



SOUTHWEST RESEARCH INSTITUTE



# Vehicle Electrification

Southwest Research Institute® (SwRI®) has been active in vehicle electrification ranging from mild hybridization to full-fledged prototype development since 1990.

A U.S. federal mandate issued on August 28, 2012, and enforced by the National Highway Traffic Safety Administration (NHTSA) requires OEMs to increase Corporate Average Fuel Economy (CAFE) to 54.5 mpg by 2025. The legislation is intended to expedite the implementation of hybrid electric vehicles and plug-in hybrid electric vehicles (EV) in the U.S. market. Electrification has become so prevalent that a start-stop mild hybrid will soon become the baseline for development of new electrified powertrains.

SwRI conducts research and development in several aspects of electrified vehicles and their components. Examples of EV projects are described below.

## Ultra-Capacitor-Based Start-Stop Mild Hybrid

SwRI converted a conventional gasoline-powered SUV to a mild hybrid vehicle and demonstrated a 5% gain fuel economy on the EPA combined city and highway driving cycle. Changes included modification of electronic throttle and addition of a 4 kW ISG, a 20V 150F ultra-capacitor, and a hybrid controller that interfaced with the engine and transmission.

*Ultra-capacitor-based start-stop mild hybrid*

## Parallel Hybrid Electric Bus

Using a standard bus chassis, SwRI integrated a downsized diesel engine, automated manual transmission, battery pack, inverter, thermal management system, electric motors, and a controller to create a parallel hybrid electric powertrain and driveable prototype vehicle. After tuning the controller, SwRI demonstrated a 30% improvement in fuel economy over the baseline vehicle. The customer produced more than 200 vehicles based on SwRI's design.

*Parallel hybrid electric bus*



## Light-Duty Hybrid Vehicle

SwRI converted a manual transmission to an automated manual transmission (AMT) with a patented actuation and control system to enable building a low-cost parallel hybrid powertrain for a passenger vehicle. The AMT, ISG, battery pack, motor, and controller were integrated with a downsized 1.6 L gasoline engine. The customer mass-produced the converted vehicle.



Light-duty hybrid vehicle

## Heavy-Duty Engine Electrification

The fixed belt ratio connections between engine and accessories such as the fan, alternator, air conditioning, and water pump cause loss of energy due to limited controllability. SwRI electrified all these accessories on a 447 kW engine by adding a 42V battery pack charged from two 5 kW fuel cells powered by onboard hydrogen. The average fuel economy improved over a two-year period of road driving by more than 18%.



Heavy-duty engine electrification

**We welcome your inquiries.  
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## SOUTHWEST RESEARCH INSTITUTE

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