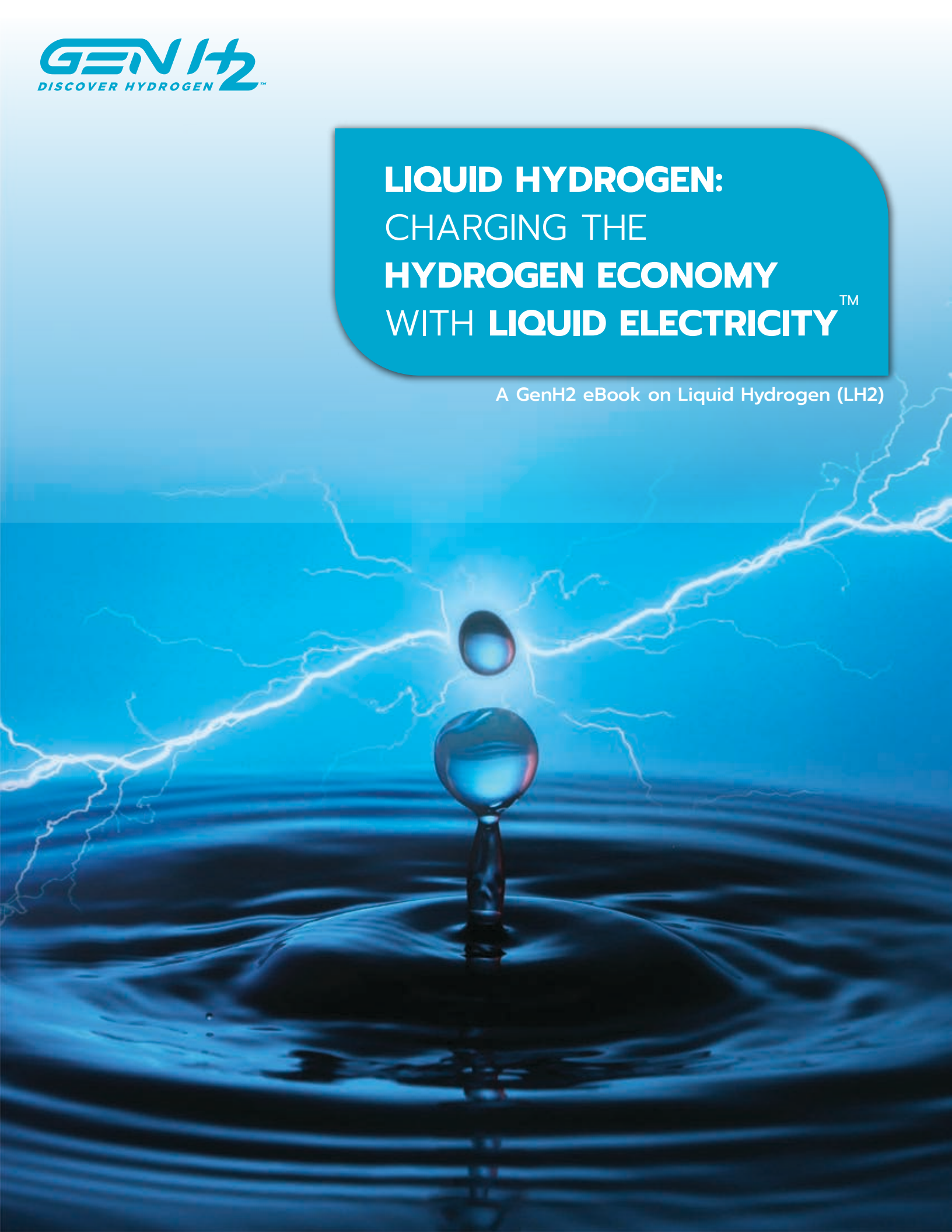
GEN H2
DISCOVER HYDROGEN™

LIQUID HYDROGEN: CHARGING THE HYDROGEN ECONOMY WITH LIQUID ELECTRICITY™

A GenH2 eBook on Liquid Hydrogen (LH2)



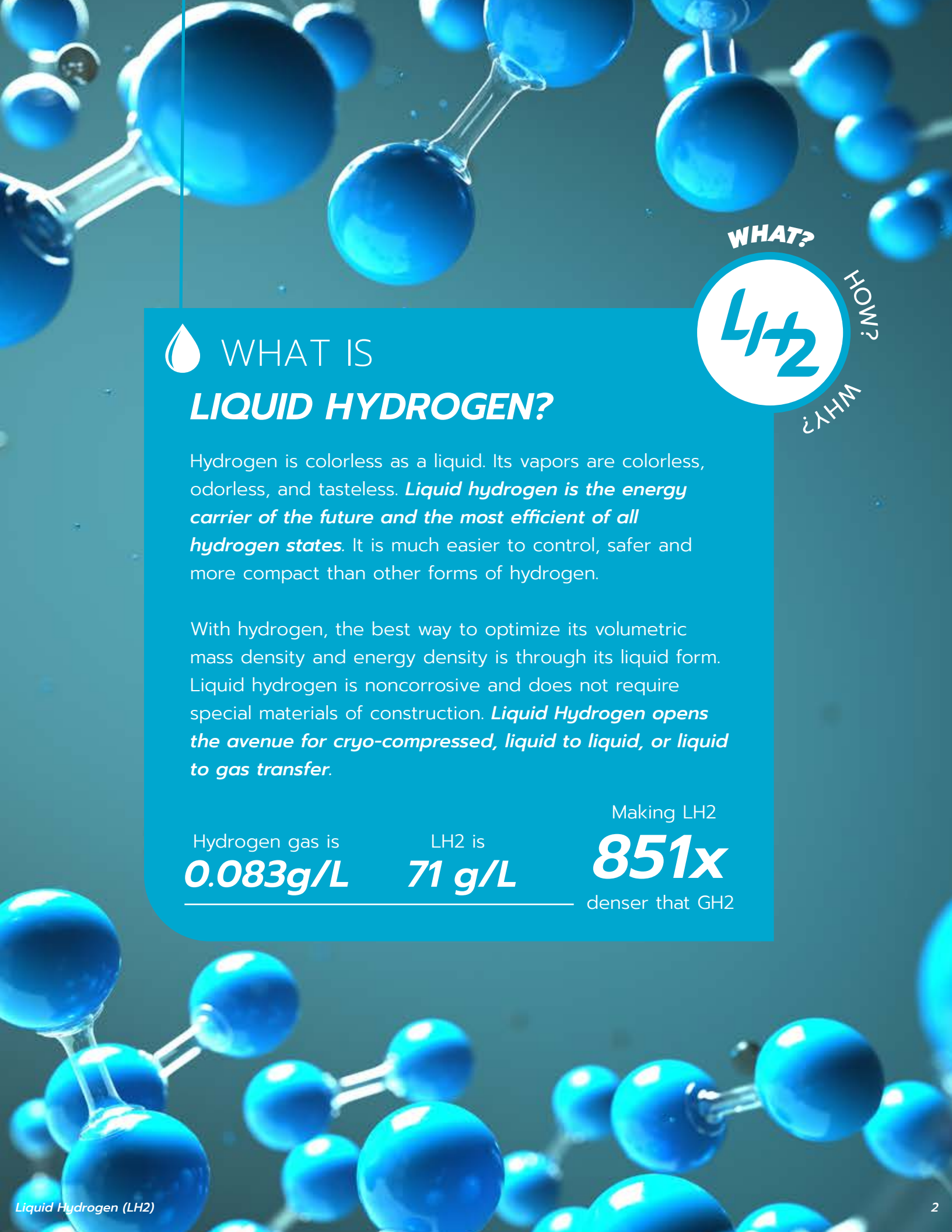
AN INTRODUCTION TO LH2

LIQUID HYDROGEN:
An imminent need.

A molecule that can be made from water, stored in a high-energy densified liquid state, and used with the potential of zero environmental impact – Hydrogen, specifically ***LH2, is a wonderful molecule and provides a feasible path towards a clean energy future***.

The global necessity for environmental concerns and climate control is dependent on finding and utilizing clean energy solutions. As a result, there is a huge demand for the more efficient, time saving use of the densified form of LH2.

A few of the LH2 applications include: space technology, aircrafts, drones, cargo ships, ferry boats, trucking, forklifts, data centers and utilities.



WHAT IS
LIQUID HYDROGEN?

Hydrogen is colorless as a liquid. Its vapors are colorless, odorless, and tasteless. ***Liquid hydrogen is the energy carrier of the future and the most efficient of all hydrogen states***. It is much easier to control, safer and more compact than other forms of hydrogen.

With hydrogen, the best way to optimize its volumetric mass density and energy density is through its liquid form. Liquid hydrogen is noncorrosive and does not require special materials of construction. ***Liquid Hydrogen opens the avenue for cryo-compressed, liquid to liquid, or liquid to gas transfer***.

Hydrogen gas is
0.083g/L

LH2 is
71 g/L

Making LH2
851x
denser that GH2

WHAT? HOW? WHY?

HOW IS HYDROGEN ***LIQUEFIED?***

Hydrogen gas flows into the liquefaction chamber of a cryogenic refrigerator and is liquefied. Hydrogen liquefies at 20.3 K (-252.9 °C, -423.1 °F). Thus, *storage vessels require sophisticated design and insulation techniques* to minimize unavoidable heat ingress leading to hydrogen loss via boil-off - *a problem which has challenged scientists for decades.*

GenH2 is advancing a specialty-controlled storage system which combines both active and passive technologies that affords full process control over the state of the hydrogen fluid. This control allows for greater operational efficiency, time savings, zero-loss transfer, flexibility in ground operations, and enhanced performance.

GenH2's mission is to make LH2 infrastructure products extensively available across the globe by using innovative hydrogen liquefaction and controlled storage technologies that results in ***ultra-pure LH2.*** The liquid hydrogen equipment used, and optimum solution selected depends on the production rate, the size/scale and the type of end use application.

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WHY?

HOW?

WHAT?

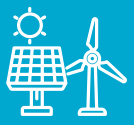
Hydrogen is the most abundant element in the universe and has been used safely and securely for over 80 years in industrial applications. This viable alternative energy carrier can be safely harnessed and used as a clean and reliable resource. It can be used for home solutions as well as in mobility applications like passenger cars, trucks, buses, trains, drones, aircrafts, space and cargo ships. **Hydrogen, and specifically Liquid Hydrogen, is also being identified as the best solution to help tackle critical, hard-to-abate sectors, such as heavy industry and long-distance transport**.

The Renewable energy source in bountiful supply

Densified to liquid energy = time savings

Stored, used later on-demand

Non-toxic, practically clean energy source that reduces pollution



Can be produced locally from numerous sources

Far more efficient and sustainable than other energy sources

THE MANY USES OF **LIQUID HYDROGEN**

The **SPACE** industry as a propellant for space rockets. When combined with liquid oxygen (as an oxidizer), LH2 can generate the tremendous power that is needed to launch a rocket into the cosmos.

The **MARITIME** industry shows increasing interest in LH2 as a sustainable energy carrier in combination with fuel cells. To meet the target on reducing CO2 emissions, a shift from fossil fuels to CO2-free fuel are expected for this industry.

The **AVIATION** industry is working persistently on technologies for LH2-powered systems for small to large aircraft. The first pilot models are expected to be built around 2030.

The **ROAD TRANSPORT** sector, comprising of both heavy-duty freight and passenger transportation. Passenger cars and trucks have been manufactured that use gaseous hydrogen and fuel cells for electric propulsion. Currently there is a push for transitioning to on-board LH2 for long haul trucking and heavy-duty vehicles.

The **ENERGY** sector, in which LH2 can be used to both cool generators in power plants and stabilize the power grid. Hydrogen is stored and used in fuel cells, which provide a stable backup of energy resulting in optimal uptime. Liquid Hydrogen allows for renewable energy storage at scale.

FURTHER GROWTH POTENTIAL OF **LIQUID HYDROGEN**

The ***AEROSPACE*** industry is one of the major users of LH2 and has invested in research. This industry already uses LH2 to launch rockets, provide electricity in space, and for other space technology. It is expected that increased capabilities and availability in small scale LH2 testing and demonstration in the U.S. will also advance the use of LH2 for commercial space and aviation.

Currently, there is a growing interest in ***SUPERCONDUCTIVITY*** (the state in which material has virtually no resistance when transporting electricity), in which LH2 plays an important role. This broad area provides many other potential uses. Superconducting electrical power systems work hand-in-hand with liquid hydrogen systems: the cooling power of the cryogenics complements the electrical power of fuel cells.

The development of ***HEAVIER TRUCKS, SHIPS,*** and other ***EXTENDED-RANGE VEHICLES*** is also moving towards the use of LH2 in on-board tanks.

SUSTAINABILITY BENEFITS OF **LIQUID HYDROGEN**

Hydrogen is an omnipresent element. So even while there are currently challenges related to greener approaches of hydrogen production, there is no shortage of raw materials.

When produced and used in a sustainable way, hydrogen doesn't adversely affect the environment.

The production of hydrogen does not require large areas of land, which for example is the case for biofuel and hydropower.

LIQUID HYDROGEN

ENERGY CARRIER OF THE FUTURE

LH2 is clean and compact. It has great compression synergy and is better due to it's ability to be controlled and captured.

Like other fuels/energy sources, there are a few risks associated with hydrogen, but specific risks are mitigated and are addressed appropriately and successfully.

LONGER DRIVE TIME

24

Hydrogen Fuel Cell Trucks can operate for 24 hours without recharging

LESS REFILLING REQUIRED

Hydrogen refills in minutes vs. hours of charging time

LARGER PAYLOADS

LH2

Hydrogen fuel cells weigh less, allowing for larger payloads

BUILDING **SAFE SOLUTIONS**

Fortunately, hydrogen has been used in various industries for a very long time. As a result, infrastructures and security measures have improved significantly over the past few decades.

Sophisticated sensors now exist that immediately indicate a leak from an infrastructure. Hydrogen tanks, pipelines, and applications are also subject to rigorous testing standards. This equipment is rigorously tested and commissioned before it can be put into service.

With the proper infrastructure in place and informed, responsible usage by the end-user, hydrogen can be safely managed without any problems.

GenH2 utilizes practices and technologies proven to be successful in addressing safety risks.

The Liquid Hydrogen Experts

GenH2 is investing in scalable hydrogen infrastructure for liquefaction, storage, and distribution solutions – all things essential for the transition to a clean energy economy.

LIQUID HYDROGEN

The Clean Energy Carrier

Higher purity for fuel cells

Significantly lower electricity requirements

Increased energy storage capacity

Eliminates need for large, expensive electric chiller

Substantial reduction in physical footprint

LH2 systems are extremely compact compared to GH2 systems

THE IMPORTANCE OF **INFRASTRUCTURE**

In order to generate consumer interest and accessibility to LH2 as an energy carrier, infrastructure must be widely accessible. **The primary focus of GenH2 is to provide hydrogen infrastructure solutions for the marketplace that span across different scales and capabilities across multiple industries**.

GenH2 is addressing innovative hydrogen solutions for up to 1 ton-per-day systems. Featuring light-scale industrial infrastructure products such as the **1 tonne per day Liquefaction, Storage, and Transfer system**. Components will be mass produced, offering modular, on-site or near-site infrastructure solutions to support the urgent demand of the rapidly expanding Hydrogen Economy.

GenH2 - An industry leader in **Hydrogen Infrastructure** solutions and products

The new clean energy economy is dependent on the development of new advanced infrastructure concepts. GenH2 is developing several infrastructure products to accelerate the Hydrogen Economy with the highest environmental standards.

- On-site modular, scalable systems or integral units
- Low to no CO2-free hydrogen liquefaction, storage, transfer & dispensing
- Reliable, safe liquid hydrogen solutions

Making **net zero emissions** a reality.

GenH2 is rapidly growing - with the global objective to revolutionize the hydrogen economy using Liquid Hydrogen. New partnerships are essential to achieve this mission and make the world a greener, more livable place. Join hands with GenH2 to be a part of the hydrogen revolution.

GenH2 Solutions include:

- Hydrogen Liquid Multiplexer (HLM) systems
- Gaseous Hydrogen Liquefier
- Transfer, Compression and Dispensing systems
- Controlled Liquid Hydrogen Storage systems with IntegratedRefrigeration and Storage (IRaS)

To learn more about Hydrogen and GenH2, go to www.DiscoverHydrogen.com

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