The 5th Wood Heater Design Challenge

OFFICIAL RULES

June 2022

The U.S. Department of Energy (DOE)'s support of the 5th Wood Heater Design Challenge (WHDC) will be governed by these official rules. The prize administrator in conjunction with the Bioenergy Technology Office (BETO), Brookhaven National Laboratory (BNL), the Alliance for Green Heat (AGH) and Lawrence Berkeley National Laboratory (LBNL) reserve the right to modify the official rules if necessary and will publicly post any such modifications, as well as notify prize competitors.

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PROGRAM SUMMARY

1. INTRODUCTION

DOE BETO is supporting the 5th Wood Heater Design Challenge (WHDC). This competition offers a total of $120,000 in prize funds and aims to inspire research and development (R&D) in the wood heater sector and accelerate commercial development of wood heaters that consistently reduce particulate matter across America. Competitors can win up to $15,000 as a prize in Phase 1 and up to $40,000 in Phase 2. The WHDC provides competitors a pathway to advance their wood heater technology to a field-tested system that may provide affordable, renewable heat in homes. The goal of the WHDC is to aid in the development of innovations that address the largest challenges in the wood heater development community such as: inconsistent emissions, low heater efficiency, affordability, ease of use, and obtaining US Environmental Protection Agency (EPA) emission certification. To help overcome these challenges, we are offering teams a prize that includes laboratory performance testing to advance their heater designs and accelerate its path to market.

2. BACKGROUND

In 2020, an estimated 10.8 million homes in the US use wood or pellets for space heating; of those 10.8 million homes, 2.2 million use wood as their primary heat source.[1] For the past 20 years wood heater usage has fluctuated between 10-15 million households, even while other heat sources, such as oil heat, have markedly decreased.[1] Further, given the push towards alternative fuels such as biomass, it is fair to assume the wood heating may see further increases in prevalence relative to other fossil fuel based heating technologies. It is therefore safe to assume that a portion of US citizens will continue to heat with wood for the foreseeable future.

The 2018 Heating Census showed 1.9% of all homes in the US use wood for primary heating and that more than 16% of these homes were located in rural counties.[2] Further, in a health impact assessment study[3] found an association between income level and wood fuel use. In this study they estimated that approximately half a million low-income individuals were exposed to air pollution due to operation of primary wood heaters in their homes. A later review of that study expended the analysis to include homes using wood as an auxiliary heat source and to include other sensitive groups such as children and the elderly, which expanded the health effect estimate to 4.8 million individuals effected[4] and in a separate epidemiology study Penn et al. estimated 10,000 premature mortalities per year related to Particulate Matter 2.5 microns and smaller

[1] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis

[2] https://www.census.gov/library/stories/2018/02/who-knew-wood-burning-fuel.html

[3] Rogalsky, D., Mendola, P., Metts, T. and Martin, W., 2014. Estimating the Number of Low-Income Americans Exposed to Household Air Pollution from Burning Solid Fuels. *Environmental Health Perspectives*, 122(8), pp.806-810.

[4] Noonan, C., Ward, T. and Semmens, E., 2015. Estimating the Number of Vulnerable People in the United States Exposed to Residential Wood Smoke. *Environmental Health Perspectives*, 123(2).

($PM_{2.5}$) emissions from residential combustion in the US, citing wood combustion as a primary driving force.[5]

In part due to the health effects associated with particulate matter generated by wood combustion, the US EPA strengthened the New Source Performance Standards (NSPS), setting new emission limits for wood heaters in 2015. Federal emission certification standards, dating back to 1988, preceded federal standards in almost all European countries,[6] giving our industry a head start in designing and deploying secondary air tubes and catalysts, which are still the primary tools for post-combustion emission reduction. In a similar way, the increase in stringency of the NSPS regulations required existing wood heater manufacturers to innovate and created marketspace for cleaner and more efficient wood heaters.

The DOE BETO has worked to facilitate this new growth via of research grants and funding of technology showcase events such as the 2018 Wood Stove Design Challenge in order to help modernize the wood heating sector by accelerating the design and deployment of clean and efficient wood and pellet heaters in the US.

3. CHALLENGE OVERVIEW

This contest, the WHDC challenge consists of two phases with a total of $120,000 in prize funding. The first phase is the Wood Heater Technology Slam scheduled for September of 2022. Following the Wood Heater Technology Slam, the second phase is research and development testing at BNL.

• PHASE 1 – WOOD HEATER SLAM

The Wood Heater Technology Slam provides an opportunity for teams to pitch innovative wood stove ideas to retailers, the public, and panels of expert judges. The expert judges will evaluate participant presentations and score the technologies based on innovation, consistent and low emissions with focus on a 20% reduction in PM emissions and 15% increase in efficiency from current EPA certification limits, and commercial potential. It is anticipated that the three (3) teams with the highest score will win a $15,000 prize and move forward to the R&D Testing Competition (Phase 2) of the 5th Wood Heater Design Challenge.

The Slam will be held virtually on September 29th, 2022. During the Wood Heater Technology Slam, teams will have eight minutes to virtually pitch their wood heater technology to a panel of expert judges and an audience of wood heater stakeholders. Teams can use slides, short videos, or any other props they choose. Next, judges will have up to 10 minutes to ask questions regarding

[5] S. L. Penn, S. Arunachalam, M. Woody, W. Heiger-Bernays, Y. Tripodis and J. I. Levy, "Estimating State-Specific Contributions to PM2.5- and O3-Related Health Burden from Residential Combustion and Electricity Generating Unit Emissions in the United States," *Environmental Health Perspectives,* pp. 324-332, 2017.

[6] Controlling Emissions from Wood Burning: Legislation and Regulations in Nordic Countries to Control Emissions from Residential Wood Burning An examination of Past Experience. Bu Thomas Levander and Svante Bodin © Nordic Council of Ministers 2014, https://www.diva-portal.org/smash/get/diva2:710531/FULLTEXT01.pdf

the team's technology and development plan. Teams will then be scored based on innovation, consistent performance, commercial potential, and expected performance (see Section 8). It is anticipated that winning teams will use their prize funds to travel to BNL, engage in further R&D of their technology and compete for additional funds in Phase 2.

- ### PHASE 2 - R&D TESTING COMPETITION

Winners of the Wood Heater Technology Slam that received a $15,000 prize will continue the development of their heater technology at BNL facilities under BNL's guidance. In addition, the winning technologies will be experimentally evaluated to validate claims made during the Wood Heater Technology Slam competition at BNL. BNL staff will also advise design improvements to achieve better performance. Experimental evaluation will include operation cycles that represent real-life use and transient combustion phases—specifically, phases such as cold-start, periods of steady-state low-loads and high-loads, and burn-out phases. Focusing on these aspects will help ensure improvements in performance and consistency—in terms of emissions and efficiency. Real-time instrumentation capturing particulate and gaseous emissions will be used to provide performance feedback and targets for R&D improvements. Team members will also learn about testing protocols and how their appliance performed during different combustion conditions, from start-up to reloading, to various heat levels to shut down.

Teams will coordinate with BNL to arrange for R&D testing. Each team will travel to BNL and collaborate over the course of a week to evaluate their technology. The goal of this phase is to validate the claims made during the Wood Heater Technology Slam and also for the teams to receive feedback regarding the performance of their heater and recommendations for areas of improvement. Teams will be given two days to set-up and shake-down their heaters followed by three days of replicate testing. Judges may also join over the course of the week, remotely or in-person, to provide additional feedback to teams.

4. PROGRAM SCHEDULE

Below is the *anticipated* schedule:

Phase 1

- A submission to participate in the Wood Heater Technology Slam is due by August 31st, 2022.
    - Teams who have provided submissions will be notified if they are invited to participate in the Wood Heater Technology Slam on September 15th, 2022.
- The Wood Heater Technology Slam will be held on Thursday, September. 29th, 10:00 – 12:00 (noon), Eastern Daylight Time (EDT).
    - Three winning teams will be determined from the Wood Heater Technology Slam. Once Phase 1 awardees are announced, Phase 2 dates will be announced.
        - Each of the three winners of the Slam, will be awarded a prize of $15,000

Phase 2

Teams will coordinate with BNL to schedule a week of testing with dates to follow after the Phase 1 winners are announced.

  - Each team will schedule their own individual week at BNL for testing. Teams will not overlap.
  - All travel costs and shipping of the heater technology is the responsibility of the winning teams.

- Over the course of one week, Teams will set-up and shake-down their heaters (Day 1 and 2) followed by triplicate testing (Days 3 – 5) that focus on various burn phases such as cold-start, periods of steady-state low-loads and high-loads, and burn-out phases.
- At the conclusion of the testing week, results will be presented to the panel of judges. The panel of judges will assess the team's testing performance in terms of emissions, efficiency, and consistency as well as their overall commercial potential and innovation. Judges will then present the scores to the deciding judge for each team.
- Based on the final scores, the following prizes will be awarded:
  - 1st prize of $40,000
  - 2nd prize of $25,000
  - 3rd prize of $10,000
- Teams must participate in testing at BNL to be considered for Phase 2 prizes.

5. PERFORMANCE METRICS

Performance metrics have been established to help competitors develop the next generation of advanced residential wood and pellet heaters. Each technology must be capable of decreasing the PM emissions by 20% and increasing the efficiency by 15% from current EPA certification limits.[7] Recognizing performance metrics may vary widely between heater types (cordwood, pellet, forced-air-furnaces, etc.), each team must clearly define their performance metrics and justify their claims using a narrative, data, and/or literature during the Wood Heater Technology Slam presentation. Performance claims will then be validated through experimental testing at BNL during Phase 2 of the WHDC.

Successful applicants should consider, fuel inputs (dry vs. wet wood), air/fuel input rates, combustion techniques, capital costs, operational costs, and emissions (e.g., particulate matter, carbon monoxide [CO], nitrous oxide [NOx] and methane [CH_4]). Measured or calculated performance metrics should also be compared to the state of the art. The table below provides minimum performance targets competitors should consider when designing their prototype. The reviewers will also consider proposed alternative markets and identified commercial opportunities not shown in this table.

[7] 40 CFR 60 Subpart AAA

Table 1: 2020 EPA Wood Heater emission compliance limits

Technology Type	PM Emission*	CO Emission	Heating Efficiency**	Consistent Performance
Cord wood stove	2.00 g/hr (2.5 g/hr if tested with cordwood)	400 ppm mean	75% HHV SLM mean	Peak emissions < 4 g/hr on an 8-minute rolling basis (visible smoke rule)
Pellet Stove	2.00 g/hr mean	100 ppm mean	75% HHV SLM mean	Peak emissions < 4 g/hr on an 8-minute rolling basis (visible smoke rule)
Furnaces or boiler intended for living room installation	0.10 lb/MMBtu (0.15 lb/MMBtu if tested with cordwood)	200 ppm mean	75% HHV SLM mean	Peak emissions < 0.30 lb/MMBtu on an 8-minute rolling basis (visible smoke rule)

* Target reduction of 20% from listed value
** Target increase of 15% from listed value

6. COMPETITOR ELIGIBILITY

Competitors for the Wood Heater Technology Slam may include private entities (for-profits and nonprofits), academic institutions, and individuals that comply with all the General Eligibility Requirements and the Program Goal Eligibility Requirements described below; and do not satisfy any criteria stated under Ineligible Parties. See below for further details:

General Eligibility Requirements:

- *Private entities must be incorporated in and maintain a primary place of business in the United States.*
- *Academic Intuitions must be based in the United States.*
- *An individual prize competitor (who is not competing as a member of a group) must be a United States citizen or a permanent resident.*
- *A group of individuals competing as one team may win, provided that the online account holder of the submission is a United States citizen or a permanent resident.*
- Teams may include foreign companies, academic institutions, or individuals if one or more of the above 4 conditions are met.
- Only competitors who win a monetary prize from the Slam shall be tested at Brookhaven National Laboratory.

***Ineligible Parties*:**

- *Individuals who worked at DOE (federal employees or support service contractors) within six months prior to the submission deadline of any contest are not eligible to participate in any prize contests in this program.*

- *Non-DOE federal entities and federal employees are not eligible to win any prize contests in this program.*
- *Employees of an organization that co-sponsors this program with DOE are not eligible to participate in any prize contests in this program.*
- BNL and LBNL *employees directly involved in administration of this prize are not eligible to participate in any prize contest in this program; however*, BNL, LBNL *and other National Laboratory employees, including laboratory researchers, may participate in their personal capacity but may not use any laboratory resources.*

Program Goal Eligibility Requirements *- Only submissions relevant to the goals of this program are eligible to compete. The prize administrator must conclude that all of the following statements about your submission are* ***true*** *in order to be eligible to compete:*

- The proposed technology is designed to be installed in the living area of a home.
- The proposed heater cannot be EPA certified, or have completed lab testing or be in the process of testing at an approved EPA lab, unless modifications have been made or are planned for the heater that have not yet been adopted by other manufacturers
- Activities that would be funded are or will be performed in the US.
- The proposed solution represents an innovation that will move the industry beyond its current state.
- The proposed solution is not dependent on new, pending, or proposed federal, state, or local government legislation, resolutions, appropriations, measures, or policies.
- The proposed solution does not involve the lobbying of any federal, state, or local government office.
- The proposed solution is based on fundamental technical principles and is consistent with a basic understanding of the U.S. market economy.
- The submission content sufficiently confirms the competitor's intent to commercialize early-stage technology in the near future.
- Competitors have not participated in any foreign government talent recruitment programs as defined in DOE Order 486.1. This prize competition is expected to positively impact U.S. economic competitiveness. Participation in a foreign government talent recruitment program[8] could conflict with this objective by resulting in unauthorized

8 "Foreign government talent recruitment program" is defined as an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals or students (regardless of citizenship or national origin, and whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to physically relocate to the foreign state for the above purpose. Some programs allow for or encourage continued employment at U.S. research facilities or receipt of

transfer of scientific and technical information to foreign government entities. Therefore, individuals participating in foreign government talent recruitment programs of foreign countries of risk are not eligible to compete. Further, teams that include individuals participating in foreign government talent recruitment programs of foreign countries of risk [9]are not eligible to compete.

7. HOW TO APPLY

In order to apply for the Wood Heater Technology Slam, an a competitor must enter a submission described in Section 8—which can be found here.

Submissions must be entered online by 4pm, Eastern Time, August 31st, 2022. Submissions must be in English and cannot be amended to after the August 31st deadline.

8. SLAM CONTEST RULES & REQUIREMENTS

1. ***Assessment*** *– Submissions will be assessed, scored, and selected based on the following concepts:*[10]

    a. **Innovation** – is the approach innovative and does it represent an advance compared to traditional heater design? The contest will only accept submissions featuring innovation that is built into or onto a heater. It will not accept stand-alone retrofit technologies that are not attached to a heating appliance.

    b. **Consistent performance –** does the design minimize the variability of PM emissions that can occur in the hands of the average operator? Submissions should showcase technologies which have a credible engineering pathway(s) toward decreasing PM emission magnitude and/or variability. There should be little scientific uncertainty regarding the technology's action and principles of operation.

    c. **Commercial potential** – can the appliance be affordably produced, installed, and maintained and offer features valued by consumers. How could this heater achieve broad commercial adoption? Submissions should include a reasonable plan, including a timeline, describing how the team will advance the technology level of their application with the awarded prize.

    d. **Expected performance –** is the proposed technology cleaner than what is currently on the market? The proposed technology should demonstrate a reduction in PM

federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

[9] China, Russia, Iran and North Korea

[10] The prize administrator will screen all completed submissions and assign subject-matter-expert reviewers to independently score the content of each submission. Reviewers can be DOE staff, contractors, and independent reviewers from industry and academia. Final selections will be determined by the prize administrator.

emissions by 20% and increase in efficiency by 15%. Submissions should include data to verify the claims or a strong engineering justification to support the claim.

9. WHAT TO SUBMIT

In order to compete in the Wood Heater Technology Slam a submission must be entered online found here. Submissions must be entered by 4pm, Eastern Time, August 31st, 2022. Submissions must be in English and cannot be amended to after the August 31st deadline.

The submission must include the following:

- Cover page
- Technical narrative
- Information about your team, your experience, your facilities, and resources
- A one-page description of what type of testing you think would help you most at BNL
- Resumes of key team members (no more than 2 pages per resume)
- Summary PowerPoint slide (publicly accessible)
- Letters of commitment or support (optional)
- 2-minute video (publicly accessible online) (optional)

A detailed description of each part of the submission package is provided below.

• COVER PAGE

The cover page of each Wood Heater Technology Slam submission should include a list of basic information about your submission in cover page format. Specifically:

- Project title
- Short description
- Key project members (names, email address, LinkedIn profiles, etc.)
- Keywords that best describe your solution
- Location of business or team (City, state, and 5-digit zip code)
- Other partners, if any

• TECHNICAL NARRATIVE

In the technical narrative applicants should answer each of the following four questions. The content bullets are only suggestions to guide responses; applicants decide where to focus their

answers. Responses to these questions must not exceed 2,500 words in total. Images, figures, or graphs may be included in the narrative. Content that is over the word limit will not be reviewed.

Question 1: *Innovation*– How is your heater innovative?

- Describe how your proposed heater technology will function, highlighting how it represents an innovation beyond existing technology.
- Describe why your idea is innovative. Highlight cost reduction and performance enhancements over state-of-the-art technology.

Question 2: *Consistent Performance* – Is your solution technically feasible?

- Describe the key technical aspects of your innovation and how it helps ensure that the emissions in the lab will be achieved by the average operator at home
- Describe the supporting body of knowledge that provides confidence that an engineering pathway exists to achieve consistency
- Describe the critical technical challenges needed for your idea to be successful

Question 3: *Commercial Potential* – Will your technology succeed in the marketplace?

- Describe the demographic that you are targeting.
- Can the unit be affordably produced, installed, and maintained?
- What are the features valued by consumers and how do you know they are valued?

Question 4: *Expected performance*—What is the expected performance of the technology in comparison to current EPA certified wood heaters?

- Justify the expected performance of the heater relative to EPA emission targets. The heater should show a minimum of 20% reduction of PM emissions and 15% minimum efficiency increase during steady state operation (i.e. a minimum of 1.6 g/hr and an efficiency of 86% should be achieved for a pellet stove). Additionally, teams should also show greater efficiencies and emission reduction during cold starts, reload events, and other types of operation.
- Teams without testing data to confirm this may provide an engineering justification (e.g. model, calculations, simulation, other relevant experiments) as to why the technology would lead to a reduction in emissions and increase in efficiency.

A panel of expert judges will score the submitted narrative based on the content provided. The panel of expert judges will evaluate submissions by agreeing or disagreeing with assigned statements on a 1-5 scale, as discussed in Section 10 below.

- ## TEAM INFORMATION

In the team information section, the applicant should provide one page of information regarding their team, experience, facilities, and resources available which will help advance development of the proposed technology. Participants looking to collaborate with other interested parties may use the LinkedIn Group page to network.

- ## RESUMES

In addition, up to 4 resumes (2 pages each maximum) for the team members that will significantly contribute to the competition efforts.

- ## SUMMARY POWERPOINT SLIDE

A summary PowerPoint slide must also be submitted. This public-facing slide will serve as a summary which contains technically specific details but can be understood by a nontechnical audience. There is no template, so you may present the information as you see fit. Please make any text readable for a standard printout and conference-room projection.

- ## LETTERS OF COMMITMENT (OPTIONAL)

Up to four (4) one-page letters of support, intent, or commitment from relevant entities to provide context may also be submitted. Letters of support from partners or others that are critical to the success of your proposed solution may increase your chances of winning. A good example is a potential distributor or a program interested in deploying the type of heater you are working on. General letters of support from parties that are not critical to the execution of your solution will likely not materially impact selection of your submission. Please do not submit multipage letters.

- ## TWO MINUTE VIDEO (OPTIONAL)

A link to a publicly accessible video online (e.g., YouTube, Vimeo, etc.) may also be submitted. This public facing video will be used as a tool to share your technology with a wider audience both before and during the Wood Heater Technology Slam. Be creative and produce a video that conveys the required information in interesting ways, but do not focus on time-consuming elements that improve only production values (e.g., décor, lighting, cinematic techniques.

10. WOOD HEATER TECHNOLOGY SLAM PHASE 1– RULES

The WHDC Slam consists of a competitive public zoom event where up to 10 teams compete, by giving wood heater technology demonstration pitches, for part of $120,000 in prizes and have

their heater tested at BNL. Proposed heaters/technologies must not be EPA certified or broadly available on the US market.

Teams will prepare the submission as described in Section 9 for judges to review. From the applicant pool, 10 teams will be selected to compete in the Slam on September 29th, 2022. Teams selected to participate in the Slam will be notified and provided a list of questions and feedback from the judges that will help with clarification. Judges may ask for more details to help understand the proposed technology or verify claims. Teams are expected to use this feedback to help strengthen their Slam presentation.

• PRESENTATION RULES

During the Slam competition, competing teams will give an eight-minute presentation on their proposed wood heater technology to a panel of judges and an audience. Teams may use PowerPoint presentations, a "fire-side chat," or a virtual facility tour during their presentation. All presentations must include:

1. At least one team member giving a live overview (i.e., not a recording) of the wood heater at the beginning of the presentation. Presentations including multiple team members are encouraged.
2. At least one slide providing an image of the wood heater. This image can be a cross-section, a diagram, and/or an image of the full prototype or finished heater
3. Stated performance metrics compared to state-of-the art and data, calculations, and/or literature supporting performance claims

In addition to the required Slam presentation, teams are also encouraged to submit a short video, up to two minutes in length, describing their technology or some features thereof for public distribution prior to and during the Slam competition. This video may be included in the submission and updated after being selected to compete by the committee panel. This video may also include footage of the prototype while it is burning, how to operate it, and/or a description of the benefits of its technological innovations. Videos that contain overt sales pitches will not be scored highly.

• EXPERT JUDGES

The WHDC organizers will assemble a panel of Expert Judges who will be responsible for the following:

1. Assess the written submissions due on August 31st, 2022, to determine which teams will advance to the Slam competition as finalists.
2. Assess the finalists during the Slam competition, using the same criteria used to assess written submissions.

HOW FINALISTS ARE DETERMINED

Expert Judges will score the submissions and Slam presentations of the Slam Finalists based on the following criteria:

- Judges will score each team based on their answers to each of the four technical questions answered in their submission as well as the discussion during their Slam presentation, on a scale from 1 to 5, as shown in the table below. Teams should both clearly answer the four technical questions in their written submission as well as the oral presentation given during the Slam. Participants chosen for the Slam should make an effort to address all questions and feedback provided by the judges during the selection process to help strengthen their Slam presentation.
- A total score from an individual judge will be calculated by summing scores from all of the questions.
- A final score for the submission and Slam presentation will be calculated by averaging total scores from all judges.
- Scores will be submitted to WHDC deciding judge for review and final determination of winners

Table 2: Wood Heater Slam Rubric

Superior	5	• The submission is of extraordinary merit that clearly represents potential for exceptional achievement • Contains significant strengths • Has no notable weaknesses • The team has successfully demonstrated the technology would decrease emissions by 20% from current EPA certification values and increase efficiency by 15% with data • Leaves no doubt of the Applicant's capability to accomplish the goals of the Challenge
Good	4	• The submission is of merit and clearly represents potential for achievement • Has significant strengths • Contains few weaknesses • Strengths significantly outweigh the weaknesses • The team has demonstrated the technology could decrease emissions by 20% from current EPA certification values and increase efficiency by 15% with either limited data or a strong engineering justification • Demonstrates the Applicant's capability to accomplish the goals of the Challenge
Satisfactory	3	• The submission is of merit and represents potential achievement • Contains correctable weaknesses • Strengths outweigh the weaknesses • The team has demonstrated the technology may decrease emissions by 20% from current EPA certification values and increase efficiency by 15% but is not confirmed by data and only with an engineering justification • Demonstrates the Applicant's capability to accomplish the goals of the Challenge
Marginal	2	• The submission is of questionable merit that represents potential for achievement • Has strength and weaknesses • Weaknesses outweigh the strengths • The team has demonstrated the technology may decrease emissions, but not by the targeted 20% from current EPA certification values and increase efficiency by 15%. The claims are not confirmed by data and only with an engineering justification • The applicant will likely be able to accomplish the goals of the Challenge
Unsatisfactory	1	• The submission displays no merit that represents potential for achievement • Contains significant weaknesses that would require a major revision • The team has not demonstrated the technology would decrease emissions by 20% from current EPA certification values and increase efficiency by 15% • The applicant's ability to accomplish the goals of the Challenge are not demonstrated

After Slam winners are announced, comments and feedback from expert judges will be provided to all applicants and are intended to help competitors continue to improve and iterate on their technology before Phase 2 R&D testing at BNL. The comments are the opinions of the expert reviewers and do not represent the opinions of the DOE.

Final Determination: Applicant winners will be selected based on final scores and program policy factors listed in Appendix 1– Additional Terms & Conditions.

Announcement: After the Slam event has concluded, the prize administrator will notify the selected winners and request the necessary information to distribute the cash prizes.

11. BNL R&D TESTING COMPETITION RULES – PHASE 2

- Winning Phase 1 teams will travel to BNL with a functional prototype to showcase and test their technology. Additional details about this competition will be provided to winning competitors.
- Judges will assess the finalized prototype tested at BNL in terms of the: 1) experimental test results (particulate and gaseous emissions) and consistency in performance, 2) innovation, and 3) commercial potential.
- Additionally, judges will evaluate the teams' performance of their prototype in Phase 2 according the testing competition rubric in Table 3 below.
- A total score from an individual judge will be calculated by summing scores from all of the questions.
- A final score for the submission and Slam presentation will be calculated by averaging total scores from all judges.

Scores will be submitted to WHDC deciding judge for review and final determination 1st, 2nd, and 3rd place prizes.

- SLAM winners that do not participate in R&D testing will not be eligible for the R&D Testing Competition prize.

Table 3: Wood Heater R&D Testing Competition Rubric

Superior	5	• The technology is highly innovative and presents new technology to the wood heater market • The technology clearly demonstrated the Challenge goals of a 20% reduction in terms of PM emissions, low gaseous emissions, increase in efficiency by 15%, and consistent performance • The technology has significant market potential in terms of installation ease, cost, appeal, and safety • Has no notable weaknesses
Good	4	• The technology is innovative and but not necessarily new in the wood heater market • The technology demonstrated periods of low emissions high efficiency, and repeatability but at times had periods of high emissions and low efficiency. However, overall. The technology was able to achieve the overall target of a 20% reduction in PM emissions and 15% increase in efficiency • The technology has market potential in terms of installation ease, cost, appeal, and safety
Satisfactory	3	• The technology contains some innovative features upon fabrication but does not present any new technology to the wood heater market • The technology demonstrated equal periods of low emissions and high efficiency with periods of high emissions and low efficiency, but ultimately did not achieve the overall target of a 20% reduction in PM emissions and 15% increase in efficiency. Instead, a reduction of 10 – 15% in emissions were achieved and a 5 – 10% increase in efficiency was observed. • The technology has market potential in terms of installation ease, cost, appeal, and safety but only after some corrections
Marginal	2	• The technology is not as innovative upon fabrication as described during the Slam and does not present any new technology to the wood heater market • The technology failed to demonstrate consistent low emissions, high efficiency, and repeatability • The technology did not achieve the overall target of a 20% reduction in PM emissions and 15% increase in efficiency. Observed emissions and efficiency values were near or at current EPA certification limits. • Before the technology has market potential, concerns need to be addressed in terms of installation ease, cost, appeal, and safety
Unsatisfactory	1	• The technology provides no innovation upon fabrication as described in the Slam and does not present any new technology to the wood heater market • The technology failed to demonstrate the Challenge goals of low emissions, high efficiency, and repeatability and had significant emissions • The technology did not achieve the overall target of a 20% reduction in PM emissions and 15% increase in efficiency and did not meet current EPA certification values. • The technology lacks market potential in terms of installation ease, cost, appeal, and safety without significant mitigation

Following the testing at BNL, the prize administrator will then publicly announce the 1st, 2nd, and 3rd place prizes. The comments are the opinions of the expert reviewers and do not represent the opinions of the DOE.

Final Determination: Applicant winners will be selected based on final scores and program policy factors listed in Appendix 1 – Additional Terms & Conditions.

Announcement: After the testing at BNL has concluded for each of the teams, the prize administrator will notify each team and their place and request the necessary information to distribute the cash prizes.

DISTRIBUTION OF FUNDS

Prizes will be distributed in Phase 1 and 2. Phase 1, the Wood Heater Slam will award three, $15,000 prizes to three teams. During Phase 2, one 1st place, 2nd place, and 3rd place prize will be awarded, in ranking order of the team scoring the highest to lowest of points. The 1st, 2nd and 3rd place prizes will be $40,000, $25,000, and $10,000, respectively.

Appendix 1

1. ADDITIONAL TERMS AND CONDITIONS

Your submissions to the Innovation, Teaming, Design, and Test contests are subject to following terms and conditions:

- *If your team is selected for the Slam, the video submission and summary slide will be made public.*
- *The cover page, narrative, technical documentation, letters of commitment/support, and résumés are not intended to be made public, however, see Section VI – Additional Terms & Conditions regarding the Freedom of Information Act.*
- *You agree to release your submission video under a Creative Commons Attribution 4.0 International License (see http://creativecommons.org/licenses/by/4.0/).*
- *You must include all the required submission's elements. The prize administrator may disqualify your submission after an initial screening if you fail to provide all required submission elements. Competitors may be given an opportunity to rectify submission errors due to technical challenges.*
- *Your submission must be in English and in a format readable by Microsoft Word. Scanned handwritten submissions will be disqualified.*
- *The prize administrator, when feasible, may give competitors an opportunity to fix no substantive mistakes or errors in their submission packages.*

2. VERIFICATION FOR PAYMENTS:

The Challenge administrator will verify the identity and role of a participant potentially qualified to receive the prize. Receiving funding is contingent upon fulfilling all requirements contained herein. The prize administrator will notify winning competitors using provided email contact information after the date that results are announced. Each competitor will be required to sign and return to the prize administrator, within 30 days of the date on the notice, a completed Request for ACH Banking Information form and a completed W9 form (https://www.irs.gov/pub/irs-pdf/fw9.pdf

TEAMS AND SINGLE ENTITY AWARDS

The Challenge administrator will award the prize to the designated primary submitter, whether consisting of a single or multiple entities. The primary submitter is solely responsible for allocating any prize funds among its team as they deem appropriate. The Challenge administrator will not arbitrate, intervene, advise on, or resolve any matters between team members.

3. SUBMISSION RIGHTS

By making a submission and consenting to the rules of the contest, a competitor is granting the Challenge administrator, and any other third parties supporting DOE in the contest, a license to display publicly and use the parts of the submission that are designated as "public" for government purposes. This license includes posting or linking to the public portions of the submission, including the contest website, DOE websites, and partner websites, and the inclusion of the submission in any other media worldwide. The submission may be viewed by the DOE, prize administrator, and judges for purposes of the contests, including but not limited to screening and evaluation purposes. The prize administrator and any third parties acting on their behalf will also have the right to publicize competitors' names and, as applicable, the names of competitors' team members and organization, which participated in the submission on the contest website indefinitely.

By entering, the competitor represents and warrants that:

1. *Competitor's entire submission is an original work by competitor and competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, dialogue from plays, likeness of any third party, musical recordings, clips of videos, television programs or motion pictures) in or in connection with the submission, unless (i) otherwise requested by the prize administrator and/or disclosed by competitor in the submission, and (ii) competitor has either obtained the rights to use such third-party content or the content of the submission is considered in the public domain without any limitations on use;*

2. *Unless otherwise disclosed in the submission, the use thereof by prize administrator, or the exercise by prize administrator of any of the rights granted by competitor under these rules, does not and will not infringe or violate any rights of any third party or entity, including, without limitation, patent, copyright, trademark, trade secret, defamation, privacy, publicity, false light, misappropriation, intentional or negligent infliction of emotional distress, confidentiality, or any contractual or other rights;*

3. *All persons who were engaged by the competitor to work on the submission or who appear in the submission in any manner have:*

    a. *Given the competitor their express written consent to submit the submission for exhibition and other exploitation in any manner and in any and all media, whether now existing or hereafter discovered, throughout the world;*

    b. *Provided written permission to include their name, image, or pictures in or with the submission (or, if a minor who is not competitor's child, competitor must have the permission of the minor's parent or legal guardian) and the competitor may be asked by the prize administrator to provide permission in writing;*

    c. *Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission*.

4. COPYRIGHT

Each competitor represents and warrants that the competitor is the sole author and copyright owner of the submission; that the submission is an original work of the competitor or that the competitor has acquired sufficient rights to use and to authorize others, including DOE, to use the submission, as specified throughout the rules; that the submission does not infringe upon any copyright or any other third-party rights of which the competitor is aware; and that the submission is free of malware.

5. CONTEST SUBJECT TO APPLICABLE LAW

All contests are subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these Official Contest Rules and administrative decisions, which are final and binding in all matters related to the contest. This notice is not an obligation of funds; the final award is contingent upon the availability of appropriations.

6. RESOLUTION OF DISPUTES

The U.S. Department of Energy is solely responsible for administrative decisions, which are final and binding in all matters related to the contest.

Neither the U.S. Department of Energy nor the prize administrator will arbitrate, intervene, advise on, or resolve any matters between team members or among competitors.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the competitor. The "authorized account holder" is the natural person or legal entity assigned an email address by an Internet access provider, online service provider, or other organization responsible for assigning email addresses for the domain associated with the submitted address. All competitors may be required to show proof of being the authorized account holder.

7. PUBLICITY

The finalists for the Slam and those who win funding will be featured on the DOE, BNL, LBL and AGH websites.

Except where prohibited, participation in the contest constitutes each winner's consent to DOE's and its agents' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media worldwide, without further permission, payment, or consideration.

8. LIABILITY

Upon registration, all participants agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this contest, development of any submission. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against AGH and the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever arising from their participation in the contest, whether the claim or cause of action arises under contract or tort.

In accordance with the delegation of authority to the DOE director has determined that no liability insurance will be required of participants to compete in this competition per 15 USC 3719(i)(2). The director will evaluate possible activities in the rest of the contests and make additional determinations. Competitors may be required to obtain liability insurance in future contests.

9. RECORDS RETENTION AND FOIA

All materials submitted to DOE as part of a submission become DOE records. The following applies only to portions of the submission not designated as public information in the instructions for submission. If a submission includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the submission. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for merit review of the submission or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

> *The submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:*

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

Competitors will be notified of any Freedom of Information Act requests for their submissions in accordance with 29 C.F.R. § 70.26. Competitors may then have the opportunity to review materials and work with a FOIA representative prior to the release of materials.

10. GENERAL CONDITIONS

DOE reserves the right to cancel, suspend, and/or modify the contest, or any part of it, at any time. If any fraud, technical failures, or any other factor beyond DOE's reasonable control impairs the integrity or proper functioning of the contests, as determined by DOE in its sole discretion, DOE may cancel the contest.

Although DOE may indicate that it will select winners, DOE reserves the right to only select competitors that are likely to achieve the goals of the program. If, in DOE's determination, no competitors are likely to achieve the goals of the program, DOE will select no competitors and will award no prize money.

ALL DECISIONS BY DOE ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CONTEST.

11. PROGRAM POLICY FACTORS

While the scores of the expert reviewers will be carefully considered, it is the role of the prize judge to maximize the impact of contest funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope of review may need to be considered to accomplish this goal. The following is a list of such factors. In addition to the reviewers' scores the below program policy factors may be considered in determining quarterfinalists, semifinalists, finalists, and winners:

- *Geographic diversity and potential economic impact of projects in a variety of solar markets.*

- *Whether the use of additional DOE funds and provided resources continue to be non-duplicative and compatible with the stated goals of this program and the DOE mission generally.*

- *The degree to which the submission exhibits technological or programmatic diversity when compared to the existing DOE project portfolio and other competitors.*

- *The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers.*

- *The degree to which the submission is likely to lead to increased employment and manufacturing in the United States or provide other economic benefit to U.S. taxpayers.*

- *The degree to which the submission will accelerate transformational technological, financial, or workforce advances in areas that industry by itself is not likely to undertake because of technical or financial uncertainty.*

- *The degree to which the submission supports complementary DOE funded efforts or projects, which, when taken together, will best achieve the research goals and objectives of DOE.*

- *The degree to which the submission expands DOE's funding to new competitors and recipients who have not been supported by DOE in the past.*

- *The degree to which the submission enables new and expanding market segments.*

- *Whether the project promotes increased coordination with nongovernmental entities for the demonstration of technologies and research applications to facilitate technology transfer.*

12. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

DOE's administration of the WHDC is subject to NEPA (42 USC 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all participants in the Design Contest will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their participation in the prize competition. Participants may be asked to provide DOE with information on fabrication and testing of their device such that DOE can conduct a meaningful evaluation of the potential environmental impacts.

13. RETURN OF FUNDS

As a condition of receiving a prize, competitors agree that if the prize was awarded based on fraudulent or inaccurate information provided by the competitor to DOE, DOE has the right to demand that any prize funds or the value of other non-cash prizes be returned to the government.