# THREE SUSTAINABLE ALTERNATIVE FUELS

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In October 2020, a little-noticed piece of news flashed across the world energy wires. The French government stepped in and **blocked** a deal that would have seen $7 billion of West Texas liquified natural shale gas sold to Engie, which is partially owned by the French government. The reason? The U.S. shale gas is too "dirty." The underlying problem is that U.S. natural gas producers emit too much methane, which as a greenhouse gas is more than **80 times** more potent than carbon dioxide in the atmosphere.

The French government's actions are part of a global push to decarbonize the world, with billions of dollars of investments being directed away from fossil fuels into renewables like solar and wind power. Although renewable, these green sources come with inherent limitations, including:

- Intermittent power generation, which makes solar and wind far less reliable than traditional energy sources;
- Lower energy density, making these renewable power sources poorly suited for manufacturing and other industrial applications;
- Limited off-grid applications: Solar and wind may play an increasingly important role in the energy grid, but in the absence of affordable battery storage at scale, neither is reliable enough for off-grid applications like in transportation.

The novelty and zero net energy promise of wind and solar often sweeps past the limitations of these energy sources. We do ourselves a disservice, however, by overlooking the benefits clean fuels are bringing today to the journey toward a low carbon world. Here's a quick overview of three:

## HYDROGEN AND AMMONIA

Hydrogen-based fuels have also shown tremendous promise in recent years. Hydrogen itself is a carbon-free carrier of energy potential, releasing zero CO2 during combustion.

Although there are many hydrogen-based derivatives, the ammonia family of fuels continues to generate the most interest. They are even more compressible than conventional hydrogen and

they offer **higher energy densities**. However, ammonia's sustainability rating depends on the actual production process used:

- Brown ammonia is generated from coal gasification, with lignite being the most popular type of coal used. Although ammonia itself might be carbon neutral, experts estimate that current production processes are responsible for **roughly 1% of global greenhouse emissions**.
- Gray ammonia is only slightly greener because it's derived from natural gas, which is less harmful than traditional coal. Nearly all the hydrogen currently produced is "gray."
- Blue ammonia is also made from fossil fuel inputs, including natural gas and coal. What sets it apart, however, is that the production process includes carbon capture and sequestration (CSS). Upgrading current refineries with CSS technology requires substantial upfront investment, which has placed severe limitations on blue ammonia's growth. In 2020, however, Saudi Arabia sent Japan the **world's first-ever shipment of blue ammonia**. And if successful, this pilot project will likely attract more investment worldwide.
- Green ammonia is the most sustainable of all hydrogen fuel sources. The water electrolysis used to generate hydrogen is powered exclusively with renewable energy sources like solar and wind. As a result, green ammonia is truly carbon-neutral – both during production and combustion. The main hurdle again is price, with green ammonia **costing 10 times more** to produce than gray hydrogen. Despite this downside, pilot projects continue popping up – from Denmark to Japan to Australia.

# RENEWABLE DIMETHYL ETHER

Derived from a range of different feedstocks, including biogas, organic waste, and even natural gas, Dimethyl Ether (DME) is a nontoxic, biodegradable fuel that burns cleanly. It has the added advantage of being easy to transport and store, making it an ideal replacement for traditional diesel fuels. This is especially true because end-devices such as legacy diesel engines, require few, if any, modifications to run on DME.

The primary limitation is cost, given that one of the intermediate products generated during the refinement process is methanol – a "biofuel" that already has a ready market. For widescale DME adoption to succeed, completing the entire refinement process would have to be more profitable than selling any of the individual byproducts.

# RENEWABLE PROPANE

**Renewable propane is not a fossil fuel**. It has the same chemical structure as traditional propane, which makes it perfect for any number of heating, cooling and transportation applications – whether shipped as a gas or as a compressed liquid. The primary difference is that renewable propane is derived exclusively from organic sources such as plants, vegetable oils and even animal fats.

Renewable propane has another major advantage as well. It's deployable at scale using existing infrastructure:  A nationwide network of propane retailers and refueling stations already serving **50 million** American households using propane for cooking and heating.

France's rejection of "dirty" shale gas illuminates the depth of concern about climate change and attitudes about how society should be powered. What is less visible in the story is the degree to which clean energy alternatives like renewable propane, DME and ammonia are already helping reduce carbon emissions.

In 2019, the U.S. had the **most significant** CO2 reduction in the world on a country basis and global energy-related CO2 emissions were down by roughly 33 gigatons. Renewable sources such as wind and solar get some of the credit, but most of it goes to low carbon fuels taking their rightful place at the clean energy table.

## ABOUT THE AUTHOR

Jeremy Wishart writes for the Propane Education & Research Council. He can be reached at **jeremy.wishart@propane.com**.