

## Task 7: Open Task

2023

### Task sponsored by Arrowhead Center, NMSU

Arrowhead Center—Supporting Innovation, Entrepreneurship, and Economic Opportunity

#### Request for Proposals—Background

The Open Task was developed to allow teams to identify their own real-world environmental challenge and address it through research, design, and development of a fully operational bench-scale demonstration of the solution.

Response to a current issue of national importance is highly encouraged, as is the participation of multi-disciplinary teams from STEM fields.

#### Topic Selection

Topics should focus on environmental issues, including, but not limited to, energy, food, air, and water. The topic chosen must maintain the goals of the contest: the pursuit of real-world, technically challenging, demonstrable, innovative solutions that are economically feasible and could be put into practice on a large scale.

To help teams design a project that is rigorous and will be competitive during judging, teams are encouraged to refer to Task 1-6 problem statements to understand the expected scope and outcomes of contest tasks.

When selecting a task, teams should be mindful that:

1. The design must produce measurable results that serve as proof-of-concept for the design.  
For example: If the project has the goal of cleaning up a particular type of air pollution:
  - a. The team will bring their pollution-removing bench-scale model to the contest.
  - b. The contest staff will provide an air sample containing the pollutant; the team will run this through their bench-scale apparatus and collect the resulting air sample (that should now be cleaner).
  - c. The WERC staff will send this “cleaned” air sample to NMSU labs to validate the team’s results.
2. The total time allowed for the bench-scale demonstration + analytical testing of the results may total no more than 48 hours.
3. Plan a bench-scale demonstration that does not require a person to tend the apparatus overnight. We cannot monitor overnight processes.
4. Computer simulations should not be the primary means of demonstrating the design.

#### Request for Proposals—Problem statement

Your team will identify a real-life environmental challenge in an emerging technological area, design the solution to the problem, and identify the potential market for your solution.

You team will build an apparatus to demonstrate a bench-scale version of your proposed solution, evaluate the cost of building and operating a full-scale version of your proposed solution, and consider regulations and implications for implementing the full-scale solution.

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### Design Considerations

Your proposed design should provide specific details and outcomes as follows.

- Describe the product or process and explain why it is valuable to society and the environment.
- Develop, demonstrate and present a complete package that includes technical performance as well as financial, regulatory, and safety information.
- Provide a process-flow diagram (PFD), complete with quantified inputs/outputs and mass and energy balances for the designed process (if applicable). If a PFD does not apply to your project, provide process diagrams that illustrate each component in your design and include a description of its function. Waste streams, if any, should be addressed in the diagrams.
- Discuss the advantages and disadvantages of your solution versus both current technologies and other possible approaches (consider cost, ease of operation, elegance of design, waste minimization, energy efficiency, etc.).
- Build an experimental apparatus to demonstrate your process.
- Identify an analytical testing protocol that will be used to evaluate your solution at the contest. Share this with the WERC staff in your ESP and your 30% Project Review.
- Present a business case for your technology, including potential incentives from appropriate levels of government and supporting economic metrics.
- Economic Analysis.
  - Teams are advised to create a multi-disciplinary team by inviting a business major to help draw up economic plans for full-scale implementation of your designs.
  - If your solution is for a one-time build, then maintenance of a treatment process, present a Techno-Economic Assessment and Analysis (TEA) to construct a full-scale operation for your chosen technology.

The TEA will include your estimate of capital costs (CAPEX) and operational costs (OPEX) for a full-scale solution and appropriate graphical representation of your cost data.

- Capital expenses typically include, but are not limited to, equipment, pipes, pumps, etc. Do not include costs of buildings and appurtenances to the treatment process.
- Operating expenses (OPEX) should include, but not be limited to, materials needed, including consumables (chemicals, sacrificial components, etc.). In addition to other operating costs that your team identifies, include these operating costs: staff labor rate of \$70/hour; solids disposal costs (\$50/ton); energy requirements using an electricity rate of \$0.10/kWh. If your full-scale solution requires natural gas as an energy source, research and use up-to-date prices.
- Include a financial analysis of any potential product salable value. Note that plant location in reference to raw materials and final consumers will have a major impact on the cost of the final product.
- Visualization tools: Sensitivity analyses, etc.

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- If your team is designing a device, instead of developing a TEA, your team will present a rudimentary business plan. Include: (*List subject to change—watch FAQs.*)
  - Costs, cost-recovery structure, recovery rate and schedule.
  - Level of profit to show viability to a prospective lender (as an indication of ability to pay off a loan needed to set up the manufacturing process).
  - Projected sales forecast, market potential, potential market share
  - Reduction in the marginal cost of each device as manufacturing progresses over successive years (to reflect economies of scale: i.e., the cost of manufacturing a single car is \$50M, but the cost of manufacturing 5M cars is \$30,000 each).
- To be considered for the WERC P2 Award, in a separate section of the report (titled “Pollution Prevention”), document success in improving energy efficiency, pollution prevention, and/or waste minimization, as it applies to your project.
- Discuss your plan’s adherence to appropriate federal (USA), state, and local laws and regulations. Attend WERC’s EH&S Short Course for tips for addressing regulatory issues. (See website for info.)
- Include a Public Involvement Plan, as applicable (see Team Manual).
- Identify waste streams, if any, for your design and plans to address them.
- Identify the hazards of the proposed solution and approaches to mitigate the them.
- Address safety aspects of operating your technology. Safety issues for both the full-scale design should be addressed in the written report. Safety issues for the bench-scale demonstration should be addressed in both the written report and the Experimental Safety Plan (ESP).
- Discuss the intangible benefits of the product or process, if any.

### Bench-Scale Demonstration

During the bench-scale demonstration, your team should plan to present a functional bench-scale model that clearly conveys the proposed solution.

Your ESP will serve as your detailed plan for operating the bench-scale demonstration at the contest. In addition to including safety aspects in your ESP, you need to include details to help WERC prepare to help you run and test your bench-scale demonstration at the contest. In the ESP, include:

1. A detailed list of analytical testing needed for WERC to evaluate the bench-scale results. (Do we need to send your resulting samples to a lab? What laboratory analyses will be needed? What will the samples likely contain? Will we need to make measurements at your booth? Etc.)
2. An estimate of the time needed to run the bench-scale demonstration.
3. An estimate of the time required for WERC to analytically test results from your bench-scale results.

Note that the time for the above items #2 and #3 must not exceed 48 hours, due to contest time limitations.

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### 30% Project Review

Suggested submission date: Feb. 6, 2023

Final submission date: February 24, 2023

An engineering “30% Project Review” reviews the engineering firm’s preliminary design and aspects of a project with a client. It provides the client an opportunity to suggest modifications for inclusion in the final design. The goal is to define the scope of the project, present a project schedule, report progress to date to meet the final deadline, and determine fatal flaws, if any.

For the design contest, the review should not exceed four pages. Submit the project review as soon as possible. You are allowed to change your plans after submitting it. Although the review is not scored, your team will receive feedback from the judges for improving your project. (The higher the quality of your project review, the more help you will get from the judges.)

At a minimum, the review must include:

- **A brief description of your project:** One bulleted list outlining: goals, planned solution to the problem, and any anticipated drawbacks.
- **A project schedule:** schedule for completion of the contest solution, including progress to date.
- **Process flow diagram** (or Process Diagram(s)) with all mass and energy balances, as needed).
- **Table of Contents** planned for the technical report (place topics in order, one line per topic)

### Experimental Safety Plan (ESP)

The ESP outlines your team’s plans for safely operating your bench-scale demonstration at the contest. This document is submitted in February (see dates below). Instructions are provided in the team manual. The Team Leader, or a designated team member, shall attend a mandatory short course that outlines the ESP process. Teams will not be able to run a bench-scale demonstration if the ESP is not received by the deadline. Your team should follow your school’s safety procedures while conducting tests prior to attending the contest.

### Evaluation Criteria

Each team is advised to read the 2023 Team Manual for a comprehensive understanding of the contest evaluation criteria. As described in the manual, there are five events: a written report, a formal oral presentation, a demonstration of your technology using a bench-scale representation, a poster presentation, and a Flash Talk. Criteria used by the judges in evaluation of these five components are described in the Team Manual.

For a copy of the Team Manual, Public Involvement Plan, and other important resources, visit the WERC website: [Guidelines | werc.nmsu.edu](https://werc.nmsu.edu)

Judges’ evaluation of your entry will include consideration of the following points specific to this task.

- Potential for real-life implementation, including expected reliability and maintainability and reasonable cost of setup and ongoing operations. Cost/benefit of your solution will be compared with those of other teams.
- Thoroughness and quality of the PFD or Process Diagram(s).
- Thoroughness and quality of the economic analysis for scale up.
- Originality, innovation, and real-world need represented by the proposed technology.
- The quality of your bench-scale results.
- Other specific evaluation criteria that may be provided at a later date (watch the FAQs), including those suggested by judges as a result of your 30% Project Review.

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### Short Courses

WERC is offering two short courses:

- *Mandatory:* Preparing the Experimental Safety Plan. The Team Leader, or a person assigned by them, must attend the course prior to submitting the ESP (and before February 20, 2023).
- *Optional:* Environmental Health and Safety (EH&S) Topics. The course is designed to prepare teams to complete the EH&S portion of their technical report. Course fees will be waived for contest-registered students, faculty, and judges. Watch the WERC website for schedules and registration information. Individuals who complete the course can earn a digital badge to add to their professional development portfolio.

### FAQs/Dates/Deadlines

- Today: Email us to let us know you are interested in this task. We will contact you with breaking news.
- Opening mid-December 2022: Optional Course: WERC Safety and Environmental Topics. Live— See website & Team Manual for more information, including dates and times.
- Opening mid-December, 2022: Mandatory Course: Preparing the Experimental Safety Plan. February 20, 2023: deadline for attending. On-demand—See website & Team Manual for information.
- February 6 - 24, 2023: 30% Project Review due.
- February 6 - 24, 2023: Experimental Safety Plan (ESP) due.
- April 5, 2023: Technical Report due
- Weekly: Check FAQs weekly for updates:
  - Task-specific FAQs: [2023 Tasks/Task FAQs](#)
  - General FAQs: [2023 General FAQs](#)
- All dates and task requirements are subject to change. Check FAQs for updates online.