

## Ford's "Model U"

Stefan Geiger, Fuel Cell Today, January 2003

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On the occasion of the North American International Auto Show in Detroit, Ford unveiled its new hydrogen hybrid vehicle "Model U".

According to Ford, the vehicle, powered by a supercharged hydrogen internal combustion engine, equipped with a hybrid electric transmission and pioneering green materials and processes, is a vision for the future.



To develop the Model U, a partnership between some of Ford's own subsidiaries and relevant departments and external suppliers, such as Dynatek, Quantum, Roush McLaren and others was formed.

### **Internal Combustion Engine**

Model U is powered by a supercharged 2.3-liter internal combustion engine that runs on hydrogen. The car also features a Modular Hybrid Transmission System. Its emission of all pollutants, including carbon dioxide, is nearly zero, and the engine is up to 25 percent more fuel-efficient than gasoline engines. Ford believes that hydrogen will be the automotive fuel of the future. The hydrogen ICE can act as a stepping stone to hydrogen-fueled mass transportation that eventually will incorporate fuel cells. The engine is based on Ford's global 2.3-liter I-4 engine used in the Ford Ranger, the European Ford Mondeo, and a number of Mazda vehicles. The engine is optimised to burn hydrogen with 12.2:1 high-compression pistons,

fuel injectors designed to handle hydrogen gas, a coil-on-plug ignition system, an electronic throttle, and new engine management software.

### **Ford Model U Concept Car**

The vehicle can reach an overall efficiency of 38 percent, which is approximately 25 percent better than a gasoline engine. Because there are no carbon atoms in the fuel, combustion of hydrogen produces no hydrocarbon or carbon-dioxide emissions.

Designing a gasoline engine to burn hydrogen fuel has typically resulted in significantly lower power output—until now. Ford researchers have shown that with supercharging, the hydrogen ICE can deliver the same power as its gasoline counterpart and still provide near-zero-emissions performance and high fuel economy. The centrifugal-type supercharger provides nearly 15 pounds per square inch (psi) of boost on demand.

### **Ford Modular Hybrid Transmission System**

The hydrogen ICE is joined with an advanced hybrid electric transmission technology called the Ford Modular Hybrid Transmission System (MHTS). The torque converter from a conventional transmission is replaced with a high-voltage electric motor and two hydraulic clutches that permit the motor to operate independently of, or in concert with, the engine. The electric motor simultaneously fills the role of flywheel, starter, alternator and hybrid traction motor.

The hybrid system is known as a "parallel" arrangement, which means that Model U can operate on either the hydrogen ICE engine or electric motor, or both for extra power. A regenerative braking function reclaims energy that would otherwise be lost as heat, storing it in the 300-volt, air-cooled battery pack for the next acceleration, passing maneuver or hill climb. When the driver comes to rest at a traffic light, the engine can automatically be switched off to save fuel. When the accelerator is applied, the electric motor instantly starts the engine, the clutch to the transmission engages, and the vehicle begins to pull away, all within 300 milliseconds. MHTS provides significant increased fuel efficiency while delivering familiar performance and drive characteristics. The technology is designed with minimal effect on the base transmission so as to reduce complexity and cost compared to other hybrid systems.

## Other Key features

Apart from the new engine, Model U comes with additional features such as reconfigurable Interior and Exterior, conversational speech interface and improved driver visibility and awareness through active safety.

## Technical Specifications:

I / w / h	4,230 / 1,810 / 1,651 mm
Fuel	Compressed Hydrogen
Fuel Capacity	7 kg
Powertrain	Hydrogen 2.3 l internal combustion engine with supercharging
Engine power	118 hp (88 kW) at 4,500 rpm
MHTS assist	33 hp (25 kW) continuous, 46 hp (35 kW) peak
Fuel consumption	45 miles per kilogram hydrogen
Range	315 miles
Operating pressure	10,000 psi
Top speed / acceleration	125 km/h (~80 mph)