Introduction to Advanced Combustion

Services provided in modern societies are driven, in large part, by energy liberated during the combustion of carbon-containing fuels. Historically, combustion devices have been inexpensive to build, fuels have been readily available, and the major atmospheric emissions (CO_2, H_2O) have been considered benign. Despite recent oil price increases and ever tightening emissions controls, combustion driven engines remain the most economical source of useful work.

Constraints on CO_2 emissions will change the competitive environment for combustion-driven devices. With today's technology, the thermodynamic efficiency of combustion devices is between 20% and 60%. The systems at the high end of this range are subject to high capital cost (combined cycles) or unacceptable criteria pollutant levels (diesel). Improving efficiency, reducing emissions and decreasing complexity could all have significant impact on total greenhouse gas emissions, possibly with modest capital outlay.

Since its inception, GCEP has conducted research in the area of advanced combustion. Research activities in combustion informatics, controlled combustion, combustion sensors, low-irreversibility combustion, and on oxygenated fuels have all been completed. Information on those efforts may be found in GCEP's technical reports from 2006 to 2009.

Professor Chris Edward’s program on pursuing engines that reduce exergy loss by conducting combustion at states of extreme energy density also came to an end this year after successfully building a free-piston device that can achieve compression ratios in excess of 100:1. The research is progressing via a systematic approach towards achieving 60% thermal efficiency and Prof Edwards received additional funding from GCEP to pursue Combustion Testing and Analysis of an Extreme-States Approach to Low-Irreversibility Engines using this device.