ATTENTION E-FESTERS! Please read this important announcement about ASME E-Fests® and ASME EFx® Events in academic year 2022 & 2023

We will be returning to IN-PERSON ASME EFx® events in academic year 2022-2023! EFx events will be IN-PERSON, locally organized throughout the world and several EFx events will include our ASME competitions. Please visit the ASME E-Fest website for an updated list of events at https://efests.asme.org/. Events will be added as they are confirmed.

ASME will ALSO continue to host our two signature FULLY virtual events: E-Fest Careers (Nov. 12, 2022) and E-Fest Digital (March 25, 2023).

We encourage students, competitors, and faculty members to take advantage of the learning experiences provided by both our competitions and other digital offerings throughout the year. Questions may be directed to efests@asme.org.

Not all EFx events will have every competition available. Check that SDC is available at that event before registering.

ASME Student Design Competition – 2023 Rules
Harvesting the Sun and Wind Again

The 2023 Student Design Competition will be a modified version of the digital 2021 competition to collect renewable solar and wind energy and move weights around a game surface. Please observe the device videos that other teams created two years ago for inspiration, but keep in mind the rules have been modified in some significant ways.

Nearly twenty percent of the energy consumed around the world for heat, power, or transportation comes from renewable sources including biomass, geothermal, solar, hydropower, wind, and biofuels. Renewable sources now generate a quarter of global electricity, projected to rise to 45 percent by 2040. Much of the increase will likely come from solar, wind, and hydropower. The ability to generate these advances in technology will require the efforts of skilled engineers who appreciate the challenges involved in both collecting and utilizing renewable energy.

The 2023 Student Design Competition requires teams to design and build a remotely controlled vehicle with the following goals:

- The device should be as small as possible, with a maximum internal size of 50 cm by 50 cm by 50 cm (a Sizing Box bonus is awarded)
- The device must be capable of collecting and using solar and/or wind energy to power its operation. Each device starts each round with one charged AAA battery for propulsion. A bonus is awarded for devices that use both solar and wind power
- The device navigates a course to transport as much weight as possible from a loading area onto a raised platform within a fixed amount of time. Teams determine the amount of weight carried per trip and number of trips made during the given time
- Weights will be manually loaded onto the device, and may either be manually or automatically unloaded on the raised unloading platform (an Automated Unloading bonus is awarded)
- Proper design practices and time management for fabrication and testing are valued. A bonus is awarded for optional design and initial operation videos submitted prior to the competition

The validation of your design is intended to take place at an in-person ASME EFx® event(s) in the spring of 2023.

General Rules: team eligibility, overall design setup and constraints:

1. Students participating in the competition must be undergraduate engineering students, including community college students and students in associate degree programs (any engineering discipline is allowed) and must be ASME student members. There is no limit on the number of students on a team or the number of teams from a school. Each

student may only participate on one team (contribute to one device) – participants from schools fielding more than one team will be asked to affirm this at the competition.

2. Teams **must provide a completely enclosed rigid sizing box with a top lid that will be measured for competition scoring.** The device, controls and all weights to be used during the competition must fit within the box, which must be less than 50 cm x 50 cm x 50 cm (internal dimensions). Teams should further minimize the box dimensions if possible. Starting each round of the competition, the device will be brought to the playing area within the sizing box. *Teams showing up at the competition without a legal sizing box face disqualification!*

$$\textit{Sizing Box Factor} = \sqrt[3]{\frac{(50cm)^3}{interior\ box\ width*length*height}}$$

3. The demonstration field will be a 5-meter by 5-meter space marked on the floor by tape (see Figure 1). Devices must stay within the taped outer boundary during demonstration. The field will have two 1-meter x 1-meter Starting/Charging Zones that specific teams will be assigned two, also marked by tape on the floor. A 1-meter x 1-meter Weight Unloading Area platform will be located in the center of the playing surface that is elevated approximately 10 cm and fabricated from wood. The unloading area will be common to both teams in the Elimination Rounds. Both ramps up to the Unloading area will be uniform and the horizontal length of the ramp will be approximately 0.5 m.

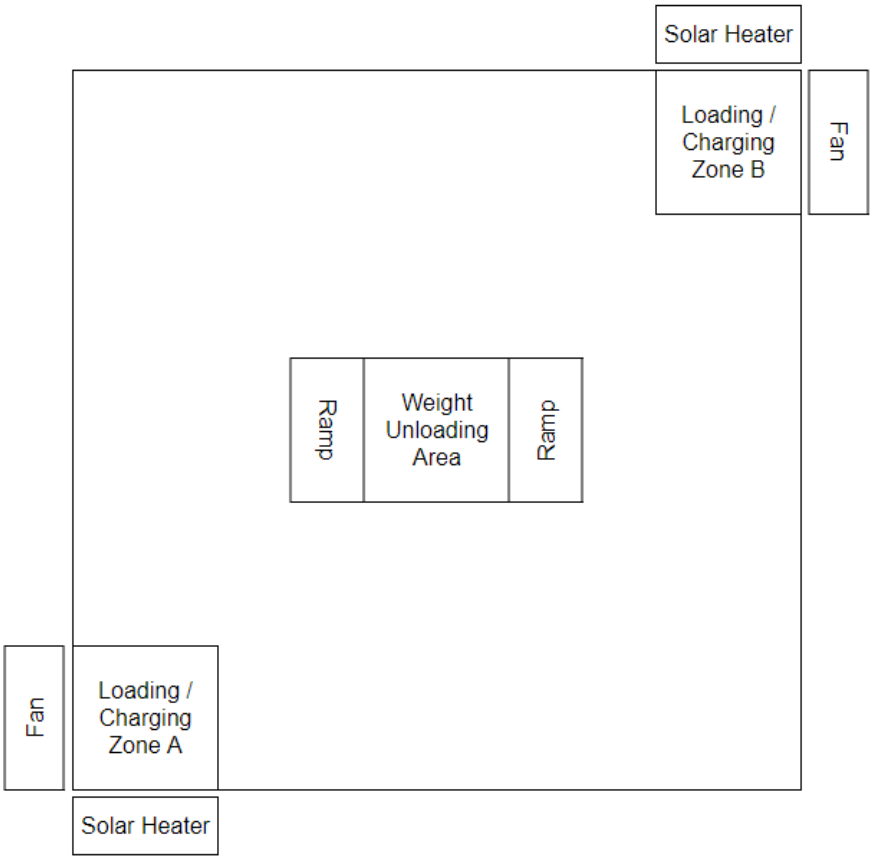
4. At the competition, ASME will provide the solar energy and wind sources at each of the two Starting/Charging Zones (see Figure 1):
    - The solar energy will be simulated by a *500W Utilitech Portable Halogen Work Light with Floor Stand* (or equivalent) set up as the source of solar energy for each Charging Zone at the competition. The solar energy source will be positioned at the edge of the Charging Zone and may not be moved or adjusted. (Teams may acquire this light or a comparable light from a variety of online sources, such as Amazon, for design and testing.)
    - The wind energy will be simulated by a Lasko model 3300 20″ Wind Machine Fan with 3 speed settings (or equivalent) set up as the source of wind energy for each Charging Zone at the competition. At the competition, the wind energy source will be positioned near the edge of the Charging Zone and may not be moved, but - teams will be allowed to manually set the desired fan speed. (Teams may acquire this fan from Amazon or other online sources for design and testing.)
    - During the competition, a team member may activate either/both energy sources while their device is in the Charging Zone, and then deactivate all energy sources when the device leaves the Charging Zone.

5. Teams must build a device propelled by energy collected from the solar and/or wind sources. Teams must decide how collected energy will be stored within the device (battery, capacitor, mechanical storage, etc.). In addition, ***one rechargeable AAA battery*** is allowed to propel the device. ***A battery will be provided to each team by***

ASME at the competition (AmazonBasics AAA Rechargeable Batteries rated at 800 mA-hrs – or equivalent) and teams will be given sufficient time to recharge batteries. At the start of each round teams must show that devices contain no stored energy to propel the vehicle other than the AAA battery.

6. The use of mechanical energy is allowed for vehicle propulsion if it is generated by the solar/wind energy collected, however teams may not use pre-loaded springs or weights (including the weights being carried to the unloading platform), or initially compressed gas to propel the device.

Figure 1: Competition Playing Field
(5m x 5m overall size)



7. Devices must completely fit within the closed sizing box at the start of each round and must only touch the ground within the Loading/Charging Zone when being loaded or charged. Team members may only remove the device and place it in the Loading Zone. Devices may expand beyond their initial size after being taken from the sizing box and may remain expanded at the end of a round. Device expansion must occur under its own power – this may involve preloaded springs or weights.

8. A remote controller operated by one team member will control the movement of the device. The remote controller may have its own battery, and does not have to be rechargeable. ***An additional battery may be used on the device for control purposes only (not to propel the vehicle)***.

9. All devices ***must be capable of collecting, storing and using*** either solar and/or wind energy sources. Before the competition each team will demonstrate this capability to the judges – teams must prove that power is being collected from the solar/wind sources. An Energy Source bonus will be given for devices that use energy from both sources:

   Energy Source Factor = 1 for one source used; = 1.2 for two sources used

10. All rounds will begin with the device in the Loading/Charging Zone. One team member may manipulate the device as long as it remains within this zone (no part of the device is ***touching the ground*** outside of the taped area), and will manually load the desired weights onto the device for transport to the Weight Unloading Zone. Teams must supply all weights for each trip to the Unloading Area. The weights can be reused for each trip, and different weight totals can be used for different trips.

11. Each team will be responsible for supplying a scale for measuring the transported weight following each successful trip. Each team will be required to demonstrate the accuracy of their scale at check-in – weight adjustments will be made for inaccurate scales.

12. After a device has been loaded, it must traverse the Playing Field and travel up either ramp to the Weight Unloading Area. Once the entire device is off the ramp and only touching the Unloading Area platform surface, the weights can then be deposited onto the raised Unloading Area to earn points. Weights can be manually or automatically removed and the device must return to the Loading Zone under its own power to complete the trip and earn points.

13. If a device becomes stranded without power on the Playing Field, a team member will be allowed to manually place the device in the Charging Zone, however the team will not score any points for any weights carried during this run.

14. An automated weight removal bonus will be applied to scoring in the Elimination Rounds. Teams that can deposit weights from the device onto the Unloading Area Platform remotely receive an ***Automatic Weight Removal Bonus = 1.2***. Devices using manual weight removal receive no bonus. In either case, devices may not be adjusted or repositioned in the Unloading Area other than to remove all weights.

15. When the device requires recharging, teams must position their device completely within the team's assigned Charging Zone. See the Initial and Elimination rules below if the device requires manual assistance to reach the Charging Zone. Within the Charging Zone one team member is allowed to position the device. The Solar and/or Wind power sources will then be turned on, and the device recharged.

16. Teams may replace the AAA battery between rounds, however, the replacement battery must be one of the batteries provided by the judges and should be stored in the sizing box throughout the competition.

Pre-Competition Deliverables (Optional): design evaluation and initial operation

17. **Four weeks before a competition**, teams may submit a 10-minute (maximum) design validation video. This is not required, but a bonus factor based on the judges score of the design validation video will be used in the competition scoring. This video or PowerPoint presentation with voice over should describe the team design and cover:
    - the design process and decisions made during the project
    - a description of the final design and its unique qualities
    - the procedures that the team is taking during fabrication and testing of the device to validate and improve operation for the competition
    - Judges Design Score will be out of a maximum of 30 points – 10 points are possible for each of the above bullet points.

18. **Two weeks before a competition**, teams may submit a device operation video. This is not required, but a bonus factor based on the judges score of the operation video will be used in the competition scoring. This video should clearly show one complete run of weights being transported: some weight (any amount) being loaded onto the device, the device being driven to an unloading platform, weights being unloaded (manually or automatically), and the device being driven back to the Loading Zone:
    - Teams that submit an operation video will be scored from 0 to 10 for completing a run on a Playing Field that matches the competition rules

19. Judging scores will be incorporated into a Pre-Competition Factor used in the Elimination Testing Round of the competition as follows:

    Pre-Competition Factor = 1 + (Judges Design Score+ Operation Video Score)/100

20. All videos are optional. Teams may submit both videos, only the design or the operation video, or neither video and still compete. Videos will require an ASME Video Release Form per submission and per team member ***appearing*** in a video. Instructions and forms will be provided by ASME after teams/team members are registered.

On-site Demonstration Rules: preparing for testing, operator/device operation

21. Team devices must be brought to the testing area in the team sizing box.
22. One person from the team will remove the device from the sizing box and prepare the device to operate. Other than connecting power to the device and setting it up to operate, no modifications are permitted during this setup time. The device may expand under its own power as it is taken from the sizing box.
23. The testing area surface will be reasonably level and may be either smooth or non-smooth (e.g. hard surfaces, carpet, or other flooring typically found in public areas).

24. Only one team member will be allowed to control the device when the clock is started. This same person will also retrieve and place the device in the Charging Zone if it becomes stranded.
25. Teams must control their device with one remote controller operated by one team member. A second team member may load/unload weights, determine the amount of weight, and control the energy sources in the Charging Area. All other team members must remain away from the playing surface area.
26. The duration of each device test is given in the following sections; if the device or devices are not able to continue, the testing round will be stopped.
27. Multiple devices may be operating simultaneously and multiple competitions may be conducted in parallel. Each team must be responsible for ensuring that the communication between their wireless controller and the device is not affected by another team's controller.

Initial Testing Rules: initial demonstration of performance

28. All devices will initially be tested one time without another competitor on the Playing Field. Multiple teams may operate their devices at the same time on different Playing Fields to expedite running the competition if necessary.
29. For the ***Initial*** testing round, each team will have 10 minutes to deposit weights on the Unloading Area platform. If a device becomes stranded and must be manually placed in the Loading/Charging Zone, no weights deposited on the platform will count for that run.
30. The top 16 scoring teams based on the amount of weight deposited on the Unloading Area platform will advance to the Elimination Round Testing. The bracket is shown below (Figure 2). ***Any ties will be broken using the Sizing Box factor (and a coin flip if still tied)***.

Trip Score for Initial Testing = (# of kg of weights deposited in Unloading Area)

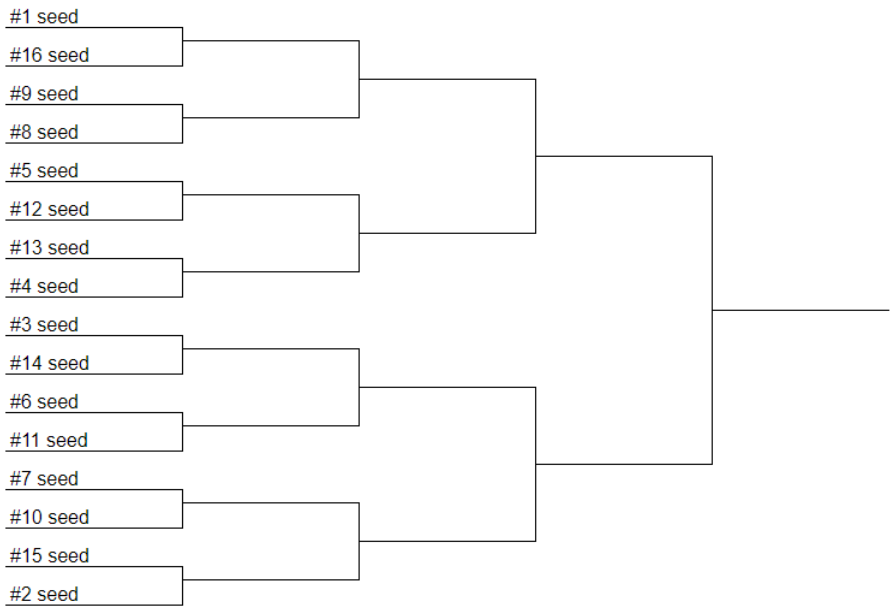
Total Score for Initial Testing = (Sum of Trip Scores)

Elimination Testing Rules: head-to-head, knockout rounds

31. For the Elimination testing rounds, two teams will compete on a Playing Field based on the Competition Bracket set by Initial Testing results. Rounds will last 15 minutes and the time will start when the first team declares that it is ready to start. The higher seeded team can select either the A or B Loading/Charging Zone position.
32. During the Elimination rounds, devices will deposit their weights on the Unloading platform and immediately return to the Loading/Charging Area. Deposited weights will immediately be removed and measured, and then be reused for a subsequent run.

Devices that are not actively working to earn Trip Score points will not be permitted to interfere with the other device.

Figure 2: Elimination Bracket (with seeding based on Initial Testing results)



33. One team's device may not enter the Loading/Charging Zone of the other team. If a device becomes stranded and must be manually placed in the Charging Zone, this will incur a 30 second time penalty for each manual intervention, and the loss of any weights deposited during that run.
34. Teams must maintain control of their device at all times and minimize the risk of a collision with another team's device during the Elimination rounds. Intentional collisions or interfering with the other device may result in a 30 second penalty or a team's dismissal from the competition.
35. At the end of each round, both teams will get a total score based on the following:

Trip Score = (Automatic Weight Removal Bonus)(Energy Source Factor)*(mass of weights deposited in Unloading Area)*

Total Score = (Pre-Competition Factor)(Sizing Box Factor)*(Sum of Trip Scores)*

36. If the Total Score of the two teams are tied in any of the head-to-head competitions, there will be a tie breaker where both teams will place their devices in their Loading/Charging Zone and the first device with **no weights** to move onto the Unloading Area platform, and return to the Loading Zone will be declared the winner.

37. Winning teams from each elimination game will advance and continue competing against each other until an overall champion is determined. A competition to determine 3rd place will be held between the two teams eliminated in the semi-final round.

Video Submission, ASME Release Form(s) & EFx Registration

EFx registration is required for team captains and team members. There is no fee to register for SDC, however EFx events will require a modest event fee. Once your EFx competition registration is complete, team captains and team members will be contacted about any video submissions and ASME Video Release Forms. **Registration dates are based per event. Not all EFx events will have every competition available. Check that SDC is available at that event before registering.**

Prizes & Winners

- 1st place - $500
- 2nd place - $300
- 3rd place - $150
- SDC competition winners will be announced at the local EFx event.

Questions & SDC Q&A Forum

- Questions may be directed to sdc@asme.org
- The SDC Q&A Forum will open in mid-September on the SDC Competition website: https://bit.ly/ASME-SDCCompetition. The Q&A Forum will close by February 1, 2023.