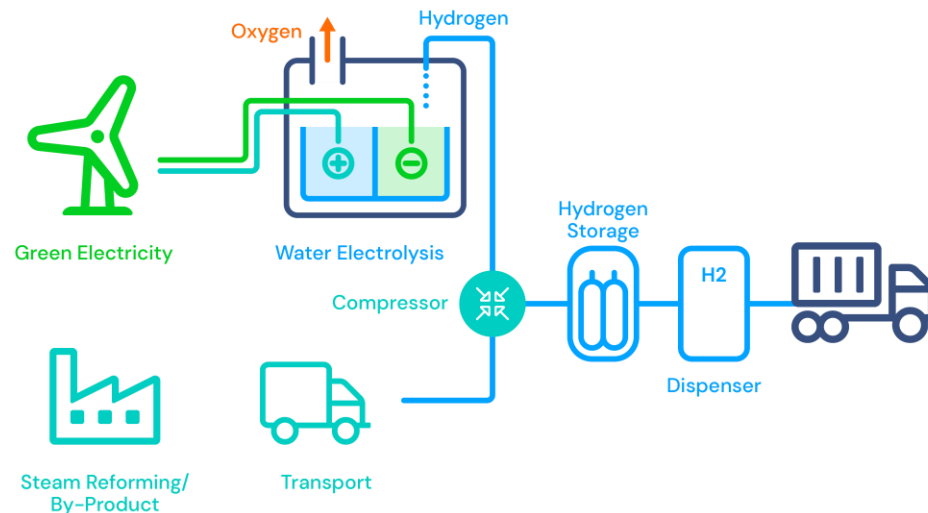
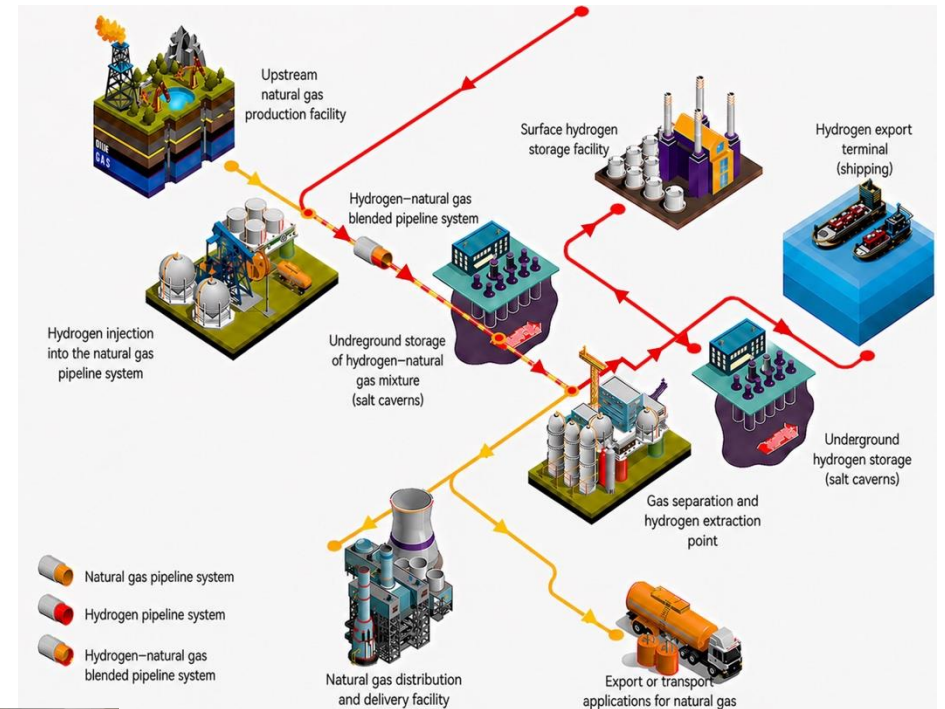
Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Education,
Research and Innovation SERI

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<https://www.fuelcellstore.com/hydrogen-education>

Hydrogen Infrastructure

<https://nwlaborpress.org/2023/11/1-billion-for-northwest-hydrogen-infrastructure/>

<https://www.h2haul.eu/hydrogen-infrastructure/>

1. Hydrogen infrastructure

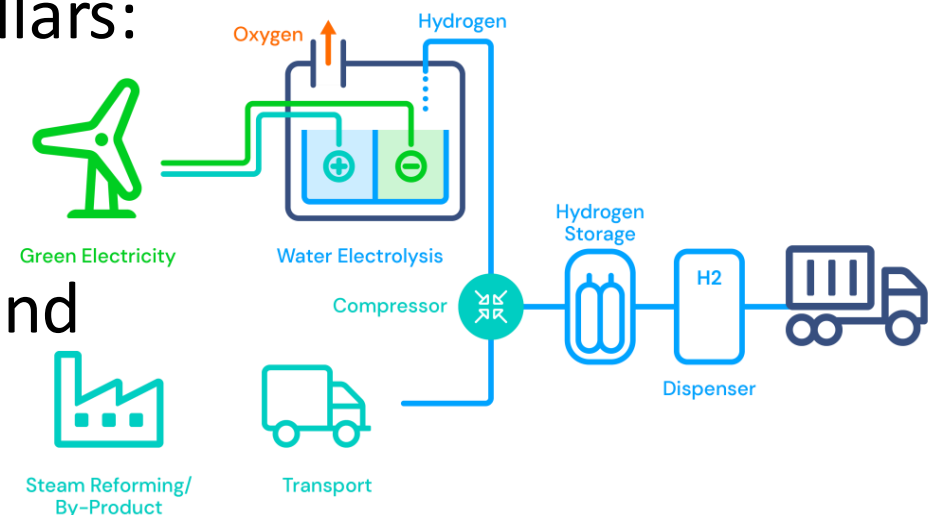
- The basic physical and organizational structures and facilities needed for the **operation of the hydrogen economy**.

A hydrogen infrastructure sums up three pillars:

(1) production,

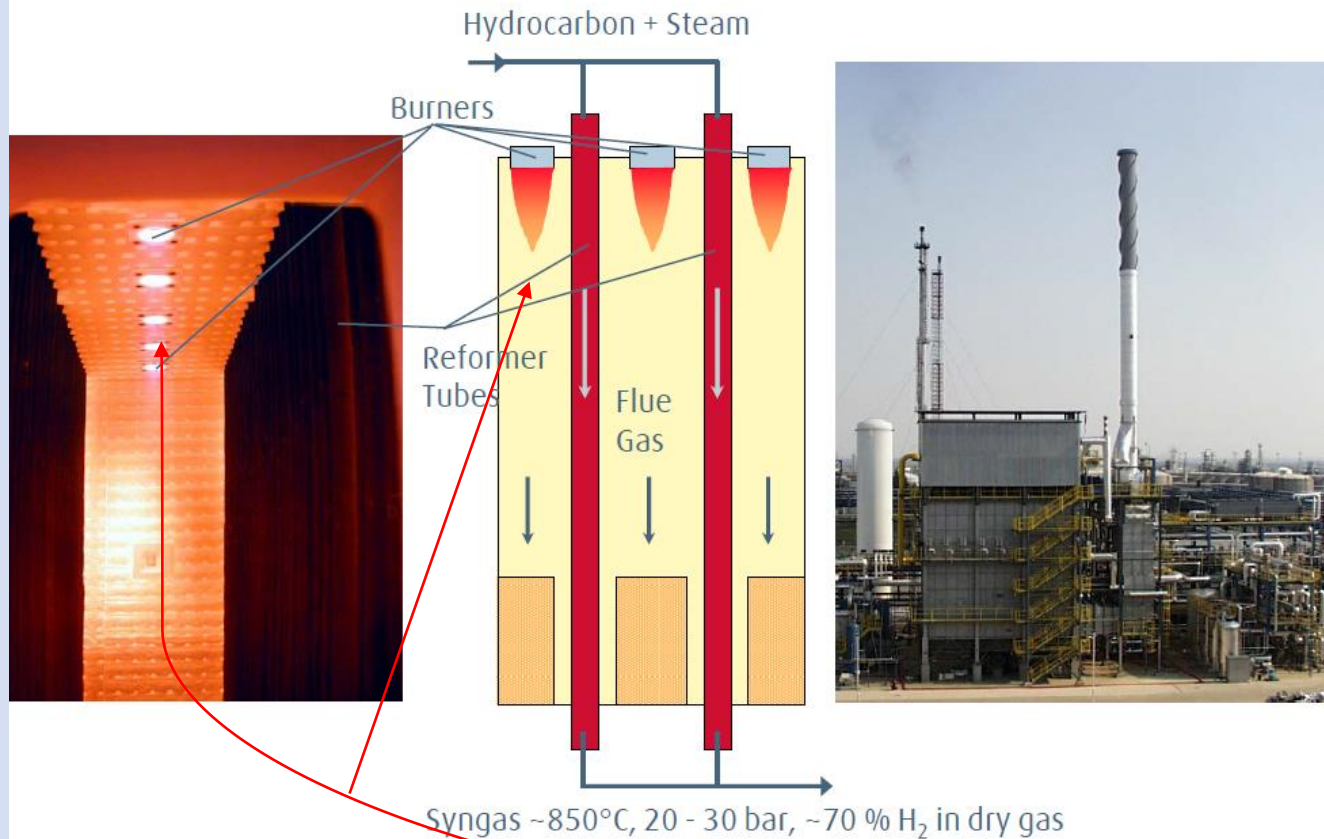
(2) transport distribution and storage, and

(3) utilization.



<https://www.h2haul.eu/hydrogen-infrastructure/>

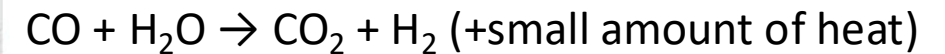
Hydrogen production, **reforming**



Steam-Methane Reforming Reaction



Water-Gas Shift Reaction

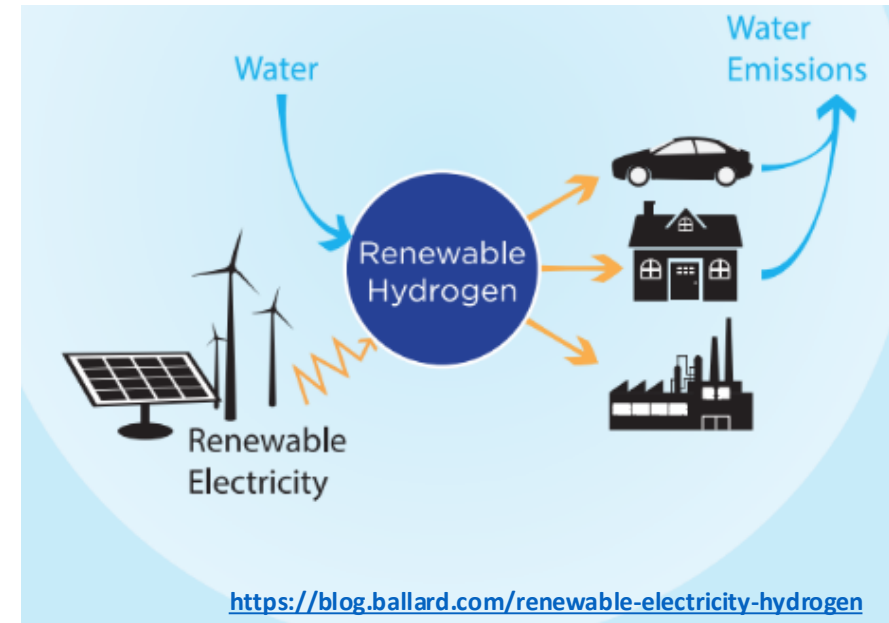


Final:



Hydrogen production, **electrolysis**

- **Water decomposition** gives **hydrogen** and oxygen gases due to the passage of an electric current.



- It is a very **promising way to produce** renewable and nonpolluting **hydrogen** if the power input is from renewable energy.



2. Hydrogen transport

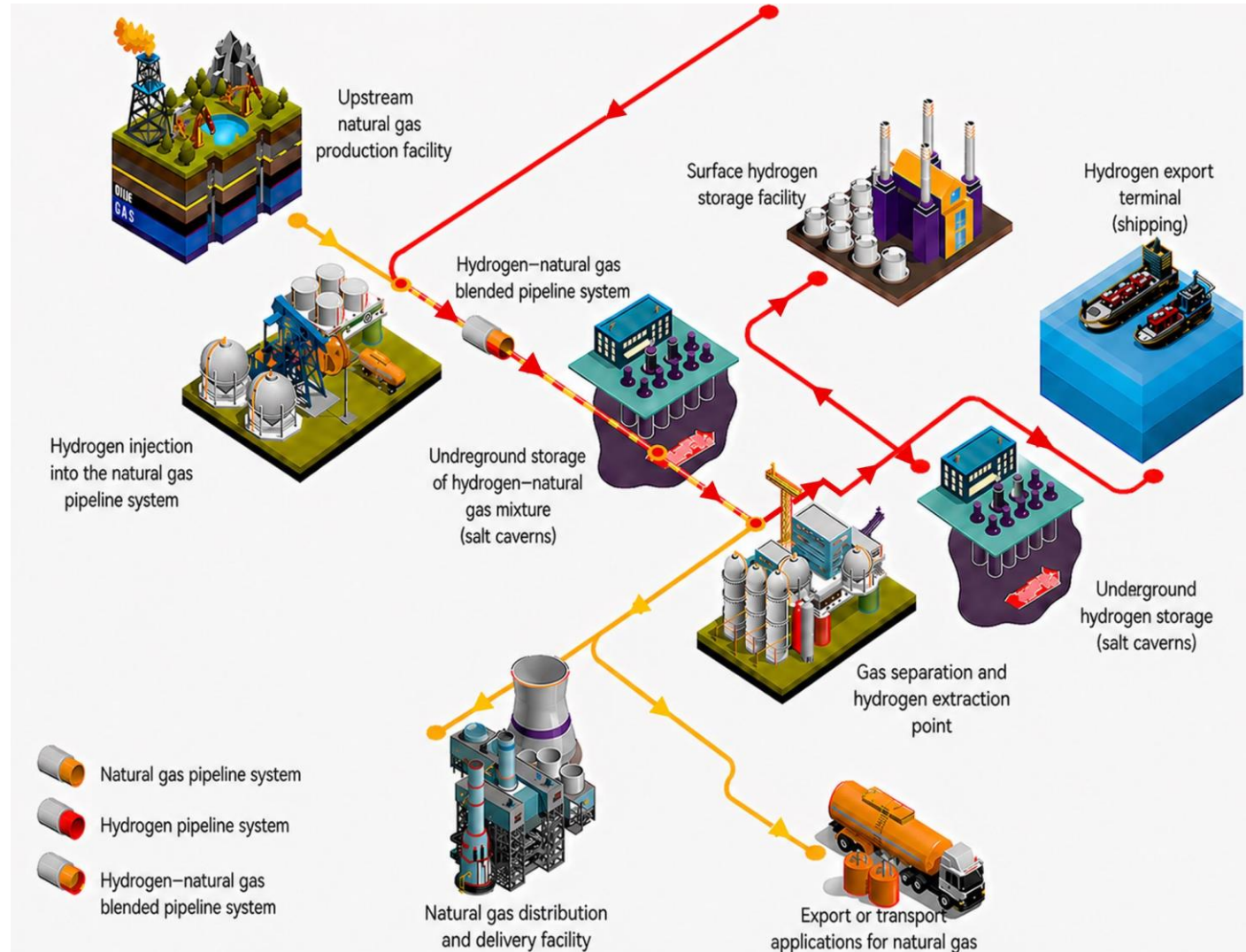
There are three primary options for hydrogen transport:

- (1) pipelines** for gaseous hydrogen or a mixture of hydrogen and natural gas transportation;
- (2) trucks, rails, barges, and ships** with tube trailers or cryogenic tanks for liquefied hydrogen delivery; and
- (3) chemical carriers** such as **ethanol, methanol, and other liquids** derived from renewable biomass that can be transported and reformed to hydrogen at the end point of use.

Hydrogen transport

Pipelines for:

- gaseous hydrogen or
- a mixture of hydrogen and natural gas transportation



Hydrogen infrastructure

trucks, rails, barges, and ships



<https://www.marinelink.com/news/kawasaki-heavy-industries-build-worlds-534052>



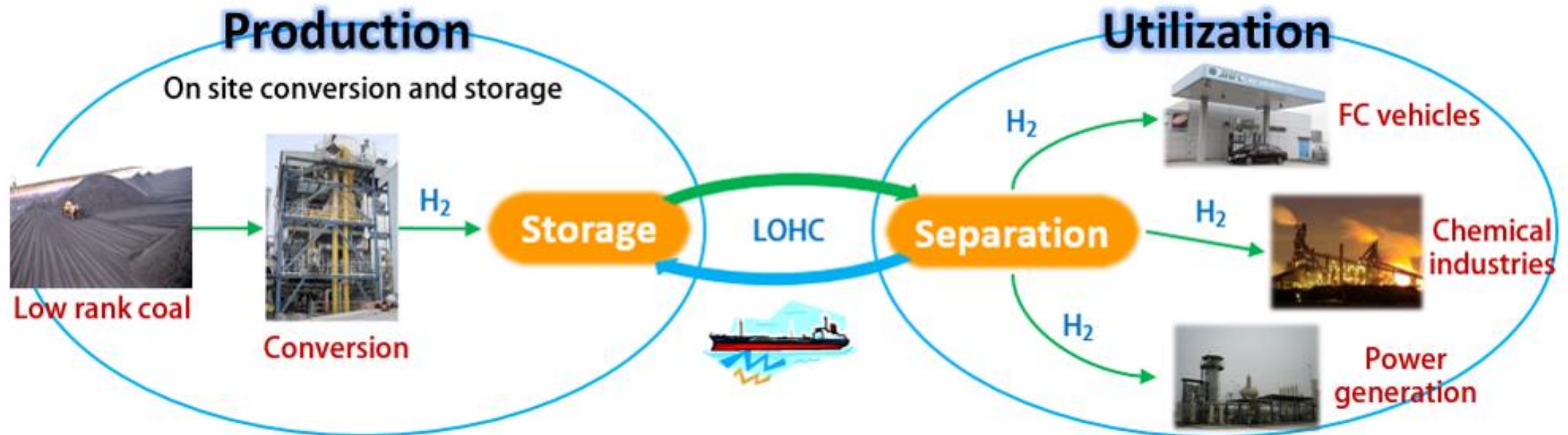
<http://www.hydroville.be/en/waterstof/hoe-transporteer-je-waterstof/>



<https://www.pv-magazine.com/2020/08/10/hydrogen-can-be-transported-by-rail-german-railway-company-says/>

Hydrogen transport, LOHC

- The use of **Chemical** or **Liquid Organic Hydrogen Carriers (LOHC)** allows transportation of hydrogen at normal temperature and pressure in standard containers. After that, hydrogen is released from the LOHC through a **dehydrogenation** process at the destination point.



3. Hydrogen (pressure gas) storage

The construction of the cylinder consists of a liner (which can be made from aluminium, steel or polymer) around which carbon fibres are wound (other fibres can be used like glass, but these result in heavier tanks) and sealed in a polymer resin.



High-pressure hydrogen storage

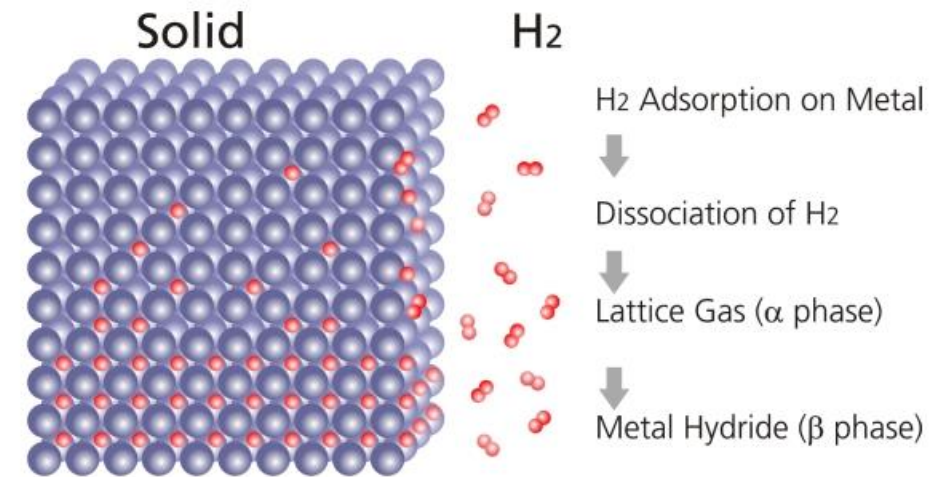
Compressed H_2 storage system for industry



hydrogen infrastructure

Source: <https://www.praxair.com/>

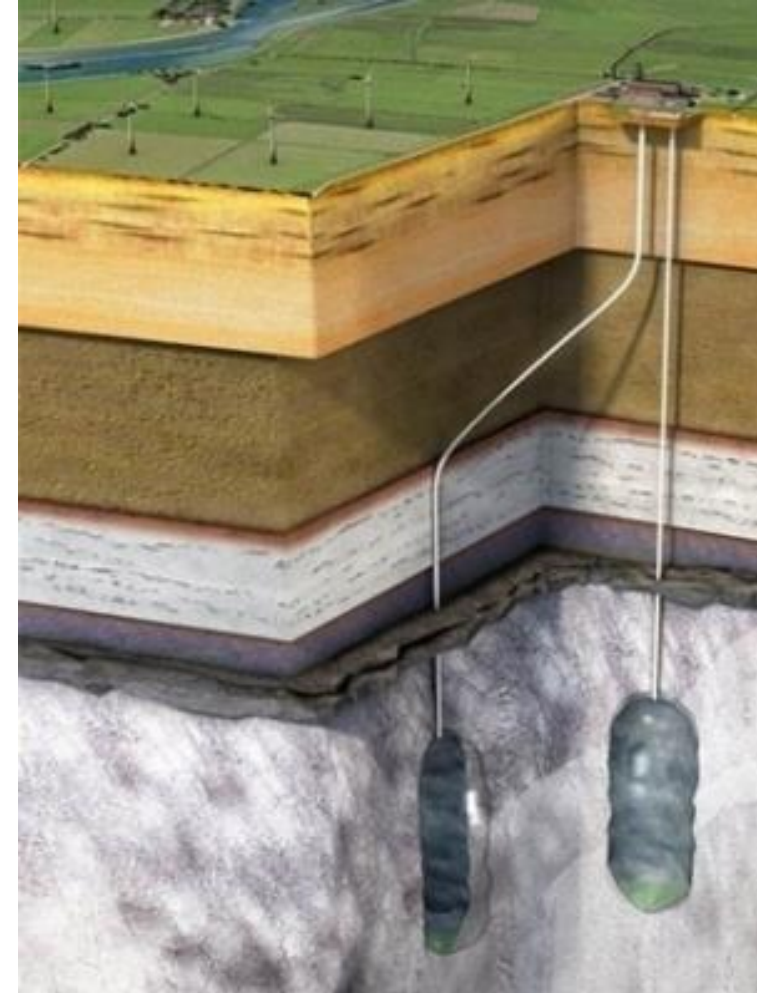
Liquid hydrogen (LH₂ or LH₂) is the liquid state, it needs to be cooled to 20.28 K (−252.87 °C), of the element hydrogen.



Chemical storage (metal hydrides) could offer high storage performance due to the strong binding of hydrogen and the high storage densities.

Underground storage

- Underground hydrogen storage is the practice of hydrogen storage in **underground caverns, salt domes and depleted oil/gas fields.**



Sources: KBB, HyUnder

4. Hydrogen Refueling Station (HRS)

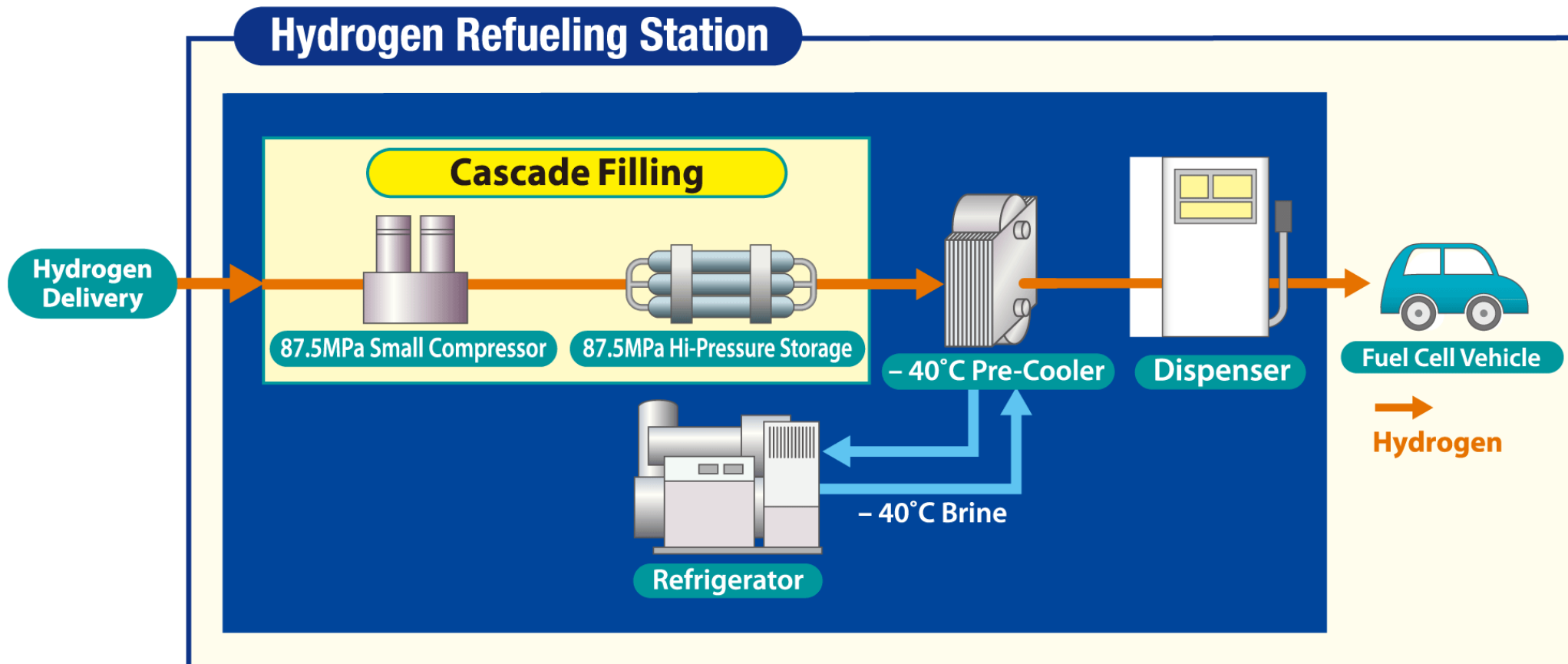
- A Hydrogen Refueling Station (HRS) is an infrastructure designed for filling a vehicle with hydrogen fuel.
- It can be part of a station for fossil fuel refueling or an independent infrastructure.

Hydrogen Refueling Station (HRS)

The component of the HRS basic unit are:

1. Hydrogen storage tanks,
2. Compressors,
3. Precooling system,
4. Dispenser.

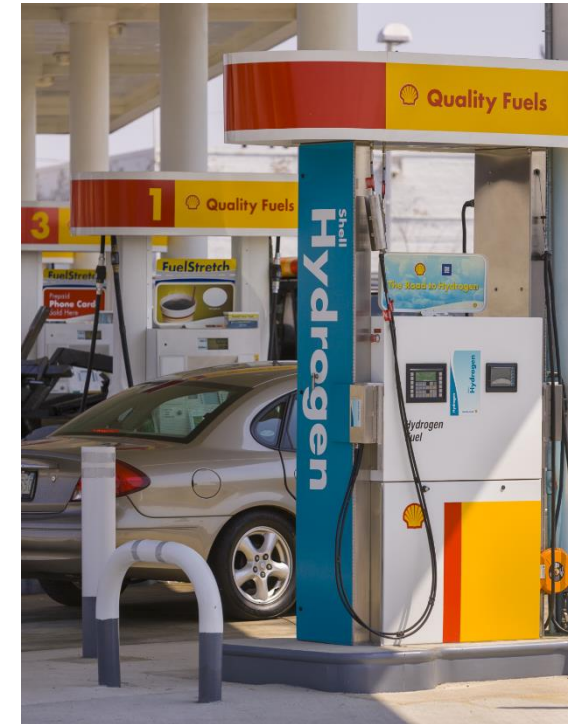
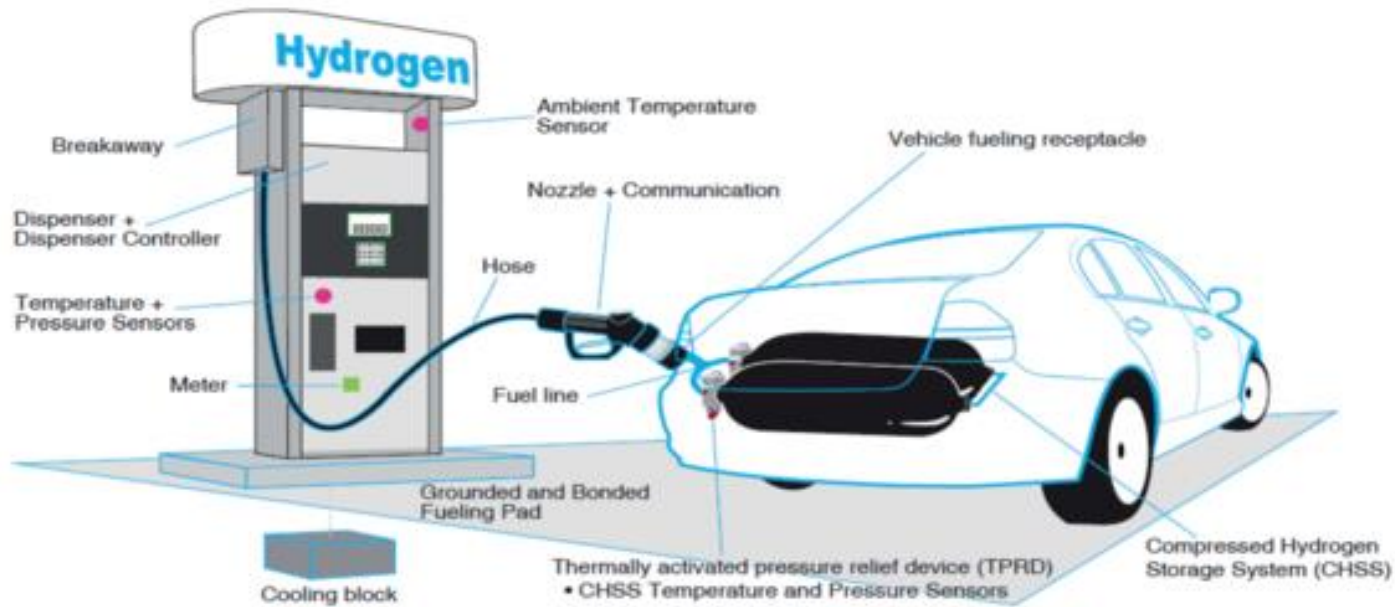
Hydrogen Refueling Station (HRS)



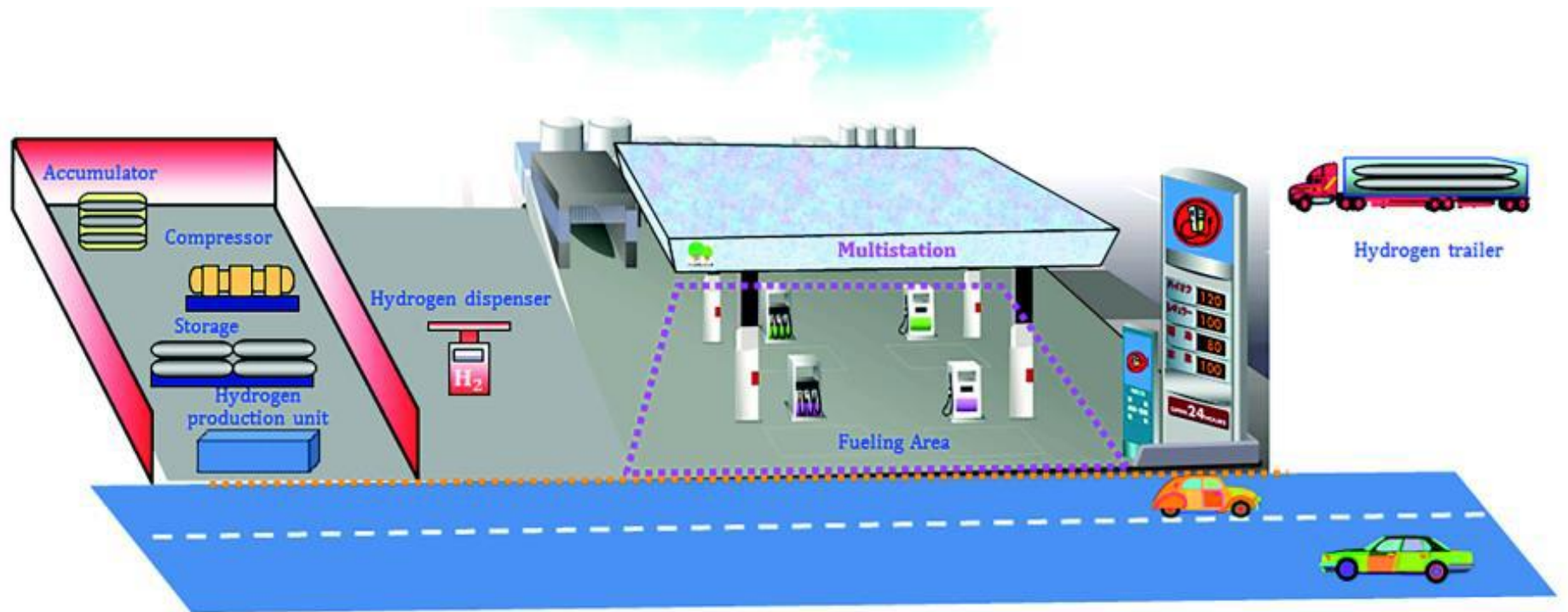
Source: http://www.kobelco.co.jp/english/products/rotating_machinery/hyac/index.html#brochure

Hydrogen Refueling Station (HRS)

Typical compressed hydrogen dispenser



Hydrogen Refueling Station (HRS)




Typical HRS

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Thank you!



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