

Society)) is a pass. Currently, the only “official” consequence is a requirement for corrective action; there is (as yet) no sanction from public authorities. That may change in the future. However, there will likely be substantial marketing problems for ships that are non-compliant e.g. charterers may refuse to hire non-compliant ships.

At the IMO’s MEPC 81 (held in March 2024), world governments agreed a draft outline of how to reach the IMO’s Net Zero Framework. This may include further updates to international law. The two key elements are (1) “a goal-based marine fuel standard regulating the phased reduction of the marine fuel’s GHG intensity” and (2) “an economic mechanism (or mechanisms) to incentivise the transition to net-zero. A variety of proposals are being considered.

Technologies, tactics, and process

The specific technologies that will decarbonise shipping are variable and at various stages of certainty and maturity. There are an enormous range of actions that can, and are, being taken by the shipping industry to decarbonise. According to the UN / Global Environment Facility / IMO project, “GloMeep,” there are a range of processes that can be improved, and these can cut a large percentage of fuel use including, among other things, engine and routing optimisation. There are also a range of energy-saving devices that can be installed such as Mewis ducts, boss caps, fins, kites and sails.

Energy / fuel – liquefied natural gas (LNG)

In May 2024, there were 1,044 LNG ships or LNG-ready ships in operation or on order (according to DNV’s Alternative Fuel Insight Database) and 147 ports around the globe could bunker LNG; this figure is likely to reach 200 by 2024. About 372.3 million tonnes of LNG is internationally traded (2021). LNG tanks on ships must be about 2.5x to 3x bigger than HFO because of the lower energy content.

LNG is the super-cold, liquid form of the compound gas, methane (CH₄). It has virtually no sulphur oxides, few particulates and little nitrous oxides.



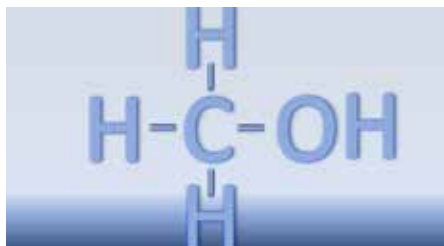
Pictured: natural gas burning blue in a domestic burner. Liquefied Natural Gas is the super cold and purified form of natural gas – otherwise known as “methane” – and which is used in domestic cooking the world over. LNG cannot get shipping to the net zero goal but, for many years, it was thought to be the likeliest bridging fuel from conventional heavy fuel oil to hydrogen. However, developments in methanol fuel could render that fuel-future somewhat redundant. Photo credit: Magnascan via Pixabay.

Incidentally, to some degree, all high temperature combustion creates some nitrous oxides because molecular atmospheric nitrogen combines with oxygen during combustion.

LNG has 20% to 25% less carbon content than conventional heavy fuel oil so it cannot get the shipping industry to net zero. Methane is also a highly potent greenhouse gas that breaks down into CO₂ after some years in the air. It is widely traded, available, and there is high knowledge of how to safely handle it. LNG is difficult to handle because it under pressure and is a cryogenic fluid at 160 degrees Celsius.

Energy / fuel – methanol

Methanol (CH₃OH) is an alcohol with six atoms – one carbon, four hydrogen, and one oxygen. Methanol has an energy



Graphic: a representation of a molecule of methanol, which can be used as a fuel. Methanol is composed of three hydrogen atoms bound to one carbon atom, which is in turn bound to an oxygen atom, which is, in turn, bound to another hydrogen atom, which gives the chemical formula CH₃OH. Methanol is a liquid at standard temperature and pressure. Graphic credit: Shipping Australia.

density (gravimetric) of 19.9 MJ/kg (LHV basis), compared to 42.7 MJ/kg for marine gas oil, so a ship powered with methanol will need to carry about 2.15 times more methanol compared to Marine Gas Oil.

Major international shipping companies committing to methanol-powered vessels include Maersk, Berge, Höegh Autoliners, Stena Bulk, CMA CGM, Waterfront Shipping, and many more.

The first methanol powered vessel (a ferry, the Stenica Germanica) entered service years ago and several box ships are due to enter service. Last year, the number of methanol vessels being built over-took the number of LNG-powered vessels being built; in May 2024, there were 281 methanol-powered vessels in service / on order – this is an achievement as, a few years ago, there were none.

Methanol has a lower gravimetric and volumetric energy content than conventional fuel oil so it requires bigger tanks, or more frequent bunkering, or some combination of both. It is non-cryogenic and it is a liquid at standard temperature and pressure.

Unfortunately, humans are sensitive to methanol. Ingestion, inhalation, or skin absorption can cause irritation, respiratory issues, nausea, headache, blindness, vomiting, diarrhea, and death. Methanol mixes with water, can be carried in the air as a vapour for about 18 days, is biodegradable, and does not bio-accumulate. Long term exposure can affect the fertility of biota and affect appearance or behaviour. However, industry experts have advised Shipping Australia that if a company or nation can handle petrol safely, then it can handle methanol. Methanol is widely traded around the world and there is a considerable body of knowledge in its safe handling, storage and use. The IMO has approved methanol as a safe fuel in MSC.1/Circ.1621, the Interim Guidelines for the Safety of Ships Using Methyl/ Ethyl Alcohol as Fuel (2020).

Methanol can be made with renewable energy, such as solar power. Two of its ingredients, hydrogen and oxygen, are commercially available gases that can be made by splitting water with green electricity. The carbon in methanol can be sourced from sustainable waste products such as forestry residues, agricultural wastes, and the like.