SOLID WASTE DESIGN COMPETITION (SWDC)

SWANA's International Student Competition

SWANA's Young Professionals Present

THE SOLID WASTE STUDENT DESIGN COMPETITION

PROBLEM STATEMENT AND PROTOCOL

VIRTUAL EVENT
April 2022

SWANA
YOUNG PROFESSIONALS

1. Introduction

SWANA's International Solid Waste Design Competition (SWDC) is a student team competition focused on solving a "real world" problem faced by solid waste professionals. The competition aims at providing a professional experience to students pursuing an education and/or career in solid waste management. The goals of the SWDC are to:

- Encourage student involvement in SWANA's Annual National Conferences.
- Provide students with real world experience in solving complex solid waste management issues in a supportive and fun environment.
- Provide students an opportunity to display their talents.
- Establish a premier networking event for students to connect with potential employers.

This document outlines the problem statement and guidelines for the competition. **Participants are advised to read the entire document as guidelines detailed in this document must be followed.**

2. Problem Statement & Competition Format

The problem statement is provided under **Attachment 1**. In general, the SWDC is organized as explained below:

- Students to review the Problem Statement and existing information. Interested teams to send completed Team Commitment Form.
- SWANA will organize a virtual kick-off meeting to explain the Problem Statement and associated data.
- Students will be guided by the SWANA SWDC committee and paired with a mentor to assist teams with the project if requested.
- Student teams present their solutions through poster, report and virtual presentation by meeting the deadlines (Section 4).

The solution to the Problem Statement must be detailed in a design report, poster and presentation. Guidelines for each of the three components are provided in Sections 5 through 7.

3. Eligibility to Participate

Participating teams must comply with the following criteria:

- Each participating team can have a minimum of two (2) and a maximum of eight (8) team members. The recommended team size is a four (4) member team.
- Every participant must be enrolled as a full-time or a part-time student during competition enrollment. We understand that some students may be graduated or near graduation at time of the presentation. However, to ensure participation, **we require at least one student in the team to be such that he or she anticipates graduation after the scheduled date for presentations**.
- Ideally, all team members should be from the same school/university; however, exceptions can be made. An exception request must be made using the *Team Commitment Form* provided as

Attachment 2, and the participant should reach out to the contacts provided for further discussion.
- The maximum number of student design teams is limited to ten (10) teams. The first ten (10) eligible entries received via *Team Commitment Form* will be entered into the competition.
- The *Team Commitment Form* must be signed by a school faculty member as their sponsor.

4. Deadlines

The deadlines for the competition are detailed below. Submissions must be made electronically (unless specified otherwise) to the contact person identified in Section 11.

- **Team Commitment Form**: Teams must submit the Team Commitment Form (**Attachment 2**) to participate in the competition. It is recommended to send the Team Commitment Form as soon as possible as the number of teams is limited to ten (10). Applications are due by October 24, 2021.
- The selected participants will be notified by October 27, 2021.
- A kickoff meeting will be held in early November 2021 to provide an overview of the competition, review the SWDC problem statement, requirements, and answer general questions. An additional follow up meeting will be scheduled for mid-January 2022. Further information will be provided to the selected teams.
- **Design Report**: The final design report must be submitted by March 4, 2022. The guidelines presented in Section 5 must be followed for the design report.
- **Poster**: Poster must be submitted by March 4, 2022. The guidelines presented in Section 6 must be followed for the poster.
- **Presentation**: The student design teams will present their solutions virtually the first week of April, 2022. The date and time for the presentation(s) are to be scheduled. The guidelines listed in Section 7 must be followed for the presentation.

Please note, these dates are subject to change due to the uncertainty of the COVID-19 pandemic. Selected teams will be notified accordingly if any schedule changes are made.

5. Design Report Guidelines

The Design Report must follow the structure listed below:

- Report must be submitted in pdf format.
- Font must be Times New Roman,12-point font and double-spaced text.
- Recommended format for Citations/References: Chicago Style.
- The maximum number of pages is limited to 30 pages.
- Tables and figures can be provided as attachments in addition to the 30 page limit. There is no page limit on the attachments (tables and figures).

Refer to the judging sheet provided as **Attachment 3** to gauge the expectation of the judges.

6. Poster Guidelines

The following guidelines must be followed.

- Poster shall be 24”H x 36”W (horizontal format)
- All posters must be created in a desktop page layout software (Adobe InDesign, Quark Express). Posters created in Microsoft Word or PageMaker will not be accepted.
- All art must be formatted as CMYK, hi-res images at least 266 dpi in RAW .jpg format.
- Final document must be saved as a hi-res PDF with all art and images embedded.
- Electronic poster file shall be submitted using Dropbox link or other similar online file sharing.
- Be clear and concise with poster design and content. Overcrowding a poster makes it difficult to read.
- Use fonts that are large enough to read at a distance. Your poster must include title, university represented, and all team member names. Figures, graphs, and tables should be uncluttered and simple and arranged in the sequence in which you want them to be viewed.
- Provide clear labels or headings for each section of your poster.
- Remember contrast. Put light-colored text on dark backgrounds and dark text on light-colored backgrounds so that your viewer can see your text clearly.
- Drawings, illustrations, and/or diagrams must be your own work.

Tips for imbedded graphics:

- Use high-resolution images.
- Do not cut and paste art or screen-filled shapes from PowerPoint.
- Text may be copied and pasted from PowerPoint into the layout software, but it will require applying the “create to outline” setting after pasting.

Refer to the judging sheet provided as **Attachment 3** to gauge the expectation of the judges.

7. Presentation Guidelines

Each of the participating teams will present their solution virtually. Presentation date(s) and time will be posted on the SWANA Website by the end of March 2022 and participating teams will be informed with further instruction. Presentation order will be chosen randomly. Plan for no more than a 20-minute presentation followed by 10 minutes for question and answer.

Presentation Guidelines and Tips:

- REMEMBER that the judges are your client and your firm is hired to solve their “real world” problem.
- The presentation needs to flow in a way that makes sense. Much as with writing a paper it should present the problem, discuss the alternatives and provide a solution.
- Don’t read word for word from the slides. Slides should contain a summary of what you will say.
- Don’t overwhelm the slide with too many images or complicated animations. Slides should be clean and easy to read with a common theme.

- Be sure to recognize team members that were not able to be present and thank anyone who provided mentorship throughout your project.
- Each speaker should have somewhat equal time presenting. It should not be mostly one person presenting and other people standing next to the only presenter. It is also nice to see everyone participating when responding to questions from the judges.
- Clearly state the main points, assumptions, and conclusions. You will have to make assumptions in the real world, so the judges need to see and understand your thought process.
- Understand that there is a balance to the amount of background information that should be presented. You can assume there might be people in your audience (including judges) that might not be familiar with the topic, so a little background is helpful, but it should be limited, since it is not the main purpose of the competition.
- Discuss the challenges that you were faced with and how that affected the outcome. Practice presenting and answering questions in front of an audience. The judges understand that you are a student, but like to see that you understand the basic engineering principles, and that you can think about their questions and come up with a reasonable answer.
- Consider recording yourself during a practice presentation and make notes of distracting mannerisms (i.e. saying “ummm” or “like” too often).
- Practice timing yourself. Make sure you dress for the part. You are presenting as though you are trying to win a job. Attire is business professional.

8. Judging

Judging sheet is provided as **Attachment 3**. The following Table provides a breakdown of the total points:

Item	Maximum Points
Design Report	100
Poster	25
Presentation	125
TOTAL	**250**

9. Award

Two team awards will be presented to the top teams with maximum overall scores. SWANA reserved the right to cancel all presentations if only one team or no teams are available to present – in that case winning teams will be based on overall scores for the Report and Posters.

The **minimum** award money is listed in the table below. In addition to these awards, every participating student will receive:

- Conference registration for a SWANA Annual National Conference
- One year SWANA membership
- SWANA Young Professionals Webinar voucher

Rank	Prize
First Place Prize	$2,000 (minimum)
Second Place Prize	$1,500 (minimum)
Third Place Prize	$1,000 (minimum)

In the past, awarded amounts were as much as double the advertised minimum amounts. Smaller monetary awards will also be given out for Best Team Presentation and Emerging Leader/Rising Star. It may be possible for a team to receive more than one award.

10. Closing Remarks

Although most information may be available online, participants should note that additional information may require contacting vendors. If this is the case, please remember that you are acting as a consultant. Be professional, polite, persistent and concise in the requests to obtain necessary information.

At the end of the day, a consultant may need to contact the client for data requests. If you run into an issue that requires critical information that you believe is not provided, please contact the persons listed below.

11. Contact Persons

All submissions must be made electronically (unless specified otherwise) to **all contacts** listed below. Any question regarding the competition must be directed to Mateja and Hailey.

- Mateja Vidovic Klanac (mvidovicklanac@scsengineers.com)
- Hailey Tatum (htatum@wm.com)
- Nathan Mayer (nmayer@swa.org)
- Karam Singh (ksingh@hdrinc.com)

ATTACHMENT 1 – Problem Statement

Problem Statement: Evaluating the limitations of the EPA's Gas Emission Model (LandGEM) and developing an alternative method for landfill gas emissions estimation.

Background:

According to the U.S. Environmental Protection Agency (EPA), landfills are one of the largest sources of methane. Methane is produced from anaerobic decomposition of the organic waste buried in landfills. If methane is not captured properly, it releases to the atmosphere and becomes harmful to the environment. Because it is able to trap heat in the atmosphere, methane is considered as a climate super pollutant which contributes to climate change. Recent studies indicate that the EPA's methods for estimating landfill methane emissions could be outdated and flawed. The EPA's methane generation rate (k) and potential methane generation capacity (L_o) used for calculating landfill methane emissions and assumptions yield estimates that are often not representative of actual site-specific methane emissions. SWANA Young Professionals (YPs) are interested in evaluating the limitations of EPA's landfill emissions estimation methods, starting with an evaluation of EPA's LandGEM default values for k and L_o, that are used to estimate landfill gas (LFG) generation. EPA created LandGEM in 1996 and last updated it in 2005 for landfill owners to use for reporting non-methane LFG Emissions under the New Source Performance Standards (NSPS). Landfill owners have been using a similar calculation method for reporting annual methane emissions to the EPA under the federal Methane Reporting Rule (MRR), since 2010.

The EPA calculates LFG and methane emissions using the following equation:

<u>Methane emissions = Methane generation - □ (methane collected & destroyed + methane oxidized)</u>

Methane generation is estimated using LFG generation models that cannot be validated with measured data, and are simplified for ease of regulatory application, and offer only default values for key inputs, with no guidance on how to make them site-specific.

Landfills calculate and report LFG emissions for compliance with Title V operating permit conditions, NSPS, and greenhouse gas (GHG) emissions reporting under the MRR. Each regulation and waste category has different model coefficients that are required for calculating emissions. Table 1 below lists the various LFG generation model coefficients as they apply to different waste categories under each regulation. Default values listed in the MRR under the "waste composition option" are not shown in Table 1, but may also be considered.

Table 1. LFG Generation Model Regulatory Default Input Coefficients

Regulation defining Defaults (Model)	Waste Category	Climate Category	Model k (1/yr)	Model Lo (m^3/Mg) / DOC
NSPS (LandGEM – CAA defaults)	Bulk waste	Dry	0.02	170
	Bulk waste	Wet	0.05	170
Title V Permit (LandGEM – Inventory defaults)	Bulk waste	Dry	0.02	100
	Bulk waste	Wet	0.04	100
GHG reporting under MRR	Bulk waste	Dry	0.02	102 / 0.20
	Bulk waste	Moderate	0.038	102 / 0.20
	Bulk waste	Wet	0.057	102 / 0.20
	Bulk MSW	Dry	0.02	158 / 0.31
	Bulk MSW	Moderate	0.038	158 / 0.31
	Bulk MSW	Wet	0.057	158 / 0.31
	C&D	Dry	0.02	41 / 0.08
	C&D	Wet	0.04	41 / 0.08

As defined in Table 1, the following are potential sources of inaccuracies arising from EPA methods for estimating landfill methane, any or all of which may be suitable to evaluate:

1. LFG generation estimation flaws caused by applying EPA default k values for bulk waste required under NSPS (0.02 and 0.05) or for emissions inventories (0.02 and 0.04).

2. LFG generation estimation flaws caused by applying EPA default Lo values for bulk wastes required under NSPS (170 m3/Mg) or for emissions inventories (100 m3/Mg).

3. LFG generation estimation flaws caused by applying EPA default k values for bulk waste required under the MRR (0.02, 0.038, and 0.057)

4. LFG generation estimation flaws caused by applying EPA default Lo values for bulk waste (or bulk MSW) required under the MRR.[1]

5. Inaccuracies in estimating oxidation. The EPA default value for oxidation is 10%, although up to 35% is allowed under the MRR. Note that increasing methane oxidation from 10% to 55% reduces net methane emissions by about 50%.

6. Inaccuracies in estimating landfill gas collection system efficiencies based on status of all or parts of an active, operating landfill.

Goals:

The Student Design Teams are tasked with the following:

- To evaluate the EPA's method for estimating and reporting landfill methane emissions.
- To estimate potential bias, the EPA methods for estimating methane generation, oxidation, and emissions may be produced at individual landfills and/or regionally.
- To develop an alternative method for calculating landfill methane emissions.

Strategy/Methods:

- Use LandGEM as the tool of analysis for estimating LFG generation under varying waste disposal inputs and model k and Lo values.
- Develop k and Lo values based on site specific waste characterization.
- Data for landfills across the U.S to run the LFG generation models is available in GHG emissions reports (2010-2019 data is at https://ghgdata.epa.gov/), including annual historical waste disposal rates and actual LFG recovery data to compare with model results. Additional data may be obtained from publicly-owned landfills.
- Develop independent estimates of collection system efficiency for each landfill modeled using publicly available information or site-specific data, such as the reported number of wells installed per acre of daily, intermediate, and final cover. Possibly apply site-specific knowledge of LFG collection system design and operations to assess collection efficiency.
- Compare actual measured LFG recovery rates to modeled LFG generation x estimated collection efficiency to evaluate whether LFG generation model assumptions are appropriate for the site based on available data.
- Consider varying the LFG model assumptions in a Monte Carlo sensitivity analysis and assess potential biases.
- Assess the range of bias in the EPA LFG model coefficients implied by the research.
- Consider the effects of EPA methods for other steps in the methane emissions calculation process not covered in the assessment (e.g. oxidation assumptions).

[1] The Lo value is calculated as m^3/Mg (metric tonne) based on the degradable organic content (DOC) and other variables (Lo=DOC x 0.5 x 0.5 x 16/12 /0.000654 Mg/m^3 (density of methane is 0.654 kg/m^3).

Student Design Team Expectations:

- Creativity and depth in the approach.
- Strong critical thinking and teamwork skills.
- Professionalism shown through communication and documentation.

Current Issues:

- Only based on 13 landfills across the country (2 of which were on fire at the time of development).
- Methane generation rate (k) and potential methane generation capacity (Lo) applied to bulk waste, not the specific waste types that make it up.
- Landfill gas system collection system efficiencies are highly variable and may not portray actual conditions.
- There is no temperature factor.
- Not enough user specified information to make it site specific.

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ATTACHMENT 2
Team Commitment Form

Name of School: ____

Team Members and Contact Information:

<u>Name</u>	<u>Email</u>	<u>Phone</u>	<u>Anticipated Graduation (MM/YY)</u>

(Maximum team members = 8)

Chosen Name of Your Consulting Firm: ____

Designated Team Contact (Captain): ____

School Faculty Name/Phone Number/Email: ____________________/__________/____________

School Faculty Signature: ____

Any Requested Exception to Section 4 Criteria: Yes ☐ No ☐

If NO, we understand that the participant complies with requirements of Section 4. If YES, briefly state the requested exemption and reason below:

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SWANA YOUNG PROFESSIONALS

ATTACHMENT 3
Judging Form

Design Report (Maximum Points = 100)			
Description	**Max. Points**	**Awarded**	**Comment #**
Introduction	5		
Evaluation of EPA's Method and Potential Bias	35		
Alternative Method for Calculating Landfill Methane Emissions	30		
Conclusion and Recommendations	10		
References	5		
Formatting & Appearance	5		
Grammar, Spelling & Overall Technical Writing	5		
Visual Aids (Graphs, Pictures etc.) presented clearly	5		
Poster (Maximum Points = 25)			
Proposed solutions are clearly described and interpreted	5		
All components of problem given appropriate level of attention	5		
Poster "stands alone" requiring no additional explanation	5		
Visually attractive, text legible, effective use of figures, tables, & graphic devices	5		
Easy to follow, focused, and organized	5		
Presentation (Maximum Points = 125)			
Clear introduction, sets stage for presentation	15		
Main points are developed, organized, and well formulated	15		
Material presented at an appropriate level and pace for audience, yet includes relevant detail and clarity	10		
Visual aids are clear, well-constructed, and effective, aiding in understanding	15		
Realistic solution to problem with high likelihood of success	10		
Solution considers broad range of impacts such as environment, economics, society, and sustainability	15		
Questions answered competently, all members demonstrate a clear understanding of topic	20		
Team presents a professional image, projecting enthusiasm and competence	15		
Timing (presentation rehearsed and less than 20 min.)	10		