National Center for Sustainable Transportation

POLICY BRIEF

Current Natural Gas Infrastructure Can Accommodate Future Conversion to Near-Zero Transportation Technology

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Issue

The emergence of natural gas (NG) as an abundant, inexpensive fuel in the United States has highlighted the possibility that it could play a significant role in the transition to low carbon fuels. It is often cited as a "bridge" to low carbon fuels in the transportation sector. Major corporations are already investing billions of dollars to build NG fueling infrastructure to expand its use in U.S. trucking fleets.

In California, NG fueling infrastructure is expanding, especially in and around the ports of Los Angeles and Long Beach, and the use of NG-fueled medium- and heavy-duty fleets is currently on an upswing. The state is relying in part on the development and use of alternative fuels such as renewable natural gas (RNG) and hydrogen, which have low greenhouse gas and criteria pollutant emissions, to meet its climate change and air quality goals.

This research project examines how NG infrastructure can be economically and technologically synergistic for both NG and RNG in the near term, and for RNG and other renewables such as hydrogen in the long term. In particular, it examines optimum paths for developing infrastructure in the near term that will accommodate alternative fuels once they become available at the commercial scale. The original design of California's Low Carbon Fuel Standard (LCFS) provides time for the development of advanced, near-zero technologies. The research considers the use of LCFS credits in its analysis.

Key Research Findings

Infrastructure requirements for NG and RNG have many synergies. Emerging RNG supplies can utilize much of the same infrastructure as fossil NG networks, sharing the same vehicles, station equipment and midstream pipelines for transmission.

Since vehicles that use NG can also use RNG, the timeframe for fuel availability and opportunity are also contiguous, allowing for RNG and fossil NG networks to be developed simultaneously, each facilitating the other. Fossil NG network investors can benefit from receiving carbon credits by blending RNG into their fossil NG fuel, while RNG investors can save costs by piggy-backing on existing fossil NG infrastructure.

Carbon pricing allows NG to compete, and is necessary long term. In California, substantial RNG supplies are commercially competitive with existing fossil fuel-based transportation fuels because carbon externalities are taken into consideration through existing programs such as the LCFS and the U.S. Renewable Fuel Standard (RFS). Those RNG resources will be enabled by the build-out of NG infrastructure and adoption of NG-fueled vehicles for commercial transportation. Furthermore, liquefied natural gas (LNG) fueling stations for heavy trucks now exist in over a dozen locations around California and continue to expand. But widespread adoption of RNG will require new facilities for making the fuel vehicle-ready. Such facilities remove impurities and upgrade the raw biogas derived from anaerobic digestion and collection of landfill gas.

Thus, RNG price support made available through LCFS credits, RFS credits and higher tipping fees for municipal solid waste (MSW) can be influential in propelling replacement of fossil NG with lower carbon gas from bio sources. To compete with fossil NG the minimal price support required per mmBTU is $11.50 for MSW, $3.75 for landfill, $5.90 for wastewater treatment plant (WWTP), and $26 for dairy. In per gasoline-gallon-equivalent (gge) terms, the minimal price support required by each pathway is $1.38, $0.45, $0.71, and $3.15 per gge for MSW, landfill, WWTP, and dairy, respectively.

Some synergies exist between hydrogen and NG infrastructure in terms of equipment and location. Hydrogen fuel cell passenger cars are now being introduced in California, with tens of thousands of vehicles expected by the early 2020s, served by 100 or more public stations located across the state. But vehicle manufacturers estimate that it will take roughly 7 to 15 years before new fuel cell trucks will be available on the market.

Hydrogen vehicles could supplement or replace commercial vehicles now running on compressed natural gas (CNG) derived from fossil NG or RNG, particularly medium- and heavy-duty vehicles used for short-haul applications, such as last mile deliveries and drayage truck operations.

Co-location of fueling infrastructure for NG, RNG and hydrogen may lower overall costs, however incentives are still needed for hydrogen infrastructure. The equipment to handle hydrogen, which can be more corrosive to pipeline and storage materials than NG, is costlier. Therefore more credits and incentives (than those needed for RNG) would be important to drive a widespread adoption of hydrogen as a fuel for medium- and heavy-duty commercial vehicles.

"Behind the fence" private hydrogen facilities could build off the same pipeline connections as natural gas if hydrogen is reformed from fossil NG or RNG. However, separate storage facilities and refueling equipment will be needed for a transition from NG or RNG to hydrogen fuel.

Hydrogen station buildout will take time. While California has already invested in public hydrogen fueling stations to serve passenger vehicles in urban locations, buildout of hydrogen stations to serve hydrogen fuel cell trucks and buses will likely take a decade or more. Therefore it will not occur simultaneously during the current expansion of the NG and RNG networks, limiting some of the potential for synergies for overlapping infrastructure for commercial fleets.

Planning for future synergies is critical. Today's synergistic limitations aside, NG fueling infrastructure built today will need to be refurbished or replaced within 15 years. Therefore, planning for eventual addition of hydrogen fueling infrastructure at new CNG and LNG fueling locations can facilitate the adoption of hydrogen fuel at a later date, though it is expensive, and smooth the transition to near-zero carbon technologies. Co-location of hydrogen and NG fueling infrastructure for medium- and heavy-duty trucks may also have some logistical benefits and cost savings. The analysis shows that certain port and urban locations will favor renewable NG due to proximity to RNG supply, and may be able to link to hydrogen supply chains in the same areas in the longer term.

Further Reading

This policy brief is drawn from the "The Potential to Build Current Natural Gas Infrastructure to Accommodate the Future Conversion to Near-Zero Transportation Technology" final report prepared for the California Air Resources Board (CARB) by Amy Myers Jaffe (formerly with the University of California, Davis). To download the report, visit https://ncst.ucdavis.edu/project/potential-to-build-current-natural-gas-infrastructure-to-accommodate-conversion-to-near-zero-transport-tech/

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