FREEDOM OF MOBILITY FORUM

2024 EDITION

“How Will Our Planet Accommodate the Mobility Needs of 8 Billion People?”

Full Report of Research Findings

“Innovation ensuring an optimal use of natural resources for the mobility of people and goods”

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How will our planet accommodate the mobility needs of 8 billion people?

Innovation ensuring **an optimal use of natural resources** for the **mobility of people and goods** (better and more efficient use of resources & resources preservation).

GROWING

by continually offering more value to our customers

INNOVATION

by creating greener and smarter mobility solutions

REALIZATION

of our commitments thanks to the power of digitalization

INTRODUCTION

In a global context marked by the rapid growth of the population, escalating urbanization, and pressing environmental challenges, the imperative to reconsider our approach to mobility becomes evident. The transportation sector, a key player in our daily lives, not only significantly contributes to greenhouse gas emissions but is also challenged by the strain posed by overpopulation. This dual pressure necessitates innovative solutions that address both the mobility needs of a growing population and the imperative to reduce environmental impact.

OVERPOPULATION

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When we use the term “overpopulation,” we specifically mean a situation in which the Earth cannot regenerate the resources used by the world’s population each year.

Ressources < People

Source : https://www.populationmedia.org/the-latest/overpopulation-cause-and-effect#:~:text=When%20we%20use%20the%20term,becoming%20more%20and%20more%20damaging.

HOW CAN WE HANDLE IT ?

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As the number of people on the planet continues to grow, so do the challenges of providing adequate resources and a decent standard of living for all. While some argue that **technology** and **innovation** will solve the problem, others maintain that the only solution is to **reduce the global population.**

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Source : https://sustainablereview.com/overpopulation-solutions-a-deep-dive/

OUR CONVICTION : INNOVATION IS THE SOLUTION

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Innovation is a process by which a domain, a product, or a service is renewed and brought up to date by applying new processes, introducing new techniques, or establishing successful ideas to create new value. The creation of value is a defining characteristic of innovation.

> **“Some people think that creativity and innovation are synonyms. They are not. Creativity means coming up with a new idea. Innovation is taking this novel idea, and solving customer pain points and creating value.”**

Source : https://innolytics.net/what-is-innovation/

THE VALUE CHAIN OF DIFFERENT RESOURCES AND ENERGY CARRIERS

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Petroleum

Lithium

Green Hydrogen

Our choice of petroleum, lithium, and green hydrogen is like a timeline for mobility. Petroleum served us in the **past**, powering traditional vehicles. Lithium, found in lithium-ion batteries is what drives our **present** electric vehicles. Looking forward, green hydrogen represents our **future**, offering a clean and sustainable alternative.

THE GLOBAL GAS VALUE CHAIN

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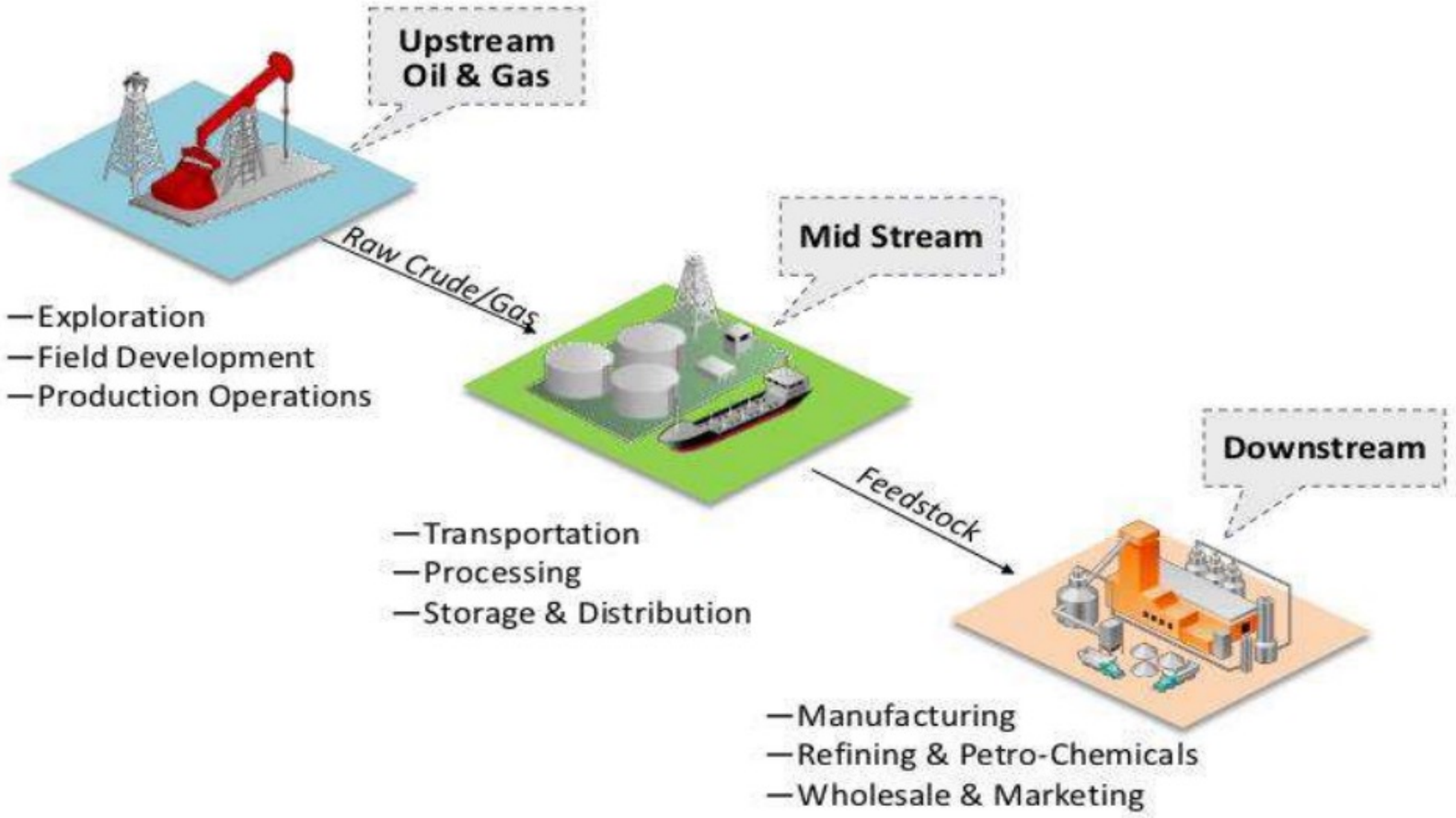

WHAT ARE THE MAIN CHALLENGES FACED IN THE GLOBAL GAS VALUE CHAIN?

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Challenges	Facts/data
• Petroleum extraction, refining, and combustion contribute to environmental pollution, including air and water pollution, habitat destruction, and greenhouse gas emissions.	• The combustion of fossil fuels, including petroleum, is a major contributor to global CO2 emissions. According to the Global Carbon Project, in 2020, CO2 emissions from fossil fuel combustion were around 34.6 billion metric tons[1]
• The finite nature of petroleum reserves poses a significant challenge as extraction rates often exceed the replenishment rate.	• According to the BP Statistical Review of World Energy 2021, proven global oil reserves were estimated at around 1.7 trillion barrels at the end of 2020]2]
• Fluctuating oil prices can impact the global economy, leading to economic instability and affecting industries that are heavily reliant on petroleum.	• The oil price collapse in 2020, partly due to the COVID-19 pandemic and a price war between major oil-producing countries, had significant economic repercussions globally[3]

Source : 1 Global Energy Review: CO2 Emissions in 2021 | IEA on March 2022
2 Statistical Review of World Energy 2021 | 70th edition
3 OECD Policy Responses to Coronavirus (COVID-19) The impact of coronavirus (COVID-19) and the global oil price shock on the fiscal position of oil-exporting developing countries | 30 September 2020

WHAT ARE THE SOLUTIONS TO HANDLE THESE CHALLENGES ?

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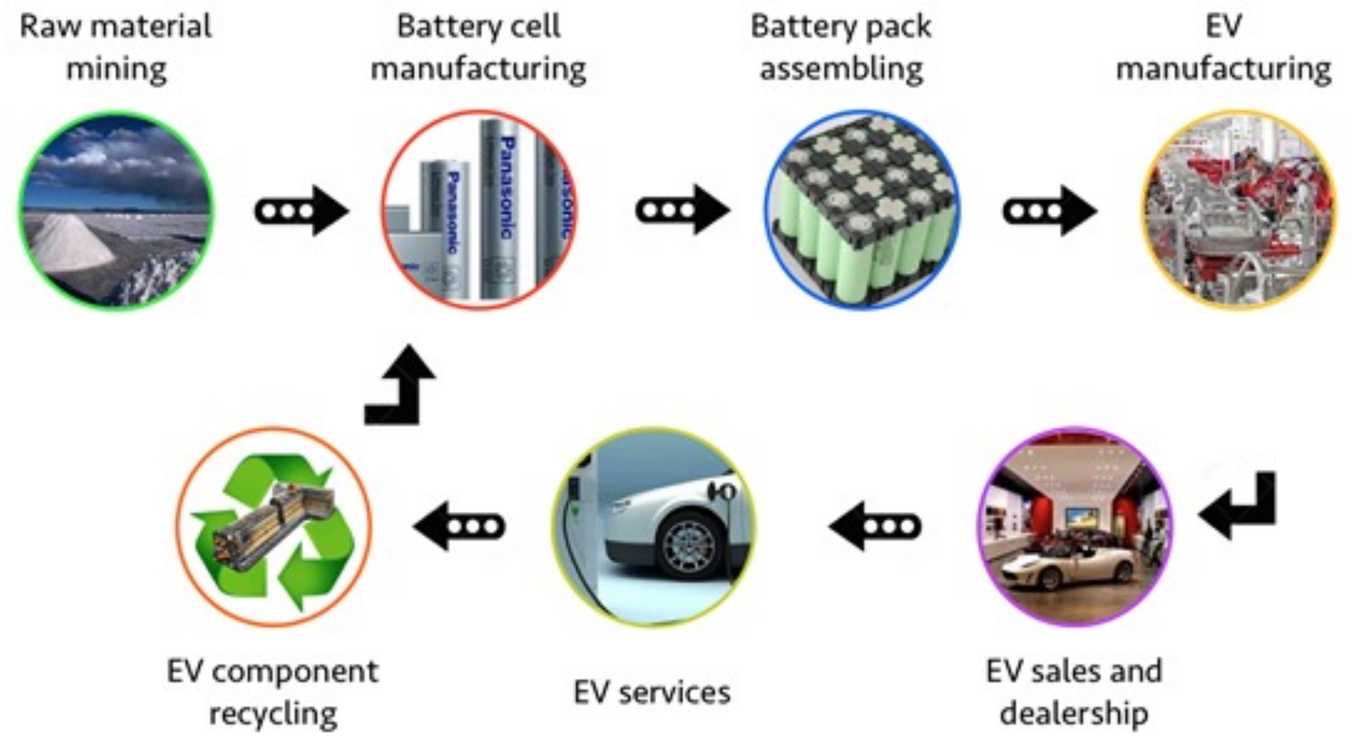
Existing solutions to scale up or New solutions	How and with whom to scale up the existing solutions? or How and with whom to implement your new solutions?
• Advanced Seismic Imaging Technology	• Develop and deploy advanced seismic imaging technologies to better understand subsurface reservoirs. This can help in more accurate reservoir characterization, reducing the number of wells drilled and minimizing the environmental impact[4]
• Smart Drilling Technologies	• Utilize smart drilling technologies that incorporate real-time data analytics and machine learning algorithms. This can optimize drilling processes, reduce downtime, and enhance drilling efficiency[5]
• Community Engagement and Environmental Monitoring	• Foster open communication with local communities and implement robust environmental monitoring systems to ensure responsible and sustainable extraction practices.[6]
• Waste Heat Recovery	• Implement waste heat recovery systems at extraction sites to capture and repurpose excess heat generated during the extraction process. This can be used for on-site power generation or to improve the overall energy efficiency of operations [7]

Source :4 Advanced sensing and imaging for efficient energy exploration in complex reservoirs | Energy Reports , November 2020
5 Journal of Natural Gas Science and Engineering,April 2017
6 A toolkit for building better environmental inspectorate | ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
7 Waste Heat Valorisation: Improving energy efficiency in process industries | European commission 2021

LITHIUM-ION BATTERIES VALUE CHAIN



LITHIUM-ION BATTERIES AND ELECTRICAL VEHICLES

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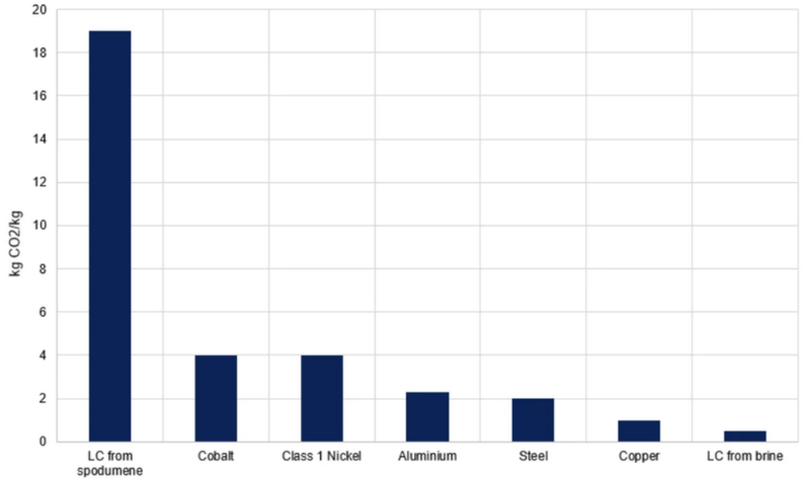
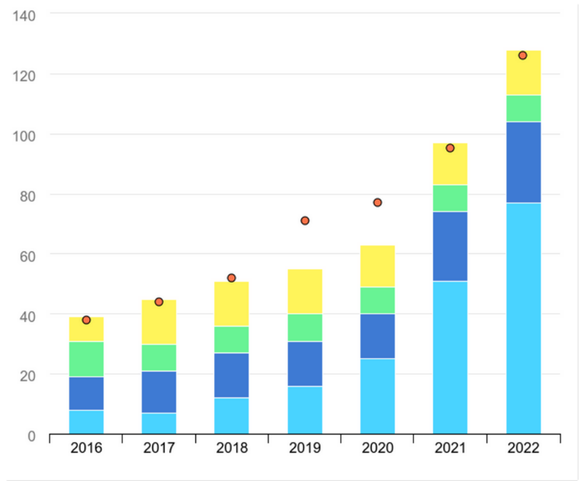
Recently, electric vehicles (EVs) have surged in popularity, marketed as symbols of eco-friendly and sustainable mobility. Most EVs are equipped with lithium-ion batteries, where lithium serves as the primary energy source despite its composition being only around 6%. Our emphasis on lithium as the primary resource recognizes both its associated environmental challenge - given concerns about high CO2 emissions, particularly during processing [1] - and its central role in EV development. Indeed, 60% of the 2022 lithium demand was propelled by EV batteries, surpassing cobalt (30%) and nickel (10%), which are other crucial materials for these batteries [2].





Sources : *1- Sucden Financial, Electric Vehicle And Battery Material Report, December 2023*
2- IEA, Global EV Outlook, April 2023

WHAT ARE THE CHALLENGES FACED IN THE PRODUCTION PHASE OF LITHIUM-ION BATTERIES ?

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Challenges	Facts/data
◦ **The lithium mining industry excessively consumes water. Addressing this challenge is essential for contributing to the broader goal of providing eco-friendly transportation options for all.**	◦ **65% of water in Chile, a major lithium mining region, is consumed by the mining industry. -** *Harvard International Review 2020* ◦ **The "Lithium Triangle," which includes Chile, Argentina, and Bolivia, holds more than 75% of the world's lithium supply under their salt flats. -** *Costmine Intelligence 2023*
◦ **Lithium batteries have limited performance, especially in terms of lifespan and energetic capacity. Additionally, these batteries pose safety issues due to the use of liquid electrolytes, which can be flammable when operating at high temperatures. These drawbacks discourage many people from considering electric vehicles (EVs).**	◦ **In China, a total of 187 EVs fire accidents were reported in 2019. And among all EV fire accidents, battery failures accounted for 77%.** *- Comprehensively analysis the failure evolution and safety evaluation of automotive lithium ion battery 2021*
◦ **Lithium batteries have varied and complex designs among different manufacturers, posing challenges for disassembly, material separation, and the automation of these processes. Nevertheless, automation is crucial not only for preventing workers' exposure to dangerous battery materials but also for contributing to the goal of ensuring freedom of mobility by creating a worker-friendly environment in the manufacturing sector.**	

WHAT ARE THE SOLUTIONS TO HANDLE THESE CHALLENGES ?

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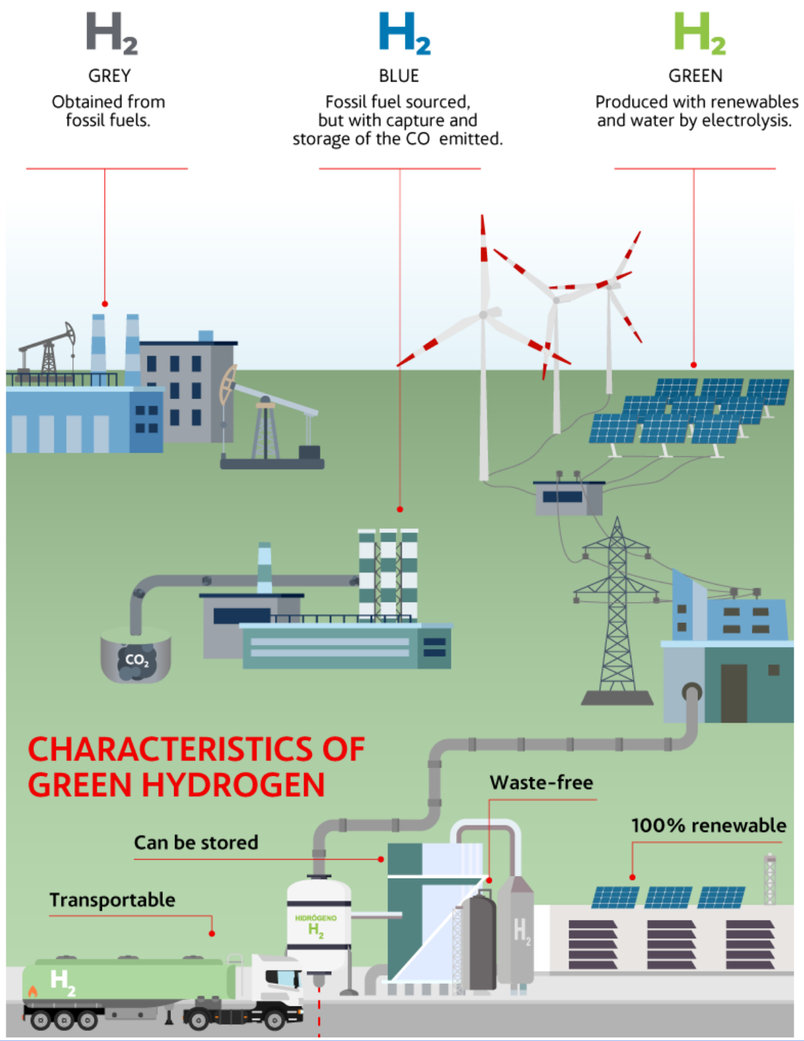
Existing solutions to scale up or New solutions	How and with whom to scale up the existing solutions? or How and with whom to implement your new solutions?
• Ensure a circular economy, notably by recycling battery materials to minimize the need for lithium extraction and other materials. This can only be possible if we ensure proper battery disposal in the first place	• Establish regional disposal facilities in every major city, at least. • Standardize battery-changing tools as an extra layer of control, ensuring that only authorized individuals can access battery replacement to prevent improper disposal. In other words, users cannot change the battery themselves or have it replaced by a random unauthorized mechanic, thus, we assure the proper battery disposal.
• Minimize human exposure to dangerous materials by replacing manual labor with robots and automated machines.	• Standardize the battery designs so to make it possible to automate disassembly and material separation procedures. • Collaborate with manufacturers to encourage the adoption of standardized battery designs.
• Aim for solid-state batteries, the upcoming technology for EV batteries, offering extended lifespan and enhanced safety by improving temperature sensitivity. • Integrating a cooling system can further boost battery performance, as seen in various automotive systems.	• Partner with academic and research institutions specializing in chemistry, materials science, and automotive technology to drive innovation in this area, as these solutions need to be engineered.

WHAT'S HYDROGEN ?

It's the most abundant element on the planet it can be : GREY , BLUE or GREEN. In our case , we will focus on Green hydrogen.



Source :https://www.acciona.com/green-hydrogen/?_adin=02021864894

GREEN HYDROGEN PRODUCTION VALUE CHAIN : KEY STEPS

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When we talk about green hydrogen, we mean hydrogen that has been obtained without generating pollutant emissions, i.e. sustainable hydrogen. A fuel that is already being presented as the key energy vector for achieving global decarbonisation and fulfilling the commitments made for 2050 in the fight against climate change.The green hydrogen value chain comprises several key stages, each crucial, as listed below:

Production

Processing

Distribution and Storage

Applications

Source :https://www.acciona.com/green-hydrogen/?_adin=02021864894

HOW IS GREEN HYDROGEN PRODUCED ?

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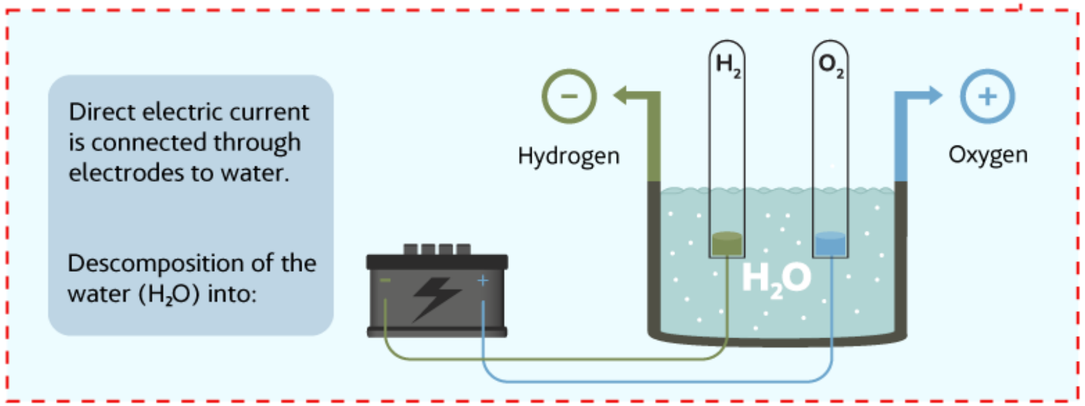
The most widespread way is by **electrolysis**; Electrolysis is a technique that consists of “breaking” the water molecules using an electric current in an electrolyzer in order to extract the dihydrogen H2. The electricity must itself be carbon-free in order to consider this hydrogen as green or renewable.



2H2O→2H2+O2

Source : https://www.engie.com/en/renewables/hydrogen/green-hydrogen-production

IN WHICH SECTORS WILL GREEN HYDROGEN BE KEY ?

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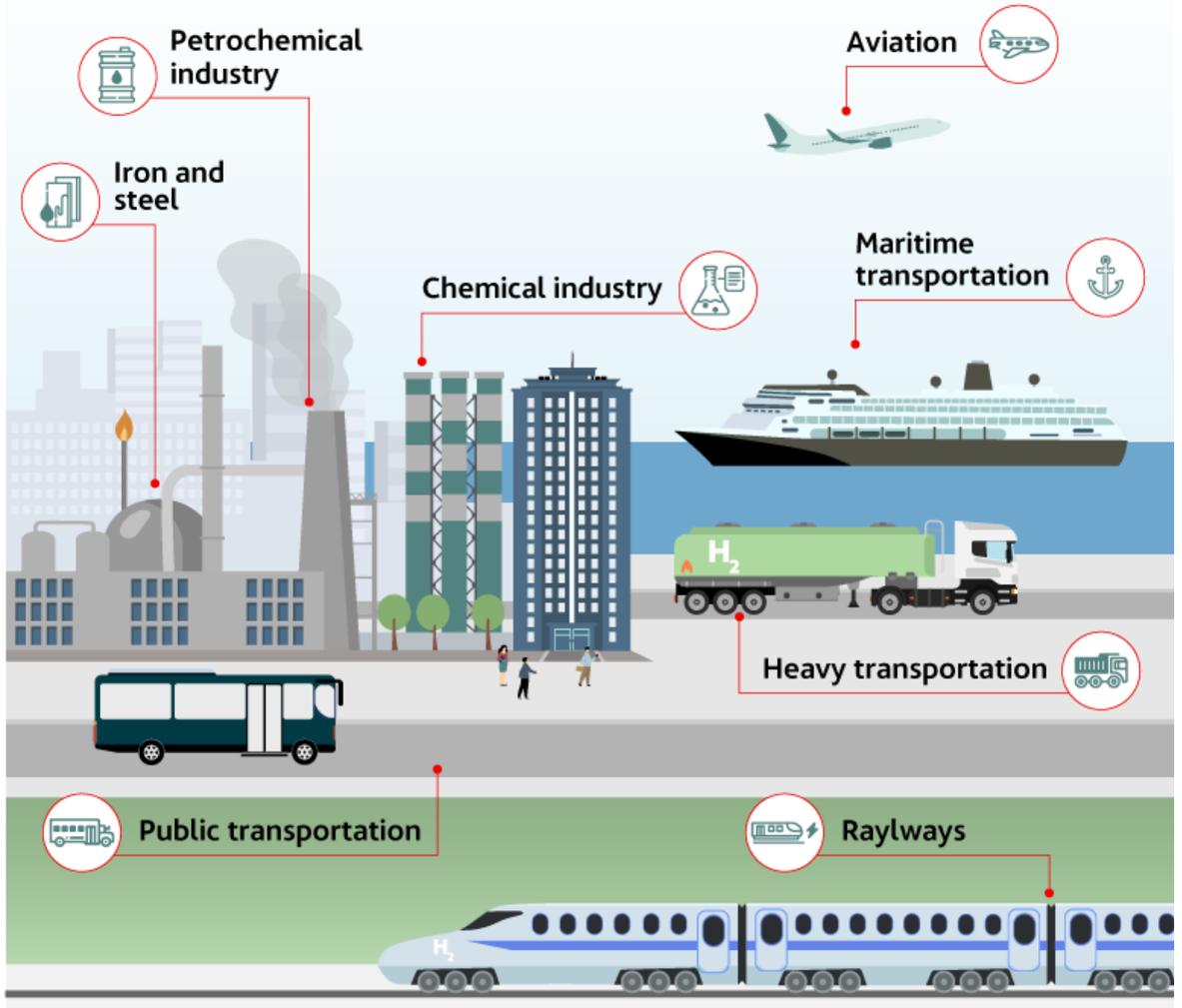
Transportation

Green hydrogen can power fuel cell vehicles, offering a clean alternative to traditional internal combustion engine vehicles.

Railways

Green hydrogen transforms the railway sector by powering hydrogen fuel cell trains, serving as an eco-friendly alternative to diesel locomotives.



Aviation

The aviation industry, which has struggled to find sustainable alternatives, could utilize green hydrogen to power hydrogen fuel cells in aircraft, reducing emissions from air travel.

Maritime

Shipping is a major contributor to global emissions. Green hydrogen can be used in fuel cells or converted into ammonia as a green shipping fuel, offering a cleaner option for the maritime industry.

Source :https://www.acciona.com/green-hydrogen/?_adin=02021864894

WHAT ARE THE CHALLENGES FACED WHILE PRODUCING GREEN HYDROGEN

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Challenges	Facts/data
• **Cost : Currently, green hydrogen production is more expensive compared to fossil fuel-based hydrogen production methods.**	• With long-term average fossil fuel prices of USD 75/bbl for oil and USD 4-6/GJ for natural gas, renewable hydrogen is two to three times more expensive to produce than the fossil references. ***https://www.irena.org/***
• **Infrastucture : Establishing the necessary infrastructure for large-scale green hydrogen production, storage, transportation, and distribution is a significant challenge. This includes building hydrogen production plants, pipelines, storage facilities, and refueling stations.**	• Globally, there are only about 4 500 km of hydrogen pipelines. Using renewable resources from remote locations would require additional investment in the transport infrastructure, from pipelines to conversion and liquefaction units, as well as storage, which increases the initial investment needed. ***https://www.irena.org/***
• **Energy requirements : Green hydrogen production relies on electrolysis, which requires a significant amount of electricity.**	• The usage of water electrolysis (PEM or alkaline electrolysis) for green hydrogen production which have an effective electrical efficiency of 70–82%, producing 1 kg of hydrogen (which has a specific energy of 143 MJ/kg or about 40 kWh/kg) requires 50–55 kWh of electricity. • ***https://en.wikipedia.org/wiki/Hydrogen_production#:~:text=Considering%20the%20industrial%20production%20of,50%E2%80%9355%20kWh%20of%20electricity.***
• **Water Availability: Electrolysis requires a substantial amount of water. Ensuring sustainable water sources and managing water usage for large-scale hydrogen production can be a challenge, especially in regions with water scarcity.**	• Most electrolysers consume 45–55 kWh per kg of hydrogen, which means that 0.16–0.2 L of ultrapure water is required per kWh, or 163–200 L/h of ultrapure water is required per MW of electrolyser capacity. • ***https://hydrogentechworld.com/water-treatment-for-green-hydrogen-what-you-need-to-know#:~:text=Most%20electrolysers%20consume%2045%E2%80%9355,per%20MW%20of%20electrolyser%20capacity.***

WHAT ARE THE SOLUTIONS TO HANDLE THESE CHALLENGES ?

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Existing solutions to scale up or New solutions	How and with whom to scale up the existing solutions? or How and with whom to implement your new solutions?
• **Technological Advancements and Scaling**	• **Economies of Scale:** Encourage large-scale green hydrogen production projects to benefit from economies of scale. Increased production volume often leads to lower unit costs. Governments and industry stakeholders can collaborate to provide incentives for scaling up production. • **Public-Private Partnerships (PPPs):** Foster collaboration between public and private sectors to share the financial burden of initial investments. Governments can offer subsidies, tax incentives, or grants to incentivize private companies to invest in green hydrogen infrastructure. • **Policy Support:** Governments can implement policies that promote green hydrogen adoption, such as feed-in tariffs, carbon pricing, or mandates for a certain percentage of hydrogen used in specific industries to be green. This can create a more favorable market environment for green hydrogen production.
• **Strategic Infrastructure Development**	• **Hydrogen Hubs:** Establish hydrogen hubs or clusters where multiple stakeholders co-locate production, storage, and distribution facilities. This shared infrastructure approach promotes efficiency, reduces costs, and encourages collaboration among various players in the hydrogen value chain. • **Investment in Research and Innovation:** Invest in R&D to develop innovative and cost-effective solutions for hydrogen infrastructure. This includes advancements in pipeline materials, storage technologies, and efficient refueling station designs. • **Hydrogen Corridors:** Designate specific regions or corridors for concentrated green hydrogen infrastructure development. These hydrogen corridors can connect production centers with end-users, creating a network that facilitates efficient transportation and distribution.

WHAT ARE THE SOLUTIONS TO HANDLE THESE CHALLENGES ?

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Existing solutions to scale up or New solutions	How and with whom to scale up the existing solutions? or How and with whom to implement your new solutions?
• **Integration of Renewable Energy Sources**	• **Co-Location with Renewable Generation:** Strategically locate green hydrogen production facilities near areas with abundant renewable energy resources. This minimizes transmission losses and enhances the efficiency of utilizing renewable electricity for hydrogen production. • **Energy Storage Solutions:** Implement energy storage systems, such as batteries, to store excess renewable energy during periods of high generation. This stored energy can then be used during periods of low renewable energy availability, ensuring a consistent power supply for electrolysis. • **Demand-Side Management:** Implement demand-side management strategies to optimize the timing of electrolysis processes based on renewable energy availability. This helps align hydrogen production with periods of high renewable energy generation.
• **Sustainable Water Management Practices**	• **Water-Efficient Electrolysis Technologies:** Invest in the development of electrolysis technologies that are more water-efficient. Research and innovation can lead to advancements in electrolysis processes that minimize water consumption. • **Site Selection:** Choose locations for green hydrogen production facilities based on water availability and consider areas with access to sustainable water sources. Strategic site selection can mitigate water scarcity challenges. • **Water Recycling and Treatment:** Integrate water recycling and treatment systems to purify and reuse water in the electrolysis process. This not only conserves water resources but also addresses concerns related to water quality.

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Thank you for your attention

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