CHALLENGE X TECHNOLOGIES

The teams in the Challenge X competition are employing many novel ideas, approaches, and technologies that (1) provide near-term and long-term solutions to significantly reduce well-to-wheel energy consumption; (2) increase energy efficiency and reduce fossil energy consumption and emissions (on a total fuel cycle basis); (3) significantly reduce criteria tailpipe greenhouse gas (GHG) emissions; and (4) increase pump-to-wheels fuel economy. Various hybrid electric vehicle (hybrid) designs–many of which are either in production or are being considered by original equipment manufacturers–are demonstrated in the student-modified vehicles, including series and parallel hybrids.

Engines modified to run on bio-based fuels, such as ethanol and biodiesel, represent a near-term approach; more advanced engines, such as homogeneous-charge compression-ignition engines and hydrogen internal combustion engines, represent more long-term approaches. Exemplifying the long-term approach to reducing onboard energy consumption, one team has chosen a "charge-from-the-wall" philosophy to extend the short electric-vehicle range of its hybrid. The teams are combining advanced power units with emerging exhaust gas after-treatment technologies to reduce emissions and total GHG production. Other systems, such as selective catalytic reduction to control oxides of nitrogen emissions, are being used with high-efficiency diesel engines. Advanced electric drive systems enable hybrid features–such as regenerative breaking, high-load electric assist, and engine transient smoothing–to further improve vehicle-level efficiency. These student-designed approaches truly represent the future of automotive powertrains.

TEAM	CONFIGURATION	ENGINE	FUEL	TRANSMISSION	ENERGY STORAGE	MOTOR
Michigan Technological University	Through the road parallel hybrid	2.0-L Ford Puma Diesel	Bio Diesel	5 Spd Mechatronic Manual	COBASYS NiMH - 288V	50kW Solectria/ 2.2kW ISG
Mississippi State University	Through the road parallel hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel	CVT	COBASYS NiMH - 288V	50kW AC Ind.
Ohio State University	Through the road parallel hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel	6 Spd Mechatronic Manual	Panasonic NiMH	75kW & ISA
Pennsylvania State University	Power split hybrid	1.3-L Fiat Diesel	Bio Diesel/ Hydrogen	Planetary Power Split	Li-ion - 300V	60kW DC Permanent Magnet
Rose-Hulman Institute of Technology	Power split hybrid	2.5-L VM Motori	Bio Diesel	Planetary Power Split	NiMH	(2) 60kW AC Ind.
San Diego State University	Through the road parallel hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel	5 Spd Manual	NiMH/ Maxwell Ultracaps	150kW AC Ind.
Texas Tech University	Through the road parallel hybrid	2.2-L GM L61 100kW SI /10kW Fuel Cell	E85/ Hydrogen	4 Spd Automatic 4T45E	COBASYS NiMH - 288V	Ballard 45kW/ 65kW IPT
University of Akron	Through the road parallel hybrid	1.9-L VW TDI diesel	Bio Diesel	VW 6 Spd DSG	Johnson Controls - 288V/ Maxwell Ultracaps	Ballard 65kW/ 45kW Drive Motor
University of California, Davis	Plug-capable, pre-transmission	1.5-L Atkinson Cycle (Toyota)/ 10kW Fuel Cell	E85/ Hydrogen	2L CVT	Valence Li-ion Saphion Pack - 350V	(2) 75kW brushless DC motors from UQM
University of Michigan	Series hydraulic hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel	Fixed Gear Reduction	15 gal. Hydraulic Accumulators	(2) Eaton Bent-Axis Variable Displacement
University of Tennessee	Through the road parallel hybrid	1.3-L Fiat Diesel	Bio Diesel	5 Spd Manual	COBASYS NiMH - 288V	Ballard Ecostar 55kW AC Ind.
University of Texas, Austin	Conventional - ISG	1.9-L High Eff. Dilute Gasoline Engine	RFG	CVT	Johnson Controls PbA - 42V	Integrated Starter/ Alternator
University of Tulsa	Through the road parallel hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel/ Hydrogen	6 Spd Manual	COBASYS NiMH - 288V	Ballard 60kW IPT
University of Waterloo	Series fuel cell hybrid	65kW Hydrogenics PEM Fuel Cell	Hydrogen	Fixed Gear Reduction	COBASYS NiMH - 288V	(2) Ballard 54kW AC Ind.
University of Wisconsin – Madison	Through the road parallel hybrid	1.9-L Fiat 110kW CIDI	Bio Diesel	6 Spd Mechatronic	Johnson Controls NiMH	Ballard IPT - 56 kW
Virginia Tech	Through the road parallel hybrid	2.0-L GM Si 4 Cyl Turbo	E85	5 Spd Manual	COBASYS NiMH - 288V	(2) 33kW AC Ind.
West Virginia University	Post transmission parallel hybrid	1.9-L VW TDI diesel	Bio Diesel	5 Spd Auto	Li-ion - 48V/ Maxwell Ultracaps	(2) Wheel Hub Motors/ 13kW AC Ind.