For over 30 years, the biennial sustainable transportation related Bridgestone World Solar Challenge has attracted some of the greatest minds at high schools and universities from around the world to Australia to push the limits of technological innovation and travel the Outback in a vehicle powered only by the energy of the sun. The course traverses 3,000km from Darwin to Adelaide.
The race is based on the simple notion that a 1000W car should be able to complete the journey in 50 hours without recourse to carbon based fuels. Solar cars that take up the competition are allowed a nominal 5kW hours of stored energy, which is 10% of the theoretical figure to get from Darwin to Adelaide. All other energy must come from the sun or be recovered from the kinetic energy of the vehicle. The solar cars developed for the Race are arguably some of the most efficient electric vehicles in the world.
Once teams leave Darwin they must travel as far as they can up until 5:00pm in the afternoon where they have to make camp in the desert wherever they happen to be. All teams must be fully self-sufficient. During the journey there are 9 mandatory check points where observers are changed and team managers may update themselves with the latest information on the weather and their position in the field. At check points, teams can perform the most basic of maintenance only like checking and maintenance of tyre pressure and cleaning of debris from the vehicle. Students and their support team have the awesome challenge of engineering and building a modern solar powered vehicle with their own hands and powering it across some of the world’s most inhospitable landscapes.
Tokai University in Japan have been competing in the Single Seat Challenge since 2009 and have won it twice and been runner up three times making them one of the most successful universities in the world regularly competing in this arduous Race. Tokai University have been using Cradle CFD software from Software Cradle for the last 12 years to design their Tokai Challenger cars because one of the most critical aspects of a solar car’s design is its aerodynamic performance and minimizing its drag in particular. Solar cars, if well designed are the ultimate road vehicle because they do not require refueling.

Tokai University has partnered with Panasonic over the years to use their advanced Solar Cells which have a 22% conversion efficiency when connected to 5kWh Lithium-Ion batteries (1, 2). The Car frames have been constructed from carbon fiber reinforced plastics and they have used Japanese suppliers for carbon fibers, plus also highly efficient motors to produce vehicles that can travel at 90km/h (56mph) using solar power and a maximum speed of 160 km/h (99mph)!

Cradle CFD software was chosen to optimize Tokai’s aerodynamic designs because it provides highly accurate and efficient meshing of CAD geometries and it has a very good aerodynamic solver that picks up flow details and forces that match with experimental measurements. In addition, the software is easy to use by their students with a short learning curve and fast times to useful engineering results (Figure 1). It is also very good at examining parametric design spaces (Figure 2).

Reference
1. https://www.cradle-cfd.com/media/sc_tetra/sc_tetra_case/a4