View from the Organ Mountains toward the Dona Ana Mountains, Las Cruces, NM.

2024 JUDGE MANUAL

YOUR SOURCE FOR:

- Contest schedules
- Judging guidelines
- Judging logistics and online score entry

INTRODUCTION

Thank you for judging the WERC Environmental Design Contest!

We depend on your experience as a professional to prepare undergraduate students for careers in engineering. Your team of judges contribute to STEM education by sharing important insights based on your experience.

Judges' experience varies widely and may include working with engineers from a variety of companies and agencies, writing and reviewing technical reports, addressing government regulations, planning for scale-up, dealing with waste streams, and maintaining good community relations. You need not have experience in all of these areas. The combined experience of the team of judges is what we need to provide a wealth of insights for the students.

Please approach your judging duties from the perspective of a colleague who is helping each team develop a successful process. Studies show that students who are treated on equal footing by more experienced professionals are motivated to work harder to develop the skills they need to be successful.

We appreciate the valuable role you will play in guiding the students to the next level in their professional development!

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JUDGING ADVICE—by HEAD JUDGE MIKE HIGHTOWER

1. Remember that you are part of a team of judges
   a. The judging team includes members with different strengths and expertise
   b. Not everyone is technical or has the same focus. Judge based on your own expertise and experience – that will contribute to an overall balanced evaluation.
   c. We want each judge to arrive at scores independently. Please do not deliberate the score among the judges until all teams finish the oral presentation–there will be time for this on Wednesday during award deliberations.
2. Be self-consistent as you score the different teams
   a. If you are consistent, then regardless of how other judges score the teams, your scores will give an accurate representation of your thoughts and an accurate relative score of the team for you. If each judge does that, the scores will give an accurate composite score of each team's paper, orals, poster, and bench-scale design.
   b. To help you be consistent, list the criteria you think important. This might be the judging rubric or 5 or 6 key points, i.e., good summary, good discussion, good process description, practical process, good data, good performance, minimal waste, etc. With those written down, you are always grading to the same criteria.
   c. Setting forth your criteria in writing will help you more easily identify each team's performance as below or above your expectations in these categories. You now have ratings on 5-6 items of whether the team was below or above your expectations. This will help establish consistent scoring for all teams.
3. Make sure you have a differential in your scores.
   a. Theoretically, a task with 4 teams should have at least one team above average, one below, and two in the middle, more or less. Try to make sure you have some differentials in your scoring so that your scores will actually discriminate between the different criteria, and the different teams. If you give each team 4's in each category, for example, your score for each team will be exactly the same, and you have essentially eliminated your score from consideration, since your score will be a constant.
   b. It is not uncommon to have a team that does well in one area and poor in another. Make sure that the areas that are good get scored well, and areas that are poor get scored poorly.
   c. Finally, be careful about where and how often you give fives. If you give the first team all fives, and the next team is better, you have set your scoring up for failure because you have no way to differentiate the teams.
4. Reviewing the Report
   a. Use the above suggestions first in scoring the papers. This is your first chance to set up your scoring priorities and being consistent, and you will have more time to think about consistency and ensuring a good variation in your scores.
   b. The papers give a good indication of the level of detail and efforts by each team.
5. Reviewing the Oral Presentation
   a. Be friendly and considerate to the teams. They will be nervous. Support and encourage them.
   b. Ask one question at a time, without 10 parts. At most, ask a question with only two related parts. e.g., What did you use for your cost basis, and what are the relative values of capital and operating costs for your design? One question, two parts.
   c. After every judge has asked a question, then you can ask a second question.
   d. Hard questions are fine, the students learn from them, but they need to be fair questions; do not argue with the answer, or try to show you are smarter!
   e. Ask your questions as questions. Be considerate of the teams and do not make a statement to show off your knowledge. e.g., "Can you explain your plan for addressing waste streams?" vs. (don't say things like this): "YOUR PLAN FOR ADDRESSING WASTE STREAMS WOULD NEVER BE APPROVED."
   f. Ask questions to help teams show their knowledge, e.g., "I did not see a cost analysis in your paper or presentation. Did you have an idea about what your costs might be?" vs. "YOU DID NOT PROVIDE A COST ANALYSIS, HOW COME?"
6. Reviewing the Bench-scale Demonstration
   a. Students are generally more relaxed in the bench-scale presentations. Give them a chance to talk about what they did. They will be excited to discuss their projects.
   b. Be friendly and show respect for the students. People learn best when they are respected by their teachers. Be sure to bring all team members into the conversation.

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JUDGING OVERVIEW

- Schedule Overview (*Detailed schedule on following page.)*
  - April 1, 2023: Begin scoring technical reports for your assigned teams (finish by April 7, before Orals)
  - April 7-10: Contest on-site in Las Cruces. NM Farm & Ranch Heritage Museum, 4100 Dripping Springs Rd.

- Judging Assignments
  - Sign up and select task judging preferences (see Task List)
  - Be a part of a group of approximately 6-8 judges per task.
  - Work with the same teams throughout the contest and guide them from your unique perspective.

- Judging site. (https://wercteams.nmsu.edu/) This is where you will:
  - Register to be a judge by signing up for the 2024 contest
  - Select task judging preferences (first choice most likely when signed up by February 7)
  - Download team reports for review (in the case of the 30% Review) or for scoring (Technical Report).
  - Enter comments and scores

- 30% Project Review: Teams will submit on March 1, 2024.
  - Read each team's 4-page 30% Project Review suggest ways to strengthen the report. You will not score the report. The goal is to help teams submit a final technical report that you will enjoy reading because it is thorough and complete.
  - Pay particular attention to the process flow diagrams (if applicable) and suggest improvements.
  - The report should touch upon the primary design considerations (see the specific Task Overview for the Task that you are judging) and some elements of the technical report (background, proposed solution, preliminary calculations and estimates of economic feasibility for scale-up, environmental health and safety, waste streams, permitting, and community outreach).
  - Judges will email comments to the teams through the WERC judging site. This will ensure a level playing field for all teams by keeping your contact information confidential.

- The Four Scored Events:
  1. Written Report—Teams submit their report by midnight April 1, 2024.
     - Download, read, and score each written report prior to the Oral Presentation on April 8.
     - Enter scores on the judging site for each rubric item.
     - Include as many comments as possible to help the teams learn after the contest.
       - You will not email your comments to the teams. They will see them online when the contest is over.
       - If the team submits a .docx file, you may include in-line comments in the report itself and summarize your comments in the "Comment" box provided on the WERC judging site.
  2. Oral Presentation (Business attire)
     - 30-minutes each (15 for presentation, 10 for questions, 5 for team setup/breakdown). There is a 15-minute break between presentations to allow time for scoring and taking a break.
     - Judges will not speak during a presentation until the team calls for questions.
     - Subtract 25 points for a team that goes over time or if a faculty advisor speaks up about the presentation (but helping teams with logistical problems is OK).
  3. Poster Presentation. (Business attire) Posters will be judged during a dedicated Poster Session.
     - All posters will be displayed in one room.
     - Judges visit each team's poster in groups of 2-3. Plan for a 15-minute visit per poster.
     - Teams will stand next to their poster, awaiting questions from judges.
  4. Bench-scale Demonstration (Laboratory/working attire)
     - Judges visit each bench-scale demonstration in groups of 2-3, spending 30-minutes per team.
     - The team initiates the discussion by giving a very brief introduction to their project. This leads to a two-way discussion of engineers working together to solve a problem.
     - Questions that the team could not answer during the Orals should be answered now.

SCHEDULE OF EVENTS

Pre-contest Duties

March 2 – 7, 2024: Review 30% Project Reviews and send feedback to teams (no scoring required)
Begin scoring when you receive an email notifying you that a team has submitted a report.

April 1 – 7, 2024: Score all 25-page technical reports that are on your judging portal.

Contest Duties April 7 - 10, 2024

All events at the NM Farm & Ranch Heritage Museum, 4100 Dripping Springs Rd., Las Cruces, NM

Sunday, April 7:

- 1:00 – 4:00 PM: Check in
- 4:00 – 4:30 PM: Welcome Ceremony – Judges are introduced
- 4:30 – 5:30 PM Flash Talks (optional for judges)
- 5:45 – 6:45 PM: Dinner and Keynote speaker
- 6:45 – 7:15 PM: Flash Talk Final Round
- 7:15 – 7:45 PM: Mandatory Judge Meeting—Mike Hightower
- 7:45 – 8:00 PM: Mandatory Judge Safety Orientation—Juanita Miller

Monday, April 8 (Business attire):

- 7:30 – 8:00 AM: Judges' Breakfast Meeting (Breakfast burritos and fruit served)
- 8:00 AM – 1:00 PM: Judge the Oral Presentations
- 1:00 – 1:45 PM: Lunch Served
- 1:45 – 4:00 PM: 15-minute break followed by Poster Session Judging
- 4:00 – 5:00 PM: Judges' Meeting and score entry (optional)

Tuesday, April 9 (Business casual attire/Lab-approved PPE*):

- 7:30 AM – 8:30 AM: Judges' Breakfast Meeting (Breakfast burritos and fruit served)
- 8:30 AM – 12:30 PM: Judge the Bench-scale Demonstrations
- 1:00 – 1:45 PM: Lunch Served
- 1:45 – 4:00 PM: Judges' Meeting, Score Entry, Preliminary awards discussions.
- 4:00 – 5:30 PM: Reception: Taco bar. Music & games. Casual dress.

Wednesday, April 10:

- 9:00 AM – Noon: Judges' Meeting: Awards selection for tasks
- Noon – 1:00 PM: Judges' Lunch served
- 1:00 – 3:00 PM: Judges' Meeting: Awards selection for "overall" awards
- 5:30 – 8:00 PM: Awards Banquet and Ceremony. Nicer attire suggested.

Schedule subject to change

Attire: Please dress in business attire or casual business dress, as suits your comfort level, for all official events (Orals, Poster, and Bench). The Tuesday night reception is casual, with taco bar, games, and karaoke.

***Required PPE:** Required all day Monday and Tuesday in the bench-scale area (Tortugas Gallery).
PPE includes: Safety glasses (provided at the event), long sleeves, and close-toed shoes. Teams will provide additional PPE, if necessary. As a judge, you will only be required to be in the bench-scale area on Tuesday, but you may want to walk around on Monday.

2024 Scoring Rubric

Total number of points possible: 600

I. Technical, Environment, Community Outreach (Scored across all events)	**Points Possible**
A. Background Research	25
B. Consideration of alternative technologies, justification for technology chosen, discussion of situations in which alternative technologies may be preferable to your team's design	30
C. Innovativeness of chosen technology	30
D. Design thoroughness (mass & energy balances; process flow diagrams; waste stream management)	45
E. Quality, thoroughness, and reasonable results of Techno-Economic Analysis and addressing costs of alternatives	40
F. Design practicality (cost-effectiveness; attainable with current technology, likelihood of implementation)	40
Local environmental health and safety	
G. Safety in construction and operation	20
H. Governmental regulations at all levels (federal, state, local) accounted for	20
I. Reasonableness (i.e., do not require a hard hat when there are no head trauma hazards)	20
Natural environment	
J. Waste stream management	20
K. Relevant agencies and permitting accounted for	20
L. Long-term sustainability	20
Community Outreach	
A. Effect on local area (quality of life; property values; pollution treatment or prevention)	15
B. Plan and schedule for communication with local population	15
C. Team connected with sponsor and WERC social media (ask WERC staff for information)	15
D. Addresses public perceptions. (For example, overcoming public perception that direct potable reuse of water is equivalent to drinking toilet water.)	15
Total category points possible	**390**

2. Quality of Technical Report + Audits	
A. Spelling and other typographical errors	5
B. Proper grammar	5
C. Organization (appropriate section flow, clearly marked sections, page numbers included in Table of Contents)	5
D. Executive summary covers important points and omits non-essential information	10
E. Appropriate balance between background research and the final design discussion	8
F. Thorough and accurate process flow diagram (where applicable)	10
G. Effective use of figures and tables (Figures & tables aid communication; all text & graphics are readable)	7
H. Late reports are penalized by 25 points per day late. This will be computed internally in the Team Judging Site.	
Audits	
I. All three audits are included (one each for topics: Economics, Health & Safety, Legal)	25
J. Auditor credentials (appropriate to the audit topic) and objectivity (far-removed from project development. For example, the faculty advisor is not an appropriate auditor)	15
K. Team's implementation of auditor comments	20
Total category points possible	**110**

	Points Possible
3. Quality of Oral Presentation	
A. Slides free of spelling and other errors	5
B. Slide design (appropriate amount and types of content on each slide; readability from the audience)	5
C. Appropriate number of slides, given the time allowed	5
D. Quality of speakers' delivery (easy to hear; easy to understand; talked to audience, not the floor; etc.)	10
E. Presentation follows prescribed schedule (ends on time; does not seem rushed)	10
F. Appropriateness of attire	5
G. Quality of answers to judges' questions	10
Subtract 10 points for each minute over time or if there are too many presenters	
Subtract 10 points if faculty advisor speaks after the presentation begins	
Total category points possible	**50**

4. Quality of Poster	
A. Poster is free of misspellings, grammar, and similar issues.	5
B. Poster is not overly nor under-worded	5
C. Sufficient white space with easy-to-follow flow	10
D. Good mix of text and graphics (graphs, tables, photos)	8
E. Poster can stand on its own to convey information	7
F. Poster can be read from a reasonable distance away (i.e., viewer should not have to stand six inches away to read)	10
G. Quality of answers to judges' questions (give full points if no questions were needed)	5
Total category points possible	**50**

5. Quality of Bench-Scale Demonstration	
A. Apparatus demonstrates proposed technology and works as intended	10
B. Apparatus is safely operated at all times	4
C. Team incorporates poster when appropriate for needed information	2
D. Team clearly explains how proposed technology works	4
E. Quality of answers to judges' questions	6
F. Teams addressed questions outstanding from oral presentation (give full points if no outstanding questions)	4
Total category points possible	**30**

6. Bench Scale Demonstration Competition	**Points Possible**
A. Apparatus solves the problem outlined in the task	25
B. Originality and craftsmanship of the apparatus.	20
C. Efficiency/simplicity of the apparatus design.	15
D. Demonstrates all steps required in the task problem statement.	20
E. Ease of use, reliability, etc.	15
F. Apparatus is safely operated at all times	20
G. Team clearly explains how proposed technology works	15
H. Quality of answers to judges' questions	15
I. Team effectively incorporates poster if/when needed	15
J. Teams addressed questions outstanding from oral presentation (give full points if no outstanding questions)	15
K. Analytical results validate claims	25
Total Points Possible	**200**

CONTEST SCORING

YOUR TASK ASSIGNMENT

You can find the teams you are assigned to judge by logging into https://wercteams.nmsu.edu/Account/Login
Click on "TEAM". You will judge all teams that populate that page. Judges scoring Task 1 will score all teams on the oral, poster, and bench-scale demonstrations, but for the technical report, they will score a smaller subset of these teams.

STUDY THE TASK REQUIREMENTS

Download the task requirements for the task(s) that you are judging. These can be found on the WERC website: https://werc.nmsu.edu/team-info/2023-tasks-faqs.html
Also on that webpage are FAQs based on questions the teams have been asking since they entered the competition. You may gain valuable insights from reading the answers to the FAQs for your assigned task(s).

ENTERING SCORES

Scores will be entered online on the WERC judging site. (See Appendix A for information about using the judging site.)

Go to https://wercteams.nmsu.edu > TEAM; then click the Grading button for each team.

SAMSUNG GALAXY TABLETS

At the contest, you can borrow a Samsung Galaxy tablet with a keyboard to use for entering scores. This might be handy since you are often on the move at the contest – walking around the poster session and the bench-scale demonstrations. Alternatively, you may use your own device to log in to the WERC judging site.

SCORING FRAMEWORK

Evaluate these items along the way and update as you progress through all four events:

- 1- Technical Content, Environment, Community Outreach

The remaining scoring categories are event-specific:

- 2- Quality of Technical Report and Audits
- 3- Quality of Oral Presentation
- 4- Quality of Poster
- 5-Quality of Bench-scale Demonstration
- 6-Bench-scale Demonstration Prize

Scoring strategy for Rubric 1. Since Rubric 1 (Technical Content, Environmental issues, and Community Outreach) is scored across all events, consider your strategy for scoring these along the way.

- Take Notes: Keep good notes throughout the events to help you finalize your scores for this rubric and ensure that the team's final score in rubric 1 reflects your impression of their work across all events.
- Setting preliminary points:
  - You may wish to enter preliminary points for Rubric 1 while reading the technical report and then update your scores after each subsequent event.
  - Each time you press the Submit button, your scores will update. Scores can be updated online until the Judges' Awards Deliberations Meeting. Scores will be frozen at that time.

PRE-CONTEST EVENT: THE 30% PROJECT REVIEW

Teams are instructed that an engineering 30% Project Review outlines for the client an engineering firm's preliminary design. 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.

Review Dates: Judges review the reports from March 2 – March 8, 2024.
If your review is delayed, please email the team to let them know when to expect your comments

How to review: Download the team's report from the wercteams.nmsu.edu site, and
Send your comments back to the team through the link provided on that site.

Emailing teams: Responding to the 30% Project Review is the only time you should email the teams.

Judge Assessments: The review is not scored, you will send feedback to the teams for improving their project, process, or report. Please guide the students following WERC's judging policy on p. 3: "Be friendly and considerate to the teams. They will be nervous. Support and encourage them."

REPORT SPECIFICATIONS:

Page Limit: Four pages.

Audience: A Business document written as a preliminary report for a "client," although the name of the client does not need to be included.

Project modifications: Teams are allowed to change their plans after submitting the Project Review. If they wish, they can re-submit a 30% Review to you for further comments, but they probably will not.

REVIEWING THE REPORT:

- Voice: Was it written from the standpoint of the team presenting preliminary findings to a client?
- Description of the project—primarily look at content. Look for one bulleted list outlining goals, planned solution to the problem, and any anticipated drawbacks.
- Process Flow Diagram or schematic diagram (as applicable)—Look for all mass and energy balances, as applicable, or other elements required in their schematic diagram. Point out omissions.
- Preliminary Technical Data – Teams may or may not yet have data. If they do not, they should state this upfront and indicate how they intend to collect the data. Do not criticize them if they report that they have no technical data.
- Rough Cost Estimate – Teams' designs should be partially cost driven. Though this is early in the process, they should at least present preliminary cost research and be able to report expected cost savings (such as, "this approach is expected to save 20% over current practices based on X data and Y data"). If they have no cost data, they should say so and indicate how they plan to obtain the data. Do not criticize them if they report that they have no cost-related data.
- Project schedule—They should report on how are they progressing in their design/build work. You may not need to comment on this, except to provide encouraging words.
- Table of Contents—This is their planned table of contents for their final technical report. Do they have a reasonable plan for their report? Do any items appear to be out of order? Did they omit anything. Please provide helpful feedback on these things.
- If the team provides insufficient information, indicate this and send it back without further comment. There is no need to attempt to comment on too little data. Teams need to know that they cannot receive help if they provide insufficient information. You may write something similar to:

  "I appreciate the report, but it looks like you are not quite ready to receive feedback. Keep moving forward, and I wish your team all the best…."

HOW TO VIEW AND COMMENT ON REPORTS

- Sign in to https://wercteams.nmsu.edu
- Go to the TEAMS tab
- Click on a "30% Project Review" button that has a green checkmark. (If the button has a red "X", the team did not submit a report).
- You will be given the option to either download the report or email the team. Click "Download…"
- Review the report:
    - If teams submitted in .docx, you can put the file in Review Mode in Word and make comments directly into the paper.
    - If teams submitted in pdf (or if this is your general preference) you may enter your comments in a file and send it to the team or you may place your comments in the body of the email box provided.
    - If you enter comments in the body of the email, first enter and save it in another file, then copy/paste it into the email. Spending too long in the email server on our wercteams site will cause you to lose your data.

HOW TO SEND YOUR COMMENTS TO THE TEAMS

- When you are ready to send your comments back to the team, click their "30% Project Review" button, then "Email to members."
    - This will give you a simple email box with a Subject, a space for text, and a button for uploading a file.
    - Clicking "Upload File" will open your file system.
    - Click on the file you want to upload
    - Click on the "link" icon that looks like a chain. This will embed the file into your email. (The file name will look odd because it will be an address where your file is stored in WERC's file system***) If you don't click the link icon, the file will not get attached***.

- The email you send will come from WERC's email. Teams will not see your email address, and therefore cannot reply to you. This is intended to protect your time and keep all teams on a level playing field.
    - Sign your name or enter your initials in the body of your email to the teams.
        - This is the only way I will know which judge sent the email.
        - This is important because sometimes teams have questions for the reviewer (I screen all questions and make sure that they really need an answer from you),
        - In one case, the reviewer accidentally sent comments to the wrong team. If I know which reviewer sent the comments, I can quickly resolve the issue.

EVENT 1: SCORING THE TECHNICAL REPORTS

Technical Report Overview

Download. Download each team's technical report from the WERC judging site (wercteams.nmsu.edu > Team) If you need help navigating the site, follow the "Judges' Guide to the Judging Site." (Appendix A)

Deadline. Reports will be submitted by 11:58 PM on April 1, 2024. The reports are scored on your own time. Please complete technical report scoring prior to the Oral Presentations on Monday, April 8, 2023.

Report Formatting

Report page limit: 27 pages, including all elements listed below, excluding the Audits. See Appendix A for published formatting guidelines.

Required elements (All included in the page limit):

- Cover page identifying the task, team number, school name, advisor(s), and team members
- Table of contents (include page numbers in the table)
- Executive summary (maximum of two pages) highlighting the proposed solution
- Report body, including PFD, figures, illustrations, photographs, and graphs
- References (No specific formatting is required, but they should be consistent within a paper)
- Audits (Three audits: Health/Safety, Legal, Economics) (Not included in the page limit). Audits have no specific formatting requirements, but should be on company letterhead, if applicable.

Scoring

To enter your scores, go to wercteams.nmsu.edu > TEAM; then click the Grading button.

- Scores for the rubric items that are specific to the Technical Report (Audits and Quality of Technical Report) should be entered online at wercteams.nmsu.edu, along with your comments. You should not need to re-visit these scores later.
- When you score the Technical Report, you will establish preliminary scores for Rubric 1 and finalize the scores for Rubric 2. You will likely update the score for Rubric 1 after you meet with the teams during subsequent events.
- Each time you press the Submit button, your scores will update. Scores may be updated online until the final Judges' Meeting during which final award decisions are made. "Submit" often to ensure you don't lose data.

Comments. Enter comments for the teams in two places (if possible):

- In-line comments in the body of the report (if team uploaded in .docx format, add comments in "Review" mode.). If you make in-line comments, please email the document to werc.nmsu.edu and we will forward it to the team after the contest.
- Comment box on the WERC judging site. Universities need the comments for ABET accreditation, and the students need to learn from these. Click the red "Comments" button at the top of each category to enter comments.
- Make sure your comments are thorough. Because your preliminary scores for Technical Content, Environment, and Community Outreach will likely change as you continue to meet with your assigned teams, your comments will be extremely important at the end as you reflect on your evaluation of the technical reports.

Recommendation for IEEE Proceedings. While reading each report, consider if you would recommend the report to be considered for publication in the IEEE WERC Design Contest Conference Proceedings.

- The paper does not need to be perfect to be selected for the next stage of review; it only needs to have potential for publication. Teams will be expected to correct their reports according to judges' comments.
- Judges will discuss IEEE publishing recommendations during the Wednesday awards deliberations.
- After the contest, you may be asked to serve as a reviewer for the IEEE reports in your task.

Freeport McMoRan's Innovation in Sustainability Award and P2 Award Recommendations.

While reading each report, make note of papers that would be most deserving of the Freeport McMoRan (FMI) Innovation in Sustainability Award and the Pollution Prevention (P2) Award. (See Awards)

EVENT 2: SCORING THE ORAL PRESENTATIONS

Oral Presentation Overview

Timing. Oral Presentations will be back-to-back, with a 15-minute break for judges between presentations.

Team introductions. At the beginning of the oral presentation, the Team Leader will introduce team members to the judges.

Number of presenters. There is a maximum of four people on the oral presentation team. These team members may be any student who officially signs in at registration. Your judging team may elect to allow more than four presenters, but if it negatively affects the presentation, reduce points for quality of presentation.

Attendees. Students, team members, and the team's faculty advisor(s) may attend the presentations made by their own universities. The oral presentations will not be open to any other participating teams.

Recording. Advisors are allowed to record the session to use as a teaching tool for their students.

Oral Presentation Schedule

5 minutes for setup/teardown. This includes the time required for moving onto the stage, setting up and breaking down displays and audio-visual equipment.

15 minutes for the team's oral presentation. Only presenters will speak. Judges remain silent.

10 minutes for Q/A from judges. This is a professional and friendly Q/A session. During this time, the judges work as advocates for the teams to help them explore implications of their designs in real-world applications. Questions may only be answered by the student-presentation team members, not anyone in the audience.

15 minutes for judges to enter scores. During this time, please do not discuss your impressions of the team in ways that might influence the other judges' scoring. Evaluations and comparisons of teams are reserved for the Judges' Meeting on April 10. You might want to use the scoring time for reflecting upon the team's presentation, jotting notes, entering scores, getting to know other judges, and asking questions about scoring guidelines.

Scoring

- At the beginning of the Oral Presentations, have handy the scoring rubrics for Rubric 1 and Rubric 3. (Print out from pp. 6-7 in this handbook or access through the judging site online).
- To enter your scores, go to wercteams.nmsu.edu > TEAM; then click the Grading button.
    - Update scores for Rubric 1
    - Enter scores for Rubric 3 (Quality of Oral Presentation)
- When entering comments, indicate that your comments refer specifically to the oral presentation.
- Special awards: Note key aspects of the presentations that might fulfill requirements of the FMI Innovation in Sustainability Award and the P2 Award. Submit recommendations to a WERC staff member.
- Point Deductions. If applicable, on the scoring site, enter:
    - To deduct points if the team's faculty advisor answers judges' questions, interjects to clarify, or distracts the team by sending signals. (Enter "1" for each time the faculty contributes, and the system will subtract 10 points.) Immediately give a polite warning to the faculty advisor to apprise him/her of the issue.
    - The number of minutes the team went over time. (Enter the number of minutes that the team went over time, rounding up to the next whole minute. The system will subtract 10 points per minute over.)

List of Suggested Questions for the Oral Presentation

1) What are your plans to overcome the community concerns related to this process?
2) What is your approach to minimize the waste generated by your process?
3) How would you improve your design?
4) What are the lessons learned?
5) Why did you choose this design?
6) Who did the audits for you? Why did you choose them?
7) Did the test results in your lab meet the Task requirements?
8) Which of the contaminants was the most difficult to remove and why?
9) What regulations (Federal and State) impacted your design the most?
10) Were you able to obtain the desired effluent limits in your test runs?
11) Did you have industrial partnerships or equipment donations for your project? In what capacity?
12) In case of spills, what is your emergency containment and cleanup plan?
13) In your process, what was the most difficult step? Why?
14) What is the most critical path for your proposed process? How do you plan to arrive at a successful process?
15) What makes your process outstanding relative to others which are currently available?

EVENT 3: SCORING THE POSTER SESSION

Poster Session Overview

- Judges will evaluate each poster based on its ability to convey the team's research, data, and conclusions from their project as a stand-alone-document.
- Maximum poster board size: 36" X 48". Only one poster is allowed per team.
- All posters will be displayed in one room (Ventanas Ballrooms).
- Judges will first be given 45 minutes to score the posters in a closed session.
- Teams will enter after 45 minutes and be on hand to discuss their posters for 1 hour and 10 minutes. At this time, Judges will visit each team/poster in groups of 2-3 and spend 10-15 minutes talking to each team about their poster.
- Judges will vote for best poster.

Scoring

- Have handy scoring Rubric 4 (Quality of Poster) (either printed or online).
- Enter scores online for Rubric 4 along with your comments.
- When entering comments, indicate that your comments refer specifically to the Poster Session.
- Poster content: The poster should tell the whole story without a team member being in attendance.
- No more than 3 team members should attend the poster at one time, due to space constraints. Teams may rotate team members during the poster session.
- You may wish to update scoring Rubric 1 after the Poster Session.

EVENT 4: SCORING THE BENCH-SCALE DEMONSTRATIONS

Bench-scale Demonstration Overview

The Bench-scale Demonstration requires teams to demonstrate that their proposed solutions work. Teams build their bench-scale models at their home college or university and use them to hone their solutions and obtain data that they report at the contest. They bring their bench-scale apparatus to Las Cruces where WERC requires them to demonstrate that their apparatus does what they claim it does.

it is likely that you will not see a given team's apparatus actively running when you arrive at their booth, due to logistical issues (teams set up the bench-scale apparatus and run it, and WERC conducts validation tests). In some cases, the team may be able to start it up to let you see it in action. In other cases, the team will only be able to point out features of their design and describe how the apparatus functions. Judges find that this, in itself, is very valuable when discussing a team's project, and the students enjoy it immensely.

Team setup. Students start setting up their bench-scale equipment at 1 PM on Sunday. WERC begins handing out samples to teams to run on their equipment on Monday at 8:00 AM, after the team has been commissioned to run the apparatus. The teams' bench-scale demonstrations are expected to be operational by Monday at 10:00 AM. WERC collects final samples for analysis no later than Tuesday at 2:00 PM.

Bench-scale demonstration logistics. On Tuesday morning, judges will be assigned to visit each team's bench-scale demonstration in groups of two or three judges. Each group of judges will spend 30 minutes visiting with their teams.

The teams will give you a tour of their bench-scale apparatus. You will can ask them questions about design details and they can point to various parts of their apparatus. The teams' posters are also on display for quick reference during this session, but they will not be scored at the bench-scale demonstration.

Faculty advisors are discouraged from attending the bench-scale demonstration. If a faculty member is present, please ensure that he/she does not answer questions for the team, but only acts as an observer.

The bench-scale demonstrations are the students' favorite part of the competition because they have the chance to show judges what they built, and they enjoy discussions with the judges. It may be difficult to leave a booth after 30 minutes because the teams are so enthusiastic about their projects.

Attire and required PPE: Dress is casual or business casual. Safety glasses (provided at the event), long sleeves, and close-toed shoes are required in the bench-scale demo area. Teams will provide additional PPE for their booth, if necessary. Teams may wear lab coats, but it is not required.

Judging considerations

- Make sure that teams address all waste streams. For example, if the proposed process includes removal of a contaminant by transferring it into another media, teams should: 1) include steps to properly clean and discharge the media and 2) address waste stream costs.
- Ensure that the bench-scale processes are being run safely. Although the teams go through a rigorous experimental safety screening, we depend on you to ensure that the teams observe expected safety measures. If you see hazards, bring it to the attention of Juanita Miller, WERC's Safety Officer, at the Safety Desk.

Scoring

- At the beginning of the Bench-scale Presentations, have handy the scoring Rubrics (print out or access online):
    - Rubric 5: Quality of Bench-scale Demonstration
    - Rubric 6: Bench-scale Demonstration Prize
- Enter scores online for Rubric 5, along with your comments.
- When entering comments, indicate that your comments refer specifically to the bench-scale presentation.
- Enter scores for Rubric 6. These are more detailed to help us award bench-scale demonstration prizes for each task.
- You may wish to update scoring Rubric 1 after the Poster Session.

AWARDS

Awards Deliberation

Wednesday, April 10, 9:00 AM – 3:00 PM (lunch served).

The morning session will be dedicated to discussing awards for your assigned task(s) with your team of judges. The afternoon session will be used for completing discussion of the task awards and discussing overall awards (Freeport-McMoRan Innovation in Sustainability Award, P2 Award, Judges' Choice Awards) and the Terry McManus Outstanding Student Awards.

Awards Ceremony

Wednesday, April 19, 5:30 PM – 8:00 PM (optional). We hope you can join us at the Awards Ceremony.

AWARD CATEGORIES

This year, the WERC Design Contest and its sponsors will award more than $31,000 in prizes:

1. Task awards (First, Second, Third Place; minimum amounts: $2500-$1000-$500, respectively). Awards are based on the judging rubric scores for each team. The number of awards will depend on the number of entries in each task. We apply the one-half rule: No more than half of the entries will receive awards. For example, if there are 3 entries in one task, there will be a First-Place award only. If there are six entries, there will be First-, Second-, and Third-place awards, etc.

2. Bench-scale Demonstration Awards (First, Second, Third Place: $1000, $750, $500, respectively.) This award is determined solely on the teams' scores from Rubric 6: Bench-scale Demonstration Prize Rubric. The number of awards will depend on the number of entries in each task. We apply the one-half rule: No more than half of the entries will receive awards.

3. Freeport McMoRan Innovation in Sustainability Award ($2500). Recognizes the team that creates the best overall innovative product, process or solution to a land management, energy, water, and/or air or other sustainability issue(s). The award is discussed in more detail on the following page.

4. WERC Resources Center Pollution Prevention (P2) Award ($1000)
   Recognizes the team that best utilizes the concepts of P2 (pollution prevention) and Energy, Environment, Economy in their solution. The award is discussed in more detail on a following page.

   Primary considerations: Reduction/elimination of waste, greenhouse gases, hazardous materials; conservation of water and air; utilization of sustainable materials; energy efficiency.

4. Judges' Choice Award ($500). This award will be explained during the judging session.

5. Peer Award ($250). Competing students vote on their favorite team projects.

6. Terry McManus Outstanding Student Award. ($500/student, according to funding).
   All participating students are eligible for the Award. Faculty will nominate up to three students per team. Judges are asked to observe students during the contest and make recommendations. The award is discussed in more detail on a following page.
   WERC anticipates awarding three Outstanding Student Awards in 2023.

7. Flash Talk competition ($1000-$750-$500-$250). You will not be judging this event. It is evaluated by a separate team of judges. We hope you can attend to see how well your assigned teams condensed their research into a 3-minute presentation.

SPECIAL AWARD CONSIDERATION:

Freeport-McMoRan Innovation in Sustainability Award

Freeport-McMoRan Award Overview

Freeport-McMoRan (FMI) offers the Innovation in Sustainability Award to recognize the WERC Environmental Design Team that creates the best overall innovative product, process or solution to a land management, energy, water and/or air or other sustainability issue(s); and meets FMI's approach to Sustainable Development and Resource Conservation.

FMI selection criteria will focus on the final innovative solution (rather than the process of developing the solution), how well it addresses the sustainability issue, and the ease and practical use in a real-world setting.

Freeport-McMoRan Award Selection Criteria

- Potential for real-life use and implementation
- The degree to which the proposed product, process, or solution successfully addresses a land management, energy, water and/or air or other sustainability issue(s).
- Demonstration of Physical, Chemical and Ecological effects on Sustainable Development as it relates to land, energy, water, and/or air.
- Energy and water use efficiency.
- An understanding of the Operational, Environmental, and Social Impacts of Product/Solution or Method, including upstream and downstream issues.
- Affordability/cost-effective operation and maintenance; quality of cost/benefit analysis including all sustainability elements or selections made in developing the product/solution/method.
- Overall potential environmental, social, and economic benefits.

Freeport-McMoRan Award Selection Process

The Freeport-McMoRan Award focuses on the final product or solution that contributes to sustainability and is not intended to duplicate the process used by the WERC judges in selecting the winners for each task. Therefore, the Freeport-McMoRan selection process centers on the bench-scale demonstrations and the results of these projects as they relate to the criteria above. Although the written and oral presentations may be used to document project results, these items will not be specifically evaluated for the Freeport-McMoRan Award.

Freeport-McMoRan Award Selection Schedule

Sunday – FMI award criteria, schedule and process reviewed with WERC judges at the Sunday evening meeting.

Monday – WERC judges review and evaluate oral presentations. Judges are encouraged to note key aspects of the solution presented that may be applicable to the FMI award. After the initial presentations, judges are asked to provide Freeport-McMoRan with an initial list of potential candidates for the FMI award.

Tuesday – WERC judges and Freeport-McMoRan personnel will review bench-scale project demonstrations and poster presentations. The Freeport-McMoRan team will focus on carefully reviewing those projects that were recommended by the WERC judges.

Wednesday – In coordination with Freeport-McMoRan personnel, WERC judges discuss projects and make final selection for the award. Freeport-McMoRan will present Innovation in Sustainability Award at the awards ceremony.

SPECIAL AWARD CONSIDERATION:

Outstanding Student Award in Memory of Intel's Terry McManus

To honor his memory, in 2006 Intel created the Terry McManus Memorial Award to be given to a student or students who demonstrates the same drive Terry had. Terry loved coming to the Design Contest every year and seeing students who shared his drive for environmental excellence. This memorial award is given to a student who demonstrates a passion for the environment and has demonstrated this through their actions.

The award is determined by the judges.
Each team is given the opportunity to nominate up to 2 students among their team. They give the names of the nominated students to their advisor.

Each advisor is asked to write 3-4 sentences in support of the nominated students. The write up should demonstrate the student's commitment to environmental excellence with a passion to pursue global environmental improvements of the future.

Each judge will observe the nominated students during the competition and make recommendations for the award during the awards deliberations on Wednesday, 19 April.

SPECIAL AWARD CONSIDERATION:

Pollution Prevention (P2) Innovation Award

Award Overview

The College of Engineering at New Mexico State University (NMSU) has been providing technical assistance and outreach on energy and environmental issues to the business, agricultural, and educational sectors in New Mexico since 1999. Currently, this work is led under the auspices of the Department of Outreach and Recruiting within the College of Engineering.

In 2014, the College of Engineering initiated a Pollution Prevention Innovation Award to recognize teams in the WERC Environmental Design Contest that best utilize the concepts of Pollution prevention (P2). P2 is any practice that reduces, eliminates, or prevents pollution at its source. Reducing the amount of pollution produced means less waste to control, treat, or dispose of. Less pollution means fewer hazards posed to public health and the environment. The student should consider the concept of P2 in their solution(s) and come up with cost-effective ways to reduce, minimize, and/or prevent pollution through improved operational processes which bring savings on all aspects of energy, environment, and economy.

Award Criteria

- Demonstration of an understanding and implementation of the following:
  - Significant reduction or elimination of wastes at their sources
  - Reduced generation of greenhouse gases
  - Reduced use of hazardous materials
  - Conservation of water and air resources
  - Utilization of sustainable materials
  - Energy efficiency measures
- Application of environmental hierarchy: reuse, reduce, recycle, treatment, disposal
- Adoption of “triple bottom line” concepts of environmental, social and economic benefits

Award Selection Process

This Award is based solely on results of the bench-scale demonstrations. Although the written and oral presentations may be used to document project results, these items will not be specifically evaluated and considered for the Pollution Prevention Award.

Award Selection Schedule

Tuesday – Design Contest Judges begin the process of reviewing the Task projects. After the bench-scale demonstrations, judges are asked to provide WERC staff with list of preliminary recommendations for the P2 Award.

Wednesday – Judges finalize selection of the award winner during awards deliberations.

2024 TASK LIST

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Task 1: Stormwater Management for Community Resilience

Task 2: Towards Net-Zero—Distributed Energy Resource Management Systems for the Electrical Grid

Task 3: Sodium Sulfate for A Circular Economy – Community-based Solutions

Task 4: Modular Carbon Dioxide Removal for Community Integration

Task 5: Treatment of Water Recovered from Salt Water Disposal Wells for Hydrogen Production

Task 6: Open Task

2023 TASK OVERVIEWS

Task overviews on the following pages are excerpts from the full task statements.

TASK 1 – STORMWATER MANAGEMENT FOR COMMUNITY RESILIENCE

Sponsors: NM Space Grant Consortium, EPA Office of ORD, Souder, Miller, & Associates, Jacobs Engineering Group.

Problem statement

Your team will research, evaluate and design an innovative, low-cost stormwater management system that is resilient to future climate scenarios that can be implemented in a selected area that is challenged by EJ/CJ issues. Solutions should be able to treat large volumes of water quickly and be practical to implement within a chosen EJ/CJ community.

Design requirements

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

- Select a community for the stormwater management system, with consideration of local stormwater needs and the relationship between demographic and risk factors.
- Design a system to handle storm-related flows and potential contaminants for the area of interest during both routine and extreme precipitation events, with consideration of the trade-offs between cost and the severity of precipitation that the system can manage.
- Present a solution that minimizes environmental impact, cost, and waste generation.
- Identify locations where the solution could be effectively sited in the selected community with minimal disturbance to infrastructure or existing land uses.
- Provide a diagram illustrating the features of the project. Diagrams may include site map(s) with dimensions and specifications and/or process-flow diagrams that include mass and energy balances of the treatment process(es), water flows, etc., as applicable.
- Quantify the local benefits of the proposal, including both direct physical improvements and any social, environmental, and economic co-benefits, to demonstrate that the needs of the targeted community and its local waterway are preserved.
- Develop an appropriate community engagement plan.
- Discuss project implementation, including permitting, safety, and regulatory compliance.
- Present a Techno-Economic Assessment and Analysis (TEA) to construct your proposed stormwater project. Target the stormwater management solution towards community needs, with the community or local government being the customer. Consider capital expenses and operating expenses, according to typical costs in the community you are addressing and include a cost/benefit analysis to assess the potential benefits to the community. Inviting a business/economics major as part of a multi-disciplinary team may be helpful as you draw up economic plans for full-scale implementation.
- 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.
- Address safety aspects of handling stormwater and any waste products. Safety issues for 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).

Bench Scale Demonstration

Bench-scale demonstrations will serve to illustrate the design considerations listed above and will consist of a three-dimensional scale model and/or a digital/virtual simulation to demonstrate functionality of the solution. The bench-scale demonstration will illustrate the selected stormwater issue, the proposed stormwater management system, and the system's effect(s) on the community.

Teams will provide at contest

A three-dimensional scale model, and/or equipment needed to display simulation(s). If the apparatus will remove contaminants from the water, teams will provide the contaminant materials, subject to ESP approval.

TASK 2. TOWARDS NET-ZERO—DERMS FOR THE ELECTRICAL GRID

Sponsors: El Paso Electric Co. and Las Cruces Utilities

Problem statement

Design and develop an analytical simulation that demonstrates power flow during grid variability and the associated BTM response for both peak-demand and excess renewable-supply events. The simulation should reflect the communication between the utility and the local DERMS. Incorporate a bench-scale demonstration as proof-of-concept of the design.

Teams will select a scenario consisting of an aggregate of households, commercial businesses or large industrial facilities to cost-effectively manage BTM devices to reduce demand and/or spread demand over peak and off-peak times. The ultimate goal is selecting an application that will yield the greatest power demand leveling per dollar spent with consideration to implementing the program in an environmentally conscious way.

Include a customer education and engagement plan and incentives to encourage participation.

Design requirements

In addition to Problem Statement requirements, your proposed design should address the following.

- Research and report actual power usage from the communities, sets of businesses or industrial facilities considered.
- Discuss the chosen large-scale application and report its advantages over other applications considered.
- Develop scalable solutions that demonstrate your solution's impact on grid support. BTM solutions will be applied to a neighborhood or business application, as outlined in the task problem statement.
- Utilize computer software or design and develop a computer simulation that demonstrates power flow during grid variability and the associated BTM response during both peak demand and low-carbon events. The simulation should reflect the communication between the utility and the local DERMS in terms of load profiles.
- Demonstrate the feasibility of the design through a bench-scale demonstration using grid-tied DERMS for local control (API, app, applet, etc.) that communicates with one or more household devices of your choice that manages the output or consumption of BTM devices. Your setup should:
    - Take input from both the utility and the household device to determine how to optimally control the power flow (binary, analog, combination, or advanced).
    - Allow the customer or the utility to select operating parameters and override settings when necessary.
        - The customer should set initial power-flow benchmarks (time of day, SoC, etc.)
        - The utility may override the customer settings in the event of a power emergency.
        - The customer may override the utility's override in the event of a household emergency.
    - Consider demand response types (binary, analog, combination, or advanced) that will optimize energy savings.
    - Select the communication type that will provide the greatest advantages (such as local [own phone or similar], with the utility's signal, or other advanced communication options).
    - Respond to a minimum of one event (only peak load or only excess renewable-supply). Teams may opt for more functionality by responding to two events (peak demand + excess), or more than two events.
- Propose a plan for
    - Device implementation
    - Budget for full-scale implementation
    - Customer rate tariff that sets up incentives for customer participation

- Report predicted environmental impacts of the design.
- Develop a customer education, outreach, and engagement plan to encourage participation.
- Present a Techno-Economic Assessment and Analysis (TEA) to construct a DERMS grid-tied solution (API, app, applet, etc.) that communicates between a New Mexico utility company and aggregate customers to manage their output or consumption. The TEA will include your estimate of capital costs (CAPEX), operational costs (OPEX), including customer education costs and incentive costs. Include appropriate graphical representation of your cost data.
- To be considered for the WERC P2 Award (an award available to all teams that participate in the contest), in a separate section of the report (titled "Pollution Prevention"), document success in improving energy efficiency, pollution prevention, and/or waste minimization. Note that this task already focuses on energy efficiency. To stand out in this award category, consider implementing additional pollution prevention or waste minimization measures.
- Address any safety aspects of implementing your design solutions.

Bench-Scale Demonstration

At the bench-scale demonstration in Las Cruces, teams will demonstrate their software solution for controllable operation of household or commercial devices.

To demonstrate feasibility of the design, develop a bench-scale demonstration using grid-tied DERMS for local control (API, app, applet, etc.) that communicates with and manages the output and consumption of at least one device that will represent communication with a device from an aggregate of households, aggregate of commercial buildings, and/or large industrial plants. Additional points will be added to the score for additional devices (up to three). See rubric below for details.

In addition to the bench-scale demonstration, teams may include video productions, computer simulations, tabletop displays, and scale or architectural models to assist in the presentation; these inclusions can be beneficial to your presentation but shall not be substitutes for the bench-scale demonstration.

Bench-Scale Testing at the Contest

Teams will bring to the contest all necessary software and hardware-control infrastructure needed for demonstration of up to five electrical connections. At the contest, teams will demonstrate to judges their app's functionality under different scenarios during the bench-scale demonstration.

TASK 3. SODIUM SULFATE FOR A CIRCULAR ECONOMY – COMMUNITY-BASED SOLUTIONS

Sponsor: Freeport-McMoRan

Problem statement

Propose a design for processing anhydrous sodium sulfate salts to create an economically viable product that can be produced on or off site of the Freeport-McMoRan refinery and rod mill.

Solutions should be innovative and cost effective to optimize the value of the sodium sulfate. The amount of product produced annually should track with FMI's current production rates of anhydrous sodium sulfate salts. The design should have a positive environmental impact, reducing the carbon footprint and the burden on landfills while finding a beneficial use of a non-hazardous resource.

The proposed site should be based on economics, environmental impact, waste management, circular economy considerations, jobs, and social justice.

Design Requirements:

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

- Describe the product, including how it can be sold at a profit.
- Include a process-flow diagram of your process(es), complete with mass and energy balances.
- Establish that your team's proposed rates of production will balance with FMI's sodium sulfate salt production rate of 3.6 million pounds/year.
- Assess the environmental impacts of your solution.
- Propose a community involvement plan that outlines how your team's plans engage a local community to implement and operate the facility.
- Address any waste products or by-products that may be produced from your process.
- Present a Techno-Economic Assessment and Analysis (TEA) of your design. Consider adding a business/economics major to your team to help with this. 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.
    - Assume that anhydrous sodium sulfate will be provided at $1/ton.
    - Consider: Any waste-disposal rates, energy and labor costs, depreciation or capital, value-added by turning the raw material into a more valuable product, maintenance of the facility, handling of hazardous waste, if applicable.
    - Operating costs: In addition to other operating costs that your team identifies, include these operating costs: staff labor rate of $50/hour; solids disposal costs ($70/ton); energy requirements (cost/yr and Kwh/yr): industrial natural gas rate (research and state in $/MM BTU); electricity rate of $0.10/kWh. Include transportation costs.
- Address safety aspects of operating your technology. Safety issues for both the full-scale design and the bench-scale demonstration should be addressed in both the written report and the Experimental Safety Plan (ESP).
- 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 the intangible benefits of your team's solution, if any.

Bench Scale Demonstration

The bench-scale setup should demonstrate your team's design for producing a product made from anhydrous sodium sulfate. Teams will bring to the contest (when feasible—see ESP, below) equipment and supplies needed to demonstrate production of their chosen product at the bench scale.

TASK 4. MODULAR CARBON DIOXIDE REMOVAL FOR COMMUNITY INTEGRATION

Sponsor: Department of Energy Office of Fossil Energy and Carbon Management

Problem Statement

Research, design, and develop an innovative modular carbon dioxide removal (CDR) system capable of removing a net of 100 metric tons of CO_2 from the atmosphere per year. Your analysis must demonstrate that all sources of potential CO_2 emissions occurring from the operation of the modular unit are accounted for. The CO_2 storage mechanism should be sufficiently durable so the CO_2 is not anticipated to be released for at least 100 years.

The design should be simple, easy to implement, aesthetically pleasing, and motivate communities to adopt the modular system.

Teams will develop plans for scaleup to implement multiple units within a community, seeking feedback from the community to determine the number of units, placement, etc., with consideration of community concerns and needs coupled with appropriate CO_2 removal for that community.

Design requirements

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

- Interview a community of your choice to assess concerns, needs, etc. relative to CDR prior to developing your solution.
- Discuss your system's means of atmospheric CO_2 removal, and, if different, your system's means of CO_2 sequestration.
- Demonstrate an annual net removal of 100 metric tons of CO_2 from the atmosphere, including a "cradle-to-grave" lifecycle assessment.
- Demonstrate the durability of the CO_2 storage for at least 100 years and propose an outline for the monitoring, reporting, and verification (MRV) protocol.
- Discuss the additionality of the CDR solution in terms of added removal of atmospheric CO_2 compared to current local policies and practices.
- Address any disbenefits and/or co-benefits of the system, such as impacts on environmental health, education, economy, etc.
- Discuss maintenance of the system, such as the need for replacing/regenerating/reorienting materials.
- Propose a community adoption strategy that includes:
    - a community education plan to inform the population of the need for and benefit of CDR
    - a community engagement plan for system design that considers the needs and concerns of the community
    - clear instructions that enable residents, a neighborhood, a school, etc., to implement and maintain the system without compromising the durability of CO_2 storage
    - consideration of scaleup
- Discuss the considerations, both technical and community-oriented, for strategic placement of the module(s) in a community.
- Conduct a techno-economic analysis for the community of interest, demonstrating the 1) all-in investment cost to set up and operate the modular system and remove 100 metric tons of CO_2 per year, 2) the marginal cost of removing one ton of CO_2, comparing to the goal of $100/net metric ton of carbon dioxide-equivalent outlined in DOE's Carbon Negative Shot [17], and
  3) income from predicted carbon credits.

- 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.
- Address safety aspects of handling the CDR system and any secondary products. Safety issues for 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).

Bench Scale Demonstration

Bench-scale demonstrations will serve to illustrate the design considerations listed above.

In particular, your team's bench-scale apparatus will demonstrate the ability to remove CO_2 from the atmosphere. The apparatus should be designed as a sealed system that accepts air from a compressed gas cylinder and lowers the air pressure to 1 atm prior to entering your process.

Teams shall discuss storage in the technical report and oral and poster presentations. It may be demonstrated in the bench-scale demonstration, but this is not required.

Teams will have up to 30 hours to complete the demonstration, provided that the apparatus can safely run unattended overnight. Operational safety will be determined from the ESP review and final commissioning.

TASK 5. RECOVERING AMMONIA FROM PRODUCED WATER FOR BENEFICIAL REUSE

Sponsors: NGL Water Solutions

Problem statement

Design a treatment train to accept water from a Class II SWD in the Permian Basin that can, as inexpensively as possible, treat this brine to meet hydrogen production influent standards of DI-quality water.

Assume that, when it reaches ground level, the surface the water will be 280^o F and 2000 psi, based on a well that is 18,000 ft deep. Assume the throughput at the well head at full scale is 1000 gal/minute.

Design requirements

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

- Develop a treatment process that is designed to operate at starting temperatures and pressures of 280^o F and 2000 psi, respectively. Support your assumptions as appropriate.
- Tailor the bench-scale demonstration to safely work at atmospheric pressure and boiling temperature of brine at the elevation of Las Cruces, New Mexico.
- Include a Process Flow Diagram (PFD) for the selected treatment process(es). The PFD must include mass and energy balances (input and output rates, waste streams, reactants, reaction rates, etc.).
- Base your analysis on a treatment facility that will yield a minimum of 20,000 bbl/day water that meets the standards shown in Table 1. Report the predicted treatment efficiency.
- Include an analysis of the energy savings and cost savings from capturing the energy from the elevated temperatures and pressures from the deep disposal wells as compared with costs of conventional PW treatments for DI-quality water.
- Address benefits and/or potential new revenue streams that may result from extracting brines from deep SWDs.

- Present a Techno-Economic Analysis (a.k.a. Techno-Economic Assessment) to construct a full-scale water treatment process to produce 20,000 bbl/day of DI-quality water. This 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.
    - Demonstrate all costs including all waste stream disposal. Although only one step in the treatment, consider that the current cost for traditional desalination is approximately $1.00/bbl.
    - Operating expenses (OPEX) should be calculated as cost/bbl of DI water produced on an annual basis. This include, but is not limited to, materials needed, including consumables (chemicals, sacrificial components, etc.). In addition to other operating costs that your team identifies, include these operating costs, as applicable: staff labor rate of $70/hour; solids disposal costs ($50/ton); energy requirements (cost/bbl and Kwh/bbl): research an industrial natural gas rate and state in $/MM BTU; use an electricity rate of $0.09/kWh.
    - Visualization tools: Sensitivity analyses, etc.
- Identify and address the fate of any waste products generated by the treatment technology.
- Include a public involvement plan that addresses public perception and contribution in utilizing PW and/or SWD brines for hydrogen production (see Team Manual).
- Document success in improving energy efficiency, pollution prevention, and/or waste minimization, as it applies to your project, to qualify for the P2 Award. Place this in a separate section of the report.
- Address any intangible benefits of the selected treatment process.
- Address safety aspects of handling the raw produced water, volatiles, and any final products. Safety issues for both the full-scale design and the bench-scale demonstration should be addressed in both the written report and the Experimental Safety Plan (ESP)

Bench Scale Demonstration

Bench-scale demonstrations will serve to illustrate the design considerations listed above.

The bench-scale unit should demonstrate a process that can be scaled up to produce 20,000 bbl/day of DI water assuming a 1000 gal/minute throughput of produced water at the wellhead. It will include a synthetic solution of produced water of chemistry given in Table A (See Appendix). The constituents of the synthetic solution are typical for a sample of produced water from the Delaware Shale play.

For safety at the contest, teams will operate their bench-scale apparatus at approximately atmospheric pressure and the boiling point of the synthetic solution (see Table A). When preparing to run the bench-scale demonstration in Las Cruces, New Mexico, consider the elevation of 3900 feet, and adjust your predicted boiling point as needed. To reflect the energy captured at the wellhead, teams will report the calculated energy budget available for treatment, including processes that will result in lowering the temperature and pressure from 280°F and 2000 psi to surface pressure and boiling temperature.

Table 1. The bench-scale apparatus shall treat water of the following chemistry

Water phase	**Amount per liter of synthetic**
DI water	750 mL
Sea Salt	120 g
Ammonium chloride	1575 mg
Oil phase	**Amount per liter of synthetic**
TrueSyn 200 I*, ***	92 mg
Solid phase	**Amount per liter of synthetic**
Fine-grade Arizona Test Dust (Medium Grade)**, ***	50 mg
Sodium Bentonite Drilling Clay (AquaGel by Baroid Industrial	50 mg

TASK 6: OPEN TASK

There were no entries for the Open Task in 2024.

APPENDIX A. JUDGES' GUIDE TO THE JUDGING SITE: WERCTEAMS.NMSU.EDU

WERCTeams.nmsu.edu is where Judges:

A. Register to be a judge

1. To register: at wercteams.nmsu.edu, click the green button: "Faculty and Judges: Sign up for the 2024 contest." On the next page, click the radio button "Judge." Complete your personal information, including email and password.
2. After receiving the email notice that you signed up successfully, log in with your email and password.
3. All judges sign up each year, as no profiles are saved from year to year. Please be ready to upload your bio and photo, and complete all items.
4. Once you complete your profile, you will have access to scoring for all teams assigned to you. You will not be able to see other judges' scores or teams in other tasks.

B. Complete a profile

1. Your profile must be complete before you can gain access to score teams.
2. Press "Save" often!
3. Indicate order of preference for judging tasks
4. Upload a photo and enter a bio to be published in the event guidebooks.
5. Indicate size preferences for clothing (t-shirt and jacket or vest). Note that "Gender for style" refers to Ladies cut (narrower at the waist) or Men's cut (more generous at the waist).
6. Indicate dietary restrictions and meals you plan to attend.
7. Enter emergency contact information (very important while on-site at contest).
8. Enter mailing address.
9. Enter demographics.
10. When completing the profile, you may click "Save and Submit" or "Save and Finish Later."
    a. Success will be indicated by a pop-up window, "Your information has been saved successfully."
    b. If you click Save and Submit and a required item is missing, a pop-up window will tell you which item is missing.
11. The profile can be changed at any time after it is completed.
12. Confirm your account: You must go to your email to confirm your account before you can judge teams.

C. Find judging assignments.

When you receive email that judging assignments have been made, you may view your assigned teams:

1. Log into your account and click on "TEAM"
2. The teams you will be scoring will be on that page, along with each team's required reports.
3. Team reports are accessed by clicking the blue buttons (30% Project Review, Written Report)
4. If the button contains a red X, the team has not yet submitted the assignment.
5. If the button contains a green checkmark, the assignment is ready for scoring.
6. Reports will not likely be ready until the due date, as teams tend to submit at the last minute.

D. Read reports

After the report due date (you can check for reports earlier, but they will not likely be there):

1. Log into your account and click on "TEAM"
2. Click on the button that is ready for scoring. (It will have a green checkmark on it.)
    a. The report will appear in a new browser window. You may read it from there or
    b. You may download the report, if you prefer.
    c. If it is a .docx file, please download it and make in-line comments in Review mode.
3. To score the technical report, click on the red "Grading" button.

E. Score reports–Finding the scoring panel

When you are ready to score a report for a specific team

1. Log into your account
2. Click on "TEAM"
3. Click the red "Grading" button within that team's scoring box
4. The scoring window will open showing the team's name.
5. Below the team's name is a drop-down menu that lets you select which items to score.
6. Click on the event in the drop-down that you wish to score and it will take you to that scoring rubric. This year's options:
    a. 1-DERMS-Technical, Environment, Community Outreach (For Task 2 only)
    b. 1-Technical, Environment, Community Outreach (For Tasks 1, 3, 4, and 5)
    c. 2-Quality of Written Report & Audits
    d. 3- Quality of Oral Presentation
    e. 4- Quality of Poster
    f. 5-Quality of Bench-scale Demonstration
    g. 6- Bench-scale Demonstration Competition

F. Scoring the reports–Enter scores

a. Begin scoring the report by clicking the radio button corresponding to your chosen score.
b. "Save and Submit" often. The WERC judging site has strict time limitations (beyond our control).
c. When finished, click "Save and Submit"
d. Wait for a confirmation that the scores were saved
e. You may go back later and change the scoring at any time before the cutoff deadline (April 10, 2024).
f. Click on the Crimson "Comment" button to enter detailed comments
    a. Please enter extremely detailed comments to help schools use the contest to meet ABET Requirements.
    b. You may wish to enter these in a Word document and copy/paste into the judging comment box.
    c. See below for ABET's list of student outcomes that universities must demonstrate

G. ABET Student Outcomes–Please address these points in your comments, if possible.

1. ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. ability to communicate effectively with a range of audiences
4. ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

APPENDIX B. MANUSCRIPT PREPARATION GUIDELINES GIVEN TO TEAMS

1. **Page limit:** 27 pages, including report cover page, table of contents, executive summary, report body, figures, tables, references, and appendices. The audits are not included in the page count.

2. **Page order:**
   - Cover page
   - Table of Contents
   - Executive Summary
   - Body of Paper
   - References
   - Audits

3. **Cover page** (Title page):
   - ***Title:*** 2" top margin, 1" minimum side and bottom margins, 14-point type
   - ***Center:*** 12-point type. School name, team name, optional team logo, task number, advisor and team member names
   - ***Spacing*** between title entries (school name, team name, etc.): 1.5 line

4. **Table of contents**
   - ***All margins:*** 1" minimum
   - ***Type:*** 12-point type
   - ***Justification:*** Left and right justified
   - ***Spacing:*** 1.0 – 1.5 lines, as appropriate to your format

5. **Executive summary and body of paper**
   - ***All margins:*** 1" minimum; left justified with ragged right edge
   - ***Spacing:*** 1.5 lines
   - ***Type:*** Title: 14-point, Body: 12-point.
   - ***Page limit:*** Maximum of two pages. Preferably one page. Include mostly data and findings – no fluff.

6. **Footers:** Required on each page
   - ***School name and task number:*** Centered
   - ***Page number:*** Centered below school name and task number

7. **Headings:**
   - ***Title:*** Center, upper case, bold; 14-point type
   - ***Major Headings (Level 1):*** Flush left, Title Case, Bold, 12-point type
   - ***Subheadings (Level 2):*** Flush left, Title Case, Bold Italic, 12-point type
   - ***Sub-subheadings (Level 3):*** Indented, Bold, Title Case, End with a period, 12-point type
   - ***Fourth-level headings (Level 4):*** Indented, Bold Italic, Title Case, End with a period, 12-point type
   - ***Leading below headings:*** no more than 6 points. (Leading=vertical distance between lines of text)

8. **References**
   - ***In text***: Use superscript numbers when referring to references in the text.
   - ***Reference list:*** List and number all bibliographical references at the end of the paper.

9. **Equations**
   - ***Variables:*** Italicize variables in equations.
   - ***Placement:*** Center equations; right-justify equation numbers and enclose the numbers in parentheses. (*Hint for aligning these: enter equation and its number in a 1-row, 2-column table*)

10. Figures and Tables

- ***Numbering:*** Number figures and tables consecutively within the text (Figure 1, Figure 2, etc.)
- ***Figure Captions:*** flush left below the figure; include figure number; description in sentence case.
- ***Table Titles:*** flush left above the table; include table number; description in sentence case.
- ***Clarity:*** Lines and images within a figure should be sharp and easy to read. Include a legend where needed.
- ***Legibility:*** All lettering should be large enough to be readable (minimum 10-point type)
- ***Size:*** Illustrations should fit on an 8.5" X 11" page (with proper margins). Be sure all elements are readable.
- ***Placement:*** Figures and tables should be placed in the document in the order in which they are referred, closely after (not before) they are referenced in the text.

11. Symbols and Abbreviations

- ***Standard:*** Use only standard symbols and abbreviations in text and illustrations.
- ***Defining:*** Define all abbreviations the first time of use by stating the full name and adding abbreviation in parentheses (even if you think the abbreviation is obvious, define it–it may not be obvious to every reader).

12. **Audits**

- ***Format:*** Audits have no specific formatting requirements, but should be on company letterhead, if possible.
- ***Voice:*** Auditors should format their audit in a professional manner that is appropriate to their field of expertise.