



MODEL



**“THE COMPANY’S CENTENNIAL OFFERS US A
UNIQUE OPPORTUNITY TO REFLECT ON OUR
MANY PAST ACCOMPLISHMENTS. BUT IT ALSO
CHALLENGES US TO LOOK AHEAD AND CREATE A
VISION OF CONTINUING SUCCESS. MODEL U IS
AN EXPLORATION OF THAT FUTURE VISION.”**

**– BILL FORD
CHAIRMAN AND CEO, FORD MOTOR COMPANY**

MODEL 

MODEL U CONCEPT: A MODEL FOR CHANGE

Building on the heritage started with the Model T, Ford's Model U concept begins Ford Motor Company's second century of innovation.

Equipped with an array of upgradable technologies and a multi-function tailgate, Model U can stick with you and adapt to your needs if your life changes.

Powered by the world's first supercharged hydrogen internal combustion engine, equipped with a hybrid electric transmission and pioneering green materials and processes, Model U is a vision for the future. It is Ford's model for change – exploring the benefits a vehicle provides to its users, the way it is manufactured and how it impacts the world.

It is the Model T of the 21st century.





Inspired by how the Model T revolutionized personal transportation in the last century, a team of Ford researchers and designers created Model U. It is a clear expression of Ford Motor Company's strategy to pursue future automotive technologies without compromising today's customer expectations for personal mobility. It is a car designed to be good to you and good for the world.

"When Henry Ford built the Model T, it was affordable, offered the most advanced manufacturing and was built with the most advanced materials," said Dr. Gerhard Schmidt, vice president of Research and Advanced Engineering. "In a similar but entirely contemporary way, Model U starts a new cycle. Emissions, safety and fuel economy, also green materials and processes, are all key issues facing the entire industry. We believe the Model U addresses them all."

A partnership was struck among Ford's Research and Advanced Engineering, Ford's Brand Imaging Group (an internal design think tank), Bill McDonough (architect of the new Rouge Center and co-founder, with Dr. Michael Braungart, of the product design firm MBDC), BP and a host of technology suppliers.

"Model U is very different from most futuristic concept vehicles," said J Mays, vice president of Design. "It tries to address the challenges of the future and proposes exciting, realistic solutions that exceed current industry standards. Therefore, I hope it does justice to the name 'Model for Change.'"

Model U offers SUV driving excitement that is affordable but can grow with a customer's lifestyle and aspirations. It is designed for mass production, but has nearly infinite capacity for being personalized and upgraded. It offers advanced technologies that respond to customers' desires for convenience, entertainment and continuously improved safety. And it looks at how building a car, truck or SUV can strengthen the environment.

"What I think is so exciting about Model U is that it opens the door to a whole new way of looking at things, just like the Model T did," said McDonough. "The vision behind Model U is entirely positive. Instead of focusing on minimizing environmental harm, which is what most approaches to sustainable mobility do, Model U starts to find ways to be re-creational and regenerative – to have fun and create environmental benefits at the same time. That's a totally new vision for the auto industry."

KEY FEATURES:

- Reconfigurable Interior and Exterior – Model U can adapt to each person’s individuality. Its interior is modular, allowing for ongoing upgrades. The Model U has a series of slots in the floor, door panels and instrument panel in which different components can be mounted, moved around or added later. The slots are designed to provide power and access to the vehicle’s electronic network. The exterior is highlighted by a power retractable roof, rear window, tailgate and trunk, allowing the vehicle to go from closed to open.
- Hydrogen ICE plus Hybrid Electric Powertrain – A 2.3-liter, four-cylinder supercharged, intercooled hydrogen internal combustion engine, coupled with a hybrid electric transmission propels Model U. It offers enhanced fuel economy – the equivalent of 45 miles per gallon and about 300 miles of range – plus near-zero regulated tailpipe emissions and a 99-percent reduction in carbon dioxide. The powertrain also features Ford’s advanced Modular Hybrid Transmission System, a way to simplify hybrid electric vehicle (HEV) technology in manufacturing, while contributing to significant fuel economy improvements. This vehicle can meet PZEV emissions.





- Conversational Speech Interface – Model U showcases the most advanced conversational speech technology displayed to date. It allows a person to speak naturally and operate on-board systems including entertainment, navigation, cellular telephone and climate control.
- Improved Driver Visibility and Awareness through Active Safety – Model U features pre-crash sensing, adaptive front headlights and an advanced night vision system to help the driver avoid accidents before they occur.
- Green materials and processes – The Model U features advanced materials that have been designed for the optimum health of the car's occupants. These were designed for their ecological effects and can go from cradle-to-cradle, instead of staying in typical cradle-to-grave waste streams.



RECONFIGURABLE INTERIOR AND EXTERIOR DESIGNS

The Model U fits Ford's Outfitters image with its flexible design that can adapt to meet any individual's needs and perform any type of function. Its design is determined and confident, accentuated by a tough stance and pronounced wheel arches. With seating for up to four people, lots of storage space and built-in flexibility, it provides sensible solutions in an innovative way.

"This project was very exciting for us," says Laurens van den Acker, chief designer for the Model U. "To embody the spirit of the Model T, we had to design an extremely ingenious car that could grow with your needs and meet an incredible packaging challenge. Model U doesn't compromise interior space for the occupants or cargo despite the storage space needed for the hydrogen tanks and the hybrid powertrain."

EXTERIOR

The Model U's unique 3-box profile exterior has a tough modular look. Body panels are visually separated through different finishes and are made of different

materials. The body side has a glossy appearance; the doors are matte and grooved for both design appearance and structural integrity. The body structure is aluminum; the front side panels are built with a natural fiber-filled composite material.

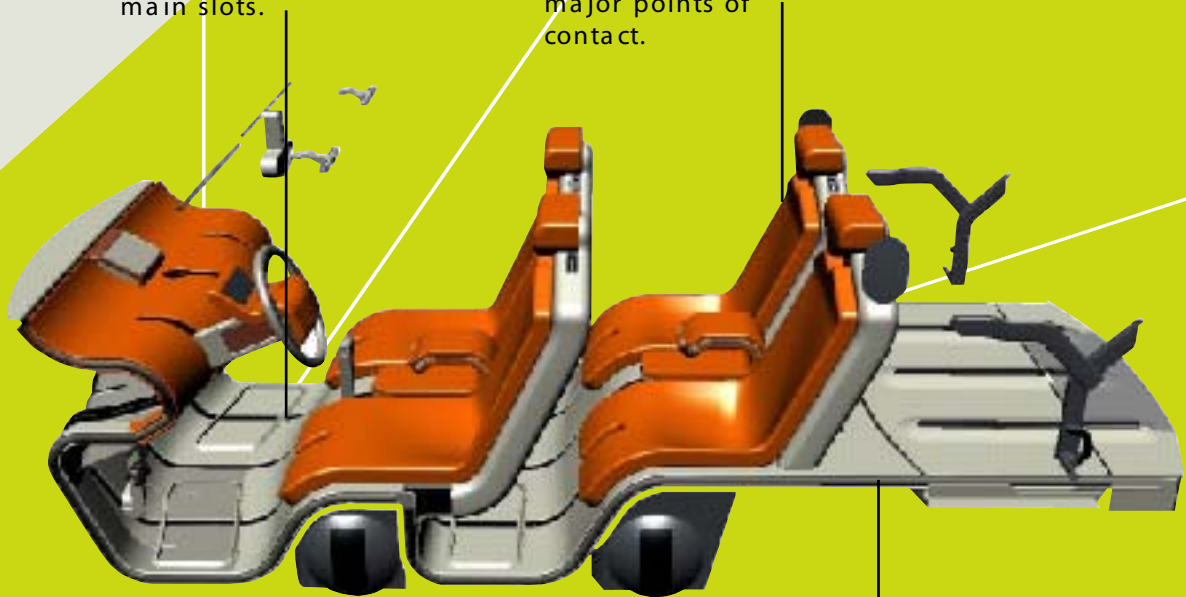
Its flexibility makes it capable of performing rugged jobs as well as driving to an evening out. Model U goes from completely closed to completely open. When completely open, it looks like a pickup. The rear seats can be removed to provide a longer loading floor.

The roof of the Model U is a power-retractable canvas soft top that opens rearward to offer a nearly open-air motoring experience. The rear of the vehicle also can be opened with power controls. The rear window folds into the deck lid and the deck lid then folds back and down into the floor so that it is hidden and safe from being damaged.

The Model U also features a power hood that opens from the windshield toward the front of the SUV. The hinges are hidden in the front bumper.

The flowing “magic carpet” layer of the interior contains the Model U’s main slots.

A layer of fabric is used on all major points of contact.



The base layer of the interior sits above the hydrogen fueling system.

INTERIOR

The interior of the Model U is uncluttered and open but allows for flexibility through the use of the innovative slot system. It is shown as an affordable base vehicle that grows with a customer’s life and aspirations. The Model U ties back to the Model T roots in that it is classless and allows people to aspire to something more, yet it delivers for the people who can already afford more.

An important feature of Model U is the ‘layering’ of major design elements. This is done to visually and physically separate the materials from each other, a vital aspect when designing for disassembly.

There are three basic layers that make up the interior:

- The bottom surface is the base of the vehicle. It is painted a dark gray and helps emphasize the glossier layer. Much of the hydrogen fueling system, including its four tanks, is beneath this surface.

- The middle layer is the floor, which has a semi-gloss appearance. Nicknamed ‘the magic carpet’ by the designers, it flows from the top of the instrument panel, down the footwell, over the hydrogen storage tanks and all the way to the tailgate. Through it run the main three slots.
- The top layer is fabric and is used on all points of contact including the seats, armrests, steering wheel and dash. The fabric is an orange color that is fresh and modern, adding visual warmth to the Model U.

Model U comes with wireless capability. The steering wheel is located in the first slot and is equipped with two controls. One operates voice controls and the other is a scroll wheel that lets the driver control fan speed and volume of the entertainment system. These buttons are repeated on the armrests in both the front and rear rows. The basic dash has analog dials, but they can be upgraded to digital.

The pedals are stationary, but the gear shifter is a wireless device that can be located between the seats or directed to the driver.

The passenger side is an open space perfect for customization. An owner can choose to place a second screen there or use the space for storage. Accessories, seats and storage bins could be left inside or moved in and out as needed.

Rear seats are located on slots and can be moved forward to offer more rear space or removed to create the pickup bed. Rear-seat passengers will have small entertainment screens in front of them. Slots allow them to plug in DVD, computer or game systems.

The three main slots end several inches behind the second row of seats to provide enough space for attachments. Additional slots, located in the doors, can hold armrests, wireless switches or any other accessory.

Finally, small slots are located in the roof for placement of the rearview mirror, sun visors and microphones for the speech system. These slots also are the design element of modular technology that is central to Model U's functionality.

The slot system allows the "U-ser" to transfer personal accessories to other vehicles, or dealers to very quickly update the look of the car when it enters the used-car market.

Model U includes individual screens for rear seat passengers.





2.3L HYDROGEN

HEU

SUPERCHARGED



HYDROGEN INTERNAL COMBUSTION ENGINE

Model U is powered by an internal combustion engine (ICE) that is optimized to run on hydrogen. The engine is supercharged and intercooled for maximum efficiency and power. 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. A hybrid-electric transmission system further improves efficiency.

“We believe that hydrogen will be the automotive fuel of the future,” says Dr. Schmidt. “The hydrogen ICE can act as a stepping stone to hydrogen-fueled mass transportation that eventually will incorporate fuel cells.”

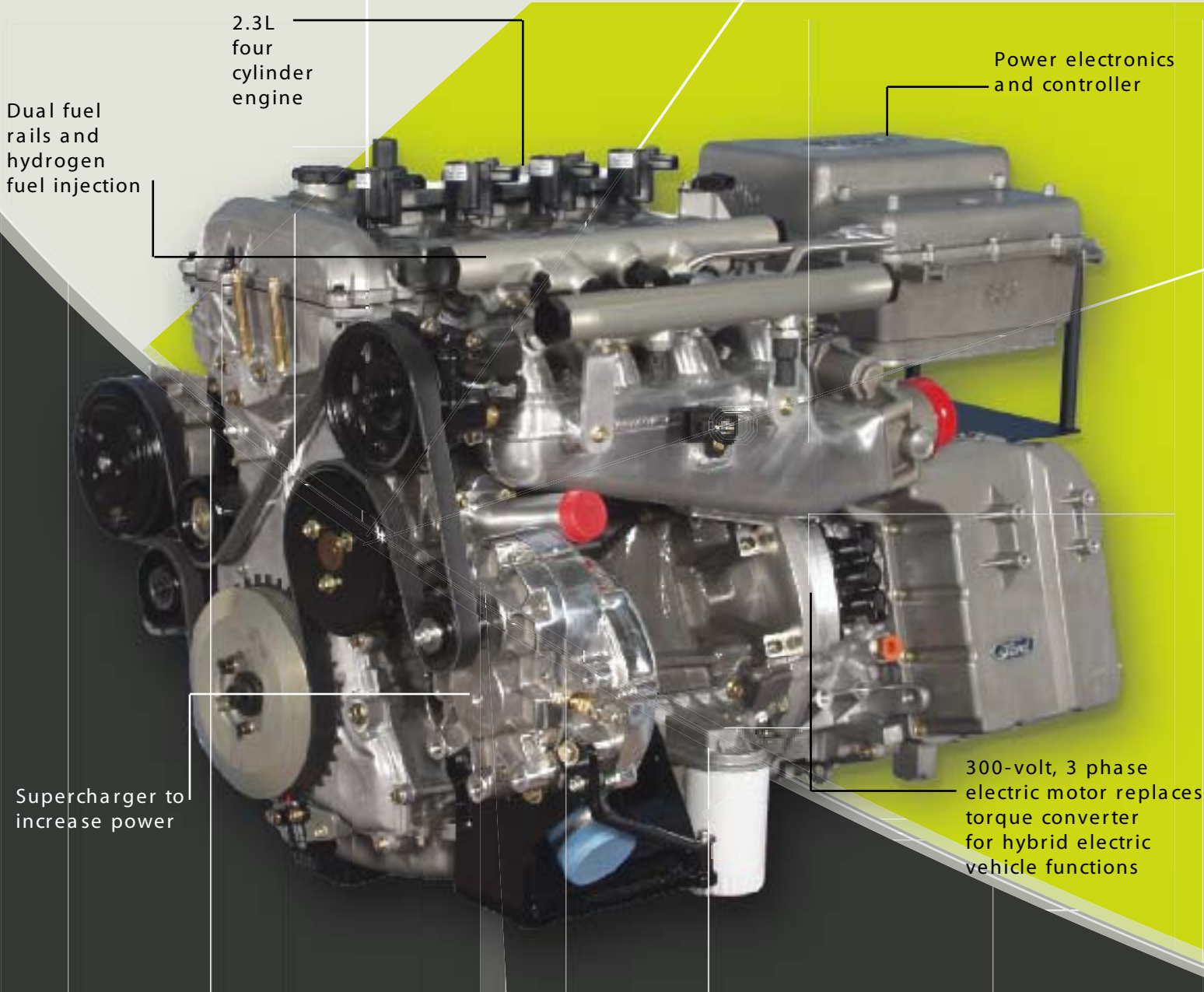
The hydrogen ICE is a common-sense powerplant that uses existing, proven technologies to deliver the environmental benefits of a hydrogen fuel cell – but at a fraction of the complexity and cost.

The hydrogen ICE 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 optimized 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.

Because hydrogen has a very wide combustion range (from 4 to 75 percent), hydrogen-fueled engines can use a wider range of air/fuel mixtures than gasoline engines, and can be run in the fuel-efficient “lean” regime without the complications of pre-ignition or “knock.” Much like a diesel engine, the hydrogen ICE runs unthrottled while under way, with air/fuel mixtures as lean as 86:1 during highway cruise, compared to the 14.7:1 of gasoline-powered vehicles. It 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. Even without aftertreatment, oxides of nitrogen (NO_x) are very low, and catalyst research may soon reduce tailpipe output of potentially smog-forming emission to below the ambient conditions in many cities.



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.

Also, Model U uses a novel dual-stage intercooling process. After leaving the supercharger, the intake air passes through a conventional air-to-air intercooler, then through an air conditioning-to-air intercooler for a further reduction in temperature. This patent-pending solution further improves the performance of the engine.

FORD MODULAR HYBRID TRANSMISSION SYSTEM

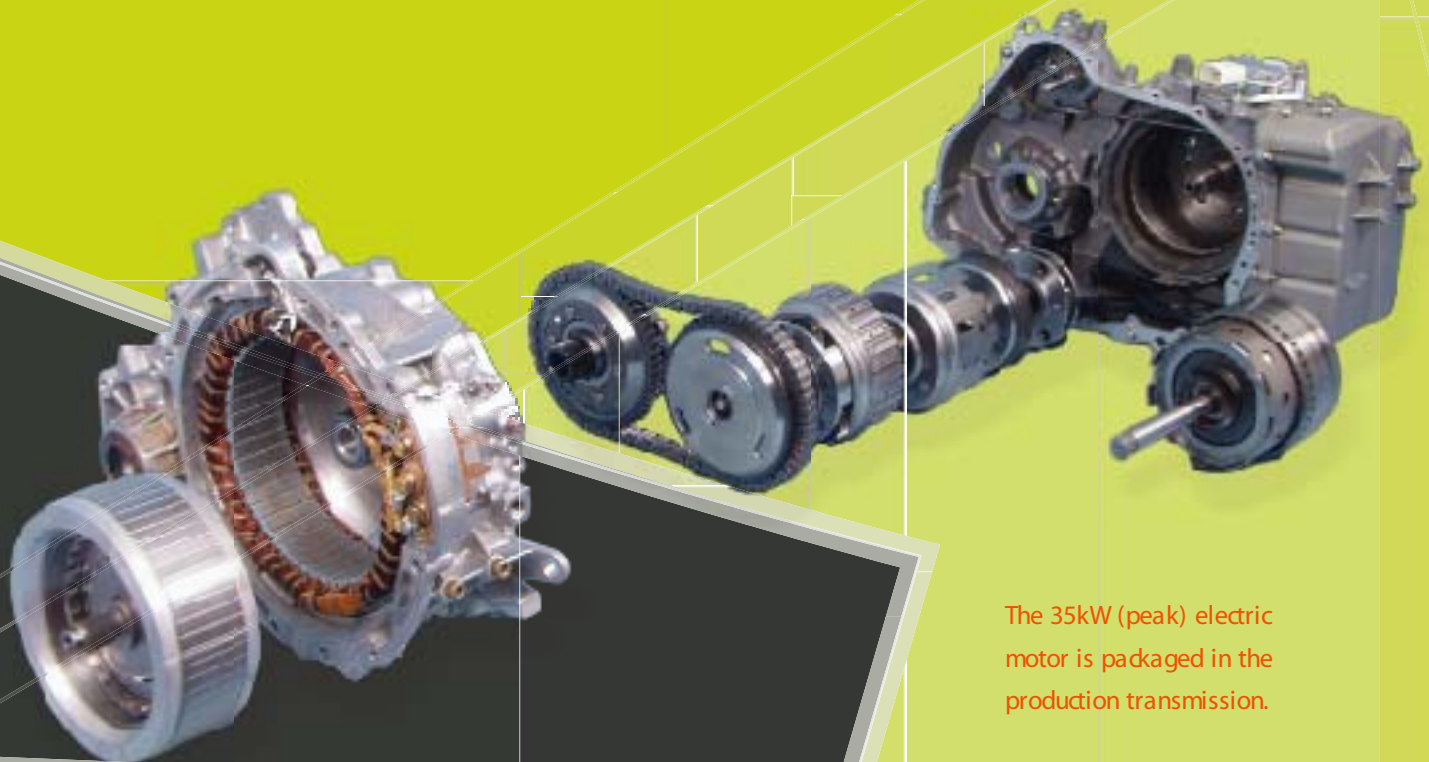
The hydrogen ICE is joined with an advanced hybrid electric transmission technology called the Ford Modular Hybrid Transmission System (MHTS). The torque converter from a conventional transmission is replaced with a high-voltage electric motor and two hydraulic clutches that permit the motor to operate 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 significantly increased fuel efficiency while delivering familiar performance and drive characteristics. The technology is designed with minimal effect on the base transmission reducing complexity and cost as compared with other hybrid systems.



The 35kW (peak) electric motor is packaged in the production transmission.



FUEL STORAGE



Hydrogen fuel tanks are located under the front and rear seats.

Model U can carry up to 7 kilograms of hydrogen on board. Its fuel tanks, made of a 3-millimeter aluminum pressure barrier with a carbon-fiber structural casing, are rated to an operating pressure of more than 10,000 psi.

Hydrogen offers the potential for a sustainable, cleaner burning fuel. Ford Motor Company, in conjunction with BP, is exploring the potential for hydrogen production. BP currently produces hydrogen from natural gas in an efficient, effective manner. Continued support from industry and government, through FreedomCAR and other efforts, might one day make its use a reality in vehicles like Model U.

CONVERSATIONAL SPEECH INTERFACE

Along with being personalized from a physical feature and capability aspect, the Model U is also a more intelligent vehicle that allows you to use technology for personalization and convenience.

“One challenge we face is having our vehicle technology keep pace with electronics developments; we believe we have a solution,” says Bryan Goodman, technical specialist in Ford’s Research and Advanced Engineering. “The Bluetooth™-enabled slot system allows for continuous additions and upgrades throughout the life of the vehicle.”

In 1999, Ford Motor Company introduced the industry’s first full-featured vehicle voice control system called JaguarVoice. This system enables control of a limited set of vehicle features using very precise spoken commands. It remains the best system in production today.

With the Model U, Ford is bringing voice recognition technology to an amazing new level. Advanced conversational speech interface technology simplifies the control of many functions by allowing you to have a normal dialogue with your vehicle. A text-to-speech system is used but will sound like a real person rather than a robot. Specific commands don’t have to be memorized. The voice system controls navigation, phone, entertainment, climate control, the retractable roof and personalization preferences.

Conversational speech interface allows you to use everyday language and flexible voice commands. If there is any ambiguity in a driver or passenger’s request the system will ask for more information in very simple language. For example, if an occupant asks the Model U to “Call Steve Smith,” and the system finds



For climate control, the driver or front passenger can ask the Model U for different temperature settings, fan speeds or locations, such as the defrost setting.

The conversational speech interface has a vocabulary of over 50,000 words so far, and speaks only when spoken to.

Model U's system can be used to configure different drivers' personalized settings – including the type of voice, the graphic style of the visual interface and even favorite music.

The Bluetooth™ technology enabling the system to work is located within the controls of the Model U. It works with any Bluetooth™-enabled cellular phone or PDA, provided the device is turned on and is located somewhere inside the vehicle. It can be inside an occupant's pocket or a purse. This allows occupants to connect with all their personal files, including phone lists and Internet addresses. The Model U and individual personal electronics are automatically synchronized when entering the vehicle.

several numbers for Steve Smith in the address book, it will list them and ask which one should be dialed. If told to play music, Model U will ask what type and then list the artists available. Music is stored in MP3 format and is downloaded through wireless technology from a PDA or a home computer.

A clear advantage can be found in using the navigation system. Current systems require a person to either type in a location or spell it out letter-by-letter, number-by-number. You can simply tell the Model U a specific address, major intersection or one of many points of interest, and it will guide you to your destination in conversational terms.

IMPROVED DRIVER VISIBILITY AND AWARENESS THROUGH ACTIVE SAFETY

The Model U offers several technologies designed to improve awareness – for both the driver and the vehicle itself. The goal is to enhance a driver’s natural abilities and supplement them with the vehicle’s ability to recognize a potential driving risk.

Four technologies in the Model U are designed to address these issues:

- Adaptive Front Lighting enhances what our eyes can see with headlights
- Active Night Vision also enhances the images we naturally see

- A stereo camera-based pre-crash sensing system
- A Ford-patented TrafficView™ system that allows the driver to see beyond vehicles directly in front of it

With Adaptive Front Lighting, the goal is to change the area being lit depending on the driving environment. For example, at an intersection broader coverage is needed than when a vehicle is going straight at a constant speed. Then a narrow but more distant area needs to be covered. The system uses vehicle inputs, speed, steering wheel angle and turn indicator position, plus global positioning satellites and digital mapping to constantly know where the Model U is located and what beam pattern is needed for safe driving.



An advanced Active Night Vision system on the Model U will allow the driver to see well beyond the range of low-beam headlights during nighttime driving without affecting drivers in oncoming vehicles.

The system uses a near-infrared (NIR) diode laser, compact optics, a sensitive CCD camera and a heads-up display. The NIR light is invisible to the human eye, so the laser is used to illuminate the roadway with a high-beam pattern at all times without blinding oncoming drivers. Natural-looking video images that include lane markings and signs are shown on the heads-up display directly below the driver's view of the roadway.

Another technology on Model U is designed to help determine if collision threats exist. Pre-crash sensing technology uses a forward-looking stereo camera system. A pair of cameras detects if a vehicle is in front of Model U. The system then processes the image to classify what type of vehicle it is and assess the potential collision threat. At that point, information is sent to the driver and appropriate safety technologies can be applied.

Vehicle classification is an emerging technology that is key to accident avoidance systems. Countermeasures could differ depending on the specific danger.

TrafficView™ uses cameras in the side mirrors to help drivers see around large vehicles. Unique to Ford, TrafficView™ enables the driver to see problems up ahead without placing the



Model U's center-mounted control screen.

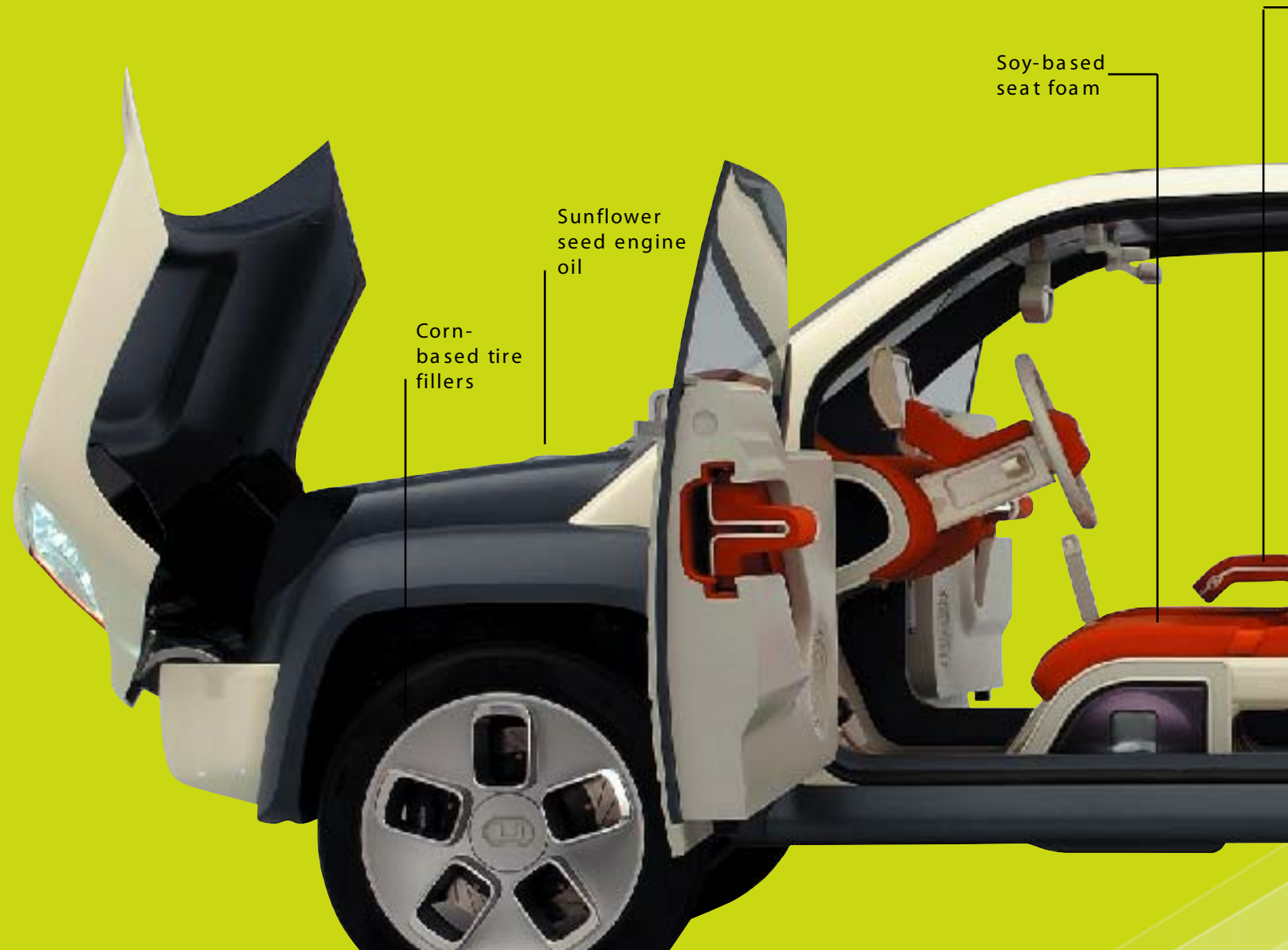
vehicle in a dangerous situation. For example, left turns at an intersection can be a challenge if vehicles waiting to turn on the other side of the intersection block the driver's view of through traffic. With TrafficView™ the driver can see if vehicles are approaching safely and make the turn decision with more information.

Model U also has four-point safety belts in all seating locations for improved protection of occupants in case of a collision.



GREEN MATERIALS AND PROCESSES

The Model U is a realistic approach to the future guided by a powerful, positive vision. It follows the traditions of the Model T by being designed for the masses and addressing social issues, specifically environmental concerns. The Model U represents how using and producing personal transportation can have a positive effect on the planet instead of simply minimizing negative effects.



Soy-based seat foam

Sunflower seed engine oil

Corn-based tire fillers

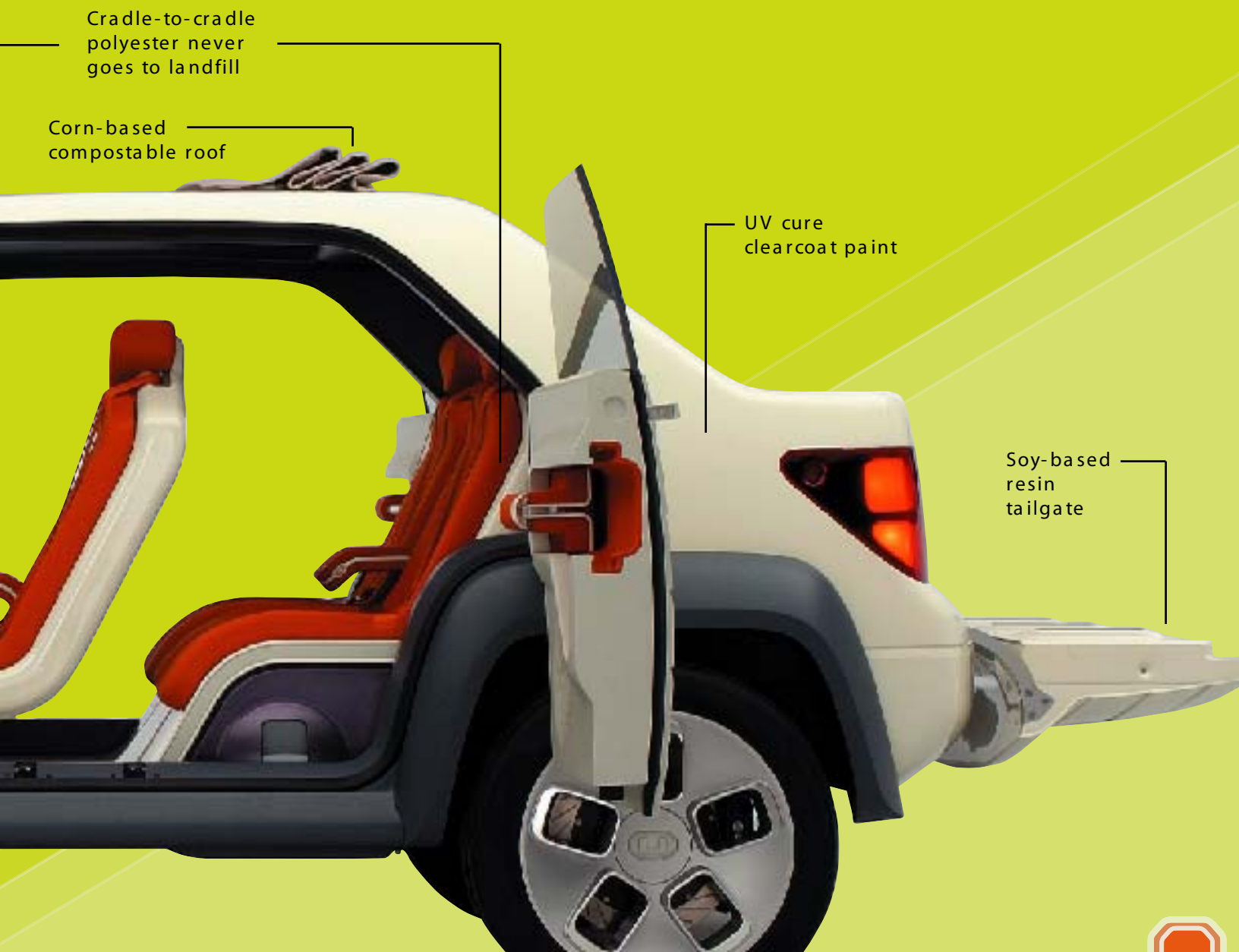
“Model U takes a positive approach to its materials and manufacturing,” says David Wagner, Model U’s technology project manager. “Some of these concepts won’t come to fruition for years to come, but this is an important first step. Examples can be found all around the vehicle, inside and out.”

The Model U is helping encourage development of materials that are safe to produce, use and recycle over and over again in a cradle-to-cradle cycle. These materials never become waste, but instead are nutrients that either feed healthy soil or the manufacturing processes without moving down the value chain.

Eco-effective polyester is the fabric designed by Milliken and Co. to be a technical nutrient. It can be recycled into base elements and reprocessed into material fiber again and again without losing any performance qualities, and it is made from healthy substances.

This polyester is used inside the Model U on its seats, dash, steering wheel, headrests, door trim and armrests.

The Model U also uses a potential “biological nutrient” made to safely return to the soil to feed the next generation of resource growth called polylactide or PLA. It is a biopolymer from Cargill Dow derived from corn. PLA fabrics, provided by Interface, are used for the



Model U's canvas roof and carpet mats. The fabric has the comfort and feel of natural fibers as well as the performance and easy care of synthetics that are petroleum based.

Because cradle-to-cradle materials (technical and biological nutrients) aren't available in all cases, other materials are used in Model U to lighten its environmental impact. Renewable, plant-based components are used in several cases to replace petroleum-based materials.

Rubber tires use corn-based fillers as a partial substitute for carbon black. They offer lower rolling resistance and lower weight, leading to improved fuel economy and improved traction on wet pavement.

There are also several soy-based components in Model U, including polyurethane seating foam and polyester resin that is reinforced with fiberglass and used to make the tailgate.

In conjunction with Model U, the team from Ford Research and Advanced Engineering is working with Shell Global Solutions to test a bio-based lubricant from sunflower seeds. The Model U also begins to address manufacturing issues trying to develop flexible manufacturing processes that reduce energy use and part complexity, as well as develop technical processes that have a positive environmental impact.

Flexible manufacturing plays a role in allowing easy reconfiguration of a vehicle in the future. Various types

Additional slots, located in the doors, can hold armrests, wireless switches or other accessories.



of vehicle body architectures can be constructed with common nodes and common extruded tubes joined with low energy-efficient methods. This could also allow many different vehicles to be built in a single assembly plant with reduced inventory and lower tooling cost.

This type of efficiency is also expressed in the interior of the Model U. The armrests on all four doors are exactly the same, as are the center armrests in the front and rear seating rows. This modularity begins to facilitate the recovery of the cradle-to-cradle materials as Model U is dismantled, assuring highest-quality recycling of these valuable substances.

Environmental concerns in manufacturing are also addressed with a new UV-cure clearcoat system developed by Akzo Nobel. Clearcoat is the topmost layer of a vehicle's paint. It gives a vehicle its shine and protects the paint from damage. During the clearcoat cure, the Model U was exposed to ultraviolet light rather than to the high temperatures that are used traditionally.

This system provides a harder finish and means the Model U will be more resistant to scratches than most cars and trucks. The process eliminates the need for a bake oven and uses less energy and solvents than traditional systems.



Model U uses soy-based polyurethane seating foam.



SUPPLIER CONSORTIUM

In addition to suppliers mentioned, many others contributed to the development of the Model U including:

Ashland	Soy resin for body panels
Brilliant Technologies	Headlight concepts
Dynatek	Hydrogen fuel tanks
Goodyear	Corn-based tires
Harman Becker	Sound system
Makel Engineering	Hydrogen sensors and controller
McLaren	Hydrogen fuel rails and supercharger
Motorola	Wireless technologies
Pi Technology	Hands-free phone
Quantum	Hydrogen fuel injectors
Roush	Engine support and build
Sarnoff	Collision avoidance systems
Sun Microsystems	Vehicle electronics programming
SpeechWorks	Conversational speech voice interface
TRW	Four-point safety belts
USSC	Soy-based foam for seats
Visteon	Exterior lighting
MIT Medialab	Wireless switches
Univ. of Northern Iowa – ABIL	Soy-based grease

SPECIFICATIONS

Vehicle type

Reconfigurable exterior (rear window, decklid, tailgate, canvas roof)

Reconfigurable interior (slot system for accessories and modularity)

Dimensions

Length (mm)	4,230
Width (mm)	1,810
Height (mm)	1,651
Wheelbase (mm)	2,685
Front track (mm)	1,583
Rear track (mm)	1,583
Front overhang (mm)	780.5
Rear overhang (mm)	764
Fuel capacity (kg)	7.0
Fuel type	Hydrogen

Powertrain

- Hydrogen 2.3-liter ICE with supercharging and dual-stage intercooling
- Modular Hybrid Transmission System

Performance

Engine horsepower	118 hp (88 kW) @ 4,500 rpm
MHTS assist	33 hp (25 kW) continuous / 46 hp (35 kW) peak
Total combined horsepower	151 hp (113 kW) @ 4,500 rpm
Torque	154 foot-pounds (210 Nm) at 4,000 rpm
Estimated fuel economy	45 miles per kilogram hydrogen (equivalent to 45 mpg)
Emissions	PZEV or better

Green materials and manufacturing

- Cradle-to-cradle polyester
- Corn-based roof canvas
- UV-cure clearcoat
- Bio-materials, including soy-based foam and tailgate, sunflower seed-based oil, corn tire filler
- Flexible manufacturing, extrusions and castings

Telematics technologies

- Conversational speech interface
- Upgradable instrument cluster
- Vehicle-to-vehicle communications

Active safety technologies

- Adaptive headlamps
- Accident avoidance stereo cameras
- Active night vision with heads-up display
- TrafficView™
- Four-point safety belts



