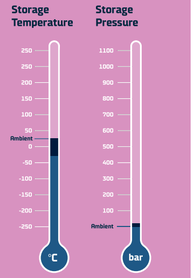
Green Ammonia (NH_3)

Green ammonia can be sustainably produced from water, air and renewable energy. It can be stored efficiently as a liquid by compressing or cooling it.



Chemistry

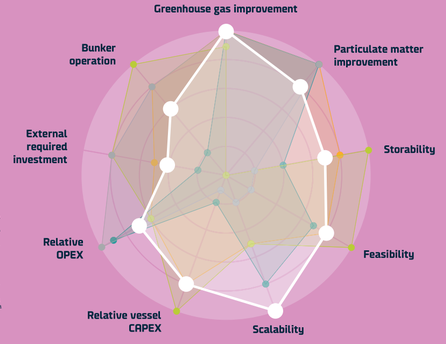
Ammonia is an inorganic compound composed of a single nitrogen atom covalently bonded to three hydrogen atoms.

Characteristics

Colourless gas with a strong suffocating odour. Causes skin, eye and respiratory burns. May cause blindness. Exposure to high levels may be fatal.

Potential explosion hazard in confines space. Use sufficient vapour ventilation to prevent vapour build-up.

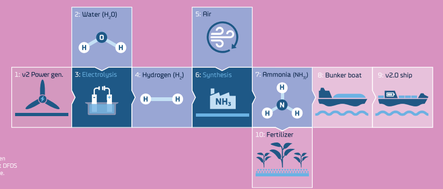
Ammonia has alkaline properties and is corrosive. Ammonia gas dissolves easily in water to form ammonium hydroxide, a caustic solution and weak base.



Production and consumption

Green ammonia is made by using renewable electricity to split water into hydrogen and oxygen via an electrolysis process . The hydrogen, and nitrogen captured from the air is synthesised into ammonia using the Haber-Bosch process . The ammonia is delivered to ships using dedicated ammonia bunker vessels .

Fertilizer production requires huge amounts of ammonia and accounts for a significant percentage of global CO_2 emissions. Fertilizer production can be decarbonized by switching from black to green ammonia . Significant synergies between shipping and fertilizer production are expected, which will help to bring the scale needed for getting the cost of green ammonia down.



Learn more online about green ammonia, check out relevant DFDS projects and join the dialogue.

Energy density

	MJ/L	MJ/kg
Hydrogen (pressure)	4.7	120
Hydrogen (cryogenic)	9.7	120
Ammonia	11.3	18.4
Ammonia -33°	11.3	18.4
Methanol	15.6	19.7
Pyrolysis (MRSH)	35.8	36.5
Electricity	3.6	0.7
HFO	42.1	42.6
LNG -162°	20.3	48

Magnolia Seaways
Gothenburg - Immingham

	M³	Tons
Hydrogen (pressure)	707	28
Hydrogen (cryogenic)	343	28
Ammonia	294	181
Ammonia -33°	294	181
Methanol	213	169
Pyrolysis (MRSH)	93	91
Electricity	923	4747
HFO	79	78
LNG -162°	164	69

DFDS

Green Hydrogen (H_2)

Green hydrogen is a highly sustainable, CO_2 neutral fuel, which can be produced using only renewable energy and water. It has the potential to become a major fuel source for v2.0 ships. and society in general.

Chemistry

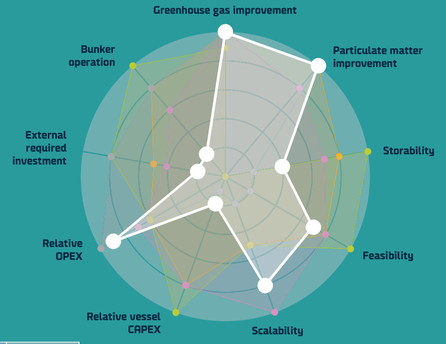
Dihydrogen is an elemental molecule consisting of two hydrogen atoms joined by a single bond.

Characteristics

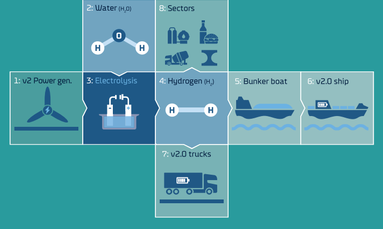
Odourless, colourless, tasteless, non-toxic gas in ambient environments.

Hydrogen burns with an almost invisible blue flame which can cause very localized heating and explosion or rupture of pressure vessels.

Hydrogen is very difficult to store and handle in large quantities. It is much lighter than air – so light that it escapes the Earth's atmosphere if spilled.



Production and consumption



Green hydrogen is made by using renewable electricity to split water into hydrogen and oxygen in an electrolysis process . Already today, hydrogen is being used in huge quantities in other sectors. Such as the petrochemical, cement, fertilizer, metal and food industry. Hydrogen is also a great fuel in fuel cells for ships. and trucks . Today, most of the hydrogen is being produce near to where it is consumed, as it is very difficult to handle and store. For shipping to adopt hydrogen as a fuel, we would need to have a new fleet of zero emission fuel cell ships and a new bunker infrastructure in place.

Learn more online about green hydrogen, check out relevant DFDS projects and join the dialogue.

Energy density

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Gothenburg - Immingham

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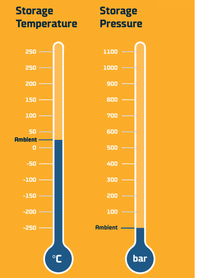
DFDS

Green Methanol (CH_3OH)

Green methanol can be made by combining sustainably produced hydrogen and CO_2 captured from renewable sources. Limited availability of sustainable CO_2 and huge potential demand from aviation make green methanol less financially attractive for shipping.



Chemistry

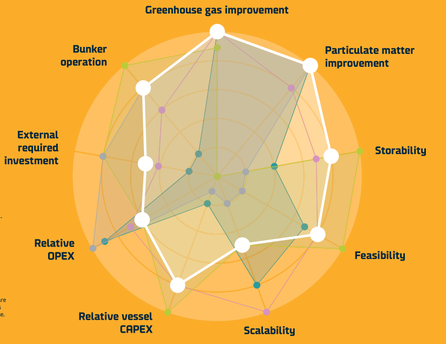
Methanol (CH_3OH), also called methyl alcohol amongst others, is the simplest alcohol, consisting of a methyl group (CH_3) linked with a hydroxy group (OH).

Characteristics

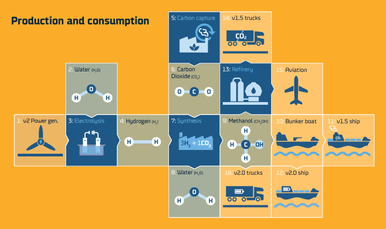
R poisonous, light, volatile, colourless, flammable liquid with a distinctive alcoholic odour similar to that of ethanol (drinking alcohol) in ambient environments.

Potential for explosion hazard, equipped with provisions for pressure relief in order to accommodate thermal expansion.

Methanol is highly flammable. Its vapours are heavier than air. It forms explosive mixtures with air and burns with a nonluminous flame. It is completely miscible in water.



Production and consumption



Green methanol is made by using renewable electricity to split water into hydrogen and oxygen in an electrolysis process . The hydrogen, combined with short-cycle CO_2 captured from renewable sources such as flue gas from biomass combustion , is synthesised into methanol. and water . Methanol is a proven fuel for normal dual-fuel ship engines . , but it can also be used as fuel for fuel cells, which can be used for new generations of very simple ships . and trucks .

By processing the methanol at an oil refinery , it is possible to make sustainable diesel for trucks . and sustainable jet fuel for aviation .

Learn more online about green methanol, check out relevant DFDS projects and join the dialogue.

Energy density

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