



## NEWS



# Is ammonia the fuel of the future?

## Industry sees the agricultural chemical as a convenient means to transport hydrogen

Ammonia saved the world once; it might do it again. A century ago, the world faced a looming food crisis. A booming population was pushing farmers to grow crops faster than nitrogen-fixing bacteria in the soil could keep up, and the South American deposits of guano and natural nitrates they applied as fertilizer were dwindling. In what may still be the biggest global problem solved by chemistry, Fritz Haber and Carl Bosch developed a process to react hydrogen and atmospheric nitrogen under pressure to make ammonia, which farmers adopted in place of natural fertilizers. The Haber-Bosch process is still responsible for nearly all the world's ammonia, as well as derivatives like urea and ammonium nitrate.

Today's crisis is climate change. This time, ammonia could come to the rescue by capturing, storing, and shipping hydrogen for use in emission-free fuel cells and turbines. Efforts are also underway to combust ammonia directly in power plants and ship engines.

Chemical companies smell an opportunity. Several firms are developing green ammonia, a route to ammonia in which hydrogen derived from water electrolysis powered by alternative energy replaces hydrocarbon-based hydrogen, making ammonia production virtually carbon dioxide-free. They are also investing in carbon capture and storage to minimize the carbon impact of making conventional ammonia, creating what the industry refers to as blue ammonia. Blue ammonia should play an important role, whether as a transition or as part of the long-term energy mix.

But establishing an ammonia fuel industry would not be easy. By most estimates, green ammonia will cost two to four times as much to make as conventional ammonia. And some of the technologies needed to harness the molecule, such as ammonia-burning engines, are still experimental. Governments and the marketplace will have to decide if green ammonia is worth the effort. On the positive side, thanks to a century of ammonia use in agriculture, a vast ammonia infrastructure already exists. Worldwide, some 180 million metric tons (t) of ammonia is produced annually, and 120 ports are equipped with ammonia terminals.

But pivoting all that infrastructure toward environmentally friendly fuels will take time. Until last year, most proposed green ammonia projects were small, tens of thousands of metric tons rather than the half million metric tons per year, or more, that a conventional ammonia plant puts out.

Up to this point, mankind harnessed the nitrogen value of the molecule. Opportunity is now to market the hydrogen portion of the molecule.

Initiatives have been taken. A Finnish company is beginning this year to test an ammonia-fueled four-stroke marine engine. In another, an automobile major is perfecting a two-stroke ammonia engine.

**Reference:**  
[Cen.acs.org/business/petrochemicals/99/i8](https://cen.acs.org/business/petrochemicals/99/i8)