

## ***Reconsider the Wheel: Protean's In-wheel Electric Drive Improves Fuel Economy and Performance for Light Duty Vehicles***

Protean Electric ([www.proteanelectric.com](http://www.proteanelectric.com)) is a leading clean technology company that has developed an award-winning, in-wheel motor, electric drive system for hybrid, plug-in hybrid and battery electric light duty vehicles. Called Protean Drive™, this system can improve fuel economy, provide additional power and be integrated into existing vehicles.

Protean is displaying its in-wheel motor technology in booths 706 and 806, and offering rides in Protean Drive™-equipped vehicles throughout the HTUF show. In addition, Protean Vice President Ken Stewart will speak on the "Hybrid Retrofit Opportunities" panel at 11 a.m. Oct. 12 in Room 301.

Protean's in-wheel motors are fundamentally different from other designs and their benefits make them a viable choice over other electric or hybrid systems. The motors can increase fuel economy more than 30 percent, depending on the size of the battery and the driving cycle. In addition, each motor also features energy-saving regenerative braking.

Importantly, the fuel savings come with the benefit of added performance. With up to 110 hp (81kW) and 590 lb.-ft. (800Nm), Protean's motors have the highest torque and power density of other leading electric propulsion systems. Yet each motor weighs only 68 lbs. (31 kg) and is sized to fit within the space of a conventional 18-inch road wheel. The lighter weight reduces concerns around unsprung mass – issues that are essentially eliminated when the suspension is tuned properly for the motors.

### **Smart design and packaging**

Protean's in-wheel motors can be used in two- and four-wheel drive models and can be added to the front, rear or all four wheels of a vehicle. They also can be added to a FWD

or RWD car or truck with an internal combustion engine drivetrain to create a hybrid configuration. In hybrid applications, the technology can be configured to give the driver the choice to operate the vehicle between two operating modes: all electric (city/stop-and-go and low speed traffic or zero-emissions zones) or hybrid (constant and higher torque and speeds). The in-wheel motors also can provide fully independent torque control, making vehicles safer.

### **Meeting fuel economy and emissions regulations while reducing development costs**

Protean Drive™ can introduce hybrid powertrains to vehicle platforms with fewer new parts, less complexity, minimal changes to final assembly, and at a lower total cost than other hybrid drive systems.

Conventional hybrid systems require extensive engineering for specific vehicles years in advance. However, Protean's

in-wheel motors – which occupy formerly unused space behind the wheels – integrate easily enough to make a hybrid or plug-in-hybrid vehicle out of existing cars and trucks in the aftermarket. There is no need to make major changes to engine or emissions components or to modify drivetrain components such as gearboxes, differentials and drive-shafts. In addition, the motors can be installed in new vehicles

built on existing assembly lines with few changes to the manufacturing process.

The Protean Drive also supports all plug-in electric drive architectures and can add fuel economy and range to internal combustion (IC) engines running on gas/petrol, diesel, or alternative and bio fuels.

"Protean Electric's in-wheel motor design is a 'game changer' for integrating electric propulsion," Stewart says. "It has the potential to revolutionize the automotive industry and provide the crucial bridge to wider scale adoption of electric and hybrid vehicles." □



### Summary of Protean Drive™ benefits:

- Provides enough power and torque for the powertrain electrification of full-size cars and light duty trucks
- Offers a unique, highly integrated, modular motor/inverter technology, eliminating the need for a separate large power electronics module
- Enables full regenerative braking or can be combined with mechanical brakes to reduce CO<sub>2</sub> emissions in full-size light duty vehicles
- Enables advanced vehicle dynamics through independent “torque vectoring” torque control of each wheel
- Designed for high-volume, low-cost automated mass production
- Reference control system software for a centralized electronic control unit (ECU) is included for electric vehicle control functionality and braking control



Available at HTUF for ride requests is the Vivaro diesel hybrid. Protean Electric and Millbrook Proving Ground, one of Europe’s leading vehicle test and demonstration centers, partnered to produce the Vivaro diesel hybrid. With the Protean conversion kit of two Protean Electric PD-18 motors attached to the rear axle, the two motors together provide torque assist of up to 1,180 lb.-ft. (1,650 Nm) peak and 740 lb.-ft. (1,000 Nm) continuous at the rear wheels. Inquire at Protean booth 806.



Protean’s fully electric Ford F150 pick-up demonstrates the benefits of the company’s in-wheel motors and ability to retrofit them on existing vehicles. Protean Electric added motors to each wheel, removed the conventional IC engine and installed a 40kWh battery, giving the truck an electric range of 100 miles. This vehicle will be on display in Protean’s booths 706 and 806.