Task 6: Open Task

2022

Task sponsored by Arrowhead Center, NMSU– Supporting Innovation, Entrepreneurship, and Economic Opportunity

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 Tasks 1-5 to generally 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 model and collect the resulting air sample.
   c. The contest staff will send this 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 demonstration may total no more than 48 hours. Plan a bench-scale demonstration that does not require a person to tend the apparatus overnight.

3. Computer simulations should not be the primary means of demonstrating the design.

Problem Statement

Your team will identify a real-life environmental- energy- or water-related challenge in an emerging technological area, design the solution to the problem, and identify the 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 implementation of a full-scale solution.

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.
- 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.).
- Reflect on alternative designs and situations in which those designs might be more viable than your chosen design, recalling that an optimal solution depends on outside factors–the "best" design may be dependent on region and may change over time.
- Create an experimental apparatus to demonstrate your process.
- Identify an analytical testing protocol which may be used to evaluate your solution and share this with the WERC staff in your Preliminary Report.
- Present a business case for your technology, including potential incentives from appropriate levels of government and supporting economic metrics.
- Provide a process-flow diagram, complete with quantified inputs/outputs and mass and energy balances for the designed process.
- Present a Techno-economic Analysis (a.k.a. Techno-economic Assessment, or 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 $0.09/kWh.
  - Visualization tools: Sensitivity analyses, etc. (Recommended: NMSU TEA Short Course).
- Estimate the capital costs (CAPEX) to build a full-scale plant. This includes, but is not limited to, equipment, buildings, land use, construction costs, engineering mark-up, etc.
- Estimate the operating costs (OPEX) (calculated as $/m3 of product produced, or other units, as appropriate) on an annual basis for a full-scale plant, including, but not limited to, any consumables used (chemicals, sacrificial components, etc.), labor, and energy requirements assuming industrial electricity rates.
- 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.
- Document success in improving energy efficiency, pollution prevention, and/or waste minimization, as it applies to your project to qualify for the P2E2 Award. Place this in a separate section of the report.
- Discuss your plan's adherence to appropriate federal (USA), state and local laws and regulations. Attend WERC's webinar for helpful tips for addressing regulatory issues. (See website or email us for webinar info.)
- Include a Public Involvement Plan, as applicable (see Team Manual).
- Identify the hazards of the proposed solution and approaches to mitigate the issue
- Address safety issues in both the written report and the Experimental Safety Plan (ESP). Attend WERC's webinar for helpful tips for addressing health and safety issues. (See website or email us for webinar info.)
- Discuss the intangible benefits of the product or process.

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 team should develop, demonstrate and present a complete package that includes technical performance as well as financial, regulatory, and safety information.

Preliminary Report—Task Plan and Testing Plan

Submit a detailed plan by January 31, 2022. You may submit this earlier than the due date.
The emphasis is content, not flowery prose. Make the report brief and to the point. Use bulleted lists when possible. The report is not scored. It is designed to help your team produce a better project and help our staff prepare for your arrival at the contest.

Your plans will be reviewed by:

1) A board of judges who will determine suitability of the project and make suggestions for improvements
2) Contest staff to help them prepare to analytically test your design.

The plan should include:

- The official title of the project and description of the engineering problem that the team plans to solve.
- A description of the approach the team plans to take to solve the problem
- A detailed list of analytical testing needed to evaluate the bench-scale demonstration at the contest.
- An estimate of time needed to run the bench-scale demonstration
- An estimate of the time required for WERC to analytically test results from your team's bench-scale results. Note that the time for #5 + #6 must not exceed 48 hours, due to contest time limitations.

Technical Report Requirements

The technical report should demonstrate your team's insight into the full scope of the issue and include all aspects of the problem, including evaluation of alternative technologies and your proposed solution. The report will be evaluated for quality of writing, logic, organization, clarity, reason, and coherence. Standards for publications in technical journals apply.

In addition to the listed requirements, your report must address in detail the items highlighted in the Problem Statement, Design Considerations, Evaluation Criteria, and 2022 Team Manual.

Evaluation Criteria

Each team is advised to read the 2022 Team Manual for a comprehensive understanding of the contest evaluation criteria. As described in this manual, your response to this Task consists of four parts: a written report, a formal oral presentation, a demonstration of your technology using a bench-scale representation, and a poster that conveys the essence of your work in a concise fashion using a mix of text and graphics. General criteria used by the judges in evaluation of these four components are described in the Team Manual.

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 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).

Task 6: Open Task

For a copy of the Team Manual, Public Involvement Plan, and other important resources, visit the WERC website: https://iee.nmsu.edu/outreach/events/international-environmental-design-contest/guidelines/.

FAQs/Dates/Deadlines

- Mid-December, 2021 EH&S Short Course (watch website for dates and registration info).
- Mid-January, 2022: EH&S Short Course; TEA Short Course
- 31 January 2022: Preliminary Report due (Task Plan and Testing Plan).
- 7 March, 2022: Send a draft of the technical report to your auditors (approx. date–see Team Manual)
- 28 March, 2022: Technical Report due
- Weekly: Teams are expected to check the FAQs online weekly for any updates in the task requirements. (wercdesigncontest.nmsu.edu)

Awards

Each year, the WERC Environmental Design Contest and its sponsors award more than $25,000 in cash prizes. Successful completion of every stage of the design project qualifies each team for the following awards.

1. Task awards (First, Second, Third Place; minimum amounts: $2500-$1000-$500, respectively).
2. Virtual Desktop Study Awards (awarded independently of the full bench-scale designs). Amounts TBA.
3. WERC Resources Center Pollution Prevention/Energy Efficiency Award (P2E2) ($500)
4. Judges' Choice Award ($500)
5. Peer Award ($250)
6. Terry McManus Outstanding Student Award. (Minimum: $500, according to funding).
7. Additional awards may be announced at a later date.

Award amounts listed are minimum amounts and may increase with available funding. Detailed award criteria: https://iee.nmsu.edu/outreach/events/international-environmental-design-contest/guidelines/