

Infiniti's VC-Turbo S.U.V.: A 'Leap Ahead' in Efficiency

By JERRY GARRETT OCT. 13, 2016

PARIS — A few years back, I asked Robert A. Lutz, who was then vice chairman of General Motors, why the auto industry seemed slow to ditch old-fashioned gasoline engine technology in favor of ideas about exciting new means of propulsion like electric motors.

“I believe the old internal combustion engine still has a few tricks up its sleeve,” he said. “Some big improvements — big leaps forward — in efficiency could be ahead.”

One of those “tricks” may have surfaced here at the 2016 Paris Motor Show.

The technology, displayed by Nissan's Infiniti luxury brand and called VC-Turbo, would make it possible for the first time in a production-ready vehicle to vary the compression ratio in the engine's combustion chambers while the car is being driven.

So what? the layperson may ask.

It matters because the compression ratio — the relationship between the smallest and largest volume in an engine cylinder during the piston stroke — is among the factors that determine the fuel efficiency and the power of an internal-combustion motor.

A lower compression ratio is desirable when the goal is to use less fuel and to produce fewer greenhouse gas emissions. A higher ratio is what you want when the purpose is to drive fast, temporarily ignoring fuel economy and environmental concerns.

Engine experts consider Infiniti's breakthrough a potential big deal.

“The ability to vary an engine's compression ratio has been a holy grail quest of engine engineers for decades,” said Frank Markus, an automotive engineer and technical editor at Motor Trend magazine.

Mr. Markus is among those who say the new technology, if the cost comes down below luxury-car levels, could help the auto industry meet its fuel economy and emissions targets in coming years without necessarily sacrificing engine performance.

Infiniti demonstrated VC-Turbo technology here in a 2.0-liter turbocharged four-cylinder engine on display. (Here's a [video rendering](#) of the inner workings.)

Alongside the engine was a muscular-looking QX Sport Inspiration S.U.V. concept vehicle that was also on display here. Infiniti said the S.U.V. could be the first to come equipped with the new engine, in a production version scheduled to go on sale in 2018.

The VC part of its nomenclature refers to variable compression.

In today's fixed-compression engines the most common ratios are in the range of 8:1 to 14:1 — although they might go as low as 6:1 for economy cars, or up to 17:1 for Formula 1 beasts.



Figure 1 Roland Krueger, president of Infiniti Motor Company, introduced the VC-Turbo powertrain at the Paris Auto Show. (Infiniti)

Heretofore, engine designers have had to choose what kind of performance they wanted from an engine. Then a design has been created around that ratio. That is why some vehicles are racecars, while others are grocery-getters.

Until now.

In the VC-Turbo technology, the engine is designed with articulating, multilink moving parts to facilitate operation at different — variable — compression ratios, depending on throttle demand.

In the case of the Infiniti engine, this is a range of 8:1 to 14:1 (and every ratio in between). The variable design gives the engine management system a choice of the optimal range of operation at all times.



Figure 2 The Infiniti variable compression turbo engine was on display at the Paris Auto Show in September. (Christophe Ena/Associated Press)

This explanation is a huge oversimplification. But the point is easy to grasp: power when you need it, and economy when you don't.

Besides offering the range of performance, the VC-Turbo technology fits in a smaller engine size — just two liters — but it churns out about as much power as Infiniti's own much-larger 3.5-liter V6.

Because it is smaller, it also saves weight: The 2.0 turbo here is 25 kilos, or 55 pounds, lighter than the V6.

That is the type of weight savings that auto engineers dream of. Many advances in vehicle weight are measured in mere ounces.

Infiniti says the little 2.0-liter turbo here, which produces 268 horsepower and 288 foot-pounds of torque, is 27 percent more efficient in terms of fuel economy and operation than a V-6 of similar output.

That would be the equivalent of a gasoline engine that gets 40 miles to the gallon improving to a 62 m.p.g. rating. That is efficiency equivalent to a similarly powered four-cylinder diesel engine, Infiniti said, although with extremely low emissions — especially compared with soot-spewing diesels.

More than 300 key patents, and many more lesser ones, have been granted over the two decades that it took to develop this engine, Infiniti said. The company said final performance and durability testing was carried out in cooperation with the Renault and Infiniti Red Bull F1 teams, using their rigorous testing regimens.

The chief engineer for the Infiniti VC-Turbo project, Shinichi Kiga, was not sure how to define it when asked whether the VC-Turbo was an engine, or a technology.

“Both,” he said, after some thought. “Some of both. But it is the technology inside this engine.”

The technology is scalable, Mr. Kiga said, so it could be built into other engine architectures.

Infiniti did not say what the price of the QX Sport with VC-Turbo would be. The S.U.V. that Infiniti now sells in which the 3.5-liter V6 engine is standard, the QX60, has a base price of \$42,600.

Mr. Markus, the Motor Trend editor, says that the complex engines incorporating variable-compression technology will be costly to build in the early going. But he predicts it will prove to be a cost-effective

way for the auto industry to reduce emissions of carbon dioxide, the greenhouse gas in vehicle exhaust that matters most to regulators.

People have been trying to get patents on variable-combustion technologies since at least 1932. And more recently, other automakers including Lotus and Saab have designed prototypes.

Mr. Markus said he was aware of at least one other company, MCE-5, a firm based in Lyon, France, that had built a working variable-compression engine.

But Infiniti, he said, seemed to be further along. “They’re probably ahead of the game.”

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