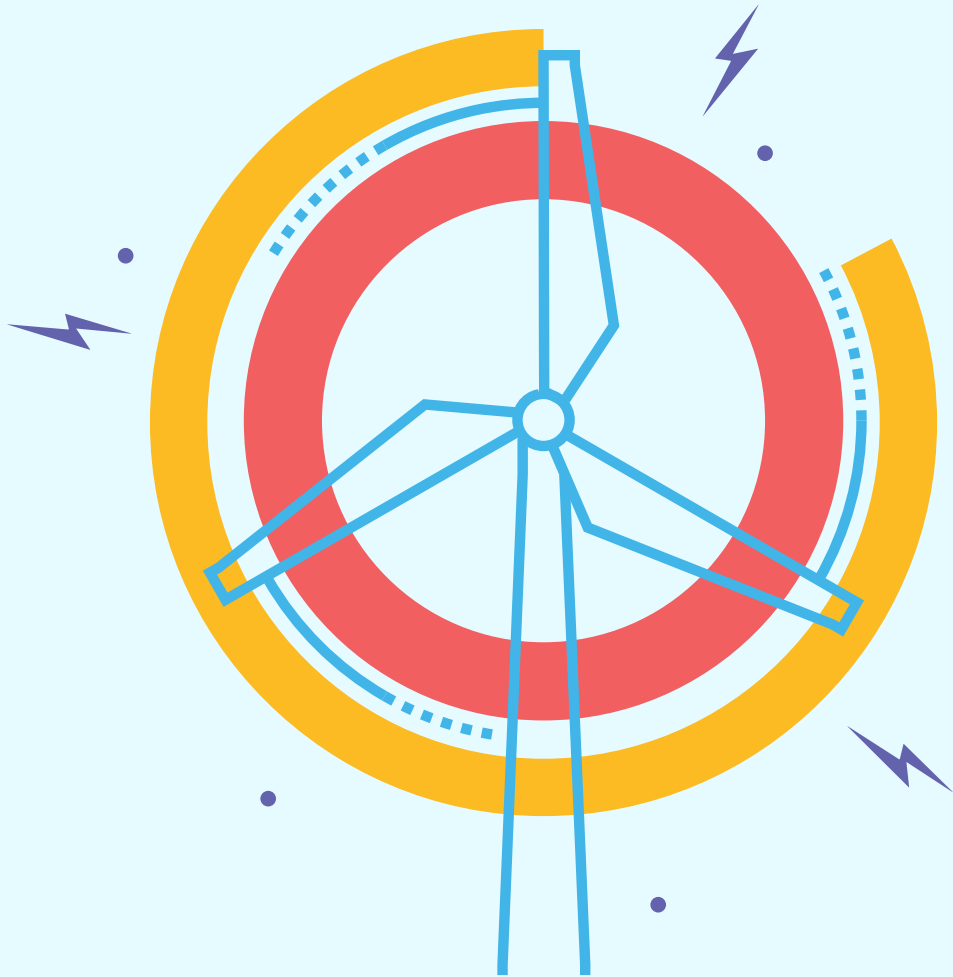


KidWind[®]

PROJECT



2026-2027 KidWind Challenge

⚡ WIND EDITION ⚡

RULEBOOK

www.kidwind.org

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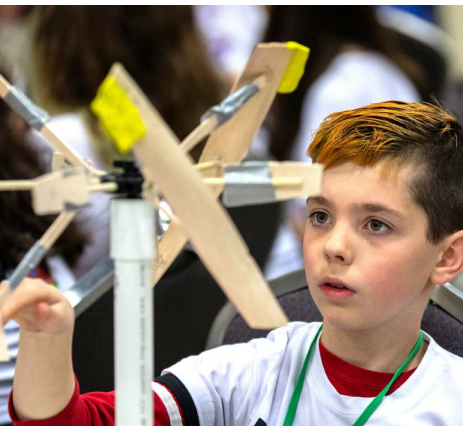
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Dedication

Without some important visionaries, the KidWind Challenge would not be the success it is today. These organizations and individuals helped us start something great.

- Asia Ward, Co-Founder of Recharge Labs
- Joe Rand, formerly KidWind's #2
- Larry Flowers (formerly of NREL Wind Technology Center)
- Trudy Forsyth (formerly of NREL Wind Technology Center)
- Original KidWind Challenge Team: Brad Weaver, Andy Lueth, & Linda Elie
- New York State Energy Research Development Authority (NYSERDA)
- Wright Center for Science Education at Tufts University
- Vernier Science Education
- Harbec Plastics

Partners & Volunteers

We have an amazing outreach team of individuals, organizations, and institutions who practically work for free. They love this project and make the magic happen at local and regional events. Without their hard work and dedication, none of this happens. We would like to specifically call out some superstars!

Thank you to the individuals who have contributed to the Wind Challenge!

- | | | |
|---------------------------|--------------------|--------------------|
| → Allison Bender | → David Yaff | → Morgan Berggren |
| → Andy Lueth | → Elise DeGeorge | → Ray Alls |
| → Angela Christine Stoltz | → Fran Poodry | → Ray Pitcher |
| → Colleen Fisk | → Gus Goodwin | → Richard Anderson |
| → Colleen McDaniel | → James Brown | → Sam Hindi |
| → David Andrade | → Jerry Bernardini | → Tim Noonan |
| → David Budai | → Kathy Jackson | → Yvonne Cook |
| → David Carter | → Mike Rinaldi | |

Educators, Students, and Parents

None of this happens without great educators and students willing to try something new and the parents that support them! Thanks for all your passion and vision!

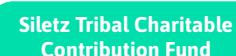
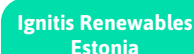
We invite you to share in our passion to inspire these future energy leaders, engineers, scientists, innovators, and problem solvers.

Please contact remy@kidwind.org to become a sponsor.

Thank you to our 2026 Sponsors!

While KidWind self-supports a few Challenge events around the country, our impact would be greatly limited without grants and sponsorships from clean energy industry organizations and foundations. Sponsoring a KidWind Challenge demonstrates an investment in our clean energy future.

Thank you to our 2026 Sponsors!



KidWind's Mission

The KidWind Project, a program of the 501c3 non-profit organization Gale Force Education, has been working with educators to integrate clean energy into classrooms since 2004. As the world is increasingly powered by clean energy, it is more critical than ever to develop a workforce and public who understand the complexities of this new power generation.

KidWind's mission is to empower educators and students to explore and engage with the challenges and opportunities of a clean-powered future.

Our primary goal is to help students find their place in a clean-powered future and help the public to better understand the impacts of clean power. The two primary challenges facing clean energy adoption are the lack of a knowledgeable and skilled clean energy workforce and public opposition to clean energy development.

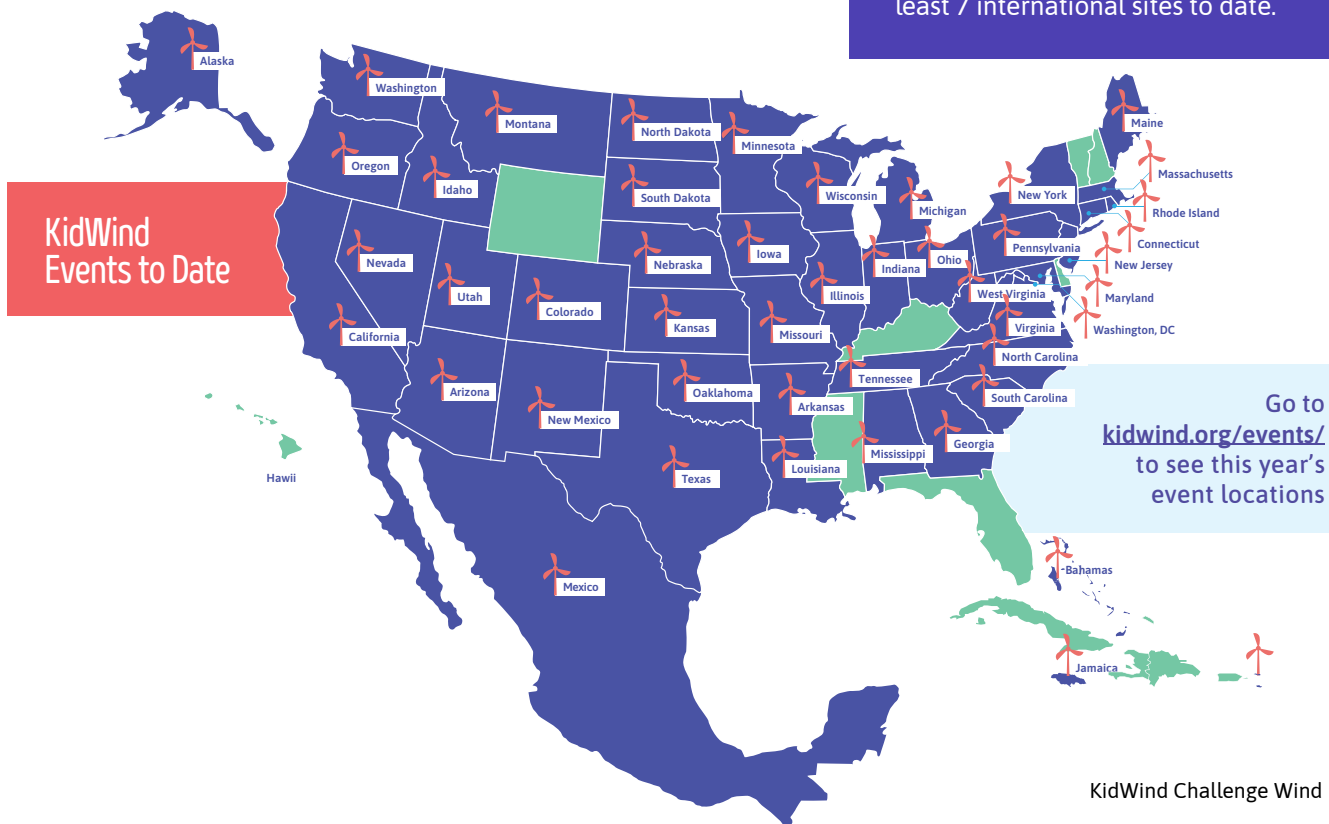
We are addressing these challenges by working with educators within current frameworks to increase their capacity to teach about a wide range of clean energy concepts.

What is the KidWind Challenge?

The KidWind Challenge is a hands-on design competition where student teams showcase their small-scale wind turbines and solar home designs with the primary goal of providing a space for students to demonstrate their knowledge, skill, creativity, and passion for clean energy to their communities, industry, and the wider public.

Student teams design and construct small-scale wind turbines or solar homes that they test, and then meet with a panel of judges to present their design process and provide documentation. Teams also demonstrate their conceptual knowledge on clean energy and engage in a variety of Instant Challenges to demonstrate their teamwork and problem-solving skills.

The KidWind Challenge is a team effort by teachers, students, engineers, and practitioners, all working to make wind energy education and other clean energy education accessible in classrooms around the world. Since 2009, KidWind has hosted hundreds of Challenges in 39 states and at least 7 international sites to date.



Types of Wind Challenges

You can participate and prepare for KidWind Challenges in many ways. We recommend starting by exploring the website and trying an Online Wind Challenge. This will help you get a feel for the kind of Wind Turbines teams have to build and the documentation teams need to provide at an In-Person KidWind Challenge. Once you are ready, your team can take their turbine on the road and participate in one of our In-Person Challenges. Those top performers from the Online and In-Person Challenges are invited to participate in the annual World KidWind Challenge.

In-Person Challenges

In-Person KidWind Challenges take place during the school year and are hosted by schools, community centers, and organizations across the country. KidWind Challenges may occur in-person, online, or in a hybrid model. [Please check the map for details](#) and contact the local organizer to learn more.

Overview	Submit Your Project	View Projects
Project Submissions		
	WAHS Wind Turbine Club Western Alamogordo High School, Mt. Shasta	
	Wind Speed (m/s)	3.5
	apples and bananas second - not rated	
	Wind Speed (m/s)	3.5
	Power Output (W)	804.2
	Power Output (W)	102
	Power Output (W)	0.178
	Voltage	2.06

Online Wind Challenge

The Online Wind Challenge is open to international submissions, and provides the most accessible approach for any student team anywhere, to participate. Student teams in grades 4th-12th participate in suggested age-level divisions to construct and test wind turbines. Our online platform allows students to upload their wind project, design details, reports, presentation, and research to compete with other team submissions. Their wind turbine will also be shared with the international KidWind

online community, displayed within the [Wind Challenge Gallery](#) on the KidWind website.

In order to participate, each team must have an adult coach whose contact information must be submitted with the project. A coach can be a parent, educator, or mentor and may supervise multiple teams.

Every quarter of the year, submissions will be judged by the KidWind team, and winners will be selected. Winners receive an invite to participate (optional) in the World KidWind Challenge, a large and prestigious in-person event, hosted at a conference center in a different state every year. **Please note: This year, teams who participate in an in-person Challenge are not eligible to receive an invite to Worlds through the Online Challenge.**



→ **Please note:** Not every site will have both a wind and solar challenge. Be sure you check the details of your local event and/or check-in with the event organizer to be sure they have a wind component.

Where should I start?

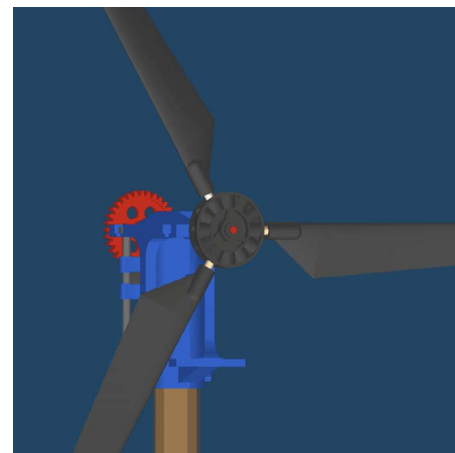
Take a peek at what projects can look like by exploring the Online Wind Challenge submissions!

This will help you get a feel for the kind of turbines others are building and the information you will be expected to provide.

Simulation Challenge

KidWind and Flinn Scientific's WhiteBox Learning (WBL) is a National Challenge that gives students the chance to use the WhiteBox Learning simulation software to construct and test virtual turbines and wind farms. While learning the software takes a little time, students will not need any of their own materials to participate. An adult educator, coach, or parent must create an account to participate in the National Simulation Challenge. The cost for this account is \$25, which you must pay during the registration process. This account holder will then be the primary contact for the Challenge and may register up to 25 students. Additional students can be added for \$1 per additional student. The only other requirement is an internet-connected computer (tablets are not supported).

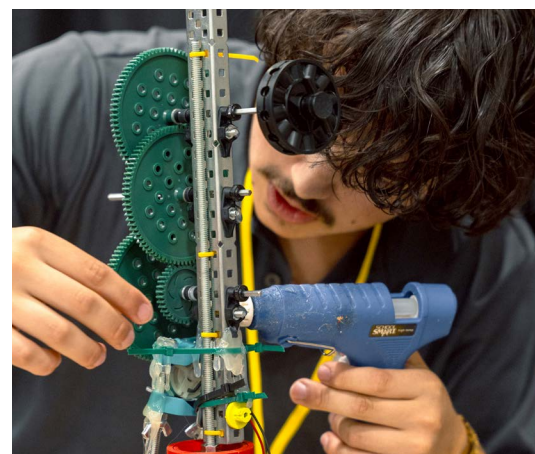
[Learn more here.](#)



KIDWIND CHALLENGE JUNIOR

The KidWind Challenge Junior is an event designed for students and teams who want a KidWind Challenge experience, but don't have the knowledge, time, or resources to do it on their own. Teachers (coaches) and students just show up to the event and complete everything on-site. No preparation is required! Students will break up into teams and design blades for already-assembled towers. The event organizers will provide all the materials students will need and will have a wind tunnel on hand so that teams can test their designs out. This is a great event for regions that have not previously had KidWind Challenges and can help students and teachers build confidence and gain experience to participate in an official KidWind Challenge the following year.

Students who participate in KidWind Challenge Junior can go on to register for an In-Person KidWind Challenge or submit their project to the Online Wind Challenge to continue gaining experience and for a chance to receive an invitation to the World KidWind Challenge.



Participation Checklist

There are two ways you can participate in a KidWind Challenge: Online or at an In-Person Challenge.

Online Wind Challenge

- ☐ Explore student turbines on the [Online Challenge](#)
- ☐ Learn about the basic parts of wind turbine
- ☐ Get some turbine-building equipment
- ☐ Build, test, and refine your turbine
- ☐ Carefully collect data as you build and test your turbine to submit to judges (notebook, photos, video, etc.)!
- ☐ Troubleshoot your turbine
- ☐ Upload information about your turbine and your team to the Online Challenge
- ☐ Wait to see if you are a quarterly winner

In-Person Wind Challenge

- ☐ See if there is an [In-Person Challenge](#) near you
- ☐ Find a coach and form a team
- ☐ Send your coach to a [virtual or in-person workshop!](#)
- ☐ Explore student turbines on the [Online Challenge](#)
- ☐ Learn about the basic parts of a wind turbine
- ☐ Get some turbine-building gear
- ☐ Build, test, and refine your solar home
- ☐ Carefully collect data as you build and test your solar home to share with judges (notebook, photos, video, etc.)!
- ☐ Fill out your Wind Project Profile Form
- ☐ Pack up your turbine & extra materials for transport to the venue
- ☐ Get to the In-Person Challenge and have fun
- ☐ If you are a top performing team, get an invite to the World KidWind Challenge

Simulation Challenge

- ☐ Make sure you have an internet connected computer
- ☐ Register for the Simulation Challenge [here](#)
- ☐ Receive your WhiteBox learning log-in details.
- ☐ Log-in and explore!
- ☐ Build and test your simulated blades.
- ☐ See if you are a top performer!

What do I bring to the Challenge?

- Turbine
- Wind Project Profile Form
- Extra parts, just in case
- Tools, just in case
- Pen/pencil
- Snacks
- Water bottle
- Extra documentation for the judges (poster, notebook, photos)



Don't forget to register your team for your local KidWind Challenge! Check the website for upcoming events in your area and links to registration.



How to Participate

Participating in the Wind Challenge

Step 1. Find a Coach

An adult coach is required to supervise the project process and sign up teams for In-Person and Online Challenges. During In-Person Challenges, coaches must be present and can supervise no more than 10 students.

Step 2. Assemble a Team

Teams can come in many shapes and sizes, but we've found that teams of 3-5 students are often the most successful! At Worlds, teams can only have a maximum of 5 team members.

Step 3. Decide: In-Person or Online?

Visit the [KidWind In-Person Challenge page](#) to see if there is an event near you, or contact the local organizer.

→ If there is no event near you, you can always participate in the [Online Wind Challenge](#).

Step 4. Learn the Rules

Review the guidelines outlined on in this Wind Challenge Rulebook.

Step 5. Learn about Wind

Coaches can help students gain knowledge and experience about wind energy by utilizing the activities found on the [KidWind Activities page](#) and in the Resources section of this Rulebook. KidWind also has [webinars and instructional videos](#) to help provide information about wind power and turbine design and construction.

Step 6. Gather Supplies

At the minimum, you will need a tower, generator, hub, blades, and a multimeter. You [can purchase a wind starter kit](#) from KidWind, get some PVC from a local hardware store, and use [our guide](#) to build your own PVC tower, or purchase a kit from our partners at Vernier.

Step 7. Start Building

Start designing and building your turbine.

Step 8. Test it Out

Test your turbine over and over with a box fan or wind tunnel. Improve your turbine as you test!

Can I Hold an In-Person Wind Challenge?

Many educators ask us if they can host a Wind Challenge. For the most part we say, "yes", but start slow! Start out by holding a Wind Challenge in your classroom, then have the teams upload their projects to the [Online Wind Challenge](#). If that goes well, try to visit an [In-Person Challenge](#) event to see a preview.

To have a KidWind sanctioned event that's featured on our map, you need to contact our team. [See our website](#) for more info about holding your own KidWind Challenge.

Does KidWind Provide Training?

Before you get into holding your own Wind Challenge, you may want training to learn more about wind power and how to host an In-Person Challenge. KidWind provides fee-based [workshops and free webinars](#) for those interested in learning more.

Are There KidWind Lessons that Teach About Wind?

KidWind has free lessons on our [Activities page](#), that will get you and your students well prepared to enter into a Wind Challenge. You can also check out the resources page located in this Rulebook.

Step 9. Tinker, Tinker, Tinker

Keep making adjustments to improve your design. Don't forget to keep track of any iterations or challenges you encounter during this process and how you addressed them. You'll want to share this documentation with the judges at an event, or upload it to the Online Challenge as an additional resource!

Step 10. COMPETITION TIME!

In-Person Challenge

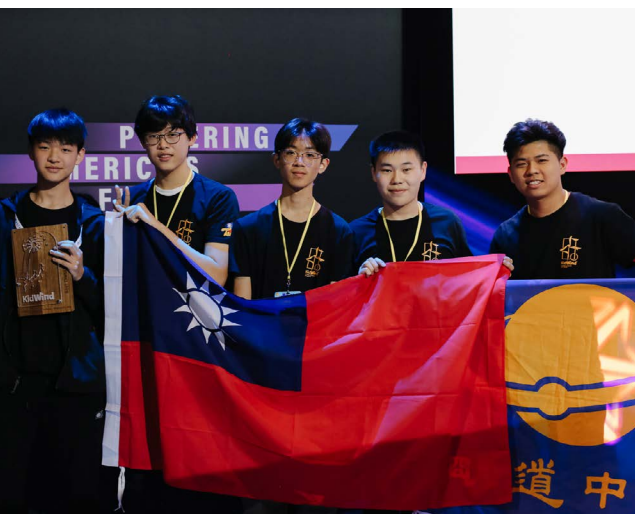
Carefully pack up your turbine and bring it to your In-Person Wind Challenge. All teams must have an adult acting as their coach during the event. At the event, teams will run their turbine through at least one wind tunnel and present their design to the judges. Be sure you prepare for this and bring some documentation to help show the judges the design process and inspiration. Some events may also have Instant Challenges and/or a Knowledge Test component. Event winners will be announced at the end of the event!

Online Wind Challenge

Submit your project and required supplementary information (photos, designs, videos, etc.) to the Online Challenge. Keep an eye on the [Online Wind Challenge gallery](#) to check out your competition. At the end of each quarter, we will select and post the winners!



World KidWind Challenge



Each year, we invite top performing teams from In-Person and Online Challenges to compete for variety of awards at the World KidWind Challenge. The location of this large and prestigious in-person event changes every year!

How Do I Get to Worlds?

1. Teams must receive an invitation from World KidWind Challenge organizers in order to attend Worlds.
2. Check the **Worlds page** of the KidWind website for the event location, dates, and details. **Please note: The maximum number of students per team at Worlds is 5!**
3. The coach must complete the **Worlds registration form**, which is included in their team's invitation. Each person attending Worlds, including coaches, team members, family, friends, etc. must also complete an Attendee Form and Liability and Media Release Form. Teams will be sent these forms after registering.
4. **Raise money!** There's no registration fee or participation cost for team members, coaches, or family joining the team. Coaches and teams will need to provide transportation, as well as room and board for the duration of the event.
5. **Book team travel and lodging.** We encourage teams to take advantage of KidWind's hotel block that includes discounted hotel rooms near the competition venue. KidWind shares hotel block details in January.
6. **Attend the event with your teams' turbine and presentations.** Teams participate in wind turbine testing, judging sessions, Instant Challenges, and Knowledge Test evaluating their clean energy knowledge. Meet other coaches and teams and maybe even secure a sponsor for next year.



Divisions

Age Divisions

There are three age divisions:

- Elementary Division (4th-5th Grade)
- Middle School Division (6th-8th Grade)
- High School Division (9th-12th Grade)



Note: Specific events might have different age or grade divisions. See the [event details on the website](#) for more information.

Generator Divisions

The generator your turbine uses determines how we classify and evaluate your turbine in the wind tunnel. There are three classes of generators you can use:

- KidWind Generator (ES, MS, & HS Divisions)
- Commercially Manufactured Generators (MS & HS Divisions ONLY)
- Homebuilt Generators (MS & HS Divisions ONLY)

Only teams participating within the same age group and division will compete against each other.

KIDWIND GEN DIVISION (KidWind Generator)

If you use a KidWind Generator, you will be placed in the KidWind division.

The easiest path is to get a few [KidWind Turbine Generators from Vernier](#).

If you use this generator, you will be in the KIDWIND GEN division.

PLEASE NOTE: ALL elementary division teams must compete in the KidWind Generator Division.

OPEN DIVISION (Commercial Manufactured Generators - MS & HS ONLY)

If you purchase a generator or use multiple KidWind generators, you will be placed in the Open Division.

You can purchase a commercially sold AC or DC generator (not a regular KidWind generator) that better matches how much power your turbine can generate.

Who Has to Show Up?

To be eligible for the competition, all members of your team must be present on the competition day. We also require one adult for at least every ten students who attend.

Exceptions include:

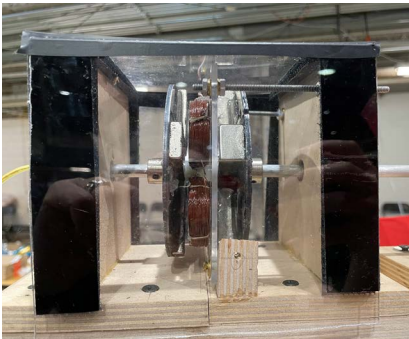
- Some of your team members are unable to attend because of a scheduling conflict with a school sanctioned trip.
- A team member cannot attend due to illness or family crisis.

Can I Change Generator Divisions at an Event?

It depends! Contact your event coordinator for details about declaring generator divisions at your local event.

Typically, and at Worlds, before a KidWind Challenge event begins ALL teams must declare the generator division they wish to participate in (KidWind, Open, or Homebuilt). Judges will inspect your generator to confirm the division. Please make sure that your generator is visible. If this is not the case, once a team makes their first wind tunnel run, they will be locked into the division they have declared. Turbines may be marked with colored stickers to indicate their generator division.

HOMEBUILT DIVISION (Homebuilt Generators - MS & HS ONLY)



If you make your own generator, you will be placed in the Homebuilt Division.

You can construct your own generator using a kit, online plans, or your own ingenuity. A homebuilt generator is defined as a generator where ALL of the major components of the generator are constructed

by the students. This would mean the coils are wound by the students, the stators and other components have been constructed, 3D printed or otherwise built by the team. This does not extend to the magnets or driveshafts and similar components in this device.



If you'd like to build your own generator, our partners at Vernier sell the **GENPack (KW-GP)** or the **simpleGEN (KW-SGEN)** which can be a good way to start learning about building your own generator and conditioning AC output to DC. You can also find many more resources and kits online about building your own generator. For the really

studious, check out **Homebrew Wind Power** by Dan Bartmann and Dan Fink and construct your own generator and turbine from scratch!

Wind Resources

As you construct and test your wind turbine, you may want to learn (or learn more about) the major parts of a wind turbine, wind energy and other related topics.

Check out these sites to learn about wind turbines and wind energy in general:

- [Student Energy - Wind Power](#)
- [PBS Wind Power Episode](#)
- [Department of Energy - Wind](#)
- [National Renewable Energy Lab - Wind](#)
- [National Laboratory of the Rockies Lab - Wind](#)



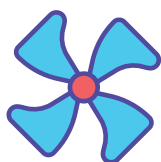
Equipment to Build Your Turbine

Whether you're building a turbine for an Online or In-Person Challenge, you will need some basic gear to get started. KidWind, through our partners at Vernier, have a number of kits and materials to get you exploring, but you can use materials from anywhere to participate in a KidWind Challenge as long as you are not violating the rules.



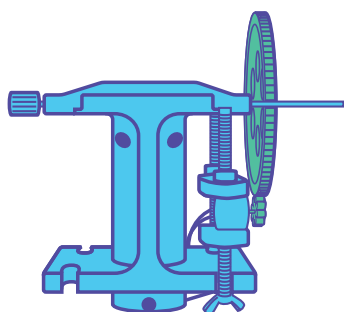
Generators

The generator your team uses determines how we classify and evaluate your turbine in the wind tunnel and compare energy and power generation. There are three classes of generators you can use.



Blades

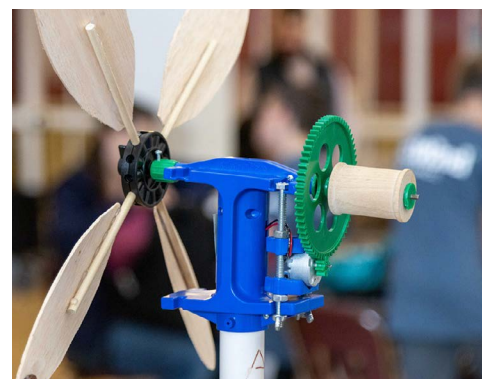
Wind turbine blades and their orientation to the wind are very important parts of a wind turbine design. You could study this for years and still not be an expert! Blades must use safe materials and fit within a 48" x 48" wind tunnel, and must **NOT USE PRE-MADE AIRFOILS** or other pre-manufactured blades. We see students using all kinds of materials to make blades: cardboard, balsa wood, 3D printers you name it. Just don't use razor blades!

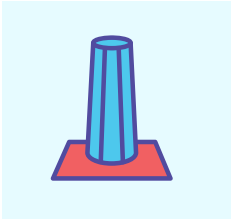


Gearboxes or Belt Drives

While building a gearbox or a belt drive can be challenging, it can also greatly increase the power output of your wind turbine. Belt drives or gears can give your wind turbine a mechanical advantage and multiply the mechanical force of the turning blades.

Your team can use [KidWind gearboxes](#) and parts through our partners at Vernier, you can find parts from other vendors, or you can construct your own gearboxes or belt drives. The only rule is that we must approve it as safe!





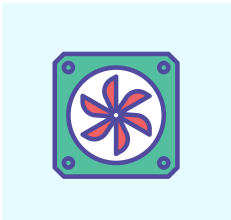
Towers

You can make a tower for your wind turbine out of practically anything. [Check out these plans to make simple PVC tower turbine](#) or get a simple [KidWind tower from Vernier](#).

Don't limit yourself to just these towers! In fact, if you want to win you will need to adapt! We have seen some great towers made from wood, cardboard tubes, Tinker-Toys, plastic, etc.

Try experimenting with different designs! Which type of tower seems strongest? Why do you think certain wind turbines use the type of towers they use?

The only rule for making your tower is that it must have a firm base to sit securely on the ground, and it must be tall enough so that your blades will not hit the ground. If your turbine has a gear or pulley system, you will need to have some kind of platform or housing on top of your tower to hold the gear/pulley box.

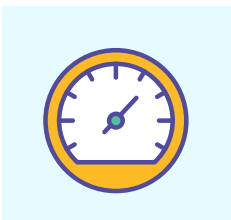


Fans or Wind Tunnels

You can use any fan to test your turbine. At our workshops and while we are preparing and tinkering, we like to use simple box fans. At In-Person Challenges, we will have a KidWind Competition Wind Tunnel (KW-TUN) or something very similar to test your turbine. The KidWind Competition Wind Tunnel is easily constructed and can be purchased from our partners at Vernier.

If you are handy, you can try to construct your own — many teachers have done this! Unlike a box fan, our tunnels suck the air through the shroud which leads to cleaner less turbulent winds.

Challenges provide weights such as sand bags to weigh down wind turbines during testing. Teams are also welcome to bring their own weights for tunnel testing.



Power Measurement

You will need to learn how to measure power output from your turbine. You can use a simple multimeter or data logging equipment. The key is to make sure that your turbine is attached to a load whenever you are collecting data. If you use a KidWind Generator, we will use a 30-ohm load when we test it in the wind tunnel. If you have a homebuilt or other generator, we can use a load that you provide.

Through our partners at Vernier, you can get more sophisticated data collection equipment. We really love their [Go Direct Energy Sensor \(GDX-NRG\)](#). It connects to all devices and is an easy way to collect detailed turbine data and even has a built in load.



Power Conditioning

We will allow devices (buck boost or other electronics) that **reduce** the output voltage and current from competing turbines to meet our 30V and 1A data collection limitations.

We will not allow devices that increase the voltage or current from your turbine.



Buck-Boost Converters and Other Power Electronics

Teams may use buck-boost converters or other electronic devices only to reduce the output voltage or current from their wind turbine so that it remains within the competition's data acquisition limits of 30 volts and 1 amp.

Devices that increase the voltage or current produced by the turbine are not permitted. The purpose of any power conditioning device must be solely to ensure compatibility with the competition's measurement equipment—not to improve turbine performance.



Capacitors, Energy Storage Devices, & Programmable Boards

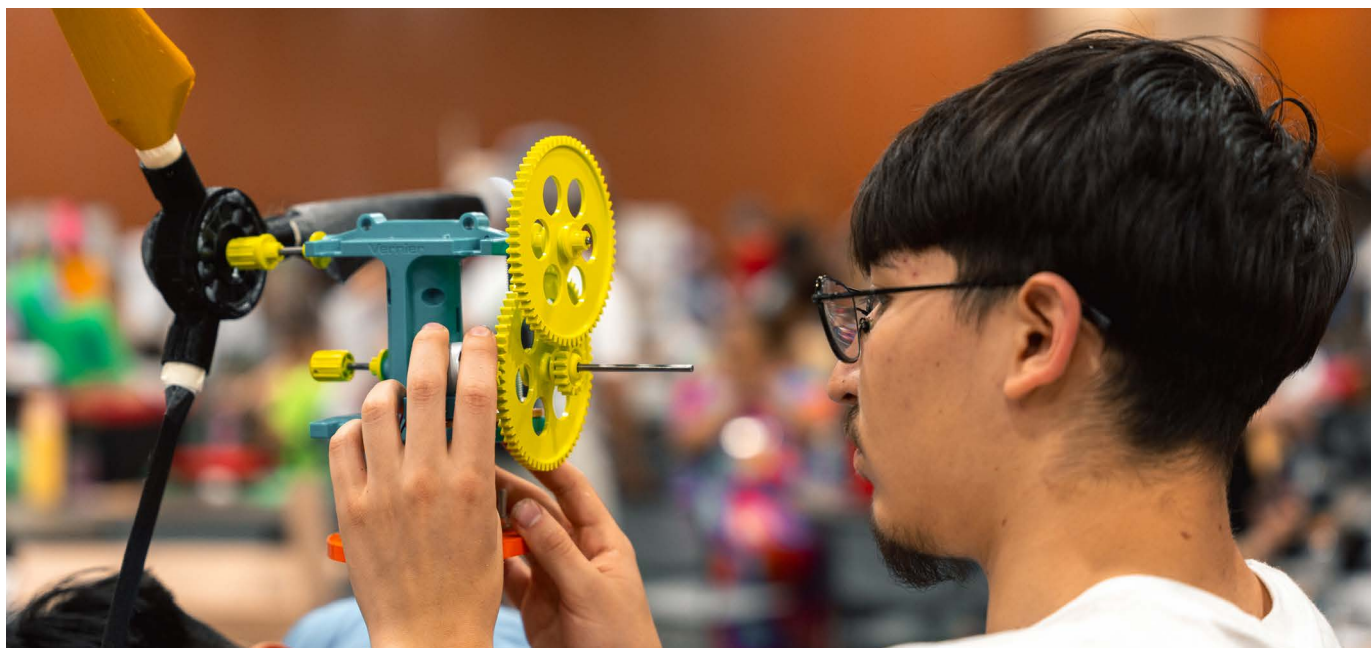
Capacitors and other energy storage devices may not be used to smooth, filter, store, or otherwise condition the electrical output of a wind turbine during testing.

This restriction also applies to programmable control boards such as Arduino, micro, or similar devices. While these controllers may be used to operate turbine systems (such as yaw control, blade pitch control, or data logging), they may not directly modify, condition, store, or inject electrical energy produced by the wind turbine into the competition measurement system.

The competition's measurement hardware and software are designed to accurately measure the turbine's electrical output without additional filtering or conditioning.

This rule also helps ensure a fair competition. Event officials cannot reliably verify that a capacitor or other energy storage device has been fully discharged before a test begins. Any stored electrical energy released during testing could be incorrectly recorded as power generated by the wind turbine.

Learn more about each part of a wind turbine by watching our **Tinker Time** webinar recordings.



Turbine Design Guidelines

As you construct your turbine please keep the following rules in mind:

1. Adult Assistance During Competition:

The KidWind Challenge is intended to showcase student learning, engineering, and problem-solving. Coaches, parents, and other adults are encouraged to support students by asking guiding questions, helping maintain a safe workspace, and assisting with logistics.

During judged events, wind tunnel testing, troubleshooting, and competition activities, adults should avoid making engineering decisions, performing repairs, adjusting turbine settings, wiring electrical components, or physically modifying student projects. Students should complete all design decisions, repairs, adjustments, and testing procedures themselves whenever reasonably possible.

Event staff may remind adults to step back if assistance exceeds coaching or safety support.

Appropriate Adult Support	Not Appropriate
• Asking guiding questions • Helping students stay organized • Rewiring generators • Safety supervision • Reading schedules	• Adjusting blade pitch • Carrying equipment • Repairing turbines • Installing parts • Making engineering decisions

2. Each registered team must have its own turbine. Teams can not share turbines, or switch blades with another team.

3. The turbine must fit inside the wind tunnel and operate within its 48" x 48" internal dimensions. Keep in mind that as the wind tunnel runs, it will suck in vinyl sides of the tunnel, reducing the internal dimensions. We HIGHLY recommend designing your turbine to fit within these dimensions with plenty of room to account for shake and wobble. Sand bags and other weights will be available for use.

4. There are no budgetary restrictions for your turbine design, but it is important to keep in mind that part of the judging process is the economical use of resources. Please use materials responsibly.

5. Teams are allowed to have multiple generators and rotors in one turbine placed in the tunnel. All of these rotors must still fit into the standard wind tunnel.

Keep in mind that if you have multiple KidWind generators, you will be placed in the Open Division.

6. Power must be generated solely by wind using the wind tunnel.

Connection and Loads

- You must have two wires at the base of your turbine. You must label which wire is positive and negative, and the turbine must produce DC power for our data logging system. If you make your own generator and it is generating AC power, you must rectify it to DC power.
- Teams that use KidWind Generators will be tested using a 30 ohm load.
- Teams in the OPEN or HOMEBUILT divisions are allowed to provide their own load during testing. They must provide the load and have it inspected by local judges. Teams may not use Maximum Power Point Tracking (MPPT) devices. Variable load/resistance devices (like **VES-VL by Vernier**) or static loads are allowed. You are allowed to change your load between each test. You can only change the load during a test using a variable load/resistance device - otherwise it cannot be changed during testing. If you do not provide a load, your turbine will be tested at 30 ohms.

Power Output

- Our data-logging software and hardware can measure Direct Current at 30V / 1A. Teams in all divisions must make sure to regulate their power output below these specifications. If your turbine exceeds this output, even for a millisecond, it may be disqualified as the equipment will not be able to properly record its power and energy output. This is very important!
- If your turbine produces so much power that it damages the generator before testing is complete, you will be able to retest your turbine as long as you can repair or replace your generator. If we are unable to record power and energy data with our equipment due to generators overheating, your turbine may not receive a power and energy score.
- Local judges reserve the right to use other methods to collect power and energy output data if probeware is unable to collect data.



- 7. Wind Turbine Kick-Start:** Teams are **not permitted to inject electrical power into their generators** to help turbines start spinning at low wind speeds.

This rule exists because we cannot reliably distinguish between electrical energy used to “kick-start” the generator and electrical energy produced by the turbine during testing. As a result, injected power could be inadvertently recorded by our energy sensor software, leading to inaccurate performance measurements.

To ensure a fair and consistent competition, all turbines must start and operate using only the energy provided by the wind in the tunnel.

- 8.** Your turbine can be built on either a vertical or horizontal axis.
- 9.** Your turbine may use a gearbox, pulley system, or similar mechanism to increase power output. You may use premanufactured gearboxes and other parts, but keep in mind that innovation is a critical judging criteria, and parts that you make on your own will earn you more points.
- 10.** **You cannot use pre-manufactured wind turbine blades or airfoils/sheets.**
- 11.** Your wind turbine must be free-standing. A tower/stand will not be provided.
- 12.** The use of 3D printed parts and components is allowed. While you do not have to use files you created yourself, you should bring documentation about the CAD files to the Challenge and be prepared to discuss the design and the 3D printing process. Judges will want to make sure you understand this technology if you decide to use it.
- 13.** No shrouds are allowed.

Example of a turbine using a shroud.

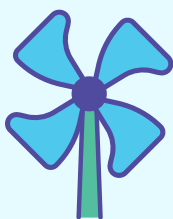


Turbine Testing



Wind Tunnel

- Wind turbines will be tested in a 48" x 48" wind tunnel at a wind speed of approximately 3.5 to 5m/s. Wind moving at 3.5 m/s within a space this large is much more powerful than a single box fan.
- All teams may be given time to tweak their turbine in the tunnel before actual testing begins. How much time will be determined by the type of event, number of entries, and free time available.



Testing Guidelines

- Once the testing session begins, you will be given two minutes to set up your wind turbine inside the tunnel.
- If you are using a KidWind Generator, the wires at the base of your turbine will be attached to a circuit with a 30 ohm resistor in series and will simultaneously measure voltage and amperage.
- If you are using a homebuilt or advanced generator, you will attach your desired load to the turbine or our measurement tools and then attach the wires at the base of your turbine to the circuit that will simultaneously measure voltage and amperage.
- In order to receive full marks for functionality, your wind turbine must be able to start producing power without external assistance once the wind tunnel is activated.
- Once your turbine is in the tunnel and connected to the data collection system, the judge will turn on the fans and ask your team if you want this test to count. If your team says yes, the judges will collect data on your turbine. If your team says no, you may remove your turbine, make a small tweak and try again. If there is a line of students waiting, you will probably need to head to the back of the line. This process will vary depending on event.
- During testing, the wind tunnel will be running constantly. We will collect power and energy output data between 30–60 seconds. Your energy output score will be calculated using a Vernier datalogging system that collects voltage and amperage readings simultaneously.
- If your wind turbine slips, breaks, or falls over once the timer is started, you will either be given two minutes to set up your wind turbine again, or you will be allowed to remove the turbine to make repairs. In the latter case, you will be moved to the back of the line for retesting.
- Depending on your local Challenge rules, size, and time frame, you may have between 1 and 5 trials for testing, and only your best trial will contribute to your final score.
- **Local judges have final say on rulings and disputes.**

Blade Pitch Control

Student teams continue to develop increasingly sophisticated blade pitch control systems. The following rules clarify what is permitted:

- **Active blade pitch control is allowed.** Teams may use servos, small motors, or other actuators to adjust blade pitch.
- These systems may be controlled by onboard programmable devices (such as Arduino, micro, or similar controllers) or by a remote-control system.
- Teams may adjust blade pitch **at any point during their testing session**, including while the turbine is operating in the wind tunnel.
- All pitch control components must remain securely attached to the turbine throughout testing and must not create a safety hazard.

Defining Catastrophic Failure

An event that causes a turbine in the wind tunnel to produce zero power while collecting test data is defined as a Catastrophic Failure Event. This could be due to either a mechanical or electrical failure. If this happens you will be offered the following options:

- Take two minutes to set up your wind turbine again **OR** remove the turbine to make repairs.

In the latter case, you will be moved to the back of the line for retesting. Failures that lead to REDUCED performance are NOT Catastrophic Failure Events.

UPDATE: Catastrophic failures that are INDUCED by a mechanism will not be treated as a catastrophic failure and NO RETEST will be awarded. This means tripping something to cause a failure, like knocking a blade or gear off, does not qualify as a catastrophic failure.



Safety

- Metal, plexiglass, and similar blade materials are highly discouraged because they are potentially dangerous. On occasion, we have allowed these types of blades to be used, but only after local judges determined that there was an extremely low risk of failure due to assembly.
- 3D printed blades must have dull ends to prevent puncturing the plastic tunnel sides if blades fly off the turbine during testing.

- Bicycle wheels are allowed on turbines but they may be disqualified if local judges deem the structure unsafe.

Local judges have the final call for safety, and turbines will be disqualified if they are deemed unsafe. If you're not sure about something, send a photo to hello@kidwind.org.

Turbine and Team Evaluation

At every KidWind Challenge, teams can expect to be evaluated on energy produced. Depending on the local event and the number of teams present, there may be turbine testing, judging, Instant Challenges, and a Knowledge Test that are part of your overall score.

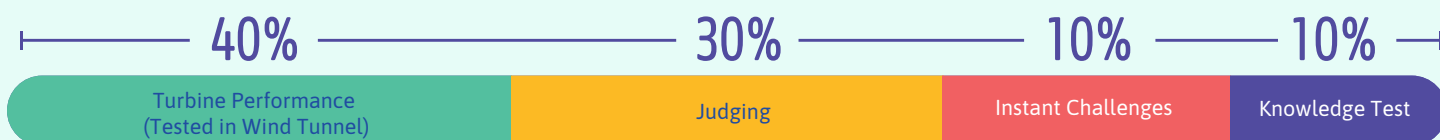
All team members present at the event must participate in all components. Please keep in mind that Judging Rubrics and categories may be different at your local event. The specifications below are intended to offer guidance. Local organizers will share specific details of how your total score will be determined prior to your event.

Please keep in mind that Judging Rubrics and categories may be different at your local event. The specifications below are intended to offer guidance and local organizers will share details of how your turbine will be evaluated prior to your event.

Here are two score breakdown examples for smaller, regional events and larger state-level events.

Example 1: Larger KidWind Challenge

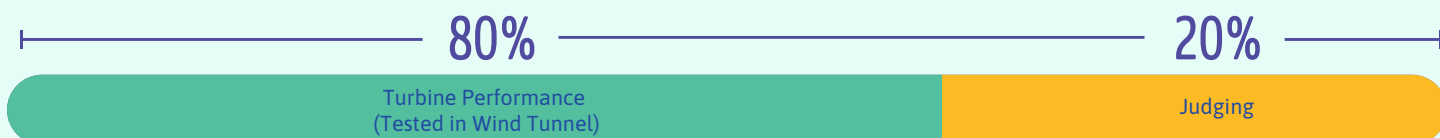
This is an example of a scoring breakdown of a larger event like a statewide Challenge or Worlds, which includes all possible competition elements.



Example 2: Smaller KidWind Challenge

Many smaller and first year events consist only of turbine testing and judging. These events may focus more heavily on blade design and might not expect students to prepare presentations. At those events, turbine performance may weigh more heavily, sometimes accounting for as much as 80% of the total score, with a more informal Q&A session with a panel of judges making up the remaining 20%.

New KidWind Challenge events may focus more heavily on the blade design component and not expect students to prepare presentations. At those events, turbine performance may weigh more heavily. For example, 80% blade design, 20% Q&A.



Turbine Performance (Tested in Wind Tunnel)

The total energy output of your turbine over the 30-60 second trial period will be collected using data-logging software. Each team's energy, measured in joules produced during the trial period, will be ranked relative to that of other competitors. Each team will receive points corresponding to its rank.

Energy scores will be ranked on a comparative basis using one of two methods. In all cases you want to generate as much energy as possible to get a high score.

Rank Method

Turbines will all be ranked by energy output. The highest producing turbine will receive the full number of energy points. Each turbine below that will receive from 2-5 less points than the one above them.

Example: The top turbine produces a total of 100J and receives 35 points. Your turbine is ranked 6th at 80J and each rank down receives 2 less points. You get 25 points.

Ratio Method

Turbines will all be ranked by energy output. The highest producing turbine will receive the full number of available energy points. All other scores are calculated based on the percentage of the top score.

Example: The top turbine produces a total of 100J and receives 35 points. Your turbine produces a total of 80J, so your team would receive 80% or 28 points.

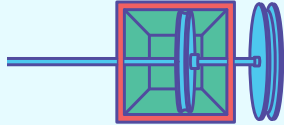


Judging (30%)

A panel of judges will examine your wind turbine design at an In-Person Challenge. This 10-20 minute interview is to get a better understanding of the process you went through as you designed and tested your turbine. You should be prepared to discuss/defend the choices you incorporated into the design.

Questions judges may ask about your turbine design:

- Does your turbine have a gearbox, a pulley system, or is it direct drive?
- Did you have any issues with friction? How did you reduce friction in your drive train?
- When building your turbine, what kinds of obstacles or challenges did you face?
- How did you balance your blades? Do you notice any vibration when your turbine spins up to speed?
- Why are modern wind turbine blades shaped like airfoils? Are your blades shaped like airfoils? Did you try to make any airfoils?
- How did you determine the number of blades you would use? What experiments or testing did you perform?
- How did you determine the pitch (angle) of the blades?
- Why are your blades as long as they are?
- What materials did you use to make your blades? Why? What was important as you were building your blades?
- What techniques did you use to increase the power output of your wind turbine?
- What materials did you use to make your tower? What were some of the challenges you faced making a tower?
- What changes did you make to your turbine that lead to the most performance gains?
- Discuss the craftsmanship of your design, including creativity, economic, and environmental decisions.
- Did you use recyclable materials?



Documentation

All students must complete a Project Profile Form (see Appendix). This sheet should be presented to your judges when you enter the judging room.

In addition to this sheet, teams may also share additional documentation with the judges that showcases with more detail their design process and knowledge of wind energy science. It is up to each team to determine how they want to document this part of their project. In the past we have seen:

- Short reports
- Engineer's notebooks
- Videos (maximum of 4 minutes)
- PowerPoints
- Science fair poster boards

Students must provide the means to play any multimedia. A projector may be available — check with your event organizers for details.



Instant Challenges

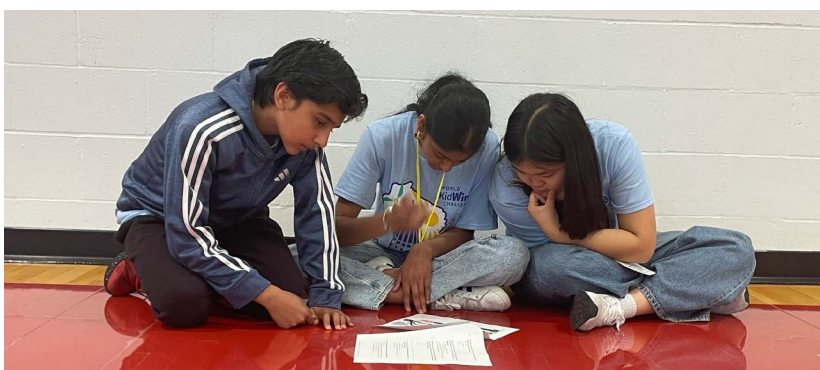
Instant Challenges are an on-the-spot test of knowledge, skills, problem-solving, and teamwork. This **will not require any preparation** prior to arriving at to the event and all materials needed to complete each Challenge will be provided. The **10 Big Questions About Energy** in the Appendix a good place to start studying for the knowledge test.

Knowledge Test

At some KidWind Challenges, students may be asked to put their knowledge of wind energy to work at an Instant Challenge. Instant Challenges don't require any preparation or planning before the Challenge, just a solid knowledge base to refer to for on-the-spot engineering.

The number of points that these Instant Challenges are worth will vary among Challenges.

During past Challenges, Instant Challenges have accounted for 10-15% of the final score. At some locations, we may be piloting bonus Instant Challenges and other categories for testing. Please check the KidWind Challenge website and your local Challenge registration page for more details.



A Note on AI Generated Content:

While we are excited about the possibilities of AI and know it can be a great learning tool, any information you present or provide to judges at a Challenge must be written, developed, designed, and/or created by you (from your brain!). If you used AI to help you brainstorm or polish your own content, please cite it so that judges are aware. Also know that judges may ask you about something you present and AI won't be in the room to answer! You'll want to be sure you are 100% confident in all the details about your project.



Appendix

Wind Project **Profile Form** (Novice)

Team Name:

School Name:

This document is meant to help guide your design process and provide documentation to the judges about your wind turbine. You should present this document to the judges at your KidWind Challenge event.

1. ☐ a. We are using a KidWind Generator
☐ b. We are using a premade, non-KidWind generator.

Brand/Model/Where you got it:

- ☐ c. We made our own generator.

Describe the design/construction:

2. Does your turbine fit in the 4'x4' wind tunnel?
☐ Yes ☐ No
3. Do you have wires at the bottom of the wind turbine?
☐ Yes ☐ No
4. Are your wires labeled + and - ?
☐ Yes ☐ No
5. Do you have a gearbox?
☐ Yes ☐ No

a. If so, what is your gear ratio?

6. What was your maximum voltage output?

7. If your turbine was under a load at the time of testing the voltage, describe the load.

8. How many blades?

9. What materials are the blades made from?

10. What was the optimal pitch of your blades?

Don't forget to bring the following items to the Challenge:

- Your wind turbine
- This form!
- Any notebooks, drawings, videos that you kept while building your turbine

Wind Project **Profile Form** (Advanced)

Team Name:

School Name:

This document is meant to help guide your design process and provide documentation to the judges about your wind turbine. You should present this document to the judges at your KidWind Challenge event.

1. ☐ a. We are using a KidWind Generator
☐ b. We are using a premade, non-KidWind generator.

Brand/Model/Where you got it:

- ☐ c. We made our own generator.

Describe the design/construction:

What resources did you use to guide your design (books, kits, etc.)?

2. What kind of power does your wind turbine generate

- ☐ a. AC: Did you rectify your output to DC?

☐ Yes ☐ No

- ☐ b. DC: Is your power output conditioned to be DC and below 30V and 1A?

☐ Yes ☐ No

3. Does your turbine fit in the 4'x4' wind tunnel?

☐ Yes ☐ No

4. Do you have wires at the bottom of the wind turbine?

☐ Yes ☐ No

5. Are your wires labeled + and -?

☐ Yes ☐ No

6. Do you have a gearbox?

☐ Yes ☐ No

- a. If so, what is your gear ratio?

7. What was your maximum voltage output?

8. If your turbine was under a load at the time of testing the voltage, describe the load.

Don't forget to bring the following items to the Challenge:

- Your wind turbine
- This form!
- Any notebooks, drawings, videos that you kept while building your turbine

9. What materials did you use?

10. What was the optimal pitch of your blades?

11. Detail any use of airfoils in your design.

☐

No airfoils used.

12. Detail any computer software you used to design/print/build your blades.

☐

No software used.

13. Detail any advanced manufacturing used to create your wind turbine (i.e. laser cutting, 3D printing, etc.).

☐

No advanced manufacturing used.

14. Describe any mechanisms or capacitors you have used to store electricity.

☐

No mechanisms or capacitors used.

15. Detail any microcontrollers integrated into your device. Describe the goal and the benefit of your microcontroller(s).

☐

No microcontrollers used.

10 Big Questions About Energy

Here are some questions to get you thinking about clean energy in broader terms. You will likely need to draw on your understanding of these questions to be successful at Instant Challenges, knowledge tests, and in the judging room!

While these broad and expansive questions can be explored by students across the grades, some subquestions may be geared to younger or older students. Coaches can help steer students to the questions most appropriate for their grade-level.

You do not need to become an expert! Just make yourself knowledgeable.

1. How do we generate and use electricity — and how do we move it around?

From what sources do we generate most of our electricity in the U.S.? How does a generator work? What are the primary sources of electricity in your region of the U.S.? What are some of the ways we transform energy from one form to another? How much of the electricity that is used in your country is generated by wind, solar, or other clean energy? How has this changed over the last ten years? How do we move electricity from power plants to our homes? What is distributed generation?

2. How do we measure and quantify electricity?

What are the units we use to measure electrical energy consumption? How much does it cost to power your house each month? What is the difference between energy and power? How much power and energy do common objects like toasters, TV, cell phones and other devices use? Can you read a power bill? How can we reduce our electrical consumption or make it more efficient? How does electrical energy usage vary between countries?

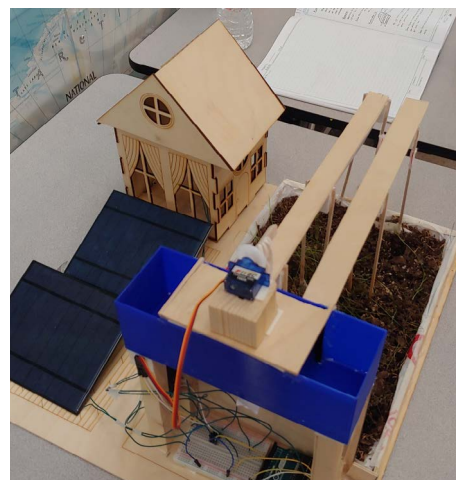
3. What is climate change and how can clean energy impact this phenomenon?

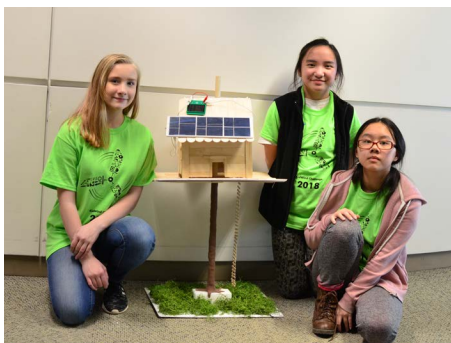
What is climate change and who does it impact? What are the environmental benefits of generating electricity using wind or solar power? What are some of the tradeoffs? What challenges might we face in generating over 50% of electricity from clean resources in the U.S.? How does efficiency and conservation play a role in reducing the climatic impact of electricity generation?

4. What kinds of devices transform the power of the wind and the sun?

What types of devices have been used to harness wind or solar power, apart from being used to generate electricity, and what were their uses? What are the various styles of windmills and turbines? What are the various types of solar thermal and solar photovoltaic panels? What is the equation that defines how much power is in the wind and what are the most important variables? How do we measure the power coming from the sun? What components of wind turbines are undergoing rapid change and development? Which changes seem to be having the most impact in improving turbine performance? How has the performance of solar panels been improved?

Wondering where to start exploring these questions? Check out the KidWind website for important links and resources: [KidWind.org](https://www.kidwind.org)





5. How does weather and geography impact clean energy production?

What causes wind? What are the windiest or sunniest parts of the U.S.? Where are most of the wind turbines or solar farms located in the U.S.? How does an offshore wind farm work, and where are they located? How do the seasons affect wind or solar energy production? How could the science of meteorology impact and improve the performance of solar or wind farms?



6. How can we store electricity?

What is electrical storage? How can storage impact the “variability” of clean energy resources? What are the challenges of implementing small or large scale storage? What kinds of technologies are used in the storage of electricity? Electric vehicles have huge batteries in them — can we use them for storage in our homes?



7. What are local impacts of a wind and solar powered future?

What are some of the physical and social impacts of solar and wind farm construction and operation? How can we reduce these impacts? Which impacts seem most concerning to local communities? How do these impacts compare to those of fossil fuel generating facilities?

8. How do we pay for clean energy?

How do we financially subsidize clean energy resources? How does this compare to fossil fuel and nuclear subsidies? Do you feel that subsidies are appropriate in the energy industry? If you feel that subsidies are okay, what energy sources would you subsidize and why? How can we provide affordable, clean energy to all communities around the globe?



9. What does a clean energy powered future look like?

Is it realistic to think we can power the grid with 100% clean energy? What role does nuclear have to play in a clean energy future? What are smart grids and microgrids and how could they be an improvement over the power grid we currently have? How would large numbers of Electric Vehicles impact the power grid? How can we use less electrical energy but still have all the modern conveniences we want?

10. What are clean energy careers?

Developing and installing clean energy components and systems like wind turbines and solar panels, requires professionals and experts from many different fields of study. What are some of the careers and jobs that make clean energy possible? What do you need to study to work in these fields?

**The development of these questions was guided by the DOE Energy Literacy and NGSS Energy Standards.*