UC Davis Utilities Landfill Gas and Biogas: Evaluation of Purification Methods and End Uses (With Respect to Cost, Infrastructure, and Environmental Impact) (Part of UC Davis Carbon Reduction Strategy?)

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Background

UC Davis owns and operates an anaerobic bio-digester that converts food waste into biogas. The heating value (or methane content) of this biogas, combined with landfill gas is too low for it to be widely useful, unless it is upgraded.

3 Options

1. **burning gas in a steam boiler: *minimal upgrading***
2. **compressing the gas to use as a transportation fuel: *moderate upgrading***
3. **compressing the gas to inject into PG&E natural gas pipeline: *substantial upgrading.***

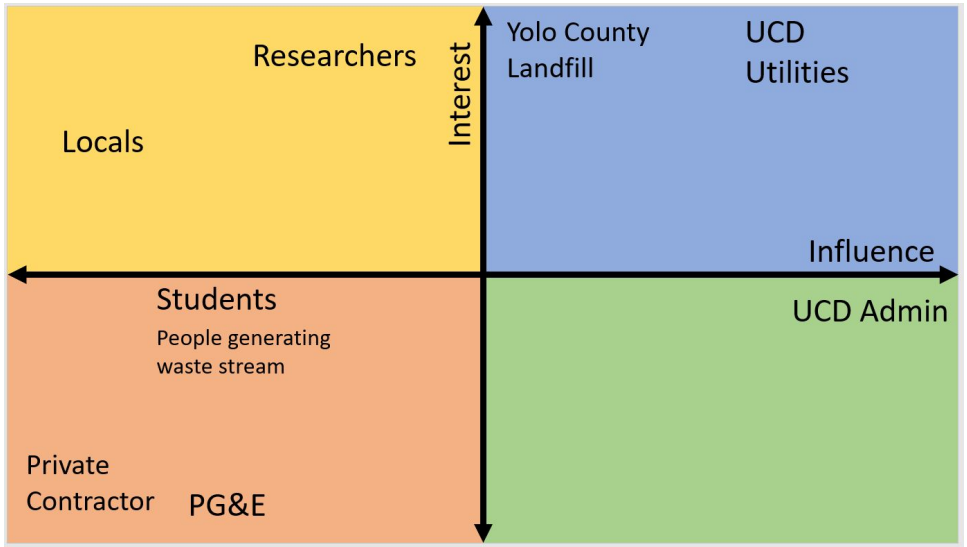
Problem Statement

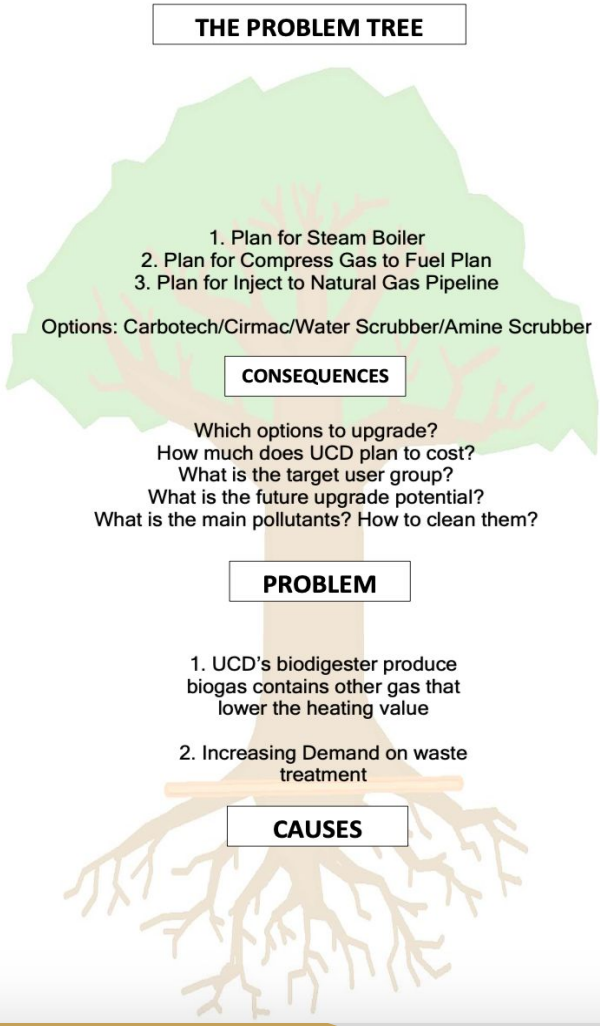
First Iteration: We need to weigh technical, economic, and environmental factors to determine the best purification method and end-use for the biogas produced from the anaerobic biodigester and landfill.

Final Iteration: A combined stream of biogas from an anaerobic biodigester and a landfill can act as a renewable resource for various potential end uses while also reducing UC Davis carbon emissions, depending on the balance of technical and economic factors.

Methodology

Stakeholder Analysis





Research Findings

1. The technical and economic perspectives are where a majority of the published literature focus
2. Landfill gas can contain higher concentrations and a wider variety of chemical contaminants
3. Numbers of different upgrading systems that are commercially available and treat biogas to a high degree, but costs a lot
4. Existing regulatory barriers would prevent UC Davis Utilities from using biogas stream beyond on-site energy generation

Importance of Upgrading

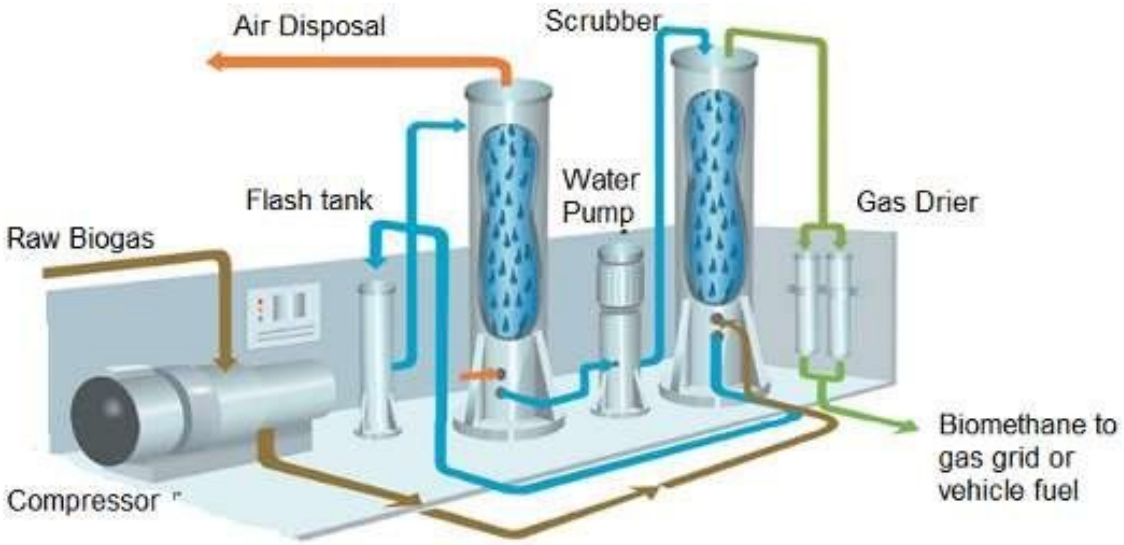
- Increase heating value of gas (increase % methane)
- Biogas and landfill gas can contain contaminants that are dangerous to human health
  - H_2S, VOCs, arsenic, etc
- Chemicals like H_2S can damage equipment

	Amine Absorption	Pressurized Water Scrubbing
CO_2		
H_2S		
N_2		
O_2		
NH_3		
Siloxanes		
VOCs		
H_2O		

Key	
Complete removal	
Complete removal; pre-removal by cleaning preferred	
Must be pre-treated	
Partial removal	
Does not remove	
Contaminant added	

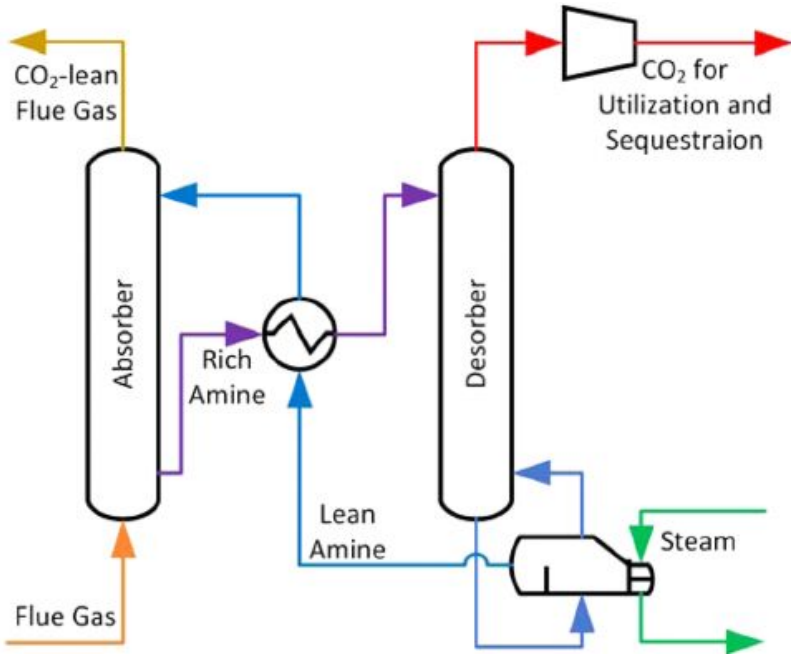
Sample Biogas Purification Technology

1. Water Scrubbing (effective in H_2S cleaning)



Sample Biogas Purification Technology

2. Amine Scrubbing for CO_2 Removing



Moving Forward

1. What are the current load size of waste treatment and the rate of gas production?
2. Determine whether the clients want to maximize power output or minimize the cost
3. Do you need a vote or survey to help determine the attitude of the local residents on using biogas?
4. Which upgrade system is scalable, in case of waste loads increase?
5. What is the current energy demand on-site?
6. What are specific contaminants in the gas stream (H_2S, siloxanes, etc), what are the concentrations, and how susceptible are these to variation throughout the year?

Any questions and feedback? Thanks !