

Trash2Gas: Implementing anaerobic digester kits into school curriculums to improve waste management education

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Abstract

Current education models are relatively superficial and lack connection to real world problems. Many educators are using base models that teach fundamentals of science but do not add relatable value that is easy for students to grasp. Additionally, according to the UN, 30% of food produced is wasted and contributes to 8% of the annual greenhouse gas emissions. Our research goal was to develop an educational kit that solved both of these problems by providing an interactive waste management education experience for students.

We completed a market survey with teachers and deemed that this is a product teachers would want to see in their classrooms. Additionally, we competed in many entrepreneurship competitions and attended an international conference to fine tune the entrepreneurial component of our educational kit. We received \$18,000 in grant money from the Idaho Space Grant Consortium and were awarded \$5,000 from the University of Idaho Pitch competition. The next phases of our entrepreneurial venture include developing a working prototype and launching these educational kits into local schools.

Introduction

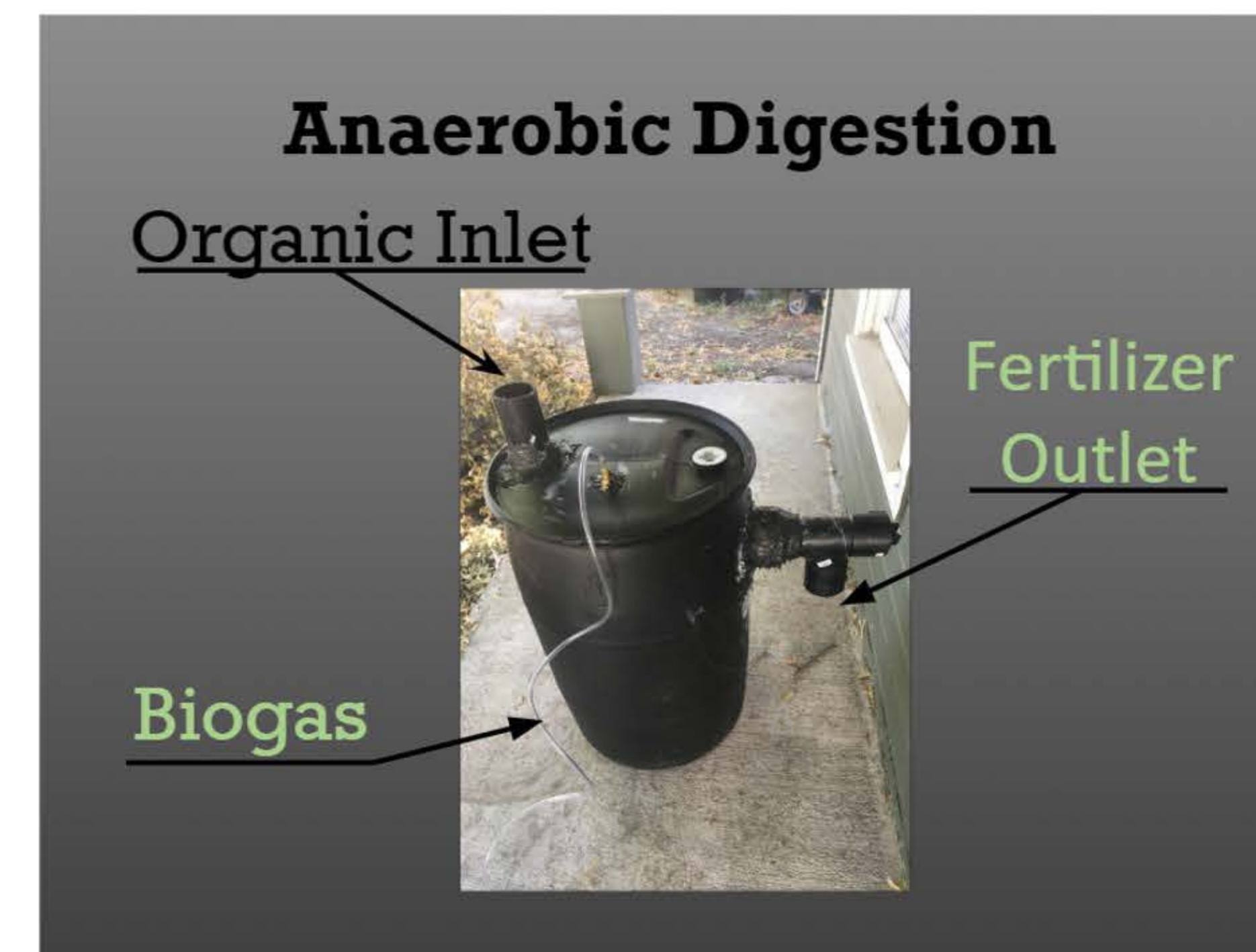
The Trash2Gas team originated out of an entrepreneurship competition for our Grand Challenge Scholars Program. We were tasked with creating a solution to sustaining a world with 10 billion people in it. Our team member who had studied abroad in Fiji brought up the idea of anaerobic digestion, a practice frequently used there. Anaerobic digestion is the process of breaking down biodegradable material without oxygen and creating a biogas which can be used as a renewable energy source. Originally, we wanted to design an anaerobic digester for household use but we realized education could have a larger market and impact.

The Trash2Gas curriculum will include an anerobic digester kit that will convert organic household waste into a useable biogas. As a nation with growing populations, landfills will only continue to amplify the amount of methane being released. Our curriculum will pave the way for additional markets, conscientious students, and open the door for innovative solutions to a global problem. Trash2Gas will educate today so that students can apply their knowledge in a future that is unpredictable.

Methodology

How Anaerobic Digestion Works

The user puts the organic waste into the drum where anaerobic digestion takes place and as the waste decomposes it creates biogas. Biogas is largely methane which can run a cook stove. Another output is a nutrient rich fertilizer which comes out the output PVC as more waste is added and used in a school garden. Students will place food waste from their school's cafeteria into the organic inlet. It will go through the natural process of anaerobic digestion and in under 30 days the students will have enough biogas to run a cookstove in their classroom. The Trash2Gas education kit comes in three parts. First being the anaerobic digester itself, second is the curriculum, and third is a biogas stove top.



Entrepreneurship Competitions

We competed at the National Academy of Engineering Grand Challenge Entrepreneurship Competition where we placed in the top 8 teams and were invited to attend the Global Grand Challenges Student Entrepreneurship competition in London, U.K. Afterwards, we tied for first place at the Idaho Pitch competition and were awarded \$5,000. This spring, we attended two virtual entrepreneurship competitions including the Boise Pitch competition and the Alaska Airlines Environmental Innovation challenge.



Market Outreach Plan

School districts in the Pacific Northwest comprising of Washington, Oregon, and Idaho will be the target market of the Trash2Gas Education kits. There are 1,819 High Schools in the Pacific Northwest we plan to have a market reach of 10% by 2030 and will start in Idaho. We will partner with University of Idaho curriculum educators to apply for the Stem Action Center's summer professional development week. Word of mouth marketing with teachers make up 70% of their curriculum decisions so we found that getting our products into their hands is the best roll out method. Additionally, we realized that schools don't usually have an abundant amount of funds to put towards new curriculum kits. To solve this problem we plan to apply to grants that offer sustainability-based curriculums to schools such as the Bill and Melinda Gates foundation.



Results

By testing our product in many entrepreneurial environments, we were able to make many improvements in our market approach. First, we switched from a household marketing approach to an educational one due to interest from our teacher interviews. We were able to estimate a kit price of \$500 for teachers and cost point of \$325 to produce the digester. The question we were asked most often was "How will schools afford this product?". Our solution to this is obtaining sustainability curriculum grants from large foundations to lower/eliminate the costs for schools.

In regard to the technical components of the digester, we have found a few key issues in developing a working prototype for schools. First, the digester tends to produce a negative smell which would need to be solved to place this in a school environment. Additionally, there is a potential safety issue as the digester contains compressed gas and produces methane. Finally, creating a sealed stirring mechanism has proven to be difficult and would need to be solved. After these technical issues have been worked through, we believe this would be a feasible product.

Conclusion

Waste management is a growing issue that we will have to face as a society in the upcoming decades. The Trash2Gas educational kit aims at solving this problem by teaching students hands-on problem solving and how to manage their own waste. After market research and receiving feedback from entrepreneurial competitions, we developed an estimated kit price of \$500, a solid market approach to high schools in the Pacific Northwest, and a grant-based approach to solving the affordability issue of the kit.

The room for the most improvement with our product is the technical side. Upon completing further research we will address the issue of the compressed gas safety component, smell reduction, and create a sealed stirring mechanism. This product has the capability to improve waste management education and create sustainable citizens that are able to tackle the real world problems of the 21st century.