Powering the Energy Future

With the world looking to accelerate decarbonization there's huge interest in both LNG and hydrogen. In this issue of our newsletter we're pleased to share some of the cool things that are happening right now in the development of our cleaner and sustainable energy future.

A little bit about hydrogen

Like natural gas, oxygen, nitrogen and many others, the most efficient way of storing and transporting hydrogen is as a liquefied gas. This is certainly not new technology and Chart has been supplying the world with liquid hydrogen (LH_2) storage, vaporization and transportation systems since the 1960's.

The challenge now is to ensure there is sufficient capacity and infrastructure to keep pace with the growing number of applications for this alternative fuel.

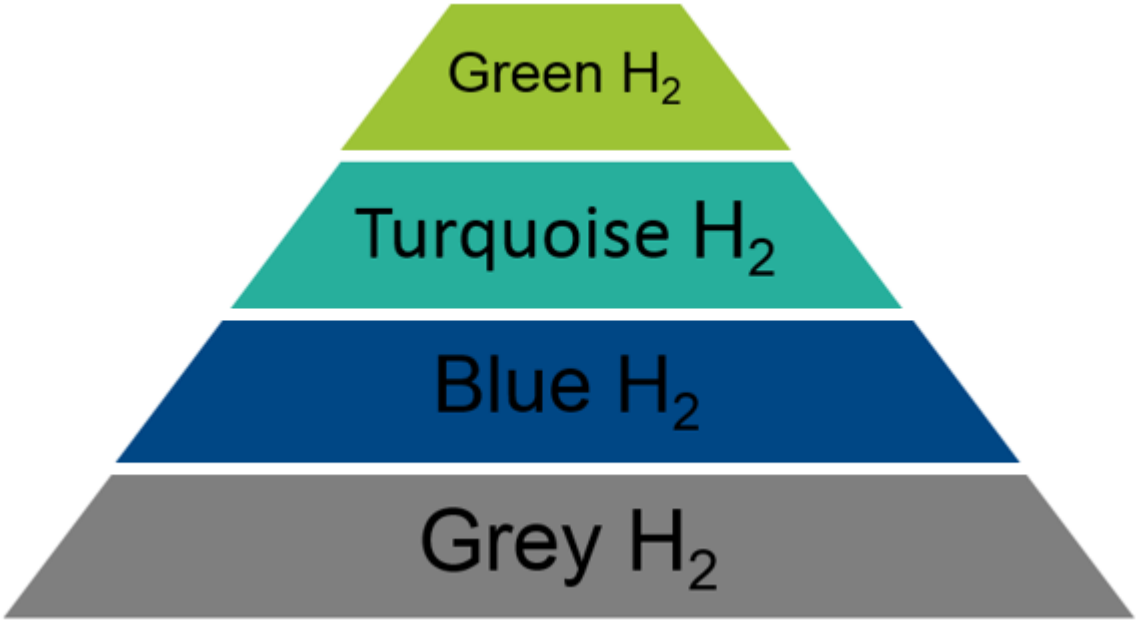
Although the equipment for transport, storage and vaporization of LNG and LH_2 looks similar on the outside, there are some fundamental differences:

- LNG is stored @ -265° (-163°C), where LH_2 is kept as cold as -450°F (-253°C.)
- Hydrogen molecules are much smaller than natural gas molecules
- LNG is fed to an internal combustion engine whereas hydrogen is converted to electricity onboard the vehicle through the use of a fuel cell stack, which powers an electric motor

Consequently, equipment for liquid hydrogen is specifically designed for deep cryogenic temperatures and to contain the much colder and smaller molecules from escaping through joints and seals.

United Colors of Hydrogen

All colors of hydrogen share the same non-toxic and clean burning characteristics producing only electricity and water at the point of use. However, the processes to yield hydrogen can run down a few pathways and it's from these that the different 'colors' of hydrogen are derived.



Grey Hydrogen – produced from hydrocarbons, for example steam methane reforming (SMR) of natural gas, partial oxidation of methane or coal gasification.

- Process produces CO2
- Least expensive way of producing large amounts of hydrogen
- Currently accounts for >90% of world hydrogen production

Blue Hydrogen – the carbon dioxide waste from the grey process, is captured and sequestered to use as the power source to make blue hydrogen.

- Can also be produced using purified landfill and digester gas (methane) and fed to a traditional SMR thereby further preventing emissions of a potent greenhouse gas

Turquoise Hydrogen – created when natural gas is broken down with the help of methane pyrolysis into hydrogen and solid carbon.

- Turquoise hydrogen produced through catalytic hydrogen stripping
- The co-product, solid carbon, is a highly valuable resource

Green Hydrogen – produced by electrolysis using renewable power.

- Production process requires a lot of energy. If this energy comes from renewable sources such as wind, solar and hydro, it is the cleanest fuel

Currently the most expensive production method, although displaced carbon can be converted to carbon credits and sold in these newly created markets
In long range planning scenarios of many utilities, local governments, and transportation companies, all colors of hydrogen are included, especially those organizations with zero emissions commitments.

Chart products and solutions are able to liquefy, distribute, transport and use all colors of hydrogen.

For more information, including our hydrogen solutions video, please click the icon below.

New Generation of Hydrogen Gas Trailers

Today's state of the art solution for high pressure Hydrogen trailers is hitting the road in Europe. The unique design is due to European regulations covering trailers of this size. The 'inside the box' photo *(above left)* shows a system comprised of 135 interconnected, vertical, high pressure cylinders engineered and built by Chart's GOFA facility in Germany,

The above trailer offers a 300 bar solution for up to 47250 Litres or 940kg. Longer versions for other governing regulations are in process and the next level for transportation of gaseous hydrogen, at pressures up to 500 bar, is already under development. With it GOFA is setting another benchmark for efficient hydrogen transportation.

To learn more about GOFA and their comprehensive range of cryogenic and non-cryogenic transport trailers visit www.gofa.de.

LNG News on the Rivers in China

In August 2020, Hunan Ocean Container Lines Co., Ltd launched the Xiang Shui Yun. Built by Jinhang Ship Building Co., Ltd at Yuanjiang City, Hunan Province, this is China's first river to sea LNG fueled vessel. The LNG fueling system includes an 89m^3 cryogenic storage tank mounted on the rear deck. The tank, the largest ever built in China for an LNG fueled inland vessel, together with inter-connecting piping, valves, instrumentation and control system were all engineered and built at Chart's facility in Changzhou PR China.

Another demonstration of the marine industry using LNG as a safe and reliable fuel solution to ensure compliance with IMO emissions' regulations.

LNG on the Rails

In the summer 2020, the US agencies having jurisdiction over transporting LNG by rail have given approval allowing it to be shipped in specially built tanker cars. In Title 49, US Code of Federal Regulations (CFR), the Pipeline and Hazardous Materials Safety Administration and the Federal Railroad Administration approved transport by rail, joining Canada, the EU and Russia in approving rail to ship LNG. The LNG tanker cars incorporate the double wall / tank-within-a-tank design common to shop built cryogenics.

Moving LNG via rail can reduce both the environmental footprint and cost of distribution. In the June 2020 edition of Gasworld, Chart's CEO Jill Evanko shared her insights into how this approval could impact LNG shipment, "Rail typically has a fee per trip per car; highway is a cost per mile. Long highway runs often require a sleeper cab and two drivers. So, in general our team's opinion is that LNG by rail is competitive with, and more cost effective than, highway on longer distances. In the US, the rail tank car will carry ~30,000 gallons, versus ~10,000 gallons in a highway trailer – 1/3 the units to move X gallons, and 1/3 the loadings and un-loadings to make."

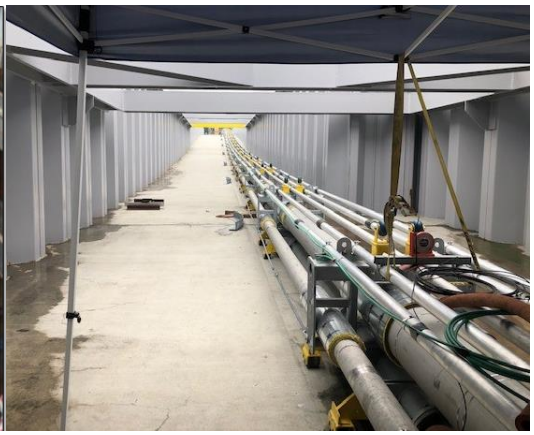
To read the full article in Gasworld, click here

LNG Bunkering and Transportation Fuel Supply in Pacific Northwest

Marine supply of LNG fuel on west coast USA is about to get easier. Puget Sound Energy is within months of commissioning their liquefied natural gas (LNG) facility at the Port of Tacoma. The facility will provide local transportation companies with a cleaner fuel alternative as well as marine vessels, such as ships within the TOTE fleet. Chart's part in this project was providing custom engineered Vacuum Insulated Piping (VIP) to deliver high flow of the LNG fuel to ships at approx. -235°F.

While many new LNG bunkering facilities encounter challenges of putting facilities in existing port locations, Tacoma's challenges included an existing road and three rail lines located between the LNG bulk storage and the shore side. A casing was built below grade to cross these obstacles. In a feat of installation engineering, the entire 800 foot pipeline was assembled and tested above ground and slowly pulled through the casing in an operation that lasted several days.

Below grade casing in construction phase



Casing view

Want to know more about this project? Click here to view the case study

Respecting the COVID-19 challenges we've all encountered; Chart is looking forward to scheduling our in-person LNG 101 and 201 courses starting again in September 2021. Contact Cathy.Dols@ChartIndustries.com to be kept informed of details. We plan to meet many of you soon for 2 ½ days of training at this popular workshop. In the meantime, stay safe and consider joining our 1 hr webinar in Feb. 2021 on LNG topic of ***Exploring LNG as your Back-Up Fuel.***

Chart is a proud supporting member of the following hydrogen organizations:

Hydrogen Council · Hydrogen Europe · California Hydrogen Business Council (Hydrogen Means Business in California!) · US-India Strategic Partnership Forum · California Fuel Cell Partnership · European Clean Hydrogen Alliance · FCHEA Fuel Cell & Hydrogen Energy Association · sGmf · MarHySafe · DNV·GL · Australian Hydrogen Council

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