Implications of Increased Renewable Gases on Emissions and Stability Behavior of Appliances

OVERVIEW
Interest in utilizing fuels created from renewable resources is growing significantly throughout the world. Renewable fuels include those generated from waste streams such as landfills, biomass, or waste water treatment. Alternatively, excess renewable electricity can be used to generate hydrogen via electrolysis of water (e.g. an “Electrofuel”). An attractive strategy for incorporating these fuels is to blend them into the existing natural gas infrastructure. As a result, the question arises as to how these blends might impact the performance of end use devices in terms of emissions, efficiency, and safety. The past few decades have witnessed plentiful and substantial achievements of advanced combustion techniques in industry, and CO, SOX, and NOX emissions produced in industry have dropped significantly. However, less research has been conducted to investigate the performance of commercial and residential appliances.

GOALS
The major task of this project is to test the combustion performance of different appliances utilizing renewable natural gas. Both experimental and simulation methods will be adopted to analyze the stability, fuel consumption, heating performance, and emissions of different appliances. This research will help evaluate the feasibility of replacing natural gas with alternative fuels in commercial and residential appliances.

RESULTS
A fuel-mixing device was built to add renewable gases to natural gas. The percentage of different fuels in the mixture can be changed by adjusting the regulators on the control panel. Being tested in the experiments are a cooktop burner, broiler, oven burner, space heater, and water heater. Computational Fluid Dynamics (CFD) will be utilized to compare the simulation results and experiment results. For example, a 3D model was developed to simulate the cooktop burner.

FUTURE WORK
Ignition performance, and CO/NOX emissions of different appliances utilizing different fuel mixtures are being tested in the experiments, and will provide validation data for the simulation methodology. Verified simulation methodology will then be applied to predict combustion performance for more appliances. Finally, the impacts of renewable fuel composition on combustion performance will be determined.

PERSONNEL
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