A 'natural' solution for transportation

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Researchers at Argonne have begun to investigate adding one more contender to the list of possible energy sources for light-duty cars and trucks: compressed natural gas (CNG). Credit: Mercedes Benz.

As the United States transitions away from a primarily petroleum-based transportation industry, a number of different alternative fuel sources—ethanol, biodiesel, electricity and hydrogen—have each shown their own promise. Hoping to expand the pool even further, researchers at the U.S. Department of Energy's Argonne National Laboratory have begun to investigate adding one more contender to the list of possible energy sources for light-duty cars and trucks: compressed natural gas (CNG).

Compressed natural gas is composed primarily of methane, which when compressed occupies less than one percent of the volume it occupies at standard pressure. CNG is typically stored in cylindrical tanks that would be carried onboard the vehicles it fuels.

Because the domestic production of natural gas has increased dramatically over the past ten years, making a large number of the cars and light trucks currently on the road CNG-compatible would help to improve U.S. energy security. "As a country, we don't lack for natural gas deposits," said Argonne mechanical engineer Thomas Wallner. "There are fewer obvious challenges with direct supply than with most other fuels."

Natural gas currently comes primarily from deep underground rock structures, including shale. Recent improvements with hydraulic fracturing, or "fracking," a controversial process that some critics claim can hurt the environment, have made it economical for natural gas companies to extract a greater supply of natural gas from unconventional sources.

Like gasoline, both the production and combustion of CNG release greenhouse gases into the atmosphere. To be able to make an accurate comparison to gasoline, scientists and engineers will need to look at each stage of the fuel's production and use, said Argonne environmental scientist Andrew Burnham.

Unlike gasoline, however, CNG markets are relatively insulated from geopolitical shocks, said Wallner. "The price of CNG has been and will probably continue to be both cheaper and more stable over the long term than gasoline," he said.

CNG currently costs the equivalent of about $2 per gallon, roughly half that of current gasoline prices, according to Wallner.

In order for CNG to take hold, many more stations will need to offer it as an option, and the infrastructure for delivering and distributing the fuel around the country will have to be built up. There are currently fewer than 1,000 publically available CNG refueling stations in the

United States, in comparison to nearly 200,000 gas stations.

Argonne already has the capability to help automotive industry leaders test and analyze CNG vehicles. In particular, Argonne's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model gives experts the ability to examine the greenhouse gas emissions of various fuels from "well-to-wheels," involving each stage of production, distribution and combustion. "We have years of expertise working with industry to develop alternative-fuel vehicles as well as the tools necessary for the public to understand the impact of these vehicles on the environment," said Argonne mechanical engineer Michael Duoba.

Although CNG vehicles emit fewer greenhouse gases than conventional automobiles as fuel is combusted, "upstream" challenges in production and distribution of CNG—particularly methane leakage -- make it somewhat less attractive when it comes to preventing climate change. "There are a lot of points in the life-cycle of the fuel where we still need better data," Burnham said. "There are technological opportunities for us to capture the leaked natural gas and reduce greenhouse gas impacts."

For heavy-duty applications, like city buses, CNG might have the potential to cut down emissions of particulate matter and nitrogen oxides, helping municipalities to meet more stringent EPA standards enacted in the past few years, according to Burnham.

In Wallner's view, CNG vehicles—like plug-ins and diesel-powered automobiles—will serve the transportation needs of some, not all. "It's important to see each of these technologies as a part of the solution but not the entire solution," he said. "The more we invest in their development, the closer we'll come to a portfolio that makes sense both economically and environmentally."

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