Power to have it all

Innovations in established fossil fuel and emerging alternative powertrain technologies are to be welcomed by everyone

We have all heard it said that necessity is the mother of invention. With today's increasingly stringent global transportation, fuel economy and other regulations, most auto makers and their top suppliers have had to invest in leading-edge innovations in an array of cleaner and more efficient gasoline and diesel-fueled engines and transmissions as well as in alternative powertrains, such as electrical, natural gas and others.

Years ago, many speculated that by the advent of the 21st century fossil fuel-powered vehicles would have gone the way of the dinosaurs and have been replaced mostly, if not completely, by clean EV, solar, natural gas, fuel cell and hybrid-powered counterparts. Today in 2015, however – and even for the 2020 outlook – the picture looks quite different from what was predicted. In fact, drivers are the ultimate winners, with a mix of both types of transportation becoming more efficient and greener with little to no trade-offs, and innovation bridging the gap between these two distinct technologies.

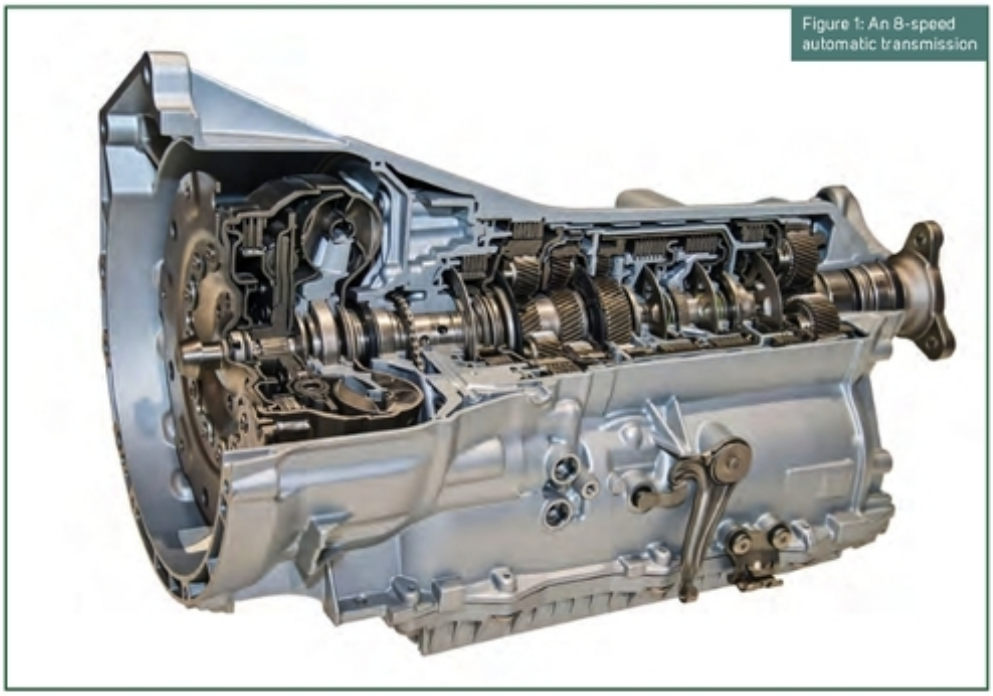

Figure 1: An 8-speed automatic transmission

Need for innovation

Fundamentally, the infrastructure costs of electric power and limitations on enabling technologies (such as battery life), in addition to the ratio of oil price to alternative power sources, have dictated the growth (or lack thereof) of some clean fuel transportation over traditional gas and diesel. Furthermore, there has been a surge of technological innovations enabling traditional powertrains to meet restrictive emissions requirements by modifying aspects of the gas/diesel transmission and/or the engine without having to replace the fuel type.

Advanced 8-, 9- and 10-speed transmission (Figures 1 and 2) designs are helping many car makers and their suppliers meet the challenging global emission/CAFE standards without full conversion to electrical/zero-emission power. Generally speaking, the more gears that a vehicle's transmission has, the more efficiently engine speed is able to be matched to driving conditions, resulting in increased fuel efficiency, which is ultimately good for both motorists' wallets and the environment. In addition, cars with more gears have shorter shift times, with a smoother transition between gears, which serves to enhance driver comfort. Overall, driving performance is also improved with smoother starting and maneuvering. Multiple precision-engineered solutions are powering this technological shift globally.

Combustion engine innovation

Gasoline direct injection (Figure 3) is another disruptive innovation that has been embraced as an enabler of next-generation traditional fuel-powered engines. GDI has been a game-changer due to increased combustion efficiency (because of the optimized high-pressure fuel injection mechanism) and the homogeneous chemical reaction that ultimately reduces harmful emissions. One important benefit is the ability to downsize the engine while maintaining the same power performance. To meet these global emissions regulations, many suppliers are racing to invest in this technology, albeit with diverse approaches to the GDI manufacturing process.

Pure electric vehicles and engines are typically associated with one-speed gearboxes. This limits either acceleration or the top speed. Multiple innovations (by top OEMs and their global suppliers) are enabling a new generation of high-performance electric vehicles with two-speed electric axles permitting top speeds of around 250km/h. This cannot be achieved with a single-speed drive and requires a fundamentally new design to reduce the weight and packaging of the electric drive components. This enables reduced size and weight of the electric motor and can dramatically increase mileage. The resulting package is extremely small and shifting is done

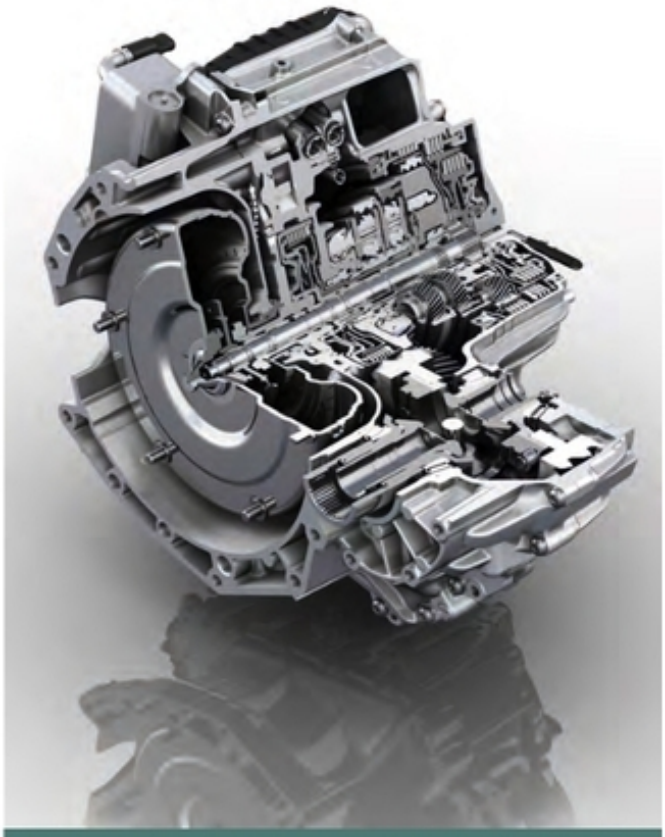

Figure 2: An example of an advanced 9-speed automatic transmission design

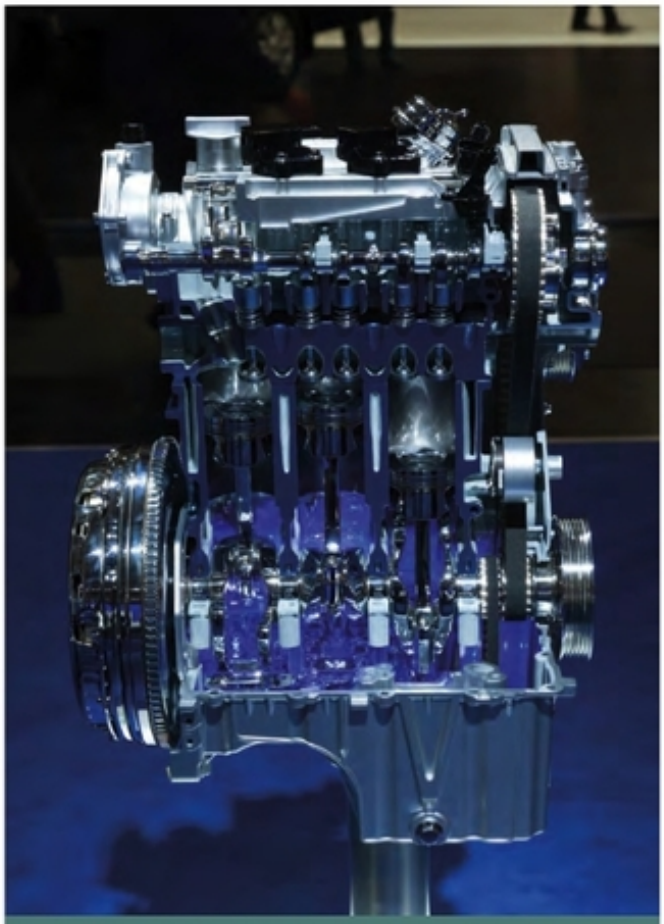

Figure 3: Example engine with GDI feature (Photo: Typhoonski/Dreamstime.com)

on the incoming shaft (as opposed to the intermediate shaft) at speeds up to 12,000rpm.

Hybrid applications usually use continuously variable transmissions to combine IC engines with the electric motor(s). Some industry experts estimate that by 2025, 15-20% of all ATs and 20-25% of all CVT applications globally will be electrified. CVTs are ideal for hybridization and have become more efficient in recent years. Also, driveability of these CVTs has improved dramatically over the past few years due to a speed mode that uses pre-selected transmission levels for feel akin to DCT/AT-equipped cars. For packaging reasons, many car manufacturers are opting to include electric motors inside the gearboxes, with some even replacing the torque converter or the dual-mass flywheel. This is innovative as the electric motor can assume the function of the flywheel and balance in a synchronistic way with the rotation speed in the drivetrain from the ICE, resulting in improved shift quality and driver comfort.

Building partnerships

These exciting powertrain inventions are enabled by OEMs partnering with global suppliers that are also invested in these technological breakthroughs and the ultimate success of these strategic platforms. An example of these leading suppliers is the Engineered Components (EC) strategic business unit (a Barnes Group business with over 158 years of rich history of innovation).

The EC organization spans 21 global manufacturing and non-manufacturing strategic locations, with over 1,500 employees dedicated to collaborating with customers, adding value through innovation and state-of-the-art technologies and strategies such as BES Next Generation, and consisting of four leading brands: Associated Spring, a leader in engineered spring and stamping solutions; Associated Spring Raymond, a leading supplier of ready-to-ship standard struts, springs and spring washers as well as custom solutions/assemblies; Heinz Hänggi, a leader in microstamping, fineblanking and micro-cold-formed solutions including state-of-the-art GDI solutions that are superior to laser drilling/EDM wire alternatives; and Seeger-Orbis, a leader in engineered retaining and snap rings for traditional as well as electric/hybrid vehicles.

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