
americansolarchallenge.org
EVENT PARTNER
2016
National Park Service
CENTENNIAL
2016 NATIONAL PARK SERVICE CENTENNIAL
American Solar Challenge
BRECKSVILLE, OH-HOT SPRINGS, SD

FORMULA SUN GRAND PRIX
July 26-28, 2016 | Pittsburgh International Race Complex

AMERICAN SOLAR CHALLENGE
July 30-August 6, 2016 | Brecksville, OH-Hot Springs, SD

ORGANIZED BY

Innovators Educational Foundation

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OVERVIEW

Traveling 1975 miles from Ohio to South Dakota, the American Solar Challenge (ASC) is a collegiate student design competition which promotes educational excellence and engineering creativity. Each team designs and builds a solar-powered vehicle within a set of regulations. Then, these solar vehicles must pass a series of inspections and prove their reliability at the Formula Sun Grand Prix (FSGP) track qualifier prior to participating in the 8-day cross-country ASC event. In recognition of the 2016 National Park Service Centennial, this year's route includes stops in 9 National Parks across the Midwest.

Welcome to the American Solar Challenge 2016! Cheer on the teams, check out their solar cars, and join us on this adventure powered by the sun!

#ASC2016
#FSGP2016
#FindYourPark

SCHEDULE

JULY 22-25: SCRUTINEERING
Pittsburgh International Race Complex

JULY 26-28: FORMULA SUN GRAND PRIX
Pittsburgh International Race Complex, North Track

JULY 26: on track 10:00 AM-6:00 PM
JULY 27: on track 9:00 AM-5:00 PM
JULY 28: on track 9:00 AM-5:00 PM

JULY 29 REST DAY
3:00-7:00 PM Public Display
Cuyahoga Valley Career Center (Brecksville, OH)

JULY 30-AUGUST 6: AMERICAN SOLAR CHALLENGE

JULY 30: CUYAHOGA VALLEY NP
Start Line at 8:30 AM
Station Rd Bridge Trailhead (Brecksville, OH)

JULY 30: DAYTON AVIATION NHP
Checkpoint 1:30-5:45 PM
Carillon Historical Park (Dayton, OH)

JULY 31 – AUGUST 1: GEORGE ROGERS CLARK NHP
Stage Finish July 31, 10:00 AM–6:00 PM
Stage Start August 1 at 10:00 AM
George Rogers Clark Visitor's Center (Vincennes, IN)

AUGUST 1: ULYSSES S. GRANT NHS
Checkpoint 12:30-3:30 PM
Grant's Farm (St. Louis, MO)

AUGUST 2-3: WILSON'S CREEK NB
Stage Finish August 2, 10:00 AM-6:00 PM
Republic High School (Republic, MO)
Stage Start August 3 at 9:00 AM
Wilson's Creek Visitor's Center (Republic, MO)

AUGUST 3: BROWN V BOARD OF EDUCATION NHS
Checkpoint 1:00-5:45 PM
Brown v Board of Education Visitor's Center (Topeka, KS)

AUGUST 3-4: HOMESTEAD NM OF AMERICA
Checkpoint Aug 3, 4:00-6:00 PM; Aug 4, 9:00 AM-1:30 PM
Heritage Center (Beatrice, NE)

AUGUST 4-6: SCOTTS BLUFF NM
Stage Finish Aug 4, 3:00-6:00 PM; Aug 5, 9:00 AM-6:00 PM
Stage Start Aug 6 at 9:00 AM
Scotts Bluff Visitor's Center (Gering, NE)

AUGUST 6: WIND CAVE NP
Finish Line 11:30 AM-4:00 PM
Wind Cave National Park Visitor's Center (Hot Springs, SD)

MEET THE TEAMS

For many of these teams, the American Solar Challenge (ASC) is a goal they have been working towards for 2 years. Many hours have gone into the design and construction of each of these solar cars to ready them for competition.

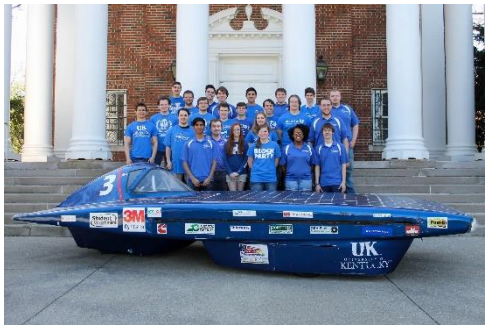
The challenge of ASC begins long before the solar cars hit the road. A solar car team effectively acts as a small business – attracting sponsors, managing public relations, developing and executing a project plan, and producing a solar car. While most teams have engineers, you will also find majors in business, marketing, and other fields. The beyond-the-textbook, multidisciplinary aspect of the solar car experience serves these students well as they graduate and prepare for their future careers in a range of disciplines.

If you are interested in getting your university involved in fielding a team, reach out to us.

University of Michigan
#2 Aurum

L x W x H: 4.50m x 1.80m x not provided
Weight: 200kg
Array: 1000W SunPower Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: Marand in-hub
Wheels: 4 Custom 16”
Chassis: Carbon Fiber Monocoque

University of Kentucky
#3 Gato del Sol V



L x W x H: 4.90m x 1.70m x 1.00m
Weight: 300kg
Array: 1000W Hybrid Si/GaAs
Batteries: 4.9kWh INR (LiNiCoAlO2)
Motor: NGM SCM-150
Wheels: 3 CACR/Custom Aluminum 16”
Chassis: Aluminum Space Frame

Michigan State University
#13

L x W x H: Not provided
Weight: Not provided
Array: Not provided
Batteries: Not provided
Motor: Not provided
Wheels: Not provided
Chassis: Not provided

ZHAW School of Engineering
#15 SER-1

L x W x H: 4.60m x 1.60m x 1.10m
Weight: 160kg
Array: 1200W SunPower Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: Mitsuba/Nomura DC brushless hub
Wheels: 3 CFRP Composite 16”
Chassis: Monocoque CFRP Composite

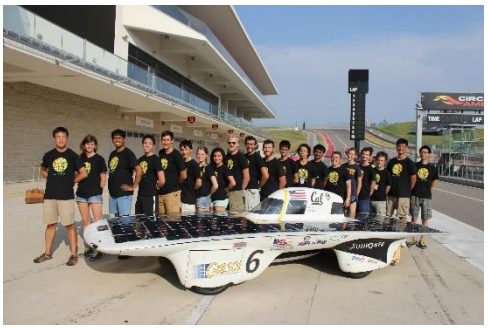
University of Minnesota
#35 Eos

L x W x H: 4.75m x 1.70m x 1.43m
Weight: 407kg
Array: 1300W SunPower Silicon
Batteries: 15.0kWh Lithium-Ion
Motor: 2 Custom
Wheels: 4 Tubeless 17”
Chassis: Carbon/Nomex Composite

Missouri S&T
#42 Solar Miner

L x W x H: 4.64m x 1.62m x 1.04m
Weight: 158kg
Array: 1310W SunPower Silicon Dioxide
Batteries: 5.4kWh Lithium-Ion
Motor: Custom Axial Flux Hub Motor
Wheels: 3 Custom Billet 16”
Chassis: Carbon Fiber Composite

UC – Berkeley (CalSol)
#6 Zephyr



L x W x H: 4.92m x 1.77m x 1.07m
Weight: 195kg
Array: 1000W SunPower Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: Dual 1kW Mitsuba M 1096-II
Wheels: 4 GH Craft Rims 16”
Chassis: Aluminum Space Frame

Iowa State (Team PrISUm)
#9 Phaeton 2

L x W x H: 4.72m x 1.72m x 1.06m
Weight: 172kg
Array: 1200W SunPower Silicon
Batteries: 4.8kWh Lithium-Ion
Motor: Mitsuba M2096-III
Wheels: 3 Custom 14”/7050 Al Billet 16”
Chassis: Aluminum Space Frame

Northwestern University
#11 SC6

L x W x H: 4.75 x 1.54 x 0.91m
Weight: 250kg
Array: 1682 SunPower Silicon
Batteries: 4.4kWh Lithium-Ion
Motor: 2 NGM-SCM150
Wheels: 3 Ecopia/GH Craft Carbon Fiber 14”
Chassis: Monocoque Carbon Fiber

Illinois State University
#17 Mercury 5s

L x W x H: 4.52m x 1.70m x 1.10m
Weight: 228kg
Array: 1100W SunPower Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: Mitsuba 3 Phase AC
Wheels: 4 Custom Aluminum 14”
Chassis: Composite Space Frame

University of Waterloo
#24 Midnight Sun XI

L x W x H: 4.50m x 1.80m x 1.20m
Weight: 360kg
Array: 1312W SunPower Silicon
Batteries: 11.0kWh Lithium-Ion
Motor: 2 NGM-SCM150
Wheels: 4 Schwalbe Energizer 18”
Chassis: Carbon Fiber Monocoque

Principia College
#32 Ra 9

L x W x H: 4.40m x 1.75m x 1.20m
Weight: 190kg
Array: 1100W SunPower Silicon
Batteries: 5.0kWh Lithium-Polymer
Motor: 2 Mitsuba Hub
Wheels: 4 Carbon Fiber 16”
Chassis: Chromoly Space Frame

Georgia Institute of Technology
#49 Endeavour

L x W x H: 4.80m x 1.80m x 1.10m
Weight: 320kg
Array: 1250W SBM Solar Silicon
Batteries: 3.8kWh $LiFePO_4$
Motor: Marand Permanent Magnet
Wheels: 3 Aluminum 16” (rear), 14” (front)
Chassis: 4140 Steel Space Frame

Dunwoody College of Technology
#51 SER-2

L x W x H: 4.40m x 1.80m x 1.10m
Weight: 160kg
Array: 1300W SunPower Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: Mitsuba/Nomura DC brushless hub
Wheels: 4 CFRP Composite 16”
Chassis: Monocoque CFRP Composite

Polytechnique Montreal
#55 Esteban 8

L x W x H: 4.72m x 1.74m x 1.08m
Weight: 220kg
Array: 1400W SunPower Silicon
Batteries: 4.3kWh Lithium-Ion
Motor: 2 Mitsuba M1096-D
Wheels: 4 Energizer Solar 16”
Chassis: Monocoque Carbon Fiber

Team Profiles continued on page 8

WIND CAVE National Park

Bison, elk, and other wildlife roam the rolling prairie grasslands and forested hillsides of one of America's oldest national parks. Below sits Wind Cave, one of the longest caves in the world. Named for barometric winds at its entrance, this maze of passages is home to boxwork, a unique formation rarely found elsewhere. nps.gov/wica

NATIONAL P
CENTE
1916

SCOTTS BLUFF NATIONAL MONUMENT

Towering 800 feet above the North Platte River, Scotts Bluff has served as a landmark for peoples from Native Americans to emigrants on the Oregon, California, and Mormon Trails to modern travelers. The area is rich with geological and paleontological history as well as human history. nps.gov/scbl

N

Homestead National Monument of America

With the promise of Free Land, the Homestead Act of 1862 enticed millions to cultivate the frontier. Families, immigrants, women, and freed slaves flooded 10 percent of the nation's land to chase their American Dream. American Indian cultures and natural environments gave way to diverse settlement, agricultural success, and industrial advancement—building our nation and changing the land forever. nps.gov/home

BROWN V. BOARD of Education National Historic Site

The story of Brown v. Board of Education, which ended legal segregation in public schools, is one of hope and courage. The plaintiffs in the case never knew they would change history. They were teachers, secretaries, welders, ministers, and students who simply wanted to be treated equally. nps.gov/brvb

WILSON'S CREEK NATIONAL BATTLEFIELD

Wilson's Creek was the first major Civil War battle fought west of the Mississippi River. The costly Southern victory on August 10, 1861 focused national attention on the war in Missouri. nps.gov/wicr

Green technology draws attention to the opportunities we all have to improve the environment we live in. Today's rapid climate change challenges national parks in ways we've never seen before.

The National Park Service is using research, technology, and education to better understand these changes and the role we can all play in keeping national parks healthy for generations to come.

FIND YO

ARK SERVICE
ENNIAL
2016

MIDWEST NATIONAL PARKS 2016 AMERICAN SOLAR CHALLENGE

The National Park Service turns 100 this year. In celebration, we're partnering with the Innovators Educational Foundation to host the 2016 American Solar Challenge. University teams from around the world will drive their solar vehicles over **1,900** miles, visiting **9** national parks in **7** Midwestern states.

MIDWEST PARKS

ATIONAL
PARK
SERVICE

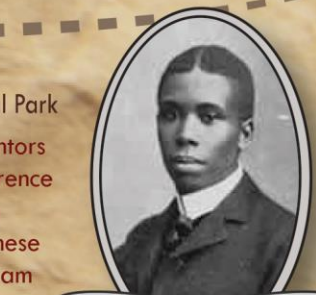
NPS 100

Cuyahoga Valley National Park

Though a short distance from the urban areas of Cleveland and Akron, Cuyahoga Valley seems worlds away. The park is a refuge for native plants and wildlife, and provides historic routes of discovery for visitors. The winding Cuyahoga River gives way to deep forests, rolling hills, and open farmlands. **nps.gov/cuva**

DAYTON AVIATION National Historical Park

Three exceptional men from Dayton, Ohio, inventors Wilbur and Orville Wright and writer Paul Laurence Dunbar, found their creative outlet here through accomplishments, failures, and finally success. These men offered the world the ability to take a dream and make it a reality. **nps.gov/daav**



Paul Laurence Dunbar

GEORGE ROGERS CLARK
National Historical Park

A classic memorial stands on the site of Fort Sackville to commemorate the capture of the fort from the British by Lt. Col. George Rogers Clark and his frontiersmen in 1779. The heroic march of Clark's men and the subsequent victory over the British remains one of the great feats of the American Revolution. nps.gov/gero

Ulysses S. Grant
National Historic Site

Ulysses S. Grant was the victorious Civil War general and the 18th President of the United States. He first met Julia Dent, his future wife, at her family home near St. Louis, named White Haven. From 1854 to 1859 the Dents, Grants, and an enslaved African-American workforce lived on the property. **nps.gov/ulsg**

OUR PARK

www.nps.gov/mwro
MIDWEST NATIONAL PARKS

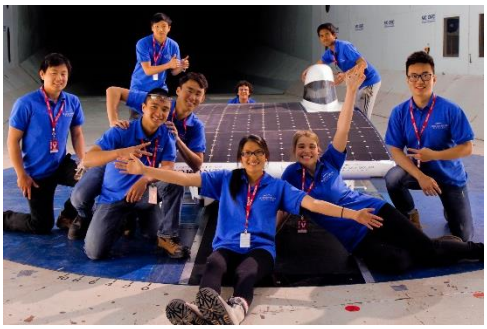
2016
National Park Service
CENTENNIAL

MEET THE TEAMS CONTINUED...

Southern Illinois Univ Edwardsville (SIUE)
#57 NOVA

L x W x H: 4.52m x 1.70m x 1.12 m
Weight: 205kg
Array: 1300W SunPower Silicon
Batteries: 5.1kWh Lithium-Ion
Motor: 7.5kW NGM SCM150
Wheels: 3 NGM Style Rims 16”
Chassis: 4130 Chromoly Space Frame

University of Toronto (Blue Sky)
#77 Horizon



L x W x H: 4.50m x 1.70m x 1.20m
Weight: 202kg
Array: 1200W Gochermann Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: NGM DC Brushless
Wheels: 4 Bridgestone
Chassis: Carbon Fiber Sandwich Boards

École de Technologie Supérieure (ETS)
#92 Éclipse 9

L x W x H: 4.50m x 1.80m x 1.15m
Weight: 175kg
Array: 1400W Gochermann Silicon
Batteries: 5.0kWh Lithium-Ion
Motor: 2 Csiro/Marand/Custom
Wheels: 4 Custom Aluminum 16”
Chassis: Titanium Space Frame

McMaster University
#116 Spitfire

L x W x H: 5.00m x 1.80m x 1.40m
Weight: 250kg
Array: 1200W SunPower Silicon
Batteries: 4.1kWh Lithium-Ion
Motor: Mitsuba 3 Phase Brushless DC
Wheels: 3 Custom Aluminum 16”
Chassis: 6061-T6 Al Space Frame

Western Michigan University
#786 Farasi

L x W x H: 4.45m X 1.70m X 1.14m
Weight: 205kg
Array: 1340W SunPower Silicon
Batteries: 5.1kWh Lithium-Ion
Motor: 2 CSIRO
Wheels: 4 Ecopia 16”
Chassis: Carbon Fiber Composite

Appalachian State (Team SUNERGY)
#828 Apperion

L x W x H: 4.97m x 1.72m x 1.21m
Weight: 190kg
Array: 1200W SunPower Monocrystalline
Batteries: 4.2kWh Lithium-Ion
Motor: Mitsuba M2096-DIII
Wheels: 3 Mitsuba Aluminum 14”
Chassis: Aluminum Space Frame

Follow the progress of the teams at americansolarchallenge.org

Western University
#96 SunStang 2016

L x W x H: 4.91m x 1.70m x 1.26m
Weight: 190kg
Array: 1423W Motech Silicon
Batteries: 3.6kWh Lithium-Polymer
Motor: NGM in-hub DC brushless
Wheels: 3 42J Moped 16”
Chassis: 6061-T6 Al Tubular Space Frame

The American Solar Challenge began as Sunrayce in 1990, with subsequent events occurring every 2-3 years.

Formula Sun Grand Prix was introduced in 2000 to provide a track event option for the solar cars to compete at annually.

HISTORY CORNER

In 2001, the road event was rebranded to the American Solar Challenge, recognizing the location of the event. In 2005 and 2008, the North American Solar Challenge special edition took the solar cars across the border into Canada.

Each event has its own uniqueness, route, and locations, but is mostly made special by the teams that participate.

SCRUTINEERING

JULY 22-25

The solar cars will undergo a series of inspections covering all aspects of the car: mechanical, electrical, and body and sizing. Inspectors make sure the solar cars are built in alignment with the regulations and have all required safety features. Scrutineering also tests the abilities of the drivers. All drivers must pass the egress test, which requires drivers to get out of the car unassisted in 10 seconds or less. Drivers are randomly selected to complete the dynamics tests, which are as much about testing the car’s braking, turning, and stability as about testing the skill of the drivers. Teams must pass all stations prior to competing in the track and road events.

TRACK EVENT

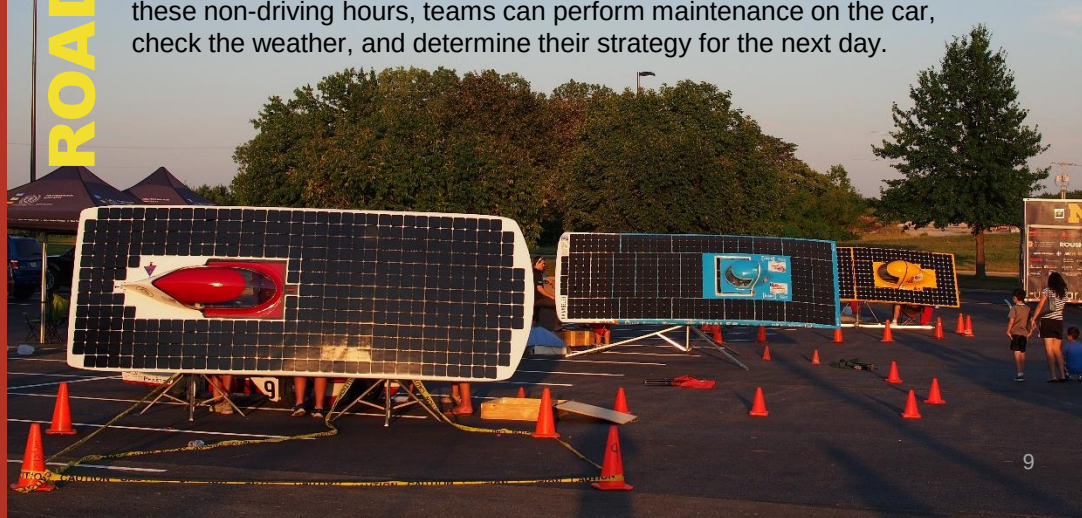
JULY 26-28

To qualify for the road event, teams must successfully participate in Formula Sun Grand Prix (FSGP), a 3-day road-course track race, where the most laps completed in the 24 hours of drive time allotted wins. For qualifying purposes, teams are required to complete a minimum number of laps. The tight turns test the car’s stability and driver’s skill. Only cars (and drivers) that prove reliable and safe on the track are permitted to participate in the American Solar Challenge on-road event.

ROAD EVENT

JULY 30-AUGUST 6

The winner of the American Solar Challenge will be the team that completes the predetermined route in the lowest overall elapsed time. Teams drive during the nominal day from 9am–6pm. Each solar car is escorted by lead and chase vehicles that carry the other team members and equipment for roadside repairs. For two hours in the morning and evening, teams are able to charge their batteries using the car’s solar array, angling the array toward the sun for maximum exposure. During these non-driving hours, teams can perform maintenance on the car, check the weather, and determine their strategy for the next day.



Frequently Asked Questions

FAQ

How do solar cars work?
Solar cars use photovoltaic cells to convert sunlight into energy. This energy powers an electric motor to make the car go or can be used to charge batteries to store energy for those not-so-sunny days.

Why do solar cars look so different?
Conventional passenger cars can spend more than 85% of their energy overcoming air resistance, known as aerodynamic drag. Solar cars are designed to minimize the energy lost due to drag, resulting in some unique shapes and designs.

How fast can the solar cars go?
Teams must obey posted speed limits, and regulations limit them to 65 mph for the event. During testing, some solar cars have been clocked at over 100 mph.

Do the solar cars have air conditioning?
No. Though teams are required to provide driver ventilation, these vehicles are designed to maximize energy efficiency. Air conditioning, power windows, and other creature comforts would only consume electricity without improving the car's performance.

Can I buy a solar car?
These solar cars are built specifically for competition and demonstration. They are not suitable for the general public. However, there are a number of electric, hybrid, and alternative fuel vehicles on the market and in use today.

What is a typical day like on the American Solar Challenge?

7:00 AM	Battery release and morning charging time
9:00 AM	Start with teams released in 1-minute intervals
The Next 9 Hours…	Drive. As needed, stop to charge, fix a flat, or change drivers. There is no lunch break. Upon arrival at a Checkpoint (designated 45-minute stops), the team jumps out of the support vehicles and points the solar array towards the sun. Drivers of support vehicles go off to find the nearest fuel station. Observers are swapped, route updates are given, and the public gathers around to see the cars. After 45 minutes, the solar car can resume driving.
6:00 PM	The driving day ends and evening charging time begins. Teams are given a 45-minute grace period to find a safe place to stop for the night.
8:00 PM	Battery impound followed by time to work on the solar car (minus batteries), find lodging, check the weather forecast, and get ready for the next day.
The Next Day…	Much the same schedule, except that the solar cars reach an overnight stage stop where they will spend the night and depart on the next stage of the route the following morning.

In Appreciation of our Volunteers!

RAYCE OFFICIALS

From inspectors to stage and checkpoint crews to our route advance team and timing, the officials perform a variety of roles during the event. Many are also involved in the preparations prior to the event - reviewing the technical design reports submitted by the teams, developing the route, and coordinating all of the logistics to make the event happen.

Dan Bohachick	Gage Eberle	Steve McMullen
Linda Bozarth	Bill Elliott	Bernie Neidert
Brian Call	Sue Eudaly	Paul Park
Mike Calvelage	Jeff Ferman	Dale Reid
Alain Chuzel	Byron Izenbaard	Dick Roberto
Tyler Coffey	Wade Johanns	Jeffrey Rogers
Steve Day	Eleanor Li	Adem Rudin
Hannah Eberle	Gail Lueck	Evan Stumpges
Maddie Eberle	Marie McMullen	Greg Thompson

JURY

Nabih Bedewi	Dan Eberle	Chris Selwood

OBSERVERS

The Observers spend a week on the road traveling with the teams. Riding in the chase vehicle, their role is to monitor the solar car's progress, impound the batteries at night, and release them back to the teams in the morning. Observers get to experience first-hand the ingenuity and hospitality of the solar cars teams.

Waleed Ahmed	Jake Herbers	Bill Stilwell
Giuseppe Coia*	Bill Lynch	Yuji Sugimoto
Rita Crocker	Ahmed Morsy	Louise Werner
Ahmed Ewida	Allen Rues	Jenifer Wilson
Chloe Gibbons	Dan Saulsberry*	Daniel Woodside
Kila Henry*		

* Dual Staff/Observer role

Special Thanks
Special recognition to Paul Hirtz and Steve Belarde who assisted with pre-event preparations but were unable to attend the event. Special thanks also to all of the hosts of our stage and checkpoint locations for welcoming the event and the solar car teams to your site!

TEAM LIST

- #2 University of Michigan
- #3 University of Kentucky
- #6 Univ of California Berkeley (CalSol)
- #9 Iowa State University (Team PrISUm)
- #11 Northwestern University
- #13 Michigan State University
- #15 ZHAW (Swiss SER)
- #17 Illinois State University
- #24 University of Waterloo (Midnight Sun)
- #32 Principia College
- #35 University of Minnesota
- #42 Missouri S&T
- #49 Georgia Institute of Technology
- #51 Dunwoody (American SER)
- #55 Polytechnique Montréal (Esteban)
- #57 Southern Illinois Univ Edwardsville
- #77 University of Toronto (Blue Sky)
- #92 École de Technologie Supérieure (ETS)
- #96 Western University (SunStang)
- #116 McMaster University
- #786 Western Michigan University
- #828 Appalachian State (Team Sunergy)

ABOUT US

Innovators Educational Foundation (IEF) is a non-profit 501c3 organization that organizes collegiate solar car events. IEF is made up of a core group of dedicated volunteers, mostly former competitors, that know first-hand the value of a hands-on, multidisciplinary, innovative project to the education experience. In addition to experiential learning, these solar car events promote energy efficiency and raise public awareness of the capabilities of solar power.

If you are interested in forming a team to participate in future events or providing support to the program as an event partner, sponsor, or volunteer, please contact us!

Innovators Educational Foundation
PO Box 2368, Rolla, MO 65402
ief@americansolarchallenge.org