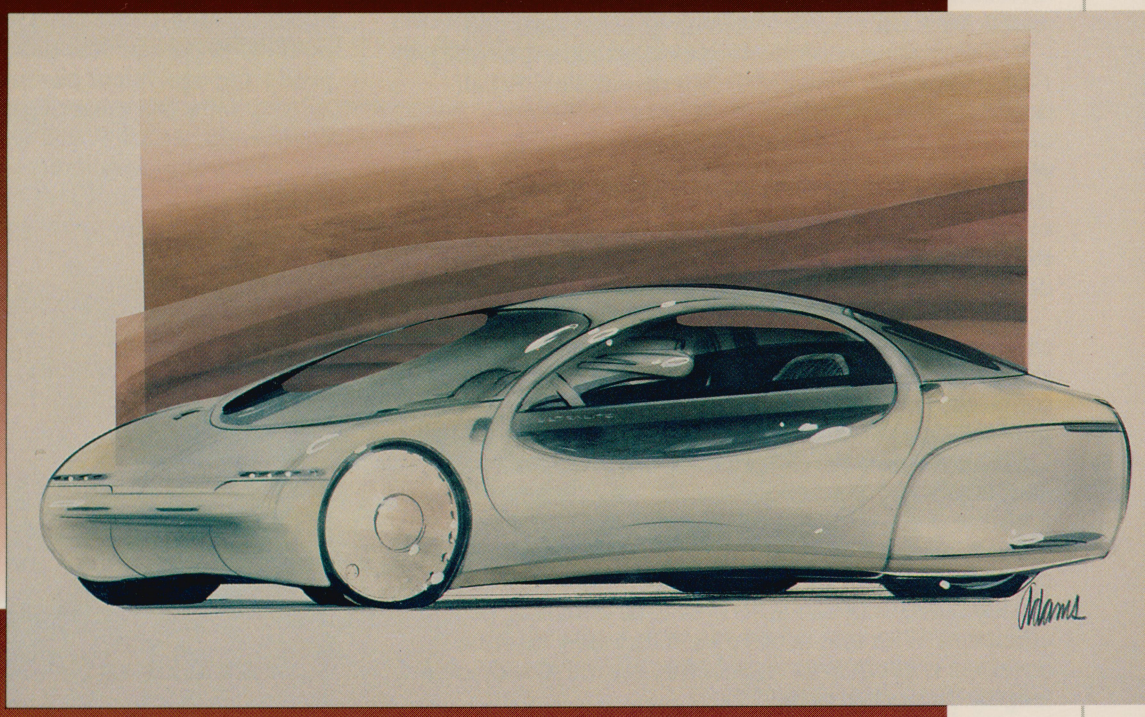


GM Ultralite

General Motors Corporation

Ultralite

In response to the demand for heightened fuel efficiency, many major automobile manufacturers are sharing ideas of how tomorrow's technology might improve the automobile. The Ultralite, introduced as the centerpiece of GM's Vision 2000 display at the 1992 North American International Automobile Show in Detroit, is a very different approach to building a concept car. Unlike most showpieces, the GM Ultralite is also a rolling laboratory—a fully driveable experimental automobile that'll be thoroughly tested long after the show circuit glitz has subsided.

Brainstorming sessions were conducted in the spring of 1991 to establish Ultralite design parameters. A half-dozen experts from a variety of General Motors disciplines—design, engineering, manufacturing and allied components groups—met for a week. The goal was to make Ultralite a showcase of GM design and technology. The designers decided that the Ultralite should weigh half as much as a comparable 1992 car and deliver twice the fuel efficiency.

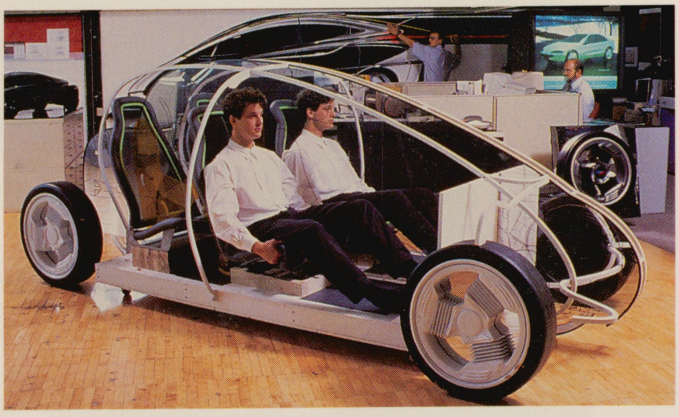
A target of 100 mpg in real-world conditions was established. While many manufacturers reach for similar goals with a variety of unrealistic assumptions and drastic compromises, the GM Ultralite is, for the most part, a practical design. It's not only fuel efficient but is also satisfying to drive; every performance parameter—handling, braking and acceleration—is exemplary. The Ultralite is also safe and comfortable for a family of four.

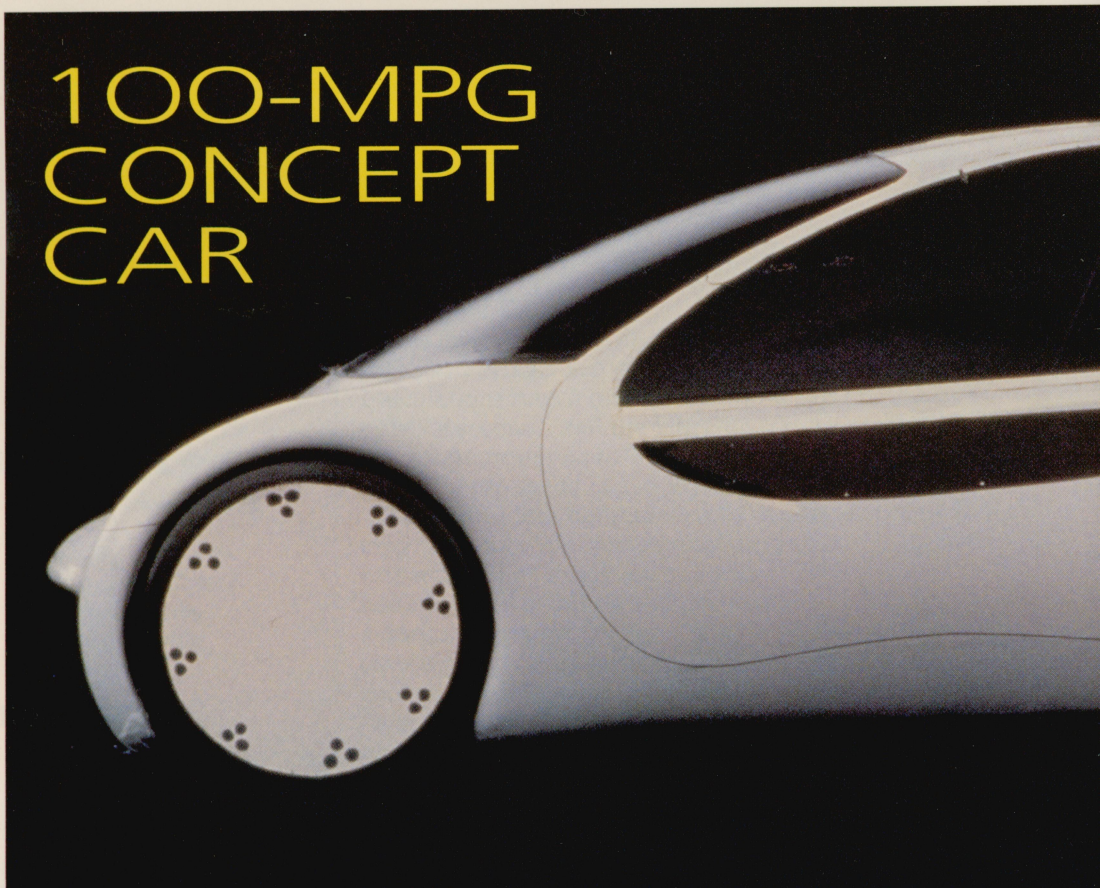
Exterior design details represent a more radical departure from today's automobile. Minimizing aerodynamic drag and lift is crucial to obtaining peak efficiency. With that in mind the Ultralite's exterior envelope is as compact as possible, yet the wheelbase is a lengthy 110 inches in the interest of ride quality. Imagine less exterior bulk than a Geo Prizm with the roominess of a Chevrolet Corsica riding on a Buick LeSabre's wheelbase. Its Cd (coefficient of drag) is 0.192, vs. 0.33 for a contemporary car, as measured with one-third scale models in the GM wind tunnel. The 1,400-pound Ultralite weighs only half as much as the Corsica.

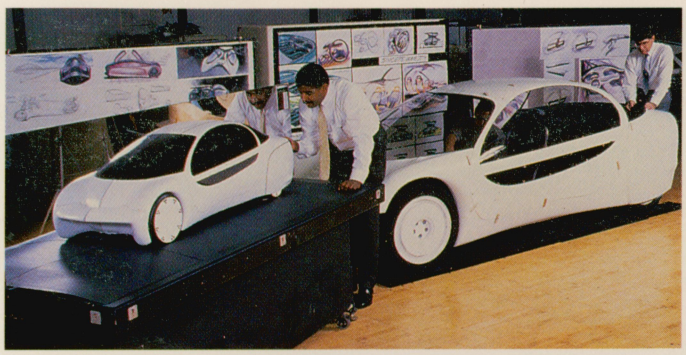
Exterior surfaces flow smoothly from the integrated front bumper to the abbreviated tail section with few openings or protuberances. Large-diameter wheels are moved out to the car's far corners. Rear tires are tucked behind flush-fitting shrouds, a detail made possible by a rear track that is five inches narrower than the corresponding front dimensions. The passenger capacity is by far the largest feature of the total package, and access to the interior is provided by two oversized doors that swing upward on hinges built into the roof panel. The Ultralite, GM designers strongly believe, clearly represents a look to the future.

The engine is the most efficient fossil-fueled power source that exists at General Motors: the experimental 1.5-liter, three-cylinder CDS2 two-stroke that was first revealed in 1990. This computer-controlled, direct-injection, stratified-charge engine weighs only 173 pounds, 40 percent less than a conventional engine producing equivalent power. It also occupies substantially less space. The GM two-stroke produces 111 horsepower at 5,000 rpm and runs so cleanly that the Ultralite would very likely qualify as an ultra-low-emissions vehicle in California.

While this engine is not ready for sale to the public, the

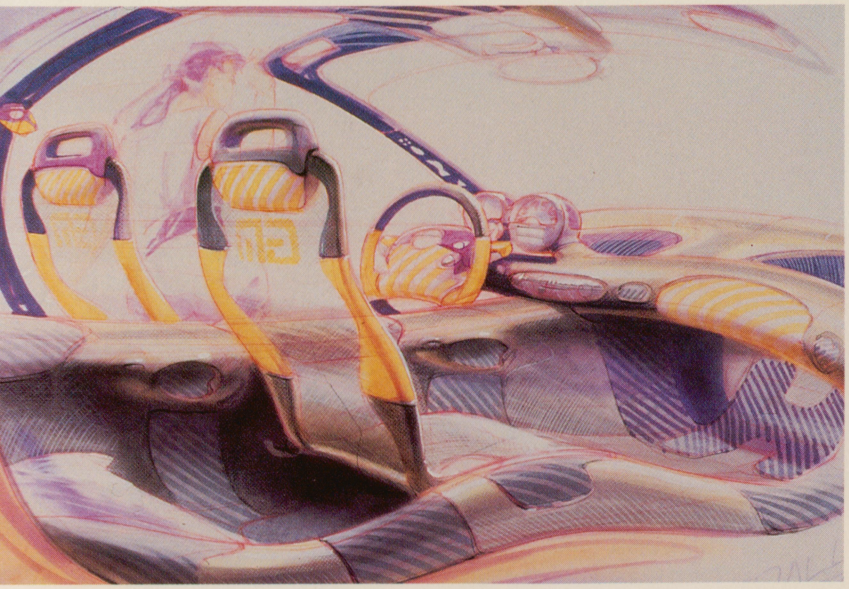






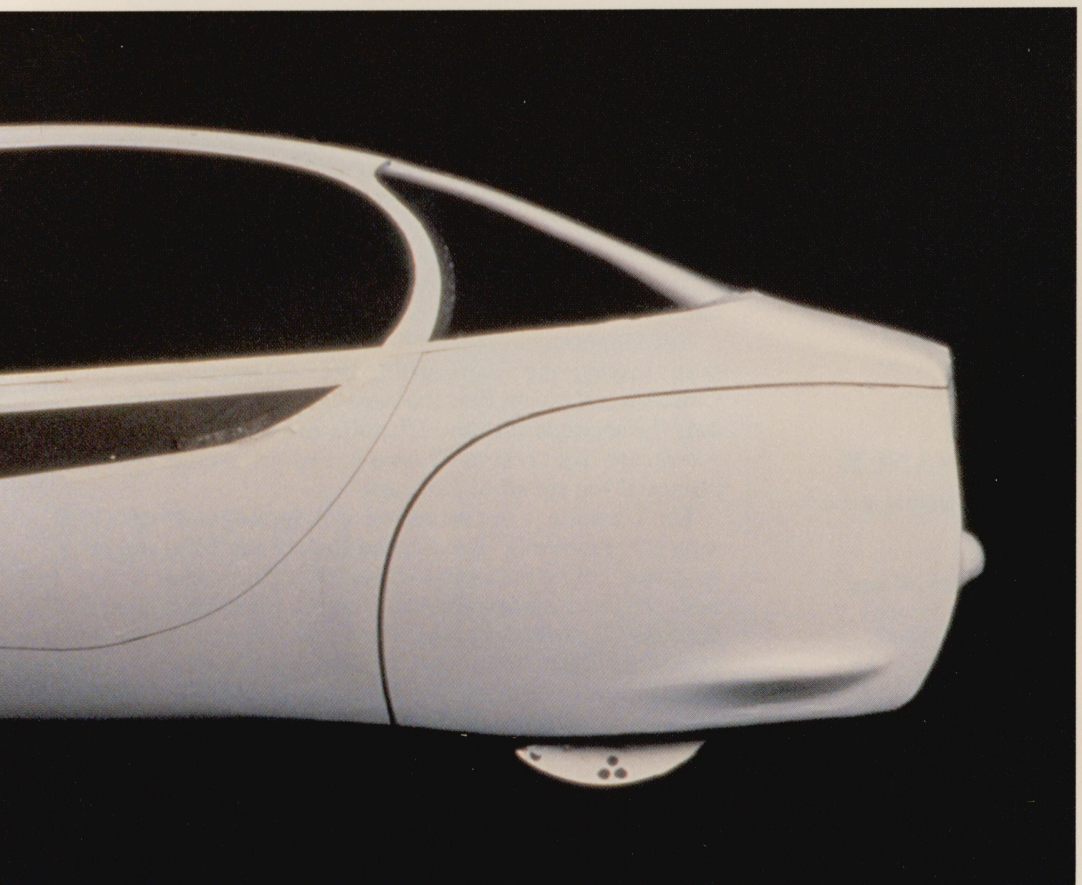
GM two-stroke's inherent advantages make it ideal for the Ultralite experiment. The lightweight and compact dimensions permitted GM engineers to position the engine and all associated components at the rear of the car in a dedicated power pod.

Chassis components are as light and as simple as possible. For example, power assists were purposely avoided in both steering and braking systems. The Ultralite is guided by a rack and pinion steering gear and stopped by four disc brakes. GM's successful ABS-VI anti-lock system is employed, and the brake rotors are special silicone-carbide, reinforced-aluminum components that save weight.



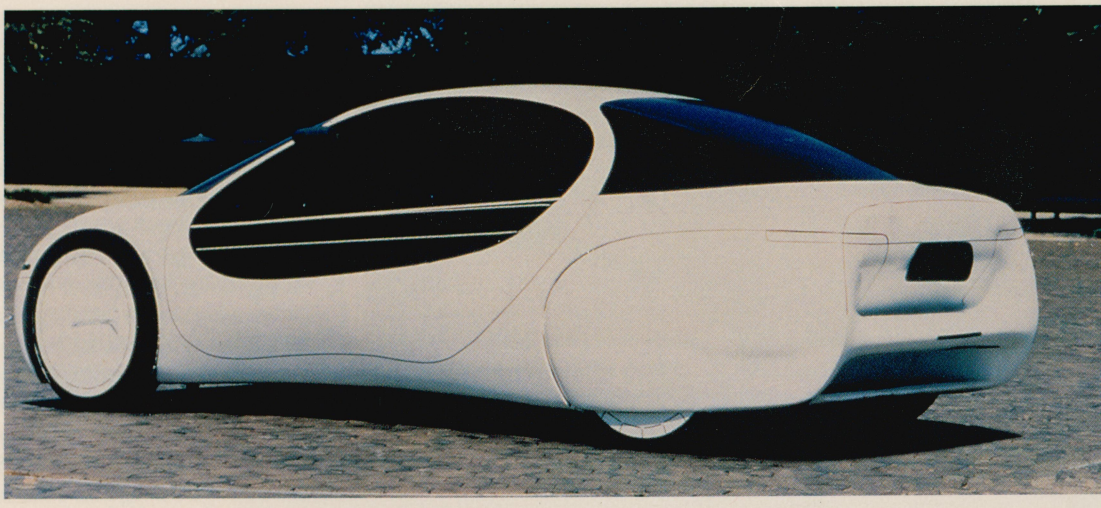
Aluminum is also the material of choice for the brake calipers, sway bars, steering knuckles, wheel hubs and the unequal-length control arms that suspend each wheel. The 4.5x18-inch forged-aluminum rims weigh only 13 pounds each. They're fitted with special Goodyear high-pressure, low-rolling-resistance 175/65R-18 tires. To save the weight and bulk of a spare, the Ultralite's tires contain a special puncture-sealant compound.

Instead of conventional springs, the Ultralite has a special computer-controlled air spring at each wheel. This sophistication is necessary for two reasons: to keep the car's pitch attitude in an optimum position to minimize aerodynamic drag and to keep wheels near the center of their travel as the load varies from the driver all the way up to four occupants. Sensors at each corner of the car provide the suspension-control computer with ride-height information. The computer then opens or closes a valve at each air spring to adjust the height of the car as needed. For example, at high speeds, the nose of the car drops slightly for improved aerodynamic penetration.



By far the most futuristic aspect of the Ultralite is its reliance on carbon fiber as a primary building material. To date, carbon fiber's synthetic black threads have been used only when maximum stiffness and minimum weight are greater priorities than the manufacturing cost. Aerospace and race-car applications are common, but carbon-fiber composites are also used to make certain high-performance consumer products. Tennis rackets, snow and water skis and high-tech golf clubs are noteworthy examples.

GM Ultralite



The entire Ultralite body shell was created from only 10 molded panels. The expertise for this phase of the project came from representatives of Scaled Composites, in Mojave, California. (In 1986 the Voyager aircraft created by Scaled Composites circumnavigated the earth non-stop with Dick Rutan and Jeana Yeager at the controls.) The main body consists of inner and outer floorpans and left and right outer body shells.

The Ultralite's inside accommodations blend comfort with practicality. A tubular-shaped cross-car member supports the steering column and a compact instrument cluster that is surrounded by high-level air vents for the driver. To supplement the conventional instrumentation, there's an advanced virtual image (head-up) display of key driving parameters. Tubular seat frames are upholstered with a special DuoFlex polymer that is patented by GM and is both strong and unusually lightweight. This open-mesh material stretches to provide properly contoured support.

Storage space is provided at the base of the windshield on the passenger side and on a large shelf behind the rear seats. Soft, contoured luggage is restrained by elastic netting.

A high-efficiency lighting system uses a central low-wattage, gas-discharge source and fiber-optic cables to illuminate both headlamps. Light-emitting diodes are used for all other exterior lamps. Interior illumination is provided by conventional incandescent light sources and vacuum-fluorescent instrument displays.

The Ultralite's combination of remarkably light weight, low aerodynamic drag and a potent engine delivers dramatic performance. According to wind-tunnel measurements and computer simulations, GM's newest experimental car achieves 100-mpg fuel efficiency at a very realistic 50-mph cruising speed. At the national speed limit of 55 mph, efficiency falls only slightly, to 96 mpg. On the EPA's city-driving cycle the Ultralite achieves 45 mpg, almost twice the efficiency of a Chevrolet Corsica.

GM engineers have also fulfilled their desire for a car that's satisfyingly responsive to the accelerator pedal. Calculations reveal that the zero-to-60 sprint requires only 7.8 seconds, and the Ultralite can theoretically accelerate from rest to 90 mph in a quarter-mile. It has a potential top speed of 135 mph.

The Ultralite is not intended to demonstrate that a 100-mpg automobile is "just around the corner." Extensive research will be necessary to perfect carbon fiber materials and composite construction for application to automobile manufacturing. However, experts agree that cars of the 21st Century will have to be much lighter than contemporary designs. The Ultralite, therefore, represents a major step forward from the status quo toward the vastly more efficient automobiles of tomorrow.

SPECIFICATIONS

Engine	GM CDS2 1.5-liter three-cylinder two-stroke
Power	111 net horsepower @ 5,000 rpm
Torque	127 lb.-ft. @ 4,000 rpm
Transaxle	Saturn electronically controlled four-speed automatic with lock-up torque converter
Wheelbase	110.0 inches
Length	165.6 inches
Width	64.0 inches
Height	50.8 inches
Curb weight	1,400 pounds
Fuel capacity	5.0 gallons
Body construction	Carbon fiber composite with bolt-on steel space frame for powertrain
Front suspension	Unequal-length control arms
Rear suspension	Unequal-length control arms
Springs	Computer-controlled air springs concentric with tubular hydraulic dampers
Steering	Rack and pinion
Brakes	Four-wheel disc with ABS-VI
Wheels	4.5x18-inch forged aluminum
Tires	Goodyear 175/65R-18 high-pressure, low-rolling-resistance containing puncture-sealant compound

THEORETICAL PERFORMANCE

100-mpg fuel efficiency	50-mph cruising speed
Fuel economy at 55 mph cruising speed	96 mpg
EPA fuel economy	45 mpg city, 81 mpg highway, 56 mpg composite rating
Zero-to-60-mph acceleration	7.8 seconds
Standing quarter-mile acceleration	16.0 sec. @ 90 mph
Top speed	135 mph