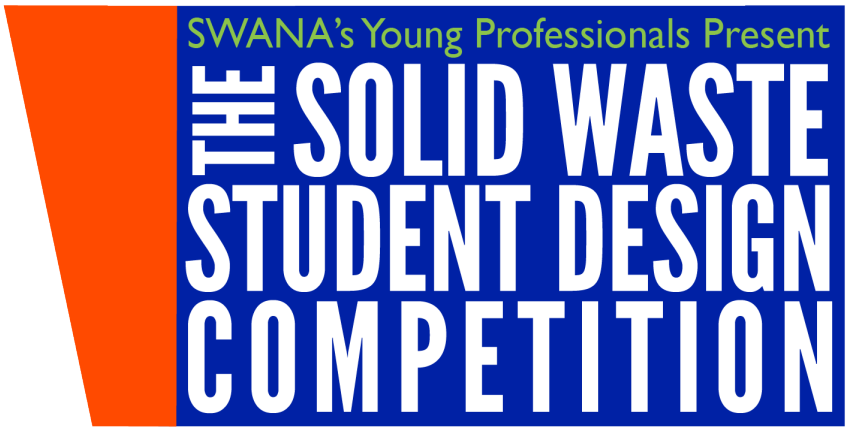
SOLID WASTE DESIGN COMPETITION (SWDC)

SWANA's International Student Competition



PROBLEM STATEMENT AND PROTOCOL

VIRTUAL EVENT
April 2023

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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:

- 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 problem-solving skills and professional writing and presentation skills.
- Connect students with potential employers through a premier virtual networking event. Attending this networking event is mandatory for the participating team members.
- Encourage student involvement in SWANA.

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 will review the Problem Statement and existing information. Interested teams will 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 upon request, paired with a mentor to assist teams with the project.
- Student teams will 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 6 through 8.

3. Eligibility to Participate

Participating teams must comply with the following criteria:

- Students must be a member of SWANA at the time of registration. Activate your FREE student membership here: SWANA Student Membership.
- 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 graduate or be near graduation at time of the presentation. However, to ensure participation, **we require at least one student in the team to anticipate 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 December 9, 2022.
- The selected participants will be notified by December 12, 2022.
- A kickoff meeting will be held beginning of January 2023 to provide the teams an overview of the competition, review the SWDC problem statement, requirements, and answer general questions. An additional follow up meeting will be scheduled for the beginning of February 2023. Further information will be provided to the selected teams.
- **Design Report**: The final design report must be submitted by March 10, 2023. The guidelines presented in Section 5 must be followed for the design report.
- **Poster**: Poster must be submitted by March 10, 2023. The guidelines presented in Section 6 must be followed for the poster.
- **Presentation**: The student design teams will present their solutions virtually the second week of April 2023. The date and time for the presentation(s) are to be scheduled. The guidelines listed in Section 7 must be followed for the presentation.

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 the student’s 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 design solution virtually. Presentation dates and times will be posted on the SWANA Website by the end of March 2023 and participating teams will be informed with further instruction. Presentation order will be chosen randomly, and all team members need to be active in the presentation. Plan for 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. Similar to 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 students 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 thank anyone who provided mentorship throughout the project.

- Each speaker should have somewhat equal time presenting. We recommend at least 50% team members to participate in the oral presentations, with a minimum of 2 presenters each team. For a team of two (2) members, both members must present. It is expected that most (if not all) team members participate 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 will 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 thoughtful 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. Students must attend the Awards Ceremony and the Networking Event to be eligible for award. The Awards Ceremony and the Networking Event are to be scheduled at the kick-off meeting.

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 (WASTECON 2023 or SOAR 2024)
- 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.

Please note: Cash prizes are subject to the laws of the winning team's country including Somalia, Iran, Cuba, Sudan, Syria, North Korea, or any other nation that may be under sanction by the United States at the time of the competition or award distribution.

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@scsengineers.com)

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ATTACHMENT 1 – Problem Statement

Problem Statement:

Cost - Benefit Analysis of Using Source Separated Organic Material in a Compost Operation versus Utilizing Landfilling Organics at a Site with a Landfill Gas Collection System and a Renewable Natural Gas (RNG) Plant

Background:

Biogas Utilization

Landfill gas (LFG) is a viable source of renewable energy and is generated through the anaerobic decomposition of organic material in the waste stream. Instead of conventionally burning landfill gas through a flare, LFG can be converted and used as an energy resource. LFG contains approximately 50% methane (CH_4), 45% carbon dioxide (CO_2), 5% nitrogen (N_2), and less than 1% non-methane organic compounds (NMOCs). Methane is the most important constituent of LFG that can be used for energy. LFG is collected from landfills via extraction wells within the waste mass, piping to convey the gas to a central location and a blower system that "vacuums" the gas out. The energy content of LFG can be recovered through a variety of technologies and end uses such as:

Most Common Options for Biogas Use:

- Medium BTU – Direct Use, often in boilers or industrial equipment;
- Landfill Gas to Energy (LFGTE) – Electricity Generation;
- High BTU – Pipeline Grade Gas/Renewable Natural Gas (RNG)/CNG Vehicle Fuel.

The Environmental Protection Agency (EPA) encourages the recovery and beneficial use of biogas as a renewable energy resource, including the production of RNG when feasible, as a means of reducing emissions and providing other environmental benefits. RNG is a term used to describe anaerobically-generated biogas that has been upgraded (or refined) for use in place of fossil-fuel natural gas. Raw biogas, which is typically between 45 and 65 percent CH_4, depending on the feedstock, must go through a series of steps to be converted into RNG (at 90 percent CH_4 or greater, depending on the specification for the pipeline or other end use). Constituents of RNG that most often have specifications or limits to meet are CO_2, O_2, inert gases (including N_2), total sulfur, H_2S, siloxanes, moisture content, and VOCs.

The primary and secondary treatment stages of a typical biogas treatment facility produce a Medium-BTU gas, which means the heating value of the gas is less than that of fossil natural gas (typically about half). The advanced treatment stage produces RNG, with a heating value similar to fossil-fuel natural gas. As part of advanced treatment, some CH_4 is stripped out along with the CO_2 and other residual constituents - especially H_2S - and routed to a flare or thermal oxidizer for destruction. The amount of CH_4 stripped out as "tail gas" depends on the technology used to upgrade the gas, the ultimate CH_4 specification for the RNG and the cost–benefit ratio of additional CH_4 capture versus the additional capital expense to achieve it.

Considerations for the feasibility of an RNG project include:

- The quantity and quality of biogas available for conversion (e.g., LFG biogas tends to require more constituent removal than manure-based or organic waste anaerobic digestion (AD) projects, especially N_2 and H_2S);
- Economic considerations (e.g., financing options, available incentives);
- End user availability for the RNG (e.g., proximity to a fossil natural gas pipeline without physical connection barriers, a local distribution company's interest in taking RNG, a local vehicle fuel demand, a natural gas-consuming business with sustainability goals); and
- A reliable power source for the compression and cleanup processes.

The two main economic barriers to producing RNG are the capital and operating costs associated with capturing and cleaning biogas into RNG, relative to the current low price of fossil-fuel natural gas, and the cost of delivering RNG to customers, often by building a pipeline interconnection or investing in equipment to deliver the RNG another way. For RNG projects, if onsite vehicle fueling, direct pipeline injection, or virtual pipeline transport is not feasible, an otherwise attractive project may not be viable.

Source Separated Organics

In comparison, more diversion goals are being adopted by cities across the nation, which require residents to separate organics from their household waste.. This source separated organic (SSO) method of waste management diverts food waste out of the landfill, which reduces emissions from the landfill. The success of a SSO collection program depends on several factors, including ensuring the collection techniques are tailored to the needs of the local community. Community involvement, education, and outreach are also critical, as are the financial aspects of such a program. When organics end up in landfills that are not managed correctly, they can release methane - a potent greenhouse gas (GHG) that is 28 to 36 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period. Less organic waste in a landfill can lead to lower emissions of methane and NMOCs, reduce odors, minimize leachate generation, and conserve landfill space.

The SSO material can be managed through digestion or a low emission alternative such as composting. Composting can produce useful end products that can improve soil health and reduce erosion. In addition, it can spur investment and job creation. Composting systems can range in expense, with several classification levels, but are broadly categorized as passively aerated (including turned) or actively aerated. Turned windrows (i.e., organic materials piled in rows that are turned periodically to maintain aerobic conditions and allow oxygen to flow to their cores) are the most common yard waste composting systems used in the US, due to their low capital costs (e.g., site improvements, equipment), their low operating costs (e.g., labor, vehicle fuel, equipment maintenance), and the wide variety and large volume of materials they can process (they are suitable for yard waste, food waste and other types of green wastes).

To develop an SSO collection program for residential, commercial, or institutional customers, student design teams should evaluate a variety of factors that will affect current solid waste management services (e.g., current collection practices) and assess the impacts of adding SSO collection (e.g., routing changes, increased vehicle traffic, vehicle maintenance or new vehicles, personnel and training, collection frequency, materials acceptance and enforcement). End markets for the processed organics are critical for a successful organic waste processing program. When developing a new project, student design teams should carefully consider these end markets to properly design the system (e.g., acceptable contamination rates, pre-processing equipment, type of compost, end product testing and labeling standards, end use of byproducts) and ensure long-term project operation and economic viability.

Local governments and municipalities are successfully using different methods of treatment and disposal for organic waste. Some municipalities with LFGTE plants, as well as diversion programs, ,treat a portion of their organic waste by sending it to anaerobic digestion (AD) facilities to generate biogas or composting facilities to produce soil amendments. Landfills provide excellent opportunities for siting new AD or compost

facilities. Diverting organic waste to generate biogas or compost can be part of an integrated solid waste management approach using multiple options for disposal or treatment.

Goals:

Student design teams are tasked with comparing the cost-benefit of two options:

1) Using source separated organic material in a compost operation; and
2) Landfilling organics at a site with a landfill gas collection system and an RNG Plant

For the purposes of this design competition, student design teams will act as a consultant hired by the County Commissioners to help them decide how best to manage their organic portion of the waste stream. The County's landfill is nearly full, and they are beginning planning stages for a new landfill site. As part of that planning process, the County would like to decide if they should continue to landfill organic waste in the new landfill and build a new RNG Plant at the new landfill site; or start a SSO collection and build a new compost operation at the new site. As a result of this analysis, design teams will make a recommendation to the County Commissioners based on consideration of the three tiers of sustainability (economic, environmental, and social).

Once the student design teams are selected in December 2022, **additional information and data will be published.** This will include background information on the site, historical materials received by type and tonnage, historical gas flow rates, etc. As a consultant, the suggested solutions are highly dependent on the assumptions made by the design team. As shown in the Judging Form in **Attachment 3**, documentation of assumptions and data analysis are a highly weighted scoring criteria. Please note that contacts provided in Section 11 serve as Mentors. Do not hesitate to contact them to answer questions or clarify the data.

Suggested Strategy/ Methods:

- Use EPA's LFG Cost-Web Landfill Gas Energy Cost Model to evaluate the initial economic feasibility of an LFG energy project
- Design Considerations for gas quality and processing needs for the equipment
- Regulatory and permitting requirements
    - Landfill Methane Outreach Program (LMOP);
    - EPA Landfill Gas Generation Model;
    - EPA's renewable fuel standards;
    - Renewable Identification Number (RIN);
    - EPA Renewable Fuel Standard (RFS) Program;
    - Energy Policy Act of 2005 & Energy Independence and Security Act of 2007 – 2022 "sunset";
    - Low Carbon Fuel Standard (LCFS).
- Research current technology
- Ease of operations
- Safety

Key Resources:

List of Publications Related to Landfill Gas and Waste Management | US EPA
LMOP Landfill and Project Database | US EPA
List of Tools Related to Landfill Gas and Waste Management | US EPA
List of Publications Related to Landfill Gas and Waste Management | US EPA
Landfill Methane Outreach Program Webinars and Events | US EPA
LMOP Landfill and Project Database | US EPA
LFGcost-Web — Landfill Gas Energy Cost Model | US EPA
Landfill Gas Energy Project Development Handbook | US EPA

Downstream Management of Organic Waste in the United States: Strategies for Methane Mitigation (epa.gov)
An Overview of Renewable Natural Gas from Biogas (epa.gov)
Renewable Natural Gas Supply and Demand for Transportation

Current Issues:

- Regulations
- Cost
- Public perception
- Project cost & financing

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ATTACHMENT 2
Team Commitment Form

Name of School: _____

Team Members and Contact Information:

Name	Email	Phone	Anticipated Graduation (MM/YY)

(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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ATTACHMENT 3
Judging Form

Design Report (Maximum Points = 100)			
Description	**Max. Points**	**Awarded**	**Comment #**
Introduction	5		
Realistic / Innovative Assumptions and Data Analysis	25		
Cost - Benefit Analysis	20		
Non - Economic Comparison – Intangible Benefits	10		
Conclusion and Recommendations	10		
Feasibility of Recommended Solution	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		