FUEL BOOST

With new mandates approaching, propane advocates see an opportunity to solidify autogas' standing with the development of direct injection fuel systems.

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As fuel economy and emission standards for on-road vehicles grow stricter, manufacturers face increasing pressure to build vehicles that meet unprecedented regulatory standards.

The Obama administration, for example, is keen on increasing the fuel economy for cars and light-duty trucks to 54.5 miles per gallon by model year 2025. When the administration announced its fuel efficiency agreement with 13 vehicle manufacturers in 2012, the standard nearly doubled the fuel efficiency of new vehicles on the road at the time.

As part of the same plan, the Obama administration aims to cut greenhouse gas emissions from cars and light-duty trucks in half by 2025. The administration's goal is to reduce emissions by 6 billion metric tons over the life of the program.

Undoubtedly, a few bumps in the road are ahead for vehicle manufacturers to reach new fuel efficiency and emission levels. However, the development of automotive solutions that can comply with new standards is already underway.

Direct injection fuel systems have emerged as one solution, and these systems are not limited to gasoline. Propane advocates say direct injection technology presents a major opportunity for their industry to expand propane's use as a motor fuel in the years to come.

"[Direct injection technology] positions propane to be a true competitor in terms of efficiency and performance, and it makes it more appealing for the OEMs (original equipment manufacturers) to offer autogas options in their assembly line," says Mike Taylor, director of autogas business development for the Propane Education & Research Council (PERC).

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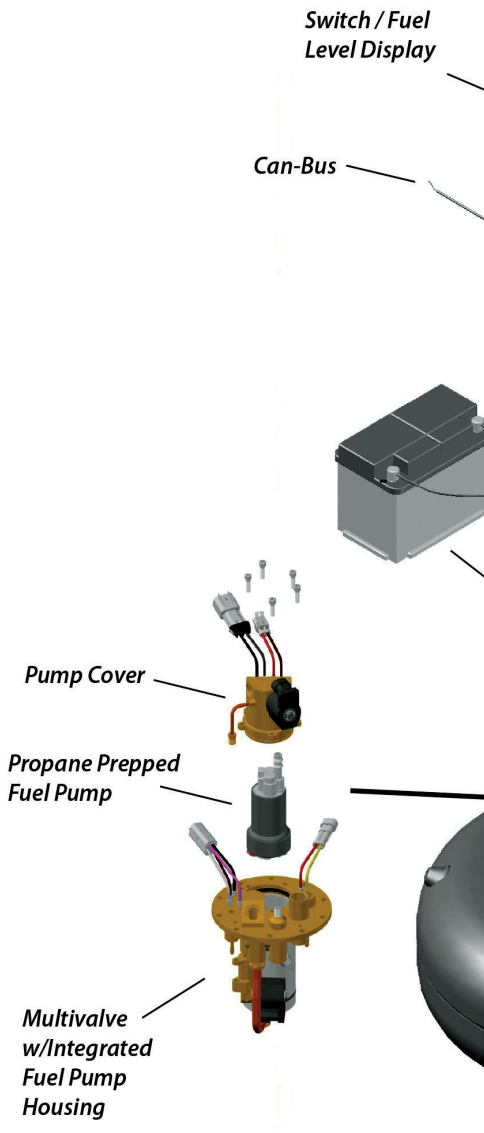
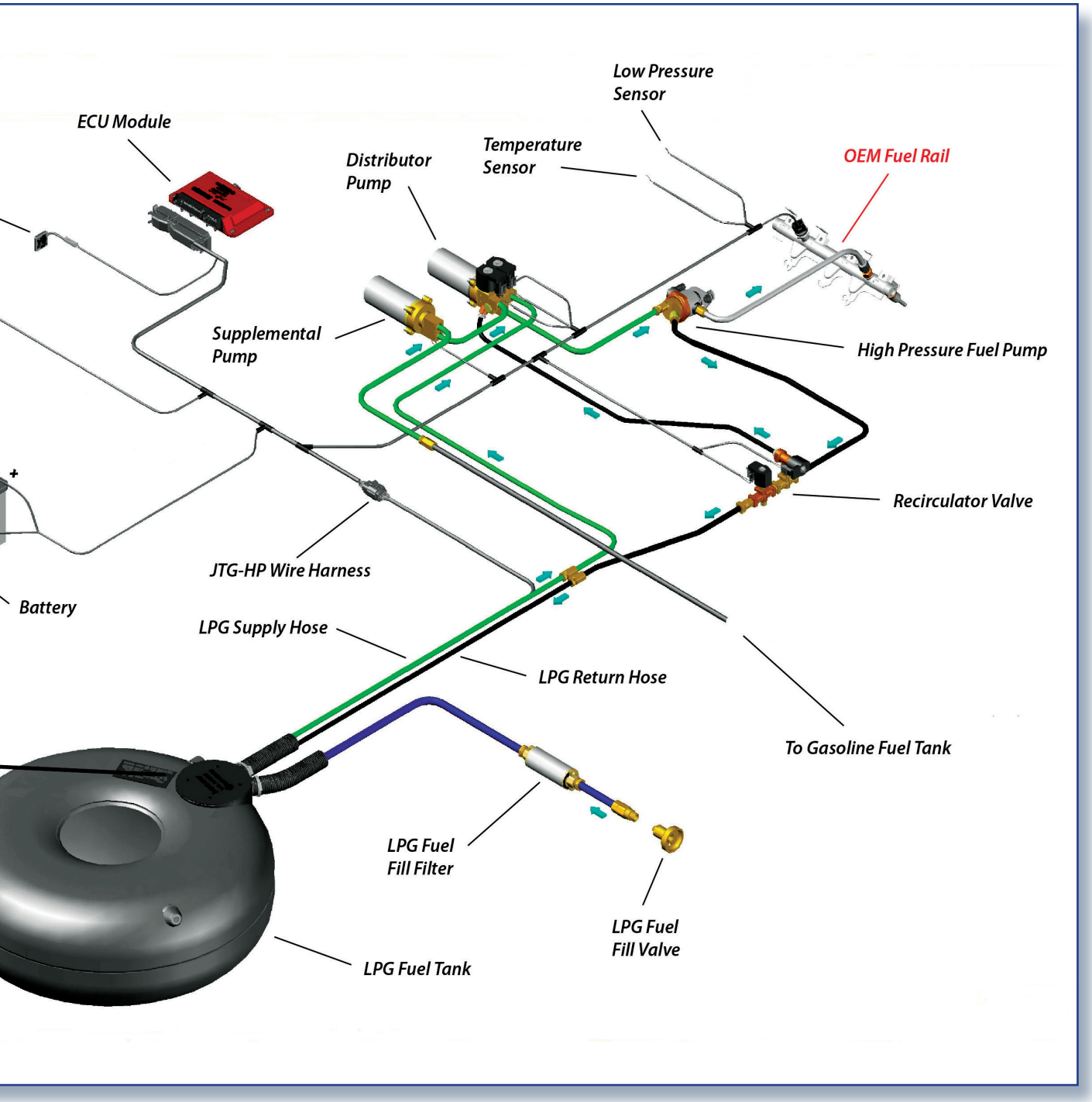
JTGHP LIQUID PROPANE DIRECT-INJECTION SYSTEM



This schematic shows Icom North America's patented JTGhp liquid propane direct injection system, which injects liquid propane directly into an engine's combustion chamber.

Illustration courtesy of Icom North America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JTG-HP Wire Harness
Battery
LPG Supply Hose
LPG Return Hose
To Gasoline Fuel Tank
LPG Fuel Fill Filter
LPG Fuel Fill Valve
LPG Fuel Tank

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"The goal of any engine development technology project is getting into the OEMs as an assembly line option and increasing the number of vehicle sales so we can be on the assembly line."

Regulatory demands will become particularly burdensome for manufacturers of gasoline and diesel vehicles, Taylor adds. As these manufacturers absorb more costs related to gasoline and diesel vehicles, the costs of these vehicles will surely rise.

"As they drive up the cost, that will make alternative fuel engines more price competitive," Taylor says.

Systems and certifications

But why direct injection? Technically, what does it offer that makes it a solution to regulatory demands?

Representatives from Icom North America offer an explanation by way of comparing a gasoline port injection engine to a gasoline direct injection engine.

COMPARED TO 2021 VEHICLES, AN AUTOMAKER'S COST PER VEHICLE IS EXPECTED TO RISE BY UP TO $1,017 BY 2025, ESTIMATES THE EPA AND NATIONAL HIGHWAY TRANSPORTATION SAFETY ADMINISTRATION.

According to Icom, gasoline port injection involves fuel injection in the manifold of a vehicle, while direct injection injects fuel directly into a vehicle's combustion chamber. The direct injection advancement allows vehicle manufacturers to use smaller, less-polluting engines that achieve better miles per gallon and reduced emissions, the company says.

A propane direct injection system from Icom operates similarly to the gasoline direct injection system company representatives describe. Icom's JTGhp liquid propane direct injection system uses the same high-pressure pump and injectors as a gasoline system, injecting liquid propane directly into the combustion chamber.

The JTGhp system monitors the original CAN bus (controller area network) communications of the vehicle and adapts the parameters for liquid propane injection based on internal algorithms. The technology runs entirely on propane upon startup, the company

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adds, and the system automatically switches to gasoline when no propane is available in the vehicle.

PERC is a supporter of the JTGhp system, approving a $600,000 funding request in 2015 to help move it through the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB) emission certification processes.

Including crossover by year, Icom now has EPA certifications for 20 vehicle models using the Ford 3.5-liter EcoBoost engine. Another 20 models with the General Motors (GM) 5.3-liter Ecotec engine are EPA certified, the company says.

For the Ford 3.5-liter EcoBoost engine, the JTGhp system is EPA certified for Ford's Explorer, F-150, Flex, Interceptor Utility, Police Interceptor and Taurus, as well as Lincoln's MKS, MKT, MKZ and Navigator. The 2015 and 2016 versions of these models are EPA certified with the Icom system.

For the GM 5.3-liter Ecotec engine, the Icom system is EPA certified for Chevrolet's Suburban and Tahoe, as well as a number of pickups and vans. The certification Icom has applies to the 2014 and 2015 versions of these vehicle models. As of press time, Icom anticipated it would receive EPA certification for these same models on 2016 versions.

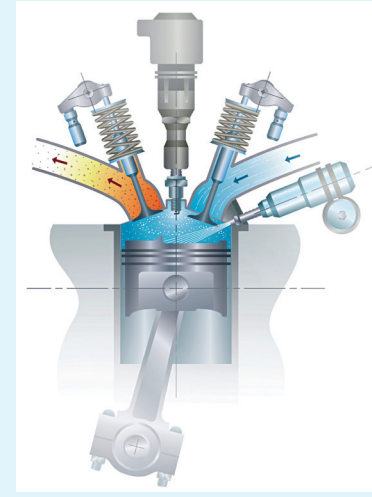
Icom isn't the only fuel system manufacturer operating in the direct injection space with propane, though. Blossman Services Inc., which earned intermediate age EPA certification for its direct injection system on a GM 3.6-liter engine, is also present in this area. Blossman's certification applies to Buick's Lacrosse, Cadillac's ATS and SRX, and Chevrolet's Caprice and Impala. Specifically, the certification applies to the 2012 and 2013 versions of these vehicle models.

Blossman also recently earned EPA certification on a direct injection GM 5.3-liter engine that features the use of port technology for several 2014 and 2015 models, including Chevrolet's Silverado, Suburban and Tahoe and GMC's Sierra, Yukon and Yukon XL. Blossman anticipates its certification coverage will soon apply to the 2016 versions of these models, as well.

To Stephen Holland, director of engineering at Blossman Services, certification of a direct injection system is a must.

More online

Want to learn more about direct injection? *LP Gas* connected with Michael G. Ross, program manager in the Engine, Emissions and Vehicle Research Division at San Antonio-based Southwest Research Institute, to gain another perspective on the technology. Check out our Q&A with Ross at www.lpgasmagazine.com.



As the illustration shows, an injector introduces fuel directly into the combustion chamber of a gasoline direct injection engine. Southwest Research Institute recently conducted tests to determine the feasibility of running a modern turbocharged gasoline direct injection engine on propane.

ILLUSTRATION COURTESY OF THE SOUTHWEST RESEARCH INSTITUTE

"I know there are conversion systems out there that don't go through the certification process," he says. "We don't legally have the option under the watchful eye of the EPA to convert these vehicles without this process. For us, certification legitimizes what we're doing."

The future

Blossman is a direct injection proponent because of the efficiencies gained from the technology.

"If you had to throw averages at it in terms of miles per gallon, you're probably looking at 80 to 85 percent efficiency if you put a port fuel propane vapor system on a gasoline-directed engine," Holland says. "If you direct inject propane instead of petrol (gasoline), you're 95 percent or better."

Mark Denton, vice president of business development at Blossman Gas and Alliance AutoGas, agrees.

"It's going to be very important for our industry – for Blossman Services and other manufacturers – to prove this concept on propane," Denton says. "If we can get 10 percent more efficient, then propane has a much greater advantage. Then, we're not having to discount the energy content [of propane]."

Like the development of the autogas market to date, Denton believes major fleet purchases will drive the development of the direct injection market.

"As we see large, recognizable fleets – UPS, FedEx, DHL and others – go to this technology, others will pay attention to what they're doing," he says.

The U.S. Department of Energy (DOE) is certainly committed to direct injection propane engines. DOE announced a $22 million program this summer of which direct injection propane engines are a part. Through the program, DOE seeks to support the research, development and demonstration of direct injection propane engines for on-highway vehicles because of the opportunity to substantially reduce greenhouse gas emissions.

Propane stakeholders with direct injection technologies are one beneficiary of the program. DOE also seeks to support plug-in electric vehicles, as well as projects that can accelerate the adoption of light-, medium- and heavy-duty vehicles that operate on biodiesel, electricity, E85, hydrogen, natural gas and, of course, propane.

"We anticipate [direct injection] is going to be well received," Taylor says. "There's a huge need in the industry, and it's not just the propane industry. It's the transportation industry as a whole regarding direct injection [and] EPA phase two greenhouse gas rules." **LPG**

LP Gas editor-in-chief Brian Richesson and contributing editor James E. Guyette contributed to this article.