



**COLLEGIATE
WIND COMPETITION**
U.S. DEPARTMENT OF ENERGY



2014 U.S. Department of Energy Collegiate Wind Competition
RULES AND REQUIREMENTS

Note to Teams in Regards to Rules and Scoring

The organizers welcome the opportunity to develop competitions that challenge the intellect and ingenuity of the nation's aspiring wind energy industry contributors. This document seeks to create fair contest rules for determining appropriate measurable outcomes.

In the spirit of this inaugural creative educational venture, the organizers reserve the right to change contest criteria, rules, and measurable outcomes as needed whenever improved approaches become apparent.

In the same spirit, the organizers encourage the teams to bring to our attention rules that are unclear, misguided or in need of improvement. The organizers will seriously consider suggestions that are aimed at improving the competition, its rules, and its measurable outcomes.

The organizers will make carefully considered changes to the rules and measurable outcomes if it is feasible within our constraints and will improve the competition in regards to fairness and precision.

Addendum #1 to the Collegiate Wind Competition Rules and Requirements November 15, 2013

- In Section 1-1, Table 1, Roles and Responsibilities, changed "Onsite Market Impacts Team" to "Onsite Market Issues Team"
- In Section 2-3, a paragraph has been added encouraging sustainability.
- In Section 3-1, several clarifying elements have been added, including, but not limited to, clarification on the Market Opportunity section, replacement of Technical/Social/Environmental Impact Analysis section with Product Development and Operations section, clarification on Financial Analysis section and associated financial worksheets, replacement of 4th bullet of Market Deployment Feasibility and Risk Reduction criterion description, and clarification of financial analysis criterion. The scoring mechanics and onsite expectations from the teams have been added as well.
- In Section 3-2, b, the Design Review scoring mechanics and onsite expectations from the teams has been added.
- Appendix D, Business Plan rubric, Financial Analysis table, the financial analysis criteria clarification on standards that financial summaries should align to GAAP standards, as possible. Elimination of ROI calculation needing to be supported with adequate data/documentation.
- Appendix D, Turbine Testing rubric, power verification criteria, a correction to the score that would be assigned to 5 m/s wind speed on the Scoring Sample for Power Curve Verification Task table was added.
- In Appendix E, Section E-1, a base flange description and drawing was added.
- There was an addition of Section E-3 defining the 5V Power Sink.
- In Appendix F, Section F-2, correction to business plan outline as defined earlier in the document.

Addendum #2 to the Collegiate Wind Competition Rules and Requirements April 15, 2014

- In Section 1-1, Roles and Responsibilities, the CWC organizing team's individual responsibilities were updated on the Roles and Responsibilities table.

- In Section 1-6, Decisions on Winning Teams, there will also be overall 2nd and 3rd place winners selected.
- In Section 3-1b, Business Plan Written and Oral Presentations, there are no requirements in place as to a business venture's initial capital conditions. This is up to each individual team to develop.
- In Section 3-1b, Business Plan Written and Oral Presentations, added that teams should include in their business plan document and presentation why/how their market turbine is aligned with their business plan if different from their prototype being tested in the wind tunnel in the instance that a team is bringing a market and prototype turbine to the competition to allow for wind tunnel testing. The market-size turbine does not need to be operational.
- In Section 3-1b.i, Business Plan, Written, clarification has been provided with respect to the plans and specifications that each team may choose to include within their business plan (and design review) documents. This direction is repeated further in the R&R document under the design review section. Essentially, the level of detail shall be commensurate with the type of review being performed by each competition judge, this being product understanding for the business plan judges and engineering review for the design review judges.
- In Section 3-1b.ii, Business Plan, Oral, clarification was added to the business plan pitch discussion in the first paragraph. Reduced the 8-10 minute presentation to 3 minutes followed by questions that are designed to reveal further information with respect to each teams' unique concepts for the purpose of deriving a winner for a People's Choice Award. Any materials being used during the business plan judging session can be used during their public pitch, if desired. As stated in Section 1-8 of the Rules and Requirements document, Confidentiality and Intellectual Property, there are portions of the competition that are decidedly open to the public for purposes of generating public interest and providing general information to the public. During these times, team members should delineate between a) information for educating the public about their turbine, team, business plan, and the competition and b) information relative to their ability to compete against the other teams and proprietary knowledge that may be used in future business endeavors. As the public portion of the business plan competition is not a *core-scored* event, the organizing team will ensure that the facilitators of this portion of the competition respect each team's established boundaries in this regard.
- In Section 3-2b, Turbine Design Basis, clarification was added regarding the area provided for non-rotor auxiliary turbine parts. It is a cylinder with a 45cm radius around the vertical centerline of the mounting flange. The switch to activate shutdown will have to be outside the tunnel, with wires exiting the tunnel at the base flange. Other electronic components could also technically be outside the tunnel, but this may be disadvantageous from a business and marketing standpoint. Also, in this same section, it now states that energy storage elements, such as capacitors and/or inductors, can be used if not used as bulk energy storage and if they start out at zero state of charge at the beginning of the test. Up to two button cell batteries of up to 3V nominal voltage and up to 250mAh of capacity, such as CR2032 Lithium Coin batteries, can be used in the turbine control system as long as they are not used to provide current to the power output lines.
- In Section 3-2c, Design Review Subcontest, 'written and oral presentations' was added to the header and clarification that teams should include diagrams suitable for an engineering review. This means that teams do not need to include construction drawings or full software code listings, etc.

- In Section 3-2e.iv, Wind Turbine Testing Subcontest, clarified that while only a single shut down mechanism will be required for the competition test turbine, the judges must be provided with a triggering mechanism.
- In Section 3-3c.ii, Market Issues Presentation, Requirements and Scoring, added that it is up to the teams to identify the audience to whom they are presenting.
- In Section 3-3e, Market Issues Presentation, Required Elements of Presentations, added that the teams should state who they are assuming their intended audience to be up front as part of their presentations.
- In Section 3-3f, Market Issues Presentation, Etiquette and Conduct, added that it may be necessary for a camera to be focused on any non-electronic visual aids so that the audience can see what the judges are viewing.
- In Section 4-4, Safety and Conduct During Competition Event, ear plugs were added as PPE.
- In Appendix B, Schedule, inserted updated schedule
- In Appendix B, Competition Event Schedule, added that a specific event schedule will be provided at the event along with a team-specific customized schedule highlighting when and where each team needs to be throughout the competition. This same detail was revised in Section 1-4 where the Competition Event Schedule is also discussed.
- In Appendix D-3, Turbine Testing, added a note to the Scoring Sample for Power Curve Verification Task table stating that “if a particular test point cannot be reached by the wind tunnel, for any competitor, all teams will receive full points for that test point.”
- In Appendix D-3, Turbine Testing, added a note to the Scoring Sample for Maximum Power Control Task that a predicted rated power of 100W is assumed.
- In Appendix D-3, Turbine Testing, added information on safety shutdown protocol including that each turbine should be able to be shut down quickly “on command.” Defined “on command.”
- In Appendix E-1, Wind Tunnel, updated the drawings and associated text in accordance with the evolution of the wind tunnel construction and discussions on the Google group, including information about the attachment stand, base flange, and connectors to connect the turbines to the test equipment.
- In Appendix E-2, CWC Generator, added that the prescribed generator is not required for the market-size turbine, if applicable.
- Added Appendix H: Competition Deliverables Checklist.

Table of Contents

- SECTION I: DEFINITIONS.....7**
- SECTION II: COMPETITION BACKGROUND.....8**
- SECTION III: GENERAL RULES.....9**
 - Rule 1. Authority and Administration..... 9
 - 1-1. Roles and Responsibilities (includes pre-, during, and post-event) and Contact Information 9
 - 1-2. Official Communications (External Website) 12
 - 1-3. Internal Communications 12
 - 1-4. Competition Timeline 13
 - 1-5. Dispute Resolution..... 13
 - 1-6. Decisions on Winning Team(s)..... 13
 - 1-7. Safety and Conduct Across Competition Timeline 14
 - 1-8. Confidentiality and Intellectual Property..... 14
 - Rule 2. Participation/Team Selection 14
 - 2-1. Team Eligibility 14
 - 2-2. RFP Process and Selection..... 15
 - 2-3. Expectations of Teams 16
 - 2.4. Use of Likeness, Content, and Images 16
 - Rule 3. Competition Components and Requirements 16
 - 3-1. Business Plan Requirements and Scoring..... 17
 - 3-2. Wind Turbine Design Development and Testing Requirements/Scoring..... 23
 - 3-3. Market Issues Presentation Requirements and Scoring 27
 - Rule 4. The Event..... 30
 - 4-1. Team and Coordinator Requirements 30
 - 4-2. Competition Event Timeline 30
 - 4-3. Logistics..... 30
 - 4-4. Safety and Conduct During Competition Event 30
- SECTION IV: APPENDICES 32**
 - APPENDIX A HIGH-LEVEL COMPETITION TIMELINE 32

APPENDIX B	COMPETITION EVENT SCHEDULE	33
APPENDIX C	JUDGING GUIDELINES.....	35
C-1.	Judging Organization	35
C-2.	Judging Rubrics	35
C-3.	Team Feedback	35
APPENDIX D	DECISION CRITERIA AND SCORING RUBRICS.....	36
D-1.	Business Plan (Written and Oral).....	36
D-2.	Design Review SubContest.....	40
D-3.	Turbine Testing SubContest	43
D-4.	Market Issues Presentation.....	48
APPENDIX E	WIND TUNNEL SPECIFICATIONS AND CWC GENERATOR	50
E-1.	Wind Tunnel Specifications	50
E-2.	CWC Generator	52
E-3.	CWC Power Sink	53
APPENDIX F	COMPETITION DELIVERABLES	54
F-1.	Project Portfolio.....	54
F-2.	Content	54
APPENDIX G	DELIVERABLE SUBMISSION INSTRUCTIONS	58
G-1.	Website URL.....	58
G-2.	PDF Requirements.....	58
G-3.	Photo and Model Release Forms.....	58
G-4.	Electronic File-Naming Instructions	58
APPENDIX H	COMPETITION DELIVERABLES CHECKLIST	60

SECTION I: DEFINITIONS

Competition

All aspects of the DOE Collegiate Wind Competition related to the contests and the scoring of those contests.

Contests

The DOE Collegiate Wind Competition consists of three contests: business plan delivery, wind turbine testing and design review, market issues presentation. Within each contest there are multiple tasks.

SECTION II: COMPETITION BACKGROUND

The central goals of the U.S. Department of Energy (DOE) are to invest in research and development efforts and innovative deployment approaches to catalyze the timely, material, and efficient transformation of the nation's energy system and maintain a vibrant U.S. effort in science and engineering. American wind plants are currently generating about 4% of U.S. electricity supply. DOE's target is to reach 20% wind energy by 2030. It is clear that growing going the nation's energy from wind from 4% to 20% in the next 17 years requires a high-impact strategy to drive significantly higher rates of annual wind deployment.

The DOE Collegiate Wind Competition (CWC or Competition) aligns with DOE's deployment, market acceleration, and barrier reduction objectives, as well as with business outcomes for DOE and the National Renewable Energy Laboratory (NREL). The CWC provides a forum for undergraduate students from multiple disciplines to be able to investigate innovative wind energy concepts; increase their knowledge of barriers to the wind industry; and gain experience designing, building, and testing a wind turbine to perform according to their customized market data-derived business plan.

Each competing team is required to design and construct a wind turbine to meet a specific need, identify a market for this turbine and develop a business plan to support it, and deliver a presentation on an important wind market issue. In the inaugural year, the theme is to design and construct a wind turbine that can be used to power small electronics (e.g. cell phone, computer, etc.). In future years, new themes might be added, and competition themes might be repeated every few years.

SECTION III: GENERAL RULES

Rule 1. Authority and Administration

1-1. Roles and Responsibilities (includes pre-, during, and post-event) and Contact Information

Below is a roles and responsibilities table complete with DOE/NREL and collegiate team roles and responsibilities. Competition organizer contact information is available on the Google Group website described within these Rules and Requirements. Each team shall provide contact information for their principal investigators (PI) and co-PI's and shall keep the contact information current in the Google application for the duration of the project.

Table 1: Roles and Responsibilities

Title	Individual Assigned	Definition
Collegiate teams	Multiple	The collegiate teams execute the will of their team members, PIs, and co-PIs within the rules and requirements of the competition.
Collegiate team principal investigator	Multiple	The collegiate team principal investigator serves as the lead faculty member and primary representative of a participating school in the project. This person also provides guidance to the team throughout the project and disseminates information received from the competition organizers.
Collegiate team co-principal investigator	Multiple	The collegiate team co-principal investigator supports the PI in the above duties.
DOE competition director	Patrick Gilman, DOE	The director represents the U.S. Department of Energy and has the final decision-making authority in all aspects of the project.

Competition managers	Julie Jones, NREL Brie Van Cleve, DOE	The competition managers are the primary coordinators for the competition. The operations manager, communications manager, the head rules official, and the competition organizers report to the competition managers. The competition managers are the primary point of contact for questions related to engagement with AWEA, keynote speakers, judges, sponsors, event rules and requirements, and other non-logistical matters. Tasks include, but are not limited to, communicating rules, requirements, and expectations to teams and all associated participants to the competition. The competition managers also provide support to the competition operations manager and head rules official.
Competition operations manager	Elise DeGeorge, NREL	The competition operations manager leads operations during the competition. This person is the primary point of contact for questions related to logistics concerning individual competition contests, including wind turbine testing, business plan presentation, and market issues presentation protocol and safety. Primary task is developing teams' schedules and coordinating/collating scores and team feedback from the testing, design review, business plan, and market issues contests in time for the awards ceremony. Other tasks include, but are not limited to, supporting the testing team, supporting the collegiate teams, communicating protocol, and supporting the competition manager and head rules official.
Competition communications manager	Alexsandra Lemke, NREL	The competition communications manager leads the development of the public website, guidance document for the teams and sponsors, and ensures all communications materials, graphics, and signage follow DOE/EERE/NREL standards. Tasks include, but are not limited to, supporting the sponsor program, competition manager, operations manager, and operations coordinator.
Competition operations coordinator	Stephanie Shuff, Energetics	The competition operations coordinator is the primary point of contact for questions related to competition logistics concerning all rooms, exhibit hall activities, sponsor assignments and signage, and safety. Tasks include, but are not limited to, overseeing room logistics, safety, and supporting the competition manager and head rules official.

Rules panel/head rules official	Lee Jay Fingersh, NREL	The rules panel members, which will be a subset of the competition organizers, are the only organizers authorized to interpret the rules. If there is any doubt or ambiguity as to the wording or intent of these rules, the decision of the rules officials shall prevail. The head rules official within the panel is the only rules official authorized to write and modify the rules. The head rules official reports to the competition manager.
Testing and design review team	Michael Arquin and KidWind staff, Ben Chicowski, Elise DeGeorge, Lee Jay Fingersh, Zach Parker	Testing team activities include running tunnel tests, documenting results, announcing results, supporting teams in getting their turbines through the testing protocol, ensuring safety, and narrating what is occurring.
Onsite business plan team	Elise DeGeorge, Zachary Parker	Onsite business plan team activities include organizing the public presentation and the pull outs for individual team scoring, supporting judges with rubrics, taking notes where needed, and collating scores.
Onsite market issues team	Michael Arquin, Ben Chicowski	Onsite market issues team activities include organizing the presentations, filtering public comments/questions, supporting judges with rubrics, taking notes where needed, and collating scores.
Awards Ceremony	Ian Baring-Gould, Patrick Gilman, Julie Jones, Alex Lemke, Stephanie Shuff, Brie Van Cleve, Wind Energy Foundation	Activities include preparing multimedia content, finalizing logistics, and identifying winning category justifications for presentation.
Organizers	Michael Arquin, Ian Baring-Gould, Ben Chicowski, Elise DeGeorge, Lee Jay Fingersh, Patrick Gilman, Julie Jones, Alex Lemke, Zach Parker, Stephanie Shuff, Brie Van Cleve, Wind Energy Foundation	The competition organizers perform all duties to ensure a safe and fair competition. The competition organizers, including the competition manager and competition operations manager, will work to ensure seamless competition execution.
Volunteers	tbd	Collegiate Wind Competition volunteers will be retained to support the competition organizers. Volunteers report to the competition operations manager.

Sponsors	tbd	The role of the sponsors will be determined during sponsorship negotiations.
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1-2. Official Communications (External Website)

Undergraduate college students from multiple disciplines will design, build, and test a wind turbine to perform according to a customized, market data-derived business plan, and make presentations relating to current wind market drivers and issues. Students from business, engineering, communications, and policy disciplines will gain and then demonstrate knowledge of technology, entrepreneurship, and marketing, thereby solidifying lifelong technical and business skills.

The [competition public website](#) will showcase the various elements of the competition, ongoing collegiate team engagement, and provide information about how to participate in future competitions. The website will also post competition documents such as this Rules and Requirement document and the DOE Collegiate Wind Competition identity guidelines. The identity guidelines document will provide information about how the competition name, logo, and identity can be used.

1-3. Internal Communications

It is the team’s responsibility to stay current with official project communications. Official communications between the teams and the organizers occur through, but are not limited to, one or more of the following:

Google Group Tool: Official communications suitable for viewing by all teams and organizers will be posted on the Google Group message board. The Google Group includes a section for posting files. If files are too large for the Google Group, they are posted in the dropbox, and the teams are notified of the exact location of file(s) via the Google Group. Other Google Group features are used for various purposes. Instructions for joining the Google Group will be provided to each team when the Rules and Requirements document is published. In subsequent years, instructions will be provided to each team immediately following the selection of teams.

Dropbox: The dropbox is used by the organizers and teams to transfer large files. Notification of or requests for file transfers are made via the Google Group or email.

Conference calls: Teams are strongly encouraged to participate in scheduled conference calls with the organizers. Invitations and instructions for participation in conference calls are provided by the competition coordinator until the Google Group has been established by the publication of the Rules and Requirements document, and then will be provided via the Google Group.

Meetings: Before the event, the teams and organizers may have one or more in-person meetings. Notification of the date(s) and agenda(s) for these meetings will be made via the Google Group. Meetings will also be held on a daily basis throughout the event.

Email: For expediency and to protect confidentiality, the organizers may choose to communicate with teams via team members’ email addresses as listed in the Google Group database. However, most official communication occurs via the Google Group message board.

1-4. Competition Timeline

A high-level competition timeline can be found in [Appendix A](#). The competition event schedule can be found in [Appendix B](#) with more specific details provided directly to the teams before and at the competition.

It should also be noted that this activity spans two fiscal years, with the determination of terms of the competition, the competitive solicitation process, and awarding of contracts taking place in the first fiscal year and the actual competition event taking place in the following fiscal year.

It is anticipated that the schedule for awarding and negotiating each of the subcontracts will conclude in the summer so that all collegiate institutions can attend a kick-off meeting prior to or in the beginning of the academic year. In the event that the negotiations and award process cannot be completed by this time, the competition organizers will make a unilateral decision regarding the selected team's continued eligibility for award due to insufficient time to execute and achieve successful completion of the subcontract.

1-5. Dispute Resolution

Any disputes or concerns during the competition event shall be submitted to the competition manager in writing. It shall include the name and signature of the collegiate team PI, the date of the protest submission, and a clear description of the action being protested. Following the receipt of a protest, the competition manager will meet with the head rules official. The head rules official will bring any disputes or concerns to the team of judges/rules panel that have jurisdiction over that issue. They will gather appropriate information through interviews or other means and post a copy of the written protest and decision on the Google Group site. If they conclude that the issue has broader impact to the entire competition, the head rules official will consult with all necessary members of the DOE organizing team.

In all cases, the head rules official has final say in all disputes.

The Decisions on the Rules database, which will be located on the Google Group site, offers interpretations of the rules contained in this Rules and Requirements document.

After the rules officials make a decision that may directly or indirectly affect the strategies of some or all teams, the rules officials will add the decision to the Decisions on the Rules database and notify the teams of the addition via the Google Group.

1-6. Decisions on Winning Team(s)

The winning team is the team who attains the highest score using the criteria weighting and ranking that is described in [Section IV](#) of the Rules and Requirements. Along with attaining the highest score, the team will have conducted themselves within the collegial spirit of the competition. There will also be second and third place winners as well as winners for each contest:

- Turbine Testing and Design Review
- Business Plan
- Market Issues Presentation.

Additional recognition may be created at the organizers and judges' discretion, including a People's Choice award and possibly a Best Spirit-of-the-Competition award. Judging will be in accordance with the judging guidelines presented in [Appendix C](#).

1-7. Safety and Conduct Across Competition Timeline

Each team member and team crew member shall work in a safe manner at all times during the project in accordance with the requirements identified in the Rules and the subcontract agreements as well as his or her respective institution's safety requirements. Each team shall supply all necessary safety equipment for all of its workers during the project. Teams must also follow OSHA rules for safety equipment based on expected activities (see NREL contract with your university, [Appendix B](#) Clause 8–Worker Safety and Health Requirements, for more information).

Organizers may issue a stop work order at any time during the project if a hazardous condition is identified. Improper conduct or the use of alcohol or illegal substances will not be tolerated. Improper conduct may include, but is not limited to, improper language, unsportsman-like conduct, unsafe behavior, distribution of inappropriate media, or cheating.

1-8. Confidentiality and Intellectual Property

There are portions of the competition that are decidedly open to the public for purposes of generating public interest and providing general information to the public. During these times, team members should delineate between a) information for educating the public about their turbine, team, business plan, and the competition and b) information relative to their ability to compete against the other teams and proprietary knowledge that may be used in future business endeavors.

Team members should keep in mind that members of various media outlets will be present during the competition. Any information made known and/or discussed with the media both before and during the competition should be expected to receive widespread and uncontrolled dissemination. Teams should consider ahead of time what level of information regarding all aspects of their turbine, business plan, etc. they desire to have publically available versus information that provides a competitive advantage, is critical to their performance in the competition, or is of a “proprietary” nature and essential to potential future business endeavors.

Rule 2. Participation/Team Selection

2-1. Team Eligibility

Eligibility for competition can be defined and/or changed annually. However, the inaugural competition teams will be made up of undergraduate students only, typically representing multiple disciplines from a single university or college. Each team will have a faculty, or staff member, to serve as an advisor and principle investigator (PI) for the project to support the team development and concept. Teams can name co-PIs at their discretion. Student/faculty interaction in all aspects of the competition is encouraged to engage the future wind energy workforce.

Co-PIs can reflect multi-department involvement and collaboration. A single graduate student may serve as a teacher assistant with competition funding to assist with managing an undergraduate course associated with the project team. PIs, co-PIs, and the graduate student may attend the competition, but cannot participate in any of the competition events. Using graduate students to help is acceptable, but faculty must demonstrate sufficient involvement to ensure continuity.

2-2. RFP Process and Selection

In a process that is likely to be repeated in subsequent years, an open competitive solicitation was offered to all colleges and universities. For the inaugural competition, the solicitation process started several months early to work through the pilot competition process. Subsequent competition year solicitations will be released in the spring prior to the competition event from the previous years' competition. Interested collegiate teams must respond to the request for proposals to be considered. Proposal responses are limited to about 10 pages, including any diagrams, charts, or appendices.

All responses are evaluated in two stages:

a. Step One: Initial Evaluation

An initial evaluation is first performed to determine if all required information has been provided for an acceptable offer. Offerors may be contacted only for clarification purposes during the initial evaluation. Offerors shall be notified if their offer is determined unacceptable and the reasons for rejection will be provided. Unacceptable offers are excluded from further consideration. Evaluation criteria and weighting may change from year to year, with changes captured in the Rules and Requirements document.

b. Step Two: Discussion, Selection, Negotiation, and Award

Responses found to meet requirements are evaluated to determine which teams demonstrate the following:

- 10% **Commitment** – The collegiate institution's commitment to the project. The commitment to developing an interdisciplinary team could be demonstrated by letters of support from multiple educational programs within the same university, college, or other academic institution. A demonstrated monetized or equipment, laboratory space or other material cost share can also be used to demonstrate organizational commitment.
- 25% **Organization and Project Planning** – A comprehensive understanding of all the activities involved in the project. Activities must be planned and organized adequately to ensure successful completion. Plans should assess unique obstacles, such as academic calendars (non-semester-based).
- 25% **Fundraising and Team Support** – The collegiate institution's commitment to fundraising and acquiring team support. The available funding provided by this solicitation is not expected to cover the entire expense of this project and participation of all students at the competition, in which case, fundraising or other opportunities for leveraging funding may be necessary. The collegiate institution should seek opportunities to leverage this effort to promote both (or either) internal or external support focused on providing benefit to the wind industry.
- 25% **Curriculum Integration** – The ability to combine the Collegiate Wind Competition with the students' course work. The institutions may incentivize top students to make long-term commitments to the project by offering scholarships, independent study credit, paid research assistantships, or other paid or academic compensation.
- 15% **Collaboration and Testing** – Commitment to provide feedback on the Rules and Requirements document, which includes the criteria by which judges will be able to measure the market impact

of proposed technological concepts and models. Demonstrate commitment to share examples of work in other student competition-type activities by which the institutions have been involved.

The selection committee will be a subset of the competition organizers including the competition manager and director. Technical reviewers will base their conclusions only on information contained in the responses. It cannot be assumed that reviewers are acquainted with the institutions or key individuals or any of their prior work or accomplishments.

2-3. Expectations of Teams

The DOE Collegiate Wind Competition is a forum for students with an interest in wind energy to showcase their innovative ideas and demonstrate their knowledge of the wind industry. Participants are expected to conduct themselves in the spirit of the competition by being a team player both within their own teams and amongst competitor teams.

DOE and NREL, as part of their organizational culture, embrace renewable energy and sustainability as they go hand in hand in our organizations. It is a common public perception as well. The Competition is about renewable wind energy. It is expected that participants will embrace and showcase sustainability where possible during all aspects of the competition. Reducing waste in packaging for shipping, re-using packaging materials that were used in transporting to the Competition, elimination of non-recyclable materials such as “styro-foam packing peanuts,” etc. are examples of more sustainable practices. Of course recycling paper, beverage containers, etc. are common sustainable activities to participate in. Team creativity in this regard is encouraged.

2.4. Use of Likeness, Content, and Images

Team members and crew agree to the use of their names, likenesses, content, graphics, and photos in any communications materials issued by the organizers and event sponsors.

- a. Content and images (graphics and photos), and any publications in which the content and images appear, may be viewable and made available to the general public via DOE’s, NREL’s, and the event sponsors’ websites with unrestricted use.
- b. The organizers and event sponsors will make all reasonable efforts to credit the sources of content and images, although they may be published without credit. To ensure proper usage of and credit for images, teams should submit photos and graphics by uploading them to the dropbox.

Rule 3. Competition Components and Requirements

The three components of the competition are summarized in the table below.

Contest	Weight	Points
Wind Turbine Design Development and Testing	45% <ul style="list-style-type: none"> • 25% Turbine Testing subcontest • 20% Design Review subcontest 	450
Business Plan Development	35%	350

Market Issues Presentation	20%	200
TOTAL		1,000

The business plan and wind turbine design shall be presented as part of a project portfolio due at the conclusion of the concept development phase, just prior to the competition, at the competition, and post-competition.

Requirements of these three contests are discussed in more detail below. More specific information surrounding the deliverables and submission requirements are provided in [Appendices F](#) and [G](#), respectively.

3-1. Business Plan Requirements and Scoring

a. Overview

For the business plan component of the competition, teams are expected to complete a written business plan following the directions herein and prepare for an oral presentation to take place during the competition itself in May 2014. The business plan portion of the competition is worth 35% of the total competition, or up to 350 points out of 1,000 total competition points. This section describes the requirements for the written and oral components as well as details on how these will be scored.

- See [Appendix C](#) for judging guidelines and [Appendix D](#) for a summary of competition criteria and a business plan scoring rubric to be used by the judges during the competition.
- See [Appendices F](#) and [G](#) for more information on business plan deliverables and deliverable submission instructions.

b. Business Plan Written and Oral Presentations

Each team is expected to compile a written business plan that will be presented at the competition event. Requirements for both the written plan and oral presentation are provided in more detail below. Additional information on business plan deliverables and deliverable submission instructions can be found in [Appendices F](#) and [G](#), respectively. There are no pre-existing expectations as to how your proposed venture will be capitalized.

If a team's wind turbine, built for the market application as outlined in its business plan, is larger than the specifications for wind tunnel testing, the team will need to build two wind turbines: a prototype, scale model to allow for wind tunnel testing and a market-size wind turbine for demonstration. The market turbine does not need to be operational. The scaled-down (prototype) is to be representative of the market-size turbine. It is expected that it is geometrically identical, to the extent possible. In your documentation and presentations explain the why/how the market turbine aligned with the business plan is different from the prototype being tested in the tunnel.

(i). Business Plan – Written

Each team's Collegiate Wind Competition business plan should be easily readable, concise, and interesting. It should outline the company's potential and the path it will take to realize this potential.

Format Requirements

The business plan shall not exceed 12 pages. The cover and appendices are not included in the final page count. The plan should be packaged into a single, bookmarked PDF file. See [Appendices F](#) and [G](#) respectively for deliverables and submission instructions.

Content Requirements

The plan shall include the following sections:

- **Cover Sheet**—Provide the team’s organization and contacts. Indicate how your team is organized and approximately how many students, faculty, and others (e.g., sponsors, volunteers, family members) are involved in the project. (1 page)
- **Executive Summary**—The executive summary should include components from all sections of the business plan, including a 100-word or less description of your team project (1 paragraph). The information in the executive summary is important to many communications-related aspects of the competition. As such, it should include important aspects of the wind turbine design. Executive summaries should:
 - Provide essential content for the organizers to use while developing various event materials (e.g., the website, event program, media kit, and signage)
 - Prepare teams to answer questions from visitors at the competition venue
 - Help organizers and teams respond effectively to media inquiries.

The executive summary should be no more than 3 pages long, including figures. It should be packaged into a single, bookmarked PDF file (see [Appendix G](#) for PDF formatting and file naming requirements) but also included within the business plan. Executive summary materials (text, photographs, computer-generated renderings, and logos) shall be saved in the formats indicated and submitted to organizers as a single .zip file. It is recommended that executive summaries be written last to best capture the distinct and unique factors of each team’s business plan.

- **Business Overview**—This section should include information about the company such as its name, its business model and vision, and a concise overview of the company’s/product’s value proposition (financial, social, and/or environmental). A triple bottom line enterprise seeks to benefit many constituencies, not exploit or endanger any group of them.
- **Market Opportunity**—This section should characterize the overall market opportunity, along with telling the story of how the company will capture a portion of this opportunity.

This section should, at a minimum, include a definition of the problem or market gap, a market opportunity forecast, and potential solutions/competition analyses. This section should also provide a pricing strategy and customer value proposition analysis to support revenue forecasts.

Some specific questions this section may seek to answer include:

- What specific market needs does your product offering meet and what segments will you compete in? How does your team’s particular turbine meet the needs and desires of the indicated target market?
- How will the company price its offering? How does this jibe with the value proposition from the customer’s perspective? How does pricing compare to the competition? How do state, federal, or other incentive programs come into play?
- **Management Team**—This section should include the team’s key management and their experience. Teams could also mention any board of advisors and/or board of directors and rationale for members, if desired and/or applicable.
- **Product Development and Operations**—A description of the activities and growth of the company outlined in the financial section should be provided.

Some specific questions this section may seek to answer include:

- How will R&D be accomplished? What will be the company’s approach to manufacturing? How will the product be distributed? What partnerships will be leveraged? What does management see as significant risks and what is the approach to managing them?

This where the wind turbine’s technical design, system specifications, energy analysis results and discussion, and engineering narratives can be included. Are there technical constraints to implementation? Is the proposed concept buildable? Teams should also include technical, social, and environmental impacts and/or opportunities.

Teams should reference their design report (available under separate cover), and plans and specifications should be included in the Appendix of the business plan. Plans and specifications may also be included in an appendix of the design report. It should be noted, however, that in both the business plan and in the design report, a team does not have to include a full set of drawings and software. The plans and specifications to be included in the business plan should be provided to aid in communication of their specific concepts to the business plan diagrams. Similarly, diagrams that each team provides for the turbine and its subsystems within their design report, including control algorithms and software, should be suitable for an engineering review of its turbine, and, as such, construction drawings or full software code listings and similar are not required (this guidance is repeated further in this R&R document within the design review section).

- **Financial Analysis**—This section should outline the future financial potential of the company along with the capital required and use of financing, to realize that potential.

Pro forma financial statements, including an income statement, cash flow statement, and balance sheet, should be presented for the first year, demonstrating the path to break even and outlining the company’s potential. It is suggested that full pro formas be included in an appendix and higher level summaries be used in the business plan narrative, as needed. It is also recommended that key assumptions be described (e.g. product marginal costs). From an investment perspective, teams should present their view of the valuation of the company at the present time, along with outlining the attractiveness of their company for investment.

- **Appendices**—Full financial analyses, plans, specifications.

Changes to Your Business Plan

Once each team’s written business plan is submitted, it will be provided for review by the judges so that the written review is completed prior to your arrival at the competition. Teams will not have a chance to modify their written business plan; however, if a team feels the need to modify its plan, when oral presentations are made, a team can incorporate these changes into their presentation. Modifications that demonstrate improved thinking are acceptable as long as they align with the general plan. Wholesale changes should not be made following the submittal of a written business plan.

The business plan shall be submitted by the date outlined in [Appendix F](#). Reading and judging of the Business Plan documents will occur in the days leading up to the competition. At the competition, teams will be expected to give a 10 minute presentation to the business plan judging panel in a closed session followed by 10 minutes of questions and answers. The documents will be scored in advance of the competition with the Q&A session to be used to get relevant questions answered by the teams for the purpose of refining scores.

(ii). **Business Plan – Oral Presentation**

A minimum of two team members should be involved in the presentation of the business plan. Team presentations are limited to 10 minutes in length, which will be followed by 10 minutes of questioning from the Collegiate Wind Competition judges only. The oral presentation may consist of posters, charts,

PowerPoint presentations, or other visual aids. Teams should plan to present their business plan alongside their market-size turbine. A laptop will be available if you are bringing your presentation or other material on a flash drive. In addition to this behind-closed-doors judging session, there will also be a timeslot during the competition where each team will be required to present their business plan pitch in a public setting. Judges will ask questions to the teams following this 3-minute pitch, but, as it is an unscored portion of the competition, the questions will focus on collecting further information with respect to each team's unique concepts for the purposes of deriving a winner for a People's Choice award, in which the winning team is selected by the public.

The materials a team is preparing for their business plan oral presentations such as posters, charts, or other visual aids can be reused for the public pitches. Teams are free to present in the way they think is most compelling.

Suggested topics for the presentation include the following:

- Product offering
- Unique differentiators
- Market opportunity and target customers
- Business model
- Milestones and success metrics
- Capital needs
- Social/environmental impact analysis.

c. Business Plan and Oral Presentations Judging Process

Judges may be comprised of entrepreneurship faculty, venture capital professionals, and/or others with business consulting experience. There are four criteria that will be used in evaluating team business plans, which make up 35% of a team's total competition score (up to 350 out of 1,000 total competition points). These include:

- Market deployment feasibility and risk reduction (niche justification, marketability, buildability, public/market acceptance)—10% weight (or up to 100 points out of the total 350 points)
- Innovation, creativity, and originality—10% weight (or up to 100 points out of the total 350 points)
- Presentation and documentation—5% weight (or up to 50 points out of the total 350 points: note that this is reduced because it is also included in the design review test)
- Financial analysis—10% weight (or up to 100 points out of the total 350 points)

These are defined as follows:

Market Deployment Feasibility and Risk Reduction: It is important that the product being developed and business plan presented minimizes project risks wherever possible. This criterion includes legal (risk of public opposition or being subject to legal challenges), financial (risk of not being able to finance the project), technical (not being able to be implemented due to technical constraints), or other factors. Is the proposed concept marketable and buildable? Is the business model both financially feasible (value created is greater than costs incurred), fundable (attractive for future investors and donors), and scalable (replicable across regions, product categories, or impact areas)?

This criterion will be measured by a panel of judges and will be assessed on a scale of 0 to 100 based on the team's demonstration of the market deployment feasibility and risk reduction surrounding its proposed product. Scores are derived as a result of the levels by which teams fall within the following four subcriteria:

- The team presents an understanding of the available market space, including the buildability opportunity and constraints.
- The team has identified risks in the areas of finance, legal, technical and/or other across the product lifecycle. The team has proposed appropriate risk mitigation strategies and performed analysis to establish the risk envelope.
- The business model is both financially feasible (value created is greater than costs incurred) and fundable (attractive for future investors and donors).
- The business model is scalable in accordance with the team's business plan.

Scores from 0 to a total possible 100 points for this criterion reflect the following:

- Teams receiving a score greater than 80 reflect an exceptional attention placed on demonstrating market deployment feasibility and risk reduction.
- Teams receiving a score between 60 and 80 reflect an adequate level of attention placed on demonstrating market deployment feasibility and risk reduction.
- Teams receiving a score between 40 and 60 reflect an average level of attention placed on demonstrating market deployment feasibility and risk reduction.
- Teams receiving a score between 20 and 40 exhibited one or more fatal flaws in their demonstration of market deployment feasibility and risk reduction.
- Teams receiving a score lower than 20 points in this criterion provided insufficient information demonstrating market deployment feasibility and risk reduction.

Innovation, Creativity, and Originality (ICO): This criterion measures the level by which the team has proposed a commercially viable and practical innovative and original engineering and business solutions to meet a market need. This creativity can relate to the turbine itself, as well as in the way the team proposes to roll-out the technology and/or addresses other risks, opportunities, or constraints.

This criterion will be measured by a panel of judges and will be assessed on a scale of 0 to 100 based on the team's demonstration of the innovation, creativity, and originality surrounding its proposed product. Scores are derived as a result of the levels by which teams fall within the following four subcriteria:

- There is evidence of ICO in industrial design (e.g. aesthetics and/or customer features and/or functions and/or other).
- There is evidence of ICO in marketing and branding (e.g. rollout branding strategy and/or niche market and/or other).
- There is evidence of ICO in financing and product strategy (e.g. product architecture and/or product portfolio and/or finance and/or funding/payment and/or business architecture and/or other).
- The team has addressed triple bottom line of economic, environmental, and social factors in the creation of their business (e.g. product lifecycle and/or environmental/social relevance).

Scores from 0 to a total possible 100 points for this criterion reflect the following:

- Teams receiving a score greater than 80 reflect an exceptional attention placed on demonstrating innovation, creativity, and originality in their business plans.
- Teams receiving a score between 60 and 80 reflect an adequate level of attention placed on demonstrating innovation, creativity, and originality in their business plans.
- Teams receiving a score between 40 and 60 reflect an average level of attention placed on demonstrating innovation, creativity, and originality in their business plans.
- Teams receiving a score between 20 and 40 exhibited one or more fatal flaws in their demonstration of innovation, creativity, and originality in their business plans.
- Teams receiving a score lower than 20 points in this criteria provided insufficient information demonstrating innovation, creativity, and originality in their business plans.

Presentation and Documentation: This criterion is designed to measure the caliber of the business case presentation conducted during the competition and the deliverables including the business plan document, design drawings, specifications, product, and all marketing materials (e.g. videos) that are included in the online project portfolio.

This criterion will be measured by a panel of judges and will assess on a scale of 0 to 50 based on the team's documentation and presentation quality and usability. Scores are derived as a result of the levels by which teams fall within the following two subcriteria:

- The oral presentation is engaging, interesting, and compelling.
- The business plan and marketing materials are usable, understandable, and well-presented and therefore could be picked up and utilized by an investor (clear, concise and precise).

Scores from 0 to a total possible 50 points for this criterion reflect the following:

- Teams receiving a score greater than 40 reflect an exceptional attention placed on quality, usability, and replicability of their concept as reflected in written and oral deliverables. The messages and/or business case are presented in a manner that could be picked up and utilized by an investor.
- Teams receiving a score between 30 and 40 reflect an adequate level of attention placed on quality, usability, and replicability of their concept as reflected in written and oral deliverables. The messages and/or business case are presented in a manner that could be picked up and utilized by an investor.
- Teams receiving a score between 20 and 30 reflect an average level of attention placed on quality, usability, and replicability of their concept as reflected in written and oral deliverables. The messages and/or business case are presented in a minimal manner that could be picked up and utilized by an investor.
- Teams receiving a score between 10 and 20 exhibited one or more fatal flaws in the demonstration of quality, usability, and replicability of their concept as reflected in written and oral deliverables. The messages and/or business case needs improvement in order to be presented in a manner that could be picked up and utilized by an investor.
- Teams receiving a score lower than 10 points in this criteria provided insufficient information in the demonstration of quality, usability, and replicability of their concept as reflected in written and oral deliverables. The messages and/or business case are not presented in a manner that could be picked up and utilized by an investor. Deliverables may be inconsistent, of poorer quality, or unclear in the messages.

Financial Analysis:

This criterion is designed to measure the caliber of each team's financial analyses and associated assumptions.

This criterion will be measured by a panel of judges and will be assessed on a scale of 0 to 100 based on the team's quality and defensibility of their financial analysis. Scores are derived as a result of the levels by which teams fall within the following four subcriteria:

- The forms were completed correctly (including summary table, cash flow analysis, balance sheet, and income statement) and in accordance with SEC standards.
- The financial statements including return on investment (ROI) calculation are supported with adequate data/documentation.
- The team considered and applied for applicable federal, state, and/or local production, consumption, and/or business operations incentives.
- The business model promotes triple bottom line investments, which are, in turn, reflected in the financial documentation.

Scores from 0 to a total possible 100 points for this criterion reflect the following:

- Teams receiving a score greater than 80 reflect exceptional attention placed on quality and defensibility of their financial analysis as presented in their business plan.
- Teams receiving a score between 60 and 80 reflect an adequate level of attention placed on quality and defensibility of their financial analysis as presented in their business plan.
- Teams receiving a score between 40 and 60 reflect an average level of attention placed on quality and defensibility of their financial analysis as presented in their business plan.
- Teams receiving a score between 20 and 40 exhibited one or more fatal flaws in the demonstration of quality and defensibility of their financial analysis as presented in their business plan.
- Teams receiving a score lower than 20 points in this criteria provided insufficient level of quality and defensibility of their financial analysis as presented in their business plan.

3-2. Wind Turbine Design Development and Testing Requirements/Scoring

a. Overview

For the Wind Turbine Design Development and Testing contest, there are two sets of distinct subcontests within this part of the competition. Overall, this portion of the competition represents 45% of the total possible points. The Design Review subcontest focuses on the team's efforts to conceive, design, and build an operable wind turbine (20% of total competition, or up to 200 points out of 1,000 total competition points) that competes on a performance basis in the Turbine Testing subcontest (25% of total competition, or up to 250 points out of 1,000 total competition points). Each of these subcontests is described below.

- See [Appendix C](#) for judging guidelines.
- See [Appendix D](#) for a summary of competition criteria and turbine testing and design development scoring rubrics to be used by the judges during the competition.
- See [Appendix E](#) for more information on the generator requirements and the wind tunnel specifications that will be used for testing.
- See [Appendices F](#) and [G](#) for more information on turbine plans and specification deliverables and deliverable submission instructions.

b. Turbine Design Basis

The turbine must be designed with the generator¹ within the confines of the following constraints with the intent that it be testable inside the CWC wind tunnel (See [Appendix E](#) for wind tunnel specifications).

- Maximum rotor dimensions—The rotor dimensions cannot exceed the following measurements:
 - 17.7 in (45 cm) length
 - 17.7 in (45 cm) width
 - 17.7 in (45 cm) height

or it WILL NOT BE ALLOWED TO COMPETE.

- Wind turbine dimensions—The wind turbine system must be mountable on the test stand at the specified location within the wind tunnel (refer to [wind tunnel appendix](#) for tunnel specifications and mounting flange specifications). Any non-rotor auxiliary turbine parts must fit within 45 cm of the vertical center line of the mounting flange. The area for non-rotor auxiliary turbine parts is a cylinder with a 45cm radius around the vertical centerline of the mounting flange. The switch to

¹ GREAT PLANES AMMO 28-56-1530 PN#GPMG5225

activate shutdown will have to be outside the tunnel, with wires exiting the tunnel at the base flange. Other electronic components could also technically be outside the tunnel, but this may be disadvantageous from a business and marketing standpoint.

- The turbine must be designed to withstand continuous winds of 17 m/s (38 mph). The maximum design wind speed for the wind tunnel (refer to [wind tunnel appendix](#) for tunnel specifications) is 17 m/s (38 mph).
- The minimum turbine output is 10 W continuous for at least one wind speed from 5–14 m/s (11–31 mph).
- The generator, gear box and system electronics must be fully accessible for the judging team to inspect. This means the judging team must be able to identify the generator, its wiring, and the gearbox. No alterations to the generator are allowed. It may be that an easily removable cover or other piece of equipment has to be removed for generator and gearbox inspection. A turbine will not be allowed to be tested in the wind tunnel if it cannot be readily inspected and components verified.
- Energy storage elements, such as capacitors and/or inductors, can be used if not used as bulk energy storage and if they start out at zero state of charge at the beginning of the test. Up to two button cell batteries of up to 3V nominal voltage and up to 250mAh of capacity, such as CR2032 Lithium Coin batteries, can be used in the turbine control system as long as they are not used to provide current to the power output lines.

(i). **Equipment Provided**

The CWC will provide identical generators for use in the wind turbine for every team in the competition. The provided generator will be the Electrify AMMO 28-56-1530 PN#GPMG5225 generator (450 W) (full specs in the appendix). Only one generator is allowed in the wind turbine.

c. Design Review Subcontest: Written and Oral Presentations

The Design Review subcontest is intended to review the process by which each team developed its turbine from concept to finished product from the engineering perspective (not cost or marketing) to ensure a durable, robust turbine that will meet safety and performance requirements.

The scoring categories of this process with general descriptors include:

- Design Objective**—Conveys the intended design features that align with the Business Plan objective and differentiates the turbine from others currently in the marketplace.
(25% of Design Review Contest or 50/450 points of Design Review and Turbine Testing)
- Design Overview**—Conveys key components of the actual design in terms suitable for executive management and the general public.
(10% of Design Review Contest or 20/450 points of Design Review and Turbine Testing)
- Design Team**—Describes the team members, the sets of skills and experience they bring to the project, and the individual roles and responsibilities in achieving the design objective.
(10% of Design Review Contest or 20/450 points of Design Review and Turbine Testing)
- Modeling and Testing**—Describes initial modeling objectives, design refinements based on modeling results, laboratory and field testing procedures, and design refinements based on testing results.
(25% of Design Review Contest or 50/450 points of Design Review and Turbine Testing)
- Engineering Diagrams**—Presents diagrams suitable for an engineering review with the baseline dimensions and properties of the turbine and its subsystems, including control algorithms and software. This does not mean you need to include construction drawings or

full software code listings, etc.

(15% of Design Review Contest or 30/450 points of Design Review and Turbine Testing)

- (vi). **Engineering Specifications**—Provides specifications suitable for an engineering review, the baseline and operating properties of the turbine and its subsystems, including loading requirements, operational limits, control algorithms, and software.

(15% of Design Review Contest or 30/450 points of Design Review and Turbine Testing)

Format Requirements

The Design Review shall not exceed 20 pages inclusive of all diagrams, specifications, cover sheet, etc. Additional information on deliverables and submission instructions can be found in Appendices [F](#) and [G](#) respectively.

The Design Review shall be submitted by the date outlined in [Appendix F](#). Reading and judging of the Design Review documents will occur in the days leading up to the competition. At the competition, teams will be expected to give a 10-minute presentation to the design review judging panel in a closed session followed by 10 minutes of questions and answers. The documents will be scored in advance of the competition, but the Q&A session will allow the judges to get questions answered by the teams for the purpose of refining scores.

d. Wind Turbine Testing Subcontest

The Turbine Testing subcontest consists of a number of individual turbine tests. This section describes the requirements for the turbine and its components, the contests in which the turbine is expected to perform, the parameters of the testing conditions, and details on the scoring algorithms.

The intent of this portion of the contest is to provide teams with opportunities to demonstrate the performance aspects of their turbine in objective contests that will delineate to what extent teams have succeeded in developing a durable and safe high-performance wind turbine as performance will ultimately be a major component of its ability to compete successfully in the marketplace. (Note that wind speeds are stated in metric units (m/s).)

The turbines will be tested in a wind tunnel provided by the organizers. The teams are expected to use the generator supplied by the CWC organizers to design, develop, construct, and test their wind turbine systems that will be able to complete all competition testing requirements safely and reliably at the CWC in May 2014.

Energy storage elements, such as capacitors and/or inductors, can be used if not used as bulk energy storage and if they start out at zero state of charge at the beginning of the test. Button cell batteries can be used for operating a clock if necessary.

Testing Procedure

Teams will follow a posted schedule for testing in the wind tunnel. Only one team will be tested at a time. Each team will have 30 minutes to complete its testing. Teams will not be able to touch their turbine or controls during the test. Turbine failure is defined as anything out of the ordinary such as cracking, breaking, pieces falling off, smoking, sparking, or failure to produce electrical current.

Any necessary re-sets or repairs that cannot be completed within the 30-minute time frame will require that the team return at another time to complete its testing.

Total team turbine contest points will be determined by the contest results during this 30-minute period only. If a team cannot complete its testing during this 30-minute period, the team may request a “re-test” for a subsequent 30-minute period later that same day. Only failed portions of the first test will be retested.

If there are unforeseen delays caused by the organizers (e.g., wind tunnel issue, power outage, etc.), the time consumed in rectifying the problem will not be included as part of the team’s allowable minutes.

(i). Power Curve Verification Task

(30% of Turbine Testing Contest or 75/450 points of Design Review and Turbine Testing)

Objective:

- The measurements taken during the Power Curve Verification task will test the team’s power curve prediction for each 1 m/s interval from 5 – 14 m/s. The teams will be given the air density to be used in their power curve calculation the day before the Power Curve Verification Testing task. Each team shall submit a tabulated power curve, precise to 1% of the predicted value or better, that will show the expected power output for each wind speed (whole number 1 m/s intervals) from 5-14 m/s. The objective is for the team to predict with reasonably accuracy the power output of its turbine at each of these 10 wind speeds.

Procedure:

- Teams will have to attach their turbine to the fixed base apparatus (e.g., bolttable flange) provided by the CWC (see appendix for details of the attachment specifications).
- Load will be constant, regulated 5V power sink provided by CWC. This is defined in [Appendix E](#).
- Each turbine will be tested at wind speeds with 1 m/s intervals between 5–14 m/s inclusive for a maximum duration of 60 second or less with the stated intent of obtaining a “stable power reading” defined as “stable in RPM and stable in power per multimeter readings” during the test period. As power output may fluctuate, for purposes of this test, the allowable power outputs to be included in the maximum average power (per electronic testing devices) during any 5 second interval will be defined to be +/-10% of the maximum average power.

(ii). Cut in Wind Speed Task

(20% of Turbine Testing Contest or 50/450 points of Design Review and Turbine Testing)

Objective:

- Cut-in wind speed is one of the turbine characteristics that can differentiate it from other turbines as being better suited to lower wind speed regimes. Lower wind speed is generally deemed more desirable in the small turbine market.

Procedure:

- Each turbine will be measured to determine at what wind speed it begins to produce power (aka “cut-in” wind speed). For purposes of the CWC, the definition of “producing power” will be achieving a positive current (A) while operating at 5V (average over 5 second interval must be positive).

(iii). Control at Maximum Power Task

(20% of Turbine Testing Contest or 50/450 points of Design Review and Turbine Testing)

Objective:

- The “rated power” or “maximum rated power” is often the label that consumers associate with a turbine. The rated power is the turbine power output at a particular wind speed (determined by the manufacturer). It is a defining characteristic of any turbine. The rated power is sometimes included in the name of the turbine. An accurate and realistic maximum power rating is an important component of turbine differentiation.

- This task is intended to determine what the actual rated power of each turbine is. The teams will be given the air density to be used in their maximum rated power calculation the day before the Control at Maximum Power task. Each team shall submit a maximum power rating that will show the expected power output precise to 1% of the predicted value or better, in the interval from 5–14 m/s.

Procedure:

- Turbines that control rated power to within 10% of target as defined by the team will earn full points (50 points). There will be a 10 point reduction in score for each 10% of power production variance. The team receives one score based on its maximum power output at any wind speed in the wind regime being tested.

(iv). **Durability and Safety Task**

(30% of Turbine Testing Contest or 75/450 points of Design Review and Turbine Testing)

Objective:

- Turbines are expected to perform long-term subject to a wide variety of weather conditions. Being able to produce power effectively and to do so over the turbine's useful life are very desirable qualities of turbine design. Turbine safety is of utmost importance to turbine designers and manufacturers. To be certified, turbines must be able to safely shut down rapidly and with fail-safe back-up shutdown capability. **While only a single shut down mechanism will be required for the competition test turbine, the judges must be provided with a triggering mechanism.** This task has two components: Durability and Safety. The Durability segment is worth 37.5 points and the Safety segment is worth 37.5 points.

Procedure:

- Each turbine will be subjected to randomly varying wind speed conditions over a 5-minute test period to verify that it can operate in a wide range of operating conditions. At the end of the 5-minute test period, that turbine will be required to safely shut down.

3-3. Market Issues Presentation Requirements and Scoring

a. Overview

The Market Issues Presentation makes up one of the three CWC contests. This contest will hereafter be referred to collectively as “Market Issues.” Overall, this portion of the competition represents 20%, or 200 of the 1,000 total competition points.

- The moderator and judges have full authority in regard to the interpretation of the following rules.
- See [Appendix C](#) for judging guidelines and [Appendix D](#) for a summary of competition criteria and a Market Issues presentation scoring rubric to be used by the judges during the competition.

b. Structure of the Market Issues Presentations

For the Market Issues Presentations, all 10 teams will make presentations in a back-to-back sequence. The presentations will take place during in one room before a panel of judges. The format is presentations, not debates in the classic sense whereby two teams compete head-to-head simultaneously. Each team will have 7 minutes to present on a wind-related topic, followed by roughly 3 minutes of Q&A with the judges.

The schedule for the market issues presentations is presented in [Appendix B](#).

c. Topic Areas

(i). Description

Part of the DOE Wind Program’s strategy is to remove barriers that impede industry progress toward responsible wind power deployment, which requires an increase in the communication around and acceptance of wind power technologies. To do so, DOE works to address market and regulatory barriers as well as issues related to siting projects (e.g., environmental and wildlife concerns, competing uses for space, and decision-makers lacking fact-based information on wind’s benefits, considerations, and impacts). Topics for the market issues presentations will be chosen from among these general issues. Teams should have a strong base of knowledge about these topics and be able to demonstrate a grasp of how the topics affect industry progress.

(ii). Selection of Topics

The method for pairing teams with topics will be as follows:

- A preview of general topical themes will be distributed when the final Rules and Requirements document is published. These themes will pertain to the issues addressed by DOE’s Market Acceleration and Deployment activities (and described in the above section c – Topic Areas). Presentation topics will ultimately be chosen from among these themes. Included with each theme will be 2–3 example topics.
- Topics will relate to specific issues but will also have context (e.g., a hypothetical scenario in which the team is presenting to a certain audience under certain circumstances). In some cases, the focus of a topic will be to persuade the audience of a position; in others, the focus will be simply to be persuasive in the presentation of objective information. It is up to the teams to identify the audience to whom they are presenting.
- Each team will select two of the given themes, and then propose two region-specific topics per theme. Teams will submit the four proposed topics by December 31, 2013.
 - a. These proposed topics will represent the team’s potential presentation topics.
 - b. Proposed topics can be either determined by the team or chosen from the example topics.
 - c. Teams are strongly encouraged to propose topics that relate to issues of direct relevance to the team’s region. It is up to each team’s discretion to determine its precise region, but “region” is defined geographically.
 - d. Topics must include situational context (see previous main bullet).
- Around February 1, 2014, after having examined all proposed topics, the CWC organizers will notify each team about which of its proposed topics will be the subject of its presentation.

d. Governing Principles and Procedures

(i). Preparation

- Teams will receive their presentation topics in advance.
- Any team that arrives late to its presentation time runs the risk of receiving zero points. This decision shall be made by the moderator.

(ii). Time Limits

- Time begins when the moderator announces it and starts the clock.
- Each team’s turn will last up to 10 minutes: up to 7 minutes for the presentation and the remaining time for Q&A with the judges.
- Each presentation will be limited to 7 minutes. A team may end before the 7 minutes is completed, but if a team is not finished at the end of 7 minutes, the moderator will call an end to the presentation.
- The 7 minutes may be divided among presenters as each team sees fit.

- Immediately following the team’s presentation, the judges will engage the team in a Q&A session for the remainder of the 10 minutes.

(iii). **Participation**

- At least two individuals must present during each team’s presentation. The presentation is limited to students only; no faculty or advisor may deliver any part of the presentation.
- A moderator will be assigned to oversee the functioning of the Market Issues, keep order, keep time, and facilitate the judges’ scoring at the conclusion of the presentations.

e. Required Elements of Presentations

Each team must present on the topic chosen in advance. Each team will determine how the material is presented, though teams should look to existing information (e.g., industry issues; description of Topic Areas above) as sources of guidance.

Presentations should acknowledge and briefly address perspectives that differ from— and may even oppose— the position taken by the presenting team. Teams should state who they are assuming their intended audience to be up front as part of their presentations.

The use of PowerPoint (or any projected electronic visual aid) is not allowed. However, although it is not required, teams may elect to use other, non-electronic, visual aids.

f. Etiquette and Conduct

Competitors are expected to behave courteously during the market issues presentations and with respect to their fellow competitors. Those who do not do so shall be penalized at the discretion of the judges, and they may be asked to exit the Market Issues Presentations if the moderator so decides. Audience members may observe but not participate. The moderator and judges will make every effort to keep the environment orderly and conducive to public presentations. It may be necessary for a camera to be focused on any non-electronic visual aids so that the audience can see what the judges are viewing.

g. Judging

At the conclusion of five presentations, the judges will adjourn to a separate breakout room to confer and decide on scores. The judges will confer on the remaining five following those final presentations. Judges’ decisions will follow the scoring criteria described in section h.

The main criterion for evaluating each team is the degree to which it was persuasive in the organization and presentation of its case. Judges are required to act fairly and impartially when considering arguments and the manner in which they were presented. Judges may not reach a decision based on personal conviction in reference to the topic.

Once judging decisions have been reached, judges will tell the moderator, who will see that the scores are incorporated in the teams’ overall scores that will be announced at the conclusion of the CWC.

h. Scoring Criteria

To evaluate market issues presentations, four (4) scoring criteria will be used, together comprising 20% of a team’s CWC score. For each team’s presentation, judges will assign a score to each criterion, thus yielding a cumulative score. The criteria include:

<i>CRITERIA</i>	<i>DESCRIPTION</i>	<i>WEIGHT (Points)</i>
#1 Strength of	Extent to which team was persuasive as to the validity of its case Sub-criteria include:	50% of Market Issues Contest (100/200 points)

Position	<ul style="list-style-type: none"> • Demonstrating grasp of concepts relevant to topic and audience • Using examples or evidence to support points • Providing a crisp and coherent presentation with logical structure and persuasive style • Justifying the logic and accuracy of claims 	
#2 Depth	Appropriate level of depth exploring the topic— not so specific as to omit highly relevant material, and not so broad as to be superficial	25% of Market Issues Contest (50/200 points)
#3 Style	Delivery characterized by high-quality level of eye contact, vocal variety, speech rate, volume, posture, and gestures	15% of Market Issues Contest (30/200 points)
#4 Timing	Adherence to time limit	10% of Market Issues Contest (20/200 points)

Rule 4. The Event

4-1. Team and Coordinator Requirements

Please see [Section III, Rule 1](#) for information on team and coordinator requirements.

4-2. Competition Event Timeline

Annotated Schedule for Collegiate Wind Competition

The competition event timeline may change from time to time. As such, [Appendix B](#) contains a high level overview of the event. The more detailed event timeline will be made available at the competition.

4-3. Logistics

Each team is responsible for the transport of its wind turbine and all necessary tools and equipment and shall be responsible for any damage to or loss of such items. Site-specific information, such as who to send the turbines to, by when, and what support will be provided for unloading of each team’s turbines, will be provided closer to the May 2014 competition date and shared via the Google Group internal communications portal. This information may vary annually if the competition location changes.

Each team is responsible for making its own reservations and arrangements for covering all necessary costs. Information on competition-funded meals and events will be provided on the Google Group site closer to the May 2014 competition date as well.

4-4. Safety and Conduct During Competition Event

Each team is responsible for the safety of its operations. Each team member shall work in a safe manner at all times during the competition in accordance with the requirements identified in this document and in the subcontract agreement.

Teams must follow OSHA rules for safety equipment based on expected activities (see NREL contract with your university, Appendix B Clause 8–Worker Safety and Health Requirements for more

information). Organizers may issue a stop work order at any time during the project if a hazardous condition is identified.

Teams shall wear appropriate personal protective equipment (PPE) when working on, testing, or operating their turbine. At the competition, it is incumbent on the teams to bring the appropriate PPE for use during wind tunnel testing and other potentially hazardous activities. Teams shall bring safety glasses at a minimum. Teams shall also bring hard hats and steel-toed boots if heavier loads are expected to be used. Electrical PPE will be required if electrical voltage demands it. Hearing protection will likely be required of anyone in certain areas in close proximity to the wind tunnels during tunnel operation. If any team does not have the appropriate PPE upon arrival to the competition, it will be up to the team to acquire necessary equipment before the actual event.

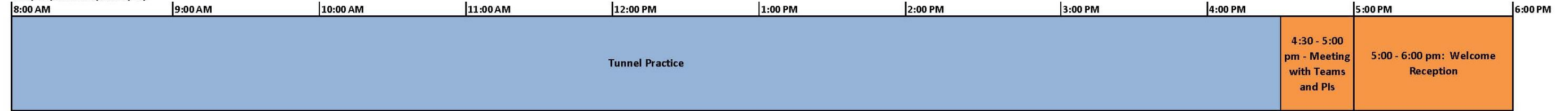
SECTION IV: APPENDICES

Appendix A High-Level Competition Timeline

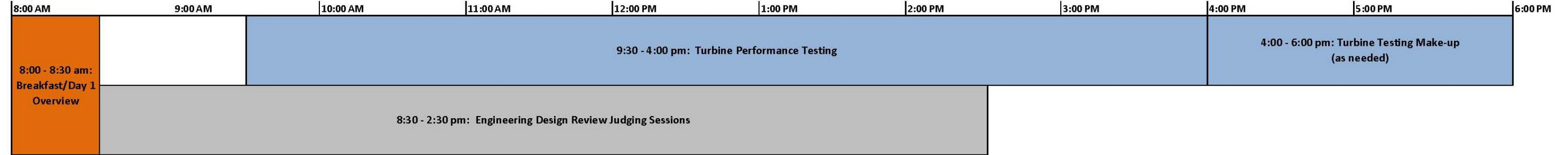
Month/Year	Competition Task
January 201Y	Release of competition request for proposals (RFP)
February 201Y	Proposals due
March-May 201Y	Announce competition teams
April-August 201Y	Negotiate contracts with selected collegiate institutions
August/September 201Y	Kick-off meeting for competition
Fall 201Y	Concept development
Spring 201Z	Testing
April/May 201Z	Competition takes place
June 201Z	The winning wind turbine is put on display at DOE. A review meeting/conference call is held between competition organizer and the Department (potentially including representatives of competing teams) to review the competition and make recommendations for the next event.

Appendix B Competition Event Schedule

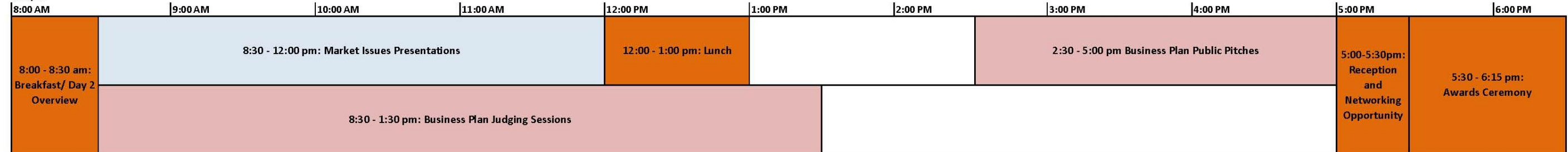
Day 0 (Monday, May 5)



Day 1



Day 2



	Turbine Testing Activities
	Business Plan Activities
	Market Issues Activities
	General Activities

In general, daily activities will be as follows:

- **Day 0**
 - Tunnel Practice
 - Evening Welcome Event
- **Day 1**
 - **Day 1 Overview Breakfast**
 - Turbine Testing
 - Design Review Judging Session
- **Day 2**
 - **Day 2 Overview Breakfast**
 - Market Issues Presentation
 - Business Plan Judging Session
 - Business Plan Public Pitches
 - Awards Ceremony

The event schedule with more specific details will be provided to the teams before and at the competition, including a team-specific customized schedule highlighting where each team needs to be and when throughout the competition.

Appendix C Judging Guidelines

A three-person panel of judges is responsible for scoring team performance in each contest in the competition (Business Plan, Turbine Testing, and Market Issues Presentation). The judges will have detailed expertise related to the content they are responsible for evaluating. Each panel will also include diverse backgrounds that allow the judges to evaluate performance from a variety of angles. The types of skills that each judge will have by competition segment are as follows:

- Business Plan Team (Types of skills – VC, business development, small wind marketing)
- Turbine Team (Types of skills – electrical engineer, mechanical engineer, small turbine manufacturer)
- Market Issues Team (Types of skills – policy and legislation, government, etc.)

Judges will be identified each Fall and will be made public at the competition.

C-1. Judging Organization

The head rules official will coordinate judging activities. The head rules official, in coordination with the rules panel, is also the final authority on disputes and challenges and changes to competition rules.

In the event that judges are unable to attend the competition, the competition organizers will ensure that there is a team of two to three alternate judges that are able to step in to fill the role of a missing judge. In the event that there cannot be a full three-person panel, a two-person panel would then fill out the judging rubrics. At no time will there only be only one judge presiding over a section of the competition.

It will be ensured that judges will not:

- Be affiliated or related to any of the team members or their representing institutions
- Provide content advice to teams, although they can provide clarification on the judging process
- Discuss team performance with other teams or their advisors.

Each team of judges will be assigned an administrative assistant to coordinate their activities and collect their rubric and feedback. Each individual judge will be assigned a volunteer who will take notes as directed by the judge. This approach will aid in providing optimum feedback to each of the teams.

C-2. Judging Rubrics

Judges will use detailed scoring rubrics shown in [Appendix D](#) of this Rules and Requirements document to evaluate team performance in each of the categories. These rubrics are provided in advance to give all participants a clear idea of how the judges will evaluate the teams in each contest.

Every judge will fill out a rubric independently as the team is performing. At the completion of each event segment, judges will discuss each team's performances before finalizing the rubrics. The team of judges will submit one unified rubric to the head rules official for official scoring purposes. Items submitted prior to the event, such as business plans, will be thoroughly reviewed and evaluated by the judges prior to the event.

C-3. Team Feedback

In an effort to provide students with as much feedback as possible on their performance, teams will receive copies of the grading rubrics that indicate how they scored. These will be provided at the end of the entire competition. Teams will also be provided a short narrative that is derived from the judges' deliberation after their presentations and notes judges may have written on their individual rubric forms.

Appendix D Decision Criteria and Scoring Rubrics

D-1. Business Plan (Written and Oral)

There are four criteria for evaluating business plans that comprise 35% of the total competition score (or up to 350 out of 1,000 total competition points). These include:

- **Market Deployment Feasibility and Risk Reduction**
(28.5% or 100/350 points of Business Plan contest)
- **Innovation, Creativity, Originality**
(28.5% or 100/350 points of Business Plan contest)
- **Presentation and Documentation**
(14% or 50/350 points of Business Plan contest)
- **Financial Analysis**
(28.5% or 100/350 points of Business Plan contest)

Judge's Score Sheet: Business Plan

Collegiate Team Name: _____

Judge's Name: _____

Combined scoring for Business Plan tasks = 350 possible points

Subcategories	0: characteristic not demonstrated	5: characteristic minimally demonstrated	10: characteristic demonstrated at a level slightly below average	15: characteristic demonstrated at a level slightly above average	20: characteristic demonstrated adequately	25: characteristic demonstrated exceptionally	Total
Market Deployment Feasibility and Risk Reduction							
The team presents an understanding of the available market space and buildability opportunity and constraints in the market.							
The team identifies risk in the areas of finance, legal, technical, and/or other areas across the product lifecycle. Risk mitigation strategies have been proposed. An analysis has been performed to establish the risk envelope.							
The business model is both financially feasible (value created is greater than costs incurred) and fundable (attractive for future investors and donors).							
The team's business plan is scalable.							
Subtotal (up to 100 possible points)							

Innovation, Creativity, and Originality							
There is evidence of ICO in industrial design (e.g. aesthetics and/or customer features and/or functions and/or other).							
There is evidence of ICO in marketing and branding (e.g. rollout branding strategy and/or niche market and/or other).							
There is evidence of ICO in financing and product strategy (e.g. product architecture and/or product portfolio and/or finance and/or funding/payment and/or business architecture and/or other).							
The team has addressed triple bottom line of economic, environmental and social factors in the creation of their business (e.g. product lifecycle and/or environmental/social relevance).							
Subtotal (up to 100 possible points)							
Presentation and Documentation							
The oral presentation is engaging, interesting and compelling.							
The business plan and marketing materials are usable, understandable and well-presented and therefore could be picked up and utilized by an investor (clear, concise, and precise).							
Subtotal (up to 50 possible points)							

Financial Analysis							
The forms were completed correctly (including summary table, cash flow analysis, balance sheet, and income statement) and aligns with GAAP standards, as possible.							
The financial statements are supported with adequate data/documentation.							
Has the team considered (and, if applicable, applied) federal, state and/or local production, consumption and/or business operations incentives.							
Business model promotes triple bottom line investments.							
Subtotal (up to 100 possible points)							

BUSINESS PLAN SCORE	Subtotals for each of the four subcriteria
Market Deployment Feasibility and Risk Reduction	
Innovation, Creativity, and Originality	
Presentation and Documentation	
Financial Analysis and Concept Cost Criteria	
TOTAL	

TURBINE TESTING AND DESIGN REVIEW

D-2. Design Review SubContest

The Design Review contest is intended to review the process by which each team developed its turbine from concept to finished product from the engineering perspective (not cost or marketing) to ensure a durable, robust turbine that meets safety and performance requirements.

Format Requirements

The Design Review shall not exceed 20 pages inclusive of all diagrams, specifications, cover sheet, etc. The document should have 8.5x11", 1-inch margins, 11-pt Calibri type, double-spaced, paginated, numbered captions for figures and tables for easy navigation through document, and be packaged into a single, bookmarked PDF file (see [Appendix G](#) for PDF formatting and file naming requirements).

The scoring categories of this subcontest with general descriptors include:

- **Design Objective**—Conveys the intended design features that both align with the Business Plan objective and differentiate the turbine from others currently in the marketplace.
(25% of Design Review Contest or 50/450 points of Design Review and Turbine Testing)
- **Design Overview**—Conveys key components of the actual design in terms suitable for executive management and the general public.
(10% of Design Review Contest or 20/450 points of Design Review and Turbine Testing)
- **Design Team**—Describes the team members, the sets of skills and experience they bring to the project, and the individual roles and responsibilities in achieving the design objective.
(10% of Design Review Contest or 20/450 points of Design Review and Turbine Testing)
- **Modeling and Testing**—Describes initial modeling objectives, design refinements based on modeling results, laboratory and field testing procedures, design refinements based on testing results.
(25% of Design Review Contest or 50/450 points of Design Review and Turbine Testing)
- **Engineering Diagrams**—Diagrams suitable for an engineering review with the baseline dimensions and properties of the turbine and its subsystems, including control algorithms and software.
(15% of Design Review Contest or 30/450 points of Design Review and Turbine Testing)
- **Engineering Specifications**—Provides specifications suitable for an engineering review, the baseline and operating properties of the turbine and its subsystems, including loading requirements, operational limits, control algorithms and software.
(15% of Design Review Contest or 30/450 points of Design Review and Turbine Testing)

Elements used to evaluate these categories will include how well the document accomplishes the following:

- a. Communicates how business factors translate to/drive functional design objectives
- b. Quantifies technical design objectives objectively and clearly
- c. Conveys understanding and essence of the overall final design
- d. Team bios: communicative and confidence building, site relevant experience

- e. Project-specific roles and responsibilities outlined
- f. Well defined objectives of modeling and testing
- g. Quality and vetting of assumptions
- h. Clear summary/data reduction
- i. Quality of conclusions, application
- j. Loads and operating conditions properly assessed
- k. Design features address functional/loading requirements
- l. Design for manufacturing and assembly integrated
- m. Proper annotation, adherence to conventions
- n. Information is complete, presents all design elements and components
- o. Changes and improvements needed to move from prototype to commercial production

Judge's Score Sheet: Design Review

Collegiate Team Name: _____

Judge's Name: _____

Combined scoring for Design Review tasks = 200 possible points

Design Review Criteria		
Description	Possible Points	Score
Design Objective —Conveys the intended design features that both align with the Business Plan objective and differentiate the turbine from others currently in the marketplace.	50	
Design Overview —Conveys key components of the actual design in terms suitable for executive management and the general public.	20	
Design Team —Describes the team members, the sets of skills and experience they bring to the project, and the individual roles and responsibilities in achieving the design objective.	20	
Modeling and Testing —Describes initial modeling objectives, design refinements based on modeling results, laboratory and field testing procedures, design refinements based on testing results.	50	
Engineering Diagrams —Diagrams suitable for an engineering review with the baseline dimensions and properties of the turbine and its subsystems, including control algorithms and software.	30	
Engineering Specifications —Provides specifications suitable for an engineering review, the baseline and operating properties of the turbine and its subsystems, including loading requirements, operational limits, control algorithms and software.	30	
Subtotal (up to 200 possible points)		

D-3. Turbine Testing SubContest

The scoring categories of this subcontest with general descriptors include:

Power Curve Verification Task

(30% of Turbine Testing subcontest or 75/450 points of Design Review and Turbine Testing)

The wind turbine will be tested for 5 seconds at 1 m/s interval wind speeds from 5–14 m/s. A power output reading will be taken at each 1 m/s wind speed interval. At a given wind speed, if the power output varies 20% or less from predicted, it will receive full points (e.g., 7.5 pt score). If the power output varies 20.1–30% from predicted, 2 points will be deducted (e.g., 5.5 pt score). If the power output varies 30.1–40% from predicted, 4 points will be deducted (e.g., 3.5 pt score), and so on to zero.

- % of Turbine Testing subcontest scoring = 30% on a 100% scale within Turbine Testing subcontest
- # of points for this subcontest = 75 of 450 points for overall Design Review & Turbine Testing Contest

Scoring Sample for Power Curve Verification Task

Wind Speed (m/s)	% of Predicted Power (%)	Score (points)
5	59%	1.5
6	70%	5.5
7	85%	7.5
8	100%	7.5
9	119%	7.5
10	126%	5.5
11	132%	3.5
12	148%	1.5
13	156%	0.0
14	45%	0.0
Subtotal		40
Out of total possible		75

Note: if a particular test point cannot be reached by the wind tunnel, for any competitor, all teams will receive full points for that test point.

Cut in Wind Speed Task

(20% of Turbine Testing subcontest or 50/450 points of Design Review and Turbine Testing)

The team will earn 10 points for being able to cut-in and produce power between 4.5–5.0 m/s. Producing power is defined as achieving a positive current (A) while operating at 5 V averaged over 5 seconds. There will be an additional 10 points earned for each incrementally lower 0.5 m/s wind speed bin the turbine can cut-in at. The team receives one score based on its cut-in wind speed.

- % of Turbine Testing subcontest scoring = 20% on a 100% scale within Turbine Testing subcontest
- # of points for this subcontest = 50 of 450 points for overall Design Review & Turbine Testing Contest

Scoring Sample for Cut-in Wind Speed Task

Cut-in Wind Speed (m/s)	Score (points)
4.7	10
4.3	20
3.4	30
2.8	40
2.3	50

Control at Maximum Power Task

(20% of Turbine Testing subcontest or 50/450 points of Design Review and Turbine Testing)

Turbines that control rated power to within 10% of the target as defined by the team will earn full points (50 points). There will be a 10 point reduction in score for each 10% of power production variance. The team receives one score based on its maximum power output at any wind speed in the wind regime being tested.

- % of Turbine Testing subcontest scoring = 20% on a 100% scale within Turbine Testing subcontest
- # of points for this subcontest = 50 of 450 points for overall Design Review & Turbine Testing Contest

Scoring Sample for Maximum Power Control Task (note: assumes predicted rated power is 100W)

Measured Power (W)	Score (points)
93	50
84	40
73	30
and so on	
107	50
115	40
121	30
and so on	

Durability and Safety Tasks

(30% of Turbine Testing subcontest or 75/450 points of Design Review and Turbine Testing)

Durability Scoring: This portion of the Turbine Testing subcontest is scored on a pass/fail basis. The turbine must be producing power during the entire 5- minute test to earn 37.5 points. If the turbine is able to produce power without fault above the cut-in speed and below the cut-out speed for the full 5 minutes, the team will get 37.5 points (out of a possible 37.5). If the turbine experiences any faults or is not able to produce power above the cut-in speed and below the cut-out speed for the full 5 minutes, then the team will get 0 pts. This includes faults detected by observation during operation that don't cause a detected fault or a loss of ability to produce power such as high vibration, cracks, loss of parts or pieces of parts or other problems detectable by visual observation.

- % of Turbine Testing subcontest scoring = 20% on a 100% scale within Turbine Testing subcontest
- # of points for this subcontest = 37.5 of 450 points for overall Design Review & Turbine Testing Contest

Scoring Sample for Durability Task

Time Producing Power (min)	Score (Pts)
5.0	37.5
4.5	0
3.2	0

Safety Scoring: Teams must be able to safely shut their turbine down on command within 10 seconds for any wind speed up to 17 m/s. For purposes of this task, "shut down" is defined as full stop or not to exceed 10% of rated RPM of the turbine rotor with no power going to the load.

- % of Turbine Testing subcontest scoring = 15% on a 100% scale within Turbine Testing subcontest
- # of points for this contest = 37.5 of 450 points for overall Design Review & Turbine Testing Contest

Scoring Sample for Safety Test

	Turbine Result	Score (points)
Teams score points in one or the other result categories, not both	Shut down in 7 sec	37.5
	Shut down in 12 sec	0
	Shut down to 8% of rated RPM	37.5
	Shut down to 13% of rated RPM	0

Safety Shutdown Protocol: The intent of the safety shutdown mechanism and procedure for the turbine is to ensure, in the event of an emergency, the turbine will shut down quickly “on command” such that a person can safely shut down the turbine without any detailed prior knowledge of its design of operation. This includes, but is not limited to, a switch. The shutdown may also be triggered by electrically

disconnecting the turbine. Depending on the turbine design, this may require a separate shutdown mechanism or system.

For the contest purposes, the judges will decide randomly for each individual turbine whether the shutdown process will be initiated “on command” or by electrical disconnect. The shutdown activity shall be the end of the Safety Test and the turbine will not have to be re-started within this test.

Teams may choose to address these shutdown scenarios with one or two systems or mechanisms.

Judge's Score Sheet: Turbine Testing

Collegiate Team Name: _____

Judge's Name: _____

Combined scoring for Turbine Testing tasks = 250 possible points

Turbine Testing Criteria		
Description	Possible Points	Score
Power Curve Verification Task	75	
Cut in Wind Speed Task	50	
Control at Maximum Power Task	50	
Durability and Safety Tasks	75	
Subtotal (up to 250 possible points)		

TURBINE TESTING AND DESIGN REVIEW SCORE

Subtotals for each subcontest

Design Review

Turbine Testing

TOTAL

D-4. Market Issues Presentation

There are four criteria for evaluating the Market Issues Presentations, which comprise 20% of the total competition score. These criteria are outlined below.

Strength of Position

(50% or 100/200 points of Market Issues contest)

This score represents the extent to which the team was persuasive as to the validity of its case. Sub-criteria include:

- Demonstrated grasp of concepts relevant to topic and audience
- Use of examples or evidence to support points
- Crisp and coherent presentation, logical structure, and persuasive style

This score also includes a representation as to the logic and accuracy of the team's claims.

Depth

(25% or 50/200 points of Market Issues contest)

This score is based on the team presenting an appropriate level of depth exploring the topic— not so specific as to omit highly relevant material, and not so broad as to be superficial.

Style

(15% or 30/200 points of Market Issues contest)

This score measures the team's delivery, specifically whether it was characterized by high-quality eye contact, vocal variety, speech rate, volume, posture, and gestures.

Timing

(10% or 20/200 points of Market Issues contest)

This score represents the team's adherence to the time limit.

Judge's Score Sheet: Market Issues Presentation

Collegiate Team Name: _____

Judge's Name: _____

Combined scoring for Market Issues Presentation = 200 possible points

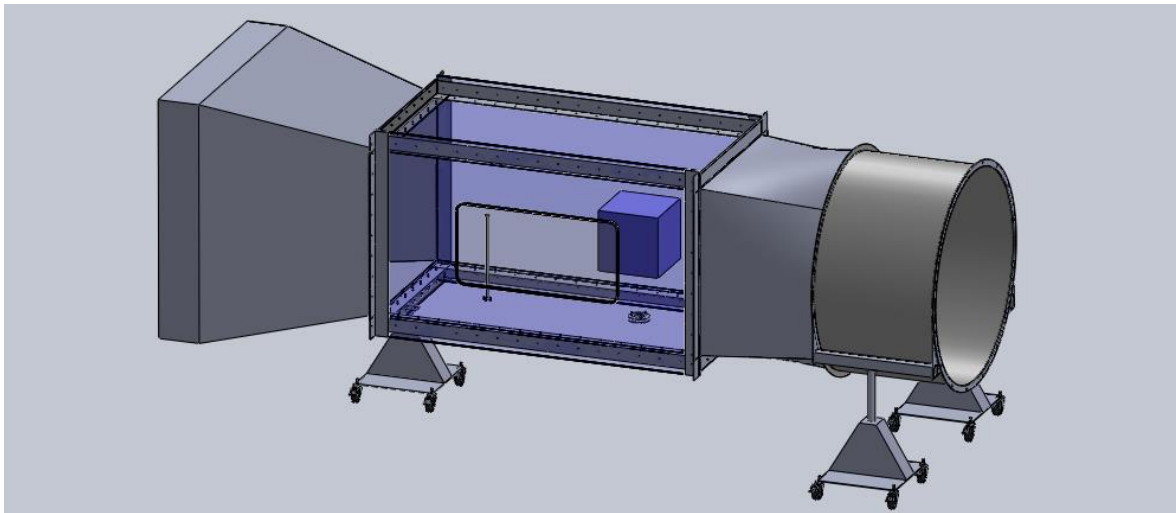
Market Issues Presentation		
Criteria	Possible Points	Score
Strength of Position	100	
Depth	50	
Style	30	
Timing	20	
TOTAL (up to 200 possible points)		

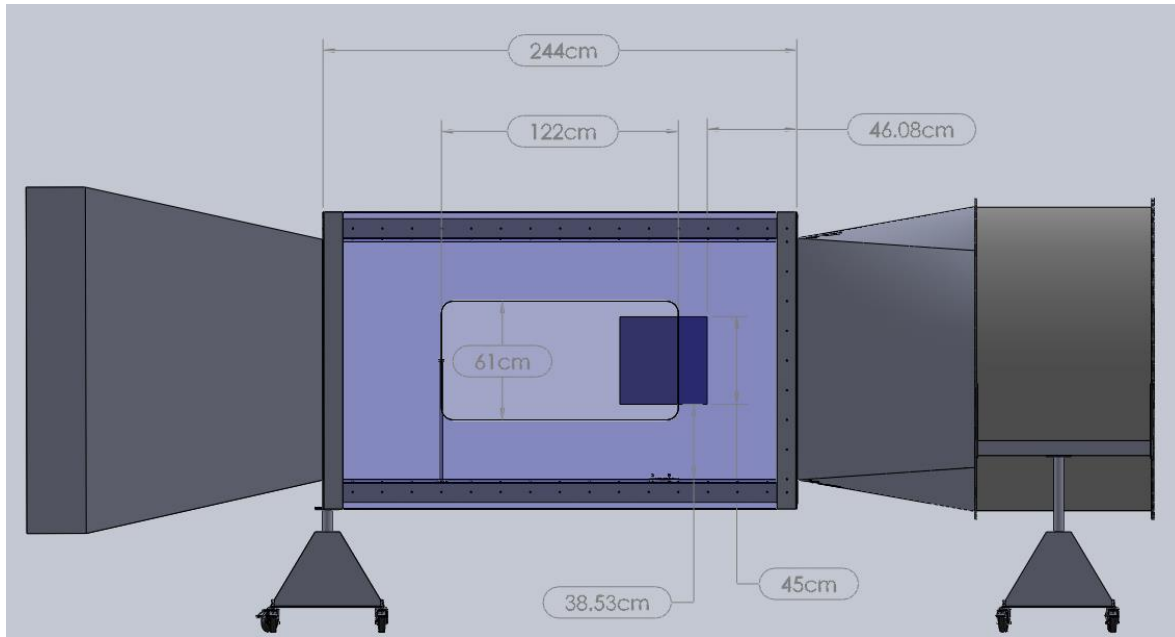
Appendix E Wind Tunnel Specifications and CWC Generator

E-1. Wind Tunnel Specifications

The basic wind tunnel configuration is shown below. The dimension of the test chamber will be 4 ft x 4 ft x 8 ft (48 in x 48 in x 96 in). The entire wind turbine system must fit within the test chamber. There are inlet and outlet components of the wind tunnel that extend beyond the test chamber as shown.

The tunnel will be a “draw down” configuration. That is, the air will be “sucked through” the box—entering at the left, exiting at the right—with the drawn down being induced by the fan on the right side of the tunnel. A honeycomb flow straightener will be at the inlet of the wind tunnel that will provide for near uniform mixing of the incoming air. There will be two debris filters—one at each side of the fan section. The screen will be composed of wire mesh to prevent turbine pieces from getting sucked into the fan unit or fingers from getting into the fan blades from the outside.





The rotor must fit within the 45 cm x 45 cm x 45 cm “cube” at a specified location within the wind tunnel and be centered at the tunnel centerline. Teams will NOT be allowed to change the location of the cube. The door is 61 cm by 122 cm. All turbines must fit through that opening in one assembly with no additional assembly occurring inside the tunnel other than attachment to the base flange.

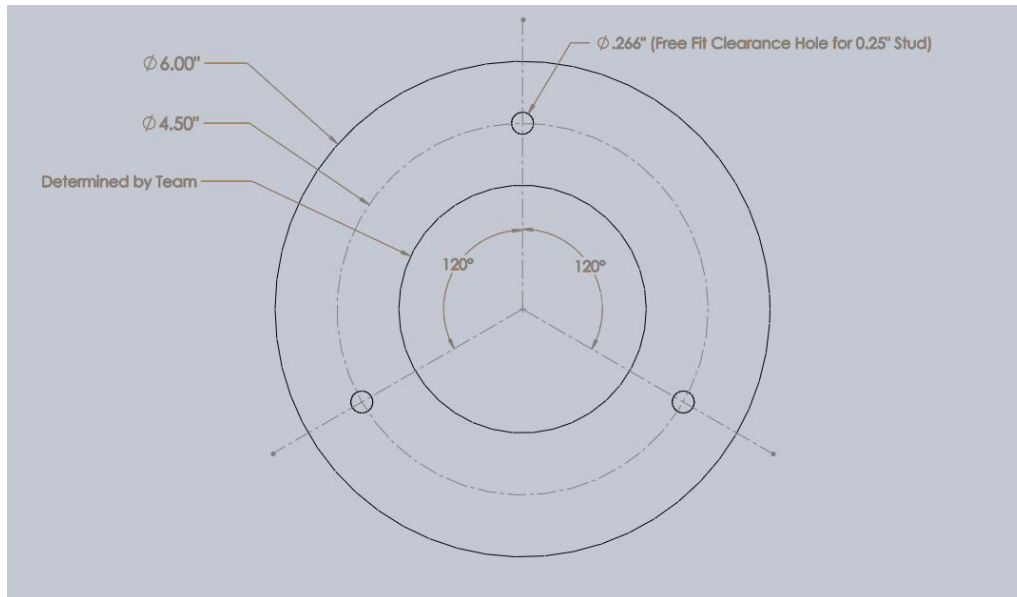
At the bottom of the cube will be an “attachment stand” (see figure below). The base flange in the tunnel is constructed as a 6” diameter, ¼” thick aluminum plate. The turbine base plate should be constructed of material no thicker than ½”, to fit the base flange, and to fit over three ¼” diameter studs where it will be secured to the base flange with nuts. The base flange in the wind tunnel will be a ¼” aluminum plate with a 3” diameter opening in the center to allow for routing electrical connections out of the wind tunnel.

The base flange specification provided was intended to universally allow for a secure and properly aligned attachment. Teams are free to apply their engineering judgment to their own base plate design, keeping in mind that turbine bases **must** be designed such that they can be attached to the base flange in the wind tunnel. The base flange will be mounted to the floor of the wind tunnel with each team's base plate mounted on top. So, the bottom plane of the team's base plate will be ¼” above the floor of the wind tunnel. The attachment stand will be fixed in its position within the wind tunnel and teams will NOT be allowed to change the location or type of the attachment stand.

In order to connect the turbines to the test equipment at the competition, there will be Anderson Powerpole connectors, PP15-45 (a red and a black for positive and negative) on the test equipment that will serve as the point of common coupling (PCC). The teams will have to provide a length of wire sufficient to exit the tunnel at the turbine base plus one additional foot to the PCC where they will meet our connectors.

Teams can provide their own Powerpole connectors if desired, or the Testing judges will provide housings, pins, and a crimp tool at the competition to make this connection. Judges will provide pins for all three Powerpole sizes, 15A, 30A and 45A, which are specified to handle wire gauges from 10AWG through 20AWG. Teams can choose what size wire they want to provide in this range. All three pin sizes fit into the same housing (PP15-45) as stated above.

The drawing shows a top view of the turbine base plate with the top of the drawing oriented toward the tunnel inlet. The air flow will be from the top of the drawing to the bottom, parallel to the reference line from the top hole/stud to the center of the plate.



E-2. CWC Generator

All teams must incorporate this generator/motor as the sole generator in their prototype wind turbine. The prescribed generator is not required for the market-size turbine, if applicable. The Electrify Ammo 28-56-1530 kV Brushless In-Runner Electric Motor has the following features and design specifications.

Product Features

- Brushless, slotless design
- Ideal for direct or gear drive use
- Powered by "rare earth" Neodymium magnets for high torque
- Double sealed bearings
- Two year warranty

Product Specifications

- Motor Diameter: 1.1" (28mm)
- Motor Length: 2.2" (56mm)
- Shaft Diameter: .126" (3.2mm)
- Shaft Length: .591" (15mm)
- kV Rating: 1530 RPM/V
- Weight: 5.9oz (166g)
- Max. Constant Current: 23A
- Max. Surge Current: 45A
- Max. Constant Watts: 426W

Low no-load running torque of about 2-3mNm

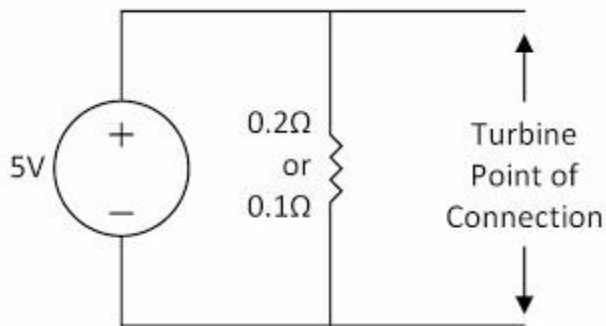
Low cogging torque of about 3-4mNm

Great-Planes Product Number: GPMG5225

E-3. CWC Power Sink

The CWC power sink will be a 5V power supply with load resistors attached. The power supply will have remote sense leads which will connect to the point of common coupling (PCC) to ensure that the voltage is sensed and regulated at that point. Line resistance between the turbine and the PCC will affect the turbines but that is a direct result of wire size, which is a team-selected design variable.

In essence, the test turbines will have to inject current into a constant, regulated, 5V sink, much like on-grid turbines have to inject current into the constant, regulated voltage (but AC instead of DC) of the power grid.



Appendix F Competition Deliverables

The materials in the project portfolio provide the primary means for a team to provide a detailed presentation of its project to the judges, given that the judges have a limited opportunity at the competition venue to evaluate the wind turbine design specifications and hear about how the business plan drove its design.

In the weeks leading up to the competition, each judge shall evaluate sections of the teams' project portfolios. At the competition venue, judges will:

- 1) Verify that the wind turbine is accurately represented in the project portfolio
- 2) Ask the team members any clarifying questions that arose during the evaluation of the project portfolio.

F-1. Project Portfolio

The project portfolio is a contractual competition deliverable that is due at the conclusion of the concept development phase, just prior to the competition, at the competition, and post-competition.

The first iteration of the project portfolio, due by December 31, 2013, shall include the business plan outline, the wind turbine technical design concept, value proposition, a team photo, including signed model release forms for each individual in the photograph. Each team will also select two of the given Market Issues themes and propose two region-specific topics per theme. Competition organizers will select topics for teams to pursue by February 1, 2014.

The project portfolio due just prior to the competition, on April 18, 2014, shall be the documentation presented at the competition and posted online by the applicant post-competition. The portfolio submitted prior to the competition will be posted online by DOE/NREL after the competition.

Team PIs, co-PIs, and industry support secured by each team can provide feedback about the team's design so the students can identify fatal flaws, prove technical rigor, or demonstrate certification of concept.

All project portfolio materials (PDFs, photographs, computer-generated renderings, and logos) shall be saved in the formats indicated and submitted to organizers packaged as a single .zip file.

Format requirements include:

8.5x11"

Pages are single-sided

Packaged into a single, bookmarked PDF file (see [Appendix G](#) for PDF formatting and file naming requirements).

F-2. Content

- [Business Plan](#)
- [Wind Turbine Technical Design Report](#)
- [Computer-Generated Renderings and Specifications](#)
- [Audiovisual Presentation \(if available\)](#)
- [Team Photographs](#)
- [Team Logo \(if available\)](#)
- [Post Supplemental Summary](#)

a. Business Plan

As presented earlier in this document, the business plan shall include the following sections:

- Cover Sheet
- Executive Summary
- Business Overview
- Market Opportunity
- Management Team
- Product Development and Operations
- Financial Analysis
- Appendices: Full financial analyses, plans, specifications (design report provided under separate cover)

Format requirements include:

- The Business Plan shall not exceed 12 pages (8.5x11", 1-inch margins, 11-pt type, double-spaced, single-sided)
- Cover and appendices not included in count
- Packaged into a single, bookmarked PDF file (See [Appendix G](#) for PDF formatting and file naming requirements).

b. Wind Turbine Technical Design Report

Format requirements include:

- The Design Review shall not exceed 20 pages inclusive of all diagrams, specifications, cover sheet, etc.
- Document shall have 8.5x11", 1-inch margins, 11-pt Calibri type, double-spaced, single-sided paginated, and numbered captions for figures and tables for easy navigation through document
- Packaged into a single, bookmarked PDF file (see [Appendix G](#) for PDF formatting and file naming requirements)
- Design Report sections are not prescribed, however, scoring criteria are provided in [Appendix D](#).

c. Computer-Generated Renderings

Computer-generated renderings shall be submitted to show the wind turbine's technical design and system specifications.

Format requirements include:

- Minimum resolution of each image shall be 3000 px wide by 2400 px
- Composed of image files (JPEG, TIFF, etc.) packaged as one .zip file

d. Audio Visual Presentation

If an audio visual presentation is prepared, it will be made publicly available soon after the submission as an update to the project portfolio.

Format requirements include:

- .MOV or H.264 compressed.MP4 (MPEG-4) file type

- 3–3.5 minute runtime
- 16:9 aspect ratio
- 720 x 480 resolution
- Accompanied by a verbatim transcript of the audio narrative to meet Section 508 Accessibility standards. Transcript should be submitted in a Microsoft Word-compatible format. For an example of a text version script, see the [Wind Power Animation \(Text Version\)](#).

Content requirements include:

- Must include video footage of the actual wind turbine
- May contain still photos and graphics
- Gives a realistic preview of what is experienced during evaluation at the competition
- Explains how the project meets the criteria listed in the relevant contest section of the Rules
- Includes an audio narrative that explains to viewers what they're seeing and describes the underlying philosophy
- Contains only originally created or properly credited work that does not violate U.S. copyright laws
- Does not contain background music that violates U.S. copyright laws. All incorporated music must be an original or royalty-free composition. Proof of licensing shall be submitted with the final file and transcript.
- Follows guidelines for logos as described in Rules
- Does not contain interactive elements that are inherently inaccessible to those with visual disabilities.

e. Team Photographs

The team photo is an important conveyance of your team's personality. It will be used in the event program, media kit, and DOE Collegiate Wind Competition website.

Format requirements include:

- Native format of the camera, such as JPEG or RAW, if available
- 2048 × 1080 minimum pixel dimensions
- RGB, 8-bit color, not black and white

Content requirements include:

- Include all team members (if possible) and strive for creativity.
- For a photograph to be properly credited, the PIX and model release forms need to be completed (see [Appendix G](#)).

f. Team Logo

The team logo is used on signage, the event program, media kit, and DOE Collegiate Wind Competition website.

Format requirements include:

- Submit two versions of your logo:
 - One for Web (GIF or JPG, at least 400 px wide). GIF is preferred for simple flat-color logos. JPG is preferred for complex logos.

- One for print (high-resolution or vector format; EPS preferred).

Content requirements include a text file with the following additional information:

- Name, phone number, and email of person submitting the logo
- A list of all Pantone (PMS) or CMYK numbers used in the logo. Please consult the graphic designer of your logo if you need help providing these specific color requirements.

g. Post Supplemental Summary

Competition organizers would benefit substantially from the following supplemental summary information post-competition in order to calibrate future competitions as well as quantify the benefits with respect to the original intent, which is to grow and foster a future wind energy workforce.

Content requirements include:

- Results of fundraising activities—final quantity of contributions (cash and in-kind); final project budget and accounting; lessons learned—what went well, what didn't, and what you would do differently.
- Results of media-outreach activities—include statistics.
- Results of on-site exhibition activities—estimates of the number of visitors to the wind tunnel testing (justify estimates); assessment of visitor experiences (include qualitative data); and lessons learned—what went well, what didn't, and what you would do differently.
- Evaluation of the team's website—number of hits, unique visits, and any other user statistics; lessons learned—what went well, what didn't, and what you would do differently.
- Team perspective on the effectiveness of the organizers' communications efforts with both the teams and the public.
- Description of future plans for the wind turbine.
- Short description of each team officer's future plans for employment, continued study, or other endeavors. NREL requests this information for possible inclusion in publications and presentations describing how the DOE Collegiate Wind Competition serves as an effective workforce development and university research project.
- Suggested competition improvements.
- Any other information you feel would be helpful to the organizers or future teams.

Appendix G Deliverable Submission Instructions

Deliverables are considered to be on time if they are received by the competition manager by 5 p.m. Mountain time on the respective due date.

G-1. Website URL

Website URLs shall be emailed to the competition manager at cwcrules@nrel.gov.

G-2. PDF Requirements

Files submitted as a PDF shall meet the following criteria:

- Embed all fonts.
- Maintain a minimum resolution of 300 dpi.

If an application does not support a direct-to-PDF function, create a postscript file by printing to a postscript printer with the “print to file” option selected. Use this postscript (.ps or .prn) file to create a PDF using Acrobat Distiller’s high-resolution job settings.

- Creating a PDF from scans, or by outputting the content into a raster image format (.jpg, .tiff, .png, .gif, etc.) and then creating a PDF from the images, is NOT ACCEPTABLE.
- All-raster PDFs are large files at 300 dpi, are of unacceptable quality at lower resolutions, and are not scalable without degradation.

G-3. Photo and Model Release Forms

The NREL Image Gallery Information and Release form and Model Release form will be available on the Google Group.

G-4. Electronic File-Naming Instructions

The required file-naming convention for all electronic files follows:

[TEAM ABBREVIATION]_[DELIVERABLE ABBREVIATION]_[SUBMISSION DATE (YYYY-MM-DD)].[EXTENSION]

See Table X for a list of team name and deliverable abbreviations.

Example: An audio visual presentation submitted by University of Alaska Fairbanks on April 18, 2014 would have the following file name:

UAF_AV_2014-04-18.MOV

Table X: Team and Deliverable Abbreviations

Team Name	TEAM ABBREVIATION
Boise State University	BSU
California Maritime Academy	CAL_MARITIME
Colorado School of Mines	MINES
James Madison University	JMU
Kansas State University	KSU
Northern Arizona University	NAU
Pennsylvania State University	PSU
University of Alaska Fairbanks	UAF
University of Kansas	KU
University of Massachusetts Lowell	UMASS_LOWELL

Deliverable Name	DELIVERABLE ABBREVIATION
Project Portfolio zip file	PORTFOLIO
Business Plan–Written zip file	BP
Executive Summary zip file	SUMMARY
Wind Turbine Technical Design Report zip file	TECHNICAL_DESIGN
Computer-Generated Renderings	RENDER
Audio Visual Presentation	AV
Team Photograph	PHOTO
Team Logo	LOGO
Post Supplemental Summary	IMPACT

Appendix H Competition Deliverables Checklist

Refer to other sections of this Rules and Requirements document to evaluate content and format requirements for each of the below deliverables.

<input type="checkbox"/>	Due April 18: The Subcontractor shall provide one (1) electronic copy of project portfolio including business plan, designs, drawings, system specifications, team photo, and other project documentation to NREL with permission to post on NREL/DOE websites.
<input type="checkbox"/>	<p>Business Plan</p> <ul style="list-style-type: none"> ○ Cover Sheet ○ Executive Summary ○ Business Overview ○ Market Opportunity ○ Management Team ○ Product Development and Operations ○ Financial Analysis ○ Appendices: full financial analyses, plans, specifications
<input type="checkbox"/>	Wind Turbine Technical Design Report
<input type="checkbox"/>	Computer-Generated Renderings
<input type="checkbox"/>	Team Photographs and Signed Release Forms
<input type="checkbox"/>	Optional: Audio Visual Presentation; Team Logo; Post Supplemental Summary (portions that can be completed pre-competition)
<input type="checkbox"/>	Due on Competition Day
<input type="checkbox"/>	The same portfolio delivered above, plus:
<input type="checkbox"/>	Safety and conduct
<input type="checkbox"/>	Emergency contact information for all students
<input type="checkbox"/>	Sustainability practices demonstrated in shipping and packing, and at the event
<input type="checkbox"/>	<p>Prototype wind turbine for testing</p> <ul style="list-style-type: none"> • Maximum rotor dimensions do not exceed (45x45x45 cm³) • The wind turbine system must be mountable on the test stand at the specified location within the wind tunnel. Any non-rotor auxiliary turbine parts must fit within 45 cm of the vertical center line of the mounting flange. • The maximum design wind speed for the wind tunnel (refer to wind tunnel appendix for tunnel specifications) is 17 m/s (38 mph). • The minimum turbine output is 10 W continuous for at least one wind speed from 5–14 m/s (11–31 mph). • CWC-provided generator, gear box and system electronics must be fully accessible for the judging team to inspect. • Personal protection equipment, tools and equipment, etc. • Turbine electrical connectivity for testing

<input type="checkbox"/>	Market Size Turbine (if applicable)
<input type="checkbox"/>	Performance Required During the Competition (See the Rules and Requirements document for specific performance required during each of the competition segments)
<input type="checkbox"/>	Wind Tunnel Testing
<input type="checkbox"/>	Design Review (with visual aids if applicable)
<input type="checkbox"/>	Business Plan Review (with posters, charts, PowerPoint presentations, or other visual aids, as desired). Teams should plan to present their business plan alongside their market-size turbine.
<input type="checkbox"/>	Business Plan Public Pitch - Not scored, but People's Choice award.
<input type="checkbox"/>	Market Issues presentation (with non- electronic visual aids, if desired)
<input type="checkbox"/>	Team Bull Pen (10x10' space, 2 tables, 4 chairs) provided, bring team materials to showcase, demonstrate to the CWC audience, posters, banners, school colors, educational program material from which multi-disciplinary team comes.
<input type="checkbox"/>	Teamwork and Sportsmanship
<input type="checkbox"/>	Resumes (if desired)
<input type="checkbox"/>	Post Supplemental Summary
<input type="checkbox"/>	The winning competitor shall provide prototype wind turbine and/or demonstration model if applicable for temporary displays at the DOE headquarters building in Washington D.C: Due June 27, 2014
<input type="checkbox"/>	An online project portfolio, hosted by the applicant, including concept business plan, designs, drawings, system specifications, and other project documentation: Due June 2, 2014