

# Biomass gasification engines: collaboration with industry

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## PROBLEM STATEMENT

In Oct. 2020, I teamed up with All Power Labs, Inc. located in Berkley, CA, and we submitted a multimillion-dollar proposal to the California Energy Commission's (CEC) Bringing Rapid Innovation Development to Green Energy (BRIDGE) 2020 Grants entitled "Development and Demonstration of Distributed Biomass CHP Microgrid Systems". Our team won the grant. Sac State's share from the grant will be \$99,890 for the next four years. In this project, Sac State team will serve as a subcontractor and will perform the following duties for the project:

- Develop a measurement, verification, and data acquisition plan to monitor system performance
- Develop data collection tools required for aggregating and analyzing performance data
- Gather operational data from testing at APL HQ and host facility
- Analyze performance data and feedstock specifications
- Perform calculation for lifecycle assessment and levelized cost of energy
- Provide written and graphical results of the system's performance
- Submit an article detailing technical findings to a peer-reviewed journal.

## BACKGROUND

There are three major sources of biomass:

- Agricultural waste byproducts
- Forest residues and byproducts
- Urban wood wastes

The above mentioned biomass can be disposed of by

- open-burning

Three times more NO<sub>x</sub>, 100 times more CO, and five times more SO<sub>2</sub> compared to the same amount of biomass used in a power production unit

- landfill

While landfills delay the release of carbon dioxide to atmosphere, in a few years period the GHG emissions can be three times greater than that of biomass-fueled power production units for the same amount of biomass due to CH<sub>4</sub> emission in landfills.



## SUMMARY OF WORK

In the power generation unit, biomass is first converted to syngas, a clean-burning gaseous fuel, in the gasifier. This gaseous product is then fed to an internal combustion engine. The engine is coupled with a generator to produce electricity. The exhaust gas of this engine can be the input flow for the PBR. While the impacts of the addition of other combustion byproducts (CO, NO<sub>x</sub>, SO<sub>x</sub>, mercury, etc.) with CO<sub>2</sub> on microalgae have been individually studied, the long-term effects of real combustion product gases on various algae species have not been extensively studied.



## IMPACT ON COMMUNITY

At Sac State, students, faculty, and staff are working together to achieve the highest standards of sustainability. Together with improving in landscape, green buildings, waste management, and alternative transportation modes, the campus energy efficiency and independence is one of the main goals. "The Sustainability Guidelines target reducing energy consumption and moving toward renewable energy resources in order to minimize greenhouse gas emissions...". Two of the main goals of the energy section in the guidelines are to "move toward net-zero energy campus where 100% of campus energy use is met by renewable energy generation on a net-annual basis" and to be energy independence. The combined biomass energy project will contribute in meeting CSUS sustainable energy needs and building a sustainable future. Also this project can help us to train work force need for the industry.

