Sunraycer

Illuminating the Path toward the Modern Electric Vehicle

By Alyce Moncourtois, Content Marketing

Solar technology isn't a recent discovery. Its history dates back to the seventh century B.C. when a magnifying glass was used to concentrate the sun's rays to make fire.

Fast forward to 1839, French physicist Edmond Becquerel discovered the photovoltaic effect (generating voltage and electric current upon exposure to light) while experimenting with a cell made of metal electrodes in a conducting solution. He saw that the cell produced more electricity when it was exposed to light. Many physicists and scientists contributed to the awareness, introduction and proliferation of solar energy technology, including AeroVironment founder Dr. Paul MacCready, Jr.

In 1986, Roger Smith, then the CEO of General Motors (GM), became interested in competing in the World Solar Challenge, the first race featuring only solar-powered cars, which would take place in Australia. Dr. MacCready, known for his alternative energy achievements, was asked by GM and Hughes Electronics to come up with a feasibility study to determine if a solar powered car could be built in 10 months for this purpose.

"My company's involvement began [...] when Edmund Ellion of Hughes (whom I knew 35 years ago at Caltech) contacted me to explore whether AeroVironment, with its reputation for developing unusual low-powered vehicles, could help."

"Our study supported the advantages of what was to become the Sunraycer concept, which emphasizes low aerodynamic drag and invulnerability to crosswinds even at the sacrifice of some solar power from additional or tilting panels."

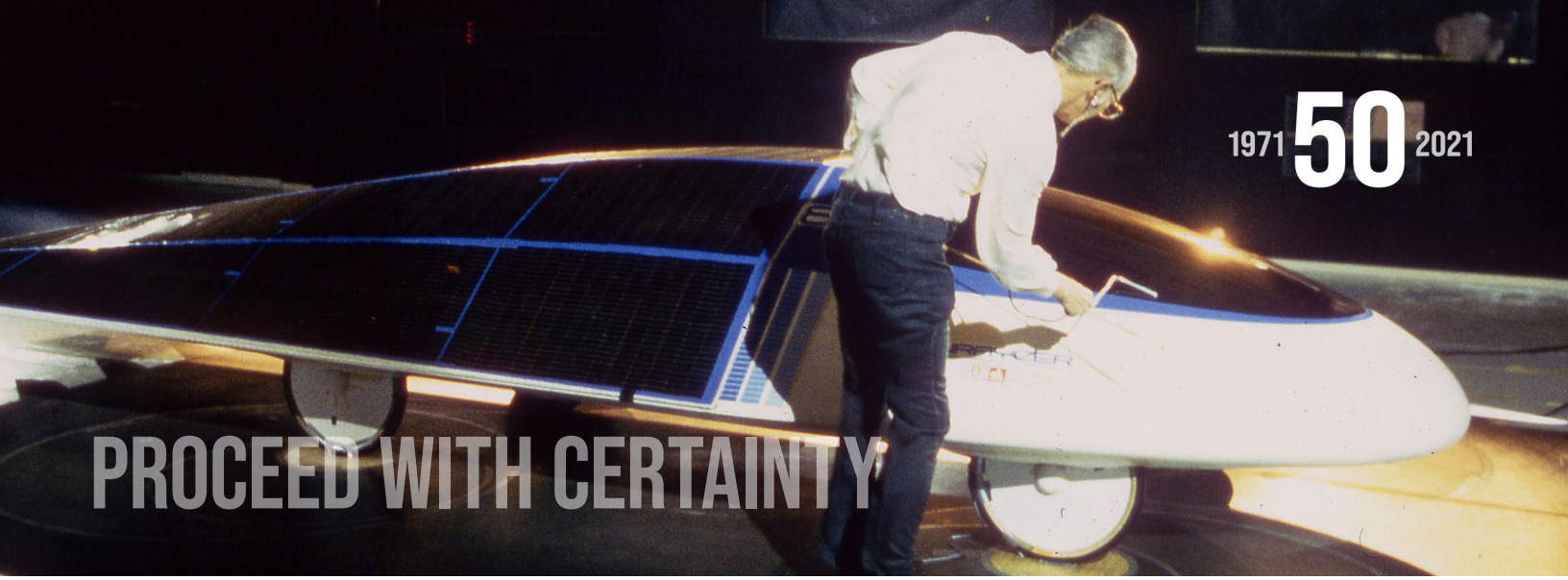
— Dr. Paul MacCready, Jr., "Sunraycer Odyssey – Winning the Solar-Powered Car Race Across Australia" Engineering & Science, Winter 1988.

With Dr. MacCready's affirmative response to GM/Hughes Electronics request, Smith hired AeroVironment to build the racecar. The project was a joint collaboration with GM, Hughes Electronics, and an AeroVironment team led by Dr. MacCready.

The development team combined lightweight materials, solar-power technology, and cutting-edge power management systems to create an extremely energy-efficient vehicle. The car's photovoltaic solar cells converted the sun's radiation into electricity to power its motor and charge its batteries. The car was named Sunraycer.

The total weight of the car was 585 pounds, with the frame weighing just 14 pounds. AeroVironment engineers used a Kevlar-Nomex-Kevlar "sandwich" for the shell of the car while constructing the chassis out of aluminum tubing. The team installed a total of 8,800 solar cells, which could generate about 1,500 watts of power at high noon. The team designed Sunraycer with a very low drag coefficient of 0.125 (for comparison, a Tesla Model 3 has a drag coefficient on 0.23), and some described its shape as "a futuristic streamlined cockroach." Aside from the driver, the single heaviest element in the car was the battery pack, which utilized silver-oxide batteries. Sunraycer was capable of a top speed of 68 mph.

The World Solar Challenge began on Nov. 1, 1987. The 1,950-mile route started in Darwin and ended in Adelaide. Sunraycer won the challenge by completing the course in 5 ¼ days with a running time of 44.9 hours and an average speed of 41.6 mph. The second place car crossed the finish line a full two days later.



After the race, Sunraycer went on a national tour of auto shows, museums and schools to promote interest among students in alternative energy technology and engineering careers. At the end of the tour, GM donated Sunraycer to the Smithsonian Institution's National Museum of American History.

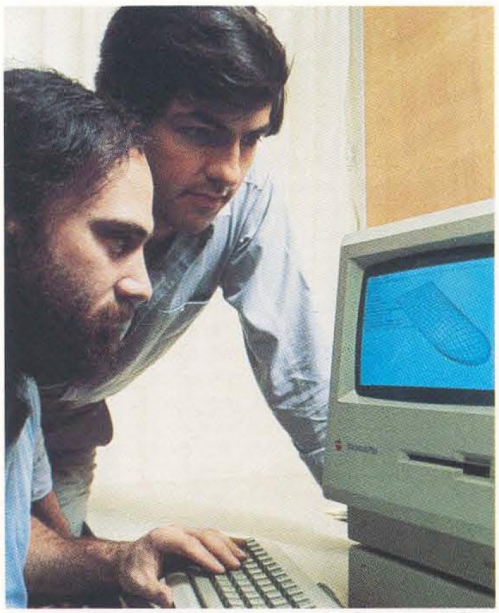
Reflecting back on the challenge, Dr. MacCready summarized his thoughts on the benefits of the entire project:

"[...] A solar car race focuses on doing big jobs with little power [...] and expands our insights into, expectations of, and demands for getting better fuel economy with gasoline and edging battery-powered and hybrid cars toward practicality. The project moves us toward handling the transportation needs of the future while make fewer demands on the earth's resources and environment. And, as a special bonus, as Sunraycer goes on an extended tour, it can serve as a stimulus to students to appreciate that engineering is fun and that nonpolluting transportation is achievable."

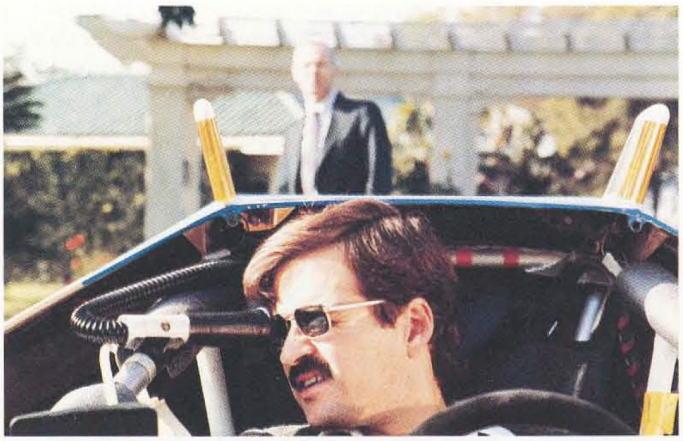
— Dr. Paul MacCready, Jr., "Sunraycer Odyssey – Winning the Solar-Powered Car Race Across Australia" Engineering & Science, Winter 1988.

Using lessons learned from the challenge, GM and AeroVironment collaborated on the development of the GM Impact battery-powered electric car, considered to be the first modern EV, which debuted at the Los Angeles Auto Show in 1990. The Impact was the prototype for the EV1, GM's first production electric car. AeroVironment used the knowledge from these endeavors to launch into other technologies, including electric vehicle charging systems and power processing systems used to test and develop electric vehicles, hybrid vehicles, and batteries. Today, EVs and EV charging systems play a rapidly growing role in the modern transportation mix. AeroVironment and Sunraycer helped illuminate the path toward a more sustainable future.

Sunraycer, Dr. Paul MacCready, Jr., December 1987



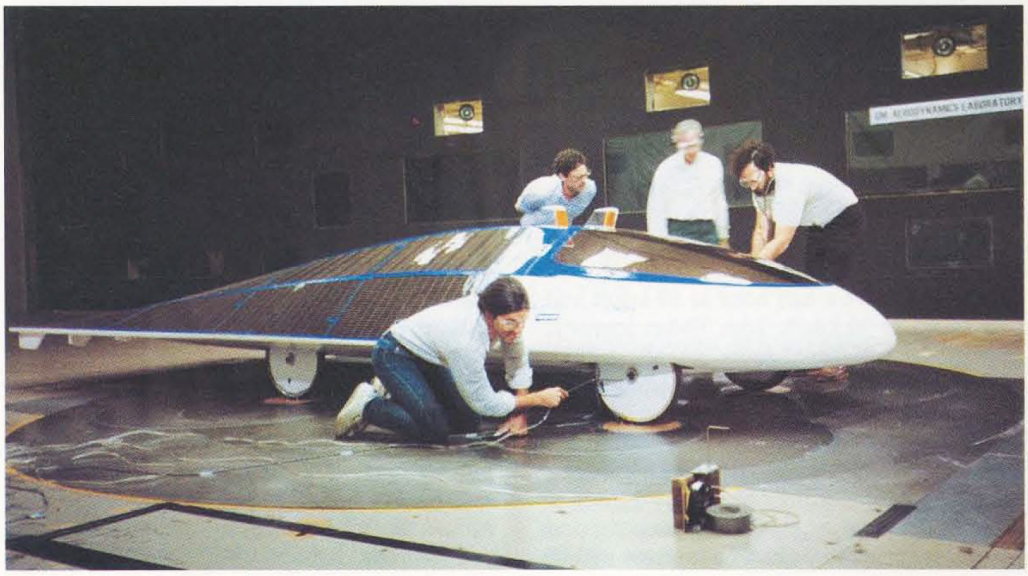
Bart Hibbs (left) and Graham Gyatt check the input data to the VSAERO program using a graphic depiction of the body shape.



Above: Alec Brooks, who was one of the six drivers in the race, observes Paul MacCready through a fiber optics remote viewing system connected to the top of the strake at left. This served as Sunraycer's rear-view "mirror."

Above: Nomex honeycomb, the sandwich filling, is laid onto the Kevlar skin in the mold for the solar-array panel.

Left: the lightness of the chassis and emptiness of the interior are apparent when the canopy is removed and the solar-array panel tilted up.



An AeroVironment crew checks out the Sunraycer prototype during tests in the GM wind tunnel. There were no surprises, but the tests quantified the effects of many small cleanups, making it possible to decide which ones justified being incorporated into the race vehicle.

Photo page from "Sunraycer Odyssey – Winning the Solar-Powered Car Race Across Australia" Engineering & Science, Winter 1988, Dr. Paul MacCready, Jr.