

# Alcohol as Marine Replacement Fuel

By David Blume

I attended a high-level think tank in Mexico some years ago. We were there to work on the world's pressing problems. There I met a board member of Maersk Shipping, the owner of the largest container ship fleet in the world. I asked him what fuel he's planning to use to replace bunker diesel since the world is ready to ban it. He told me that his company was looking at Liquefied Natural Gas or Liquefied Hydrogen.

I told him that if he were to choose one of these fuels, then his company would be a world of pain. Then I asked him if he has seen the movie *Syriana* with George Clooney. There's a part of the movie where a collection of small boats going out to fish is seen as if from a helicopter. Also seen from the air is a Liquefied Natural Gas (LNG) tanker with its spherical tanks.

All of a sudden one of the little fishing boats breaks from the group and hangs a left. The point of view switches to water level, looking a few feet away at the fishing boat with the two young Islamic boys. When you look closer, you see under the nets, a large missile. The boys ram it into the ship and the screen goes to white. That ship with its load of LNG, has more explosive power than the atom bomb dropped on Hiroshima in WW II. Such an explosion would flatten all buildings within 10 miles of the port.

I asked the board member if he thought he could actually buy liability insurance for that risk. He got my point. Of course he asked me, if I was such a smart guy what would I do? I pointed out the highly efficient 4-story-tall freighter engines could be relatively easy to convert to perfectly clean-burning alcohol, and in the event of a shipwreck the alcohol would cause very little environmental damage as it diluted with water.

He asked me to write a white paper on the subject for him to take to his upcoming board meeting. Of course I did. In 2023 Maersk launched its first 5 alcohol-powered container ships.

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### The Problem Is the Solution!

As discussed below, the climate change being effected by fossil fuel emissions is often attributed to land vehicles. After all, we burn nearly 500 Billion gallons of toxic fossil and syn-gas fuel in the 1.3 Billion registered vehicles on the world's highways today. The discussion, when it comes to oceans, is that about 90% of the CO<sub>2</sub> produced by vehicles ends up in the ocean as carbonic or sulfuric acid (pollutants plus rainwater). But there is actually a 900-pound gorilla that no one is talking about that needs to be addressed.

That's the pollution produced by the world's fleet of tankers, container ships, and freighters that travel to and fro around the planet. It's the basis of all economies in the world, since moving raw material, parts of products, and finished products makes up all the essential and optional consumer goods that humans want. It turns out that 99.9% of the pollution from fossil-fueled engines comes from these transoceanic ships.

The **root** of the problem is materialism, the desire for stuff. If we were willing to change our habits to only buying locally manufactured products and abandoning our desire for stuff, climate change and toxic pollution would largely be a thing of the past. But we like things the way they are. Ask anyone who wants an avocado in January.

So approaching the **root** of this problem is not likely to result in much change. What is realistic is that we need to replace ship, land transportation, and electrical generating fuel with something, non-toxic, non-polluting, renewable, and oxygen-producing, **reversing** the excess of climate change gasses already in the atmosphere/ocean — and, while we are at it, generate all our electricity, instead of using fossil fuels/nuclear power, while replacing fossil-energy-intensive agricultural fertilizers used to produce food planet-wide. **The fuel that meets all these criteria is alcohol aka ethanol.**

As it turns out, the highest-yielding crop to make ethanol is marine algae. It can be fermented to produce a whopping 100 times the alcohol that corn produces per acre without chemical fertilizers. It does this while cleaning and oxygenating the coastal oceans.

It's not surprising, since marine algae doesn't have to waste energy standing up to gravity, and is bathed in all the nutrients it needs. Best of all, we humans have a lot of experience with marine algae farming over vast areas of ocean for non-fuel purposes.

There is no requirement to continue to do things stupidly. In a generation or two we can be well down the path to rapidly reversing global climate change with a trivial amount of capital. In fact, a typical tax cut proposed by an American president, by cutting social programs budgets, would be enough to accomplish much of the goal of fixing the biggest problems the planet faces.

## The Opportunity

There are over 53,000 commercial ships, excluding military vessels, and a huge number of slightly smaller ships. Just these commercial ships pollute over 1600 times more than all the land vehicles in the world. Another way to see this is that all the land-based vehicles' emissions add up to far less than 1% of the total maritime pollution produced each year. This is true of both climate change gasses and highly toxic polluting chemicals.

Many countries and regions are in the process of phasing out diesel fuel usage in cities on land. There is legislation pending in California to phase diesel out altogether. The Clean Ports Initiative is advocating that all ports in the world ban diesel bunker fuel use, and many port cities have restricted bunker-fueled freighters from entering their ports. Marine fuel is squarely in the projected target area for global reduction and elimination.

## **Are There Safe, Non-Toxic Alternatives That Are Affordable?**

YES. Since modern life as we currently know it depends on a robust maritime system of moving products, it's a good thing we have alternatives that will work. Ideally it should be a fuel that does not require more than modest refitting. What's more, it needs to be compatible with ships' engines and the associated fuel systems such as tankage, pumping, and refueling infrastructure. What equally important is a fuel's energy density. Liquid fuels are unique in their amount of energy per gallon. Of all the liquid fuels proposed for Marine use, only ethanol has the possibility of worldwide production in the volumes necessary to both service the industry while meeting the climate and pollution goals desired.

## **Ethanol and Emissions**

Ethanol is a liquid, so will work in current liquid-fueled vessels. Alcohol is a single consistent non-toxic substance rather than a stew of hundreds of waste chemicals left over from oil refining. Bunker exhaust is made up of incompletely burned toxic breakdown products from this "junk" oil. Alcohol also contains oxygen in its structure, which makes for a nearly complete combustion (oxidation of fuel) for energy. As a result, it is easy to make sure alcohol is fully consumed, extracting almost all the energy for work while having roughly no emissions. In land vehicles and aircraft tests of emissions show more than 99% reduction. In some cases, alcohol's exhaust is cleaner than the urban port's air entering the engine! But perhaps the dramatic outcome is that alcohol contains NO sulfur and therefore makes absolutely no Sulfur oxides (SO<sub>x</sub>).

When it comes to climate change gases, the raw material, and plant matter, used to make alcohol removes carbon dioxide from the air via photosynthesis. CO<sub>2</sub> in alcohol exhaust is used to feed next year's crops, making it zero emission and totally renewable, unlike fossil fuel.

Another important benefit of alcohol fuel is that it is clean burning. Typically, that means we can triple engine life while reducing lubricating oil changes by 80%. Engine oil never turns black and foul with carbon, shellac and all the crude chemical compounds found in gasoline.

The best part of all is that alcohol can be made at a lower cost than diesel, employs vastly more people in its manufacture, is locally produced, and eliminates the massive export of national capital to oil-producing countries. As long as the sun shines and plants grow, we will have alcohol fuel. It is truly a renewable and clean fuel.

Do we need to replace all of the marine diesel engines to use alcohol?

No, we do not. Refitting the world's ships with new engines would require a crushing amount of capital. Current engines can be converted to be dual fuel, both bunker diesel and alcohol, until alcohol becomes universally available in ports.

## **To Sum It Up**

Alcohol fuel is renewably produced from food waste and energy crops. It generates greater power than diesel, and runs 300 degrees cooler for longer engine life. It will always be less expensive than any unsubsidized fuel. It will never run out. In the event of a spill, the only result is a few drunken fish, and it dissipates harmlessly in a few hours. Our oceans, and planet, deserve better than what we're giving them now. It is absolutely possible to distill this solution for the maritime industry, yielding both modest costs and increased profits.