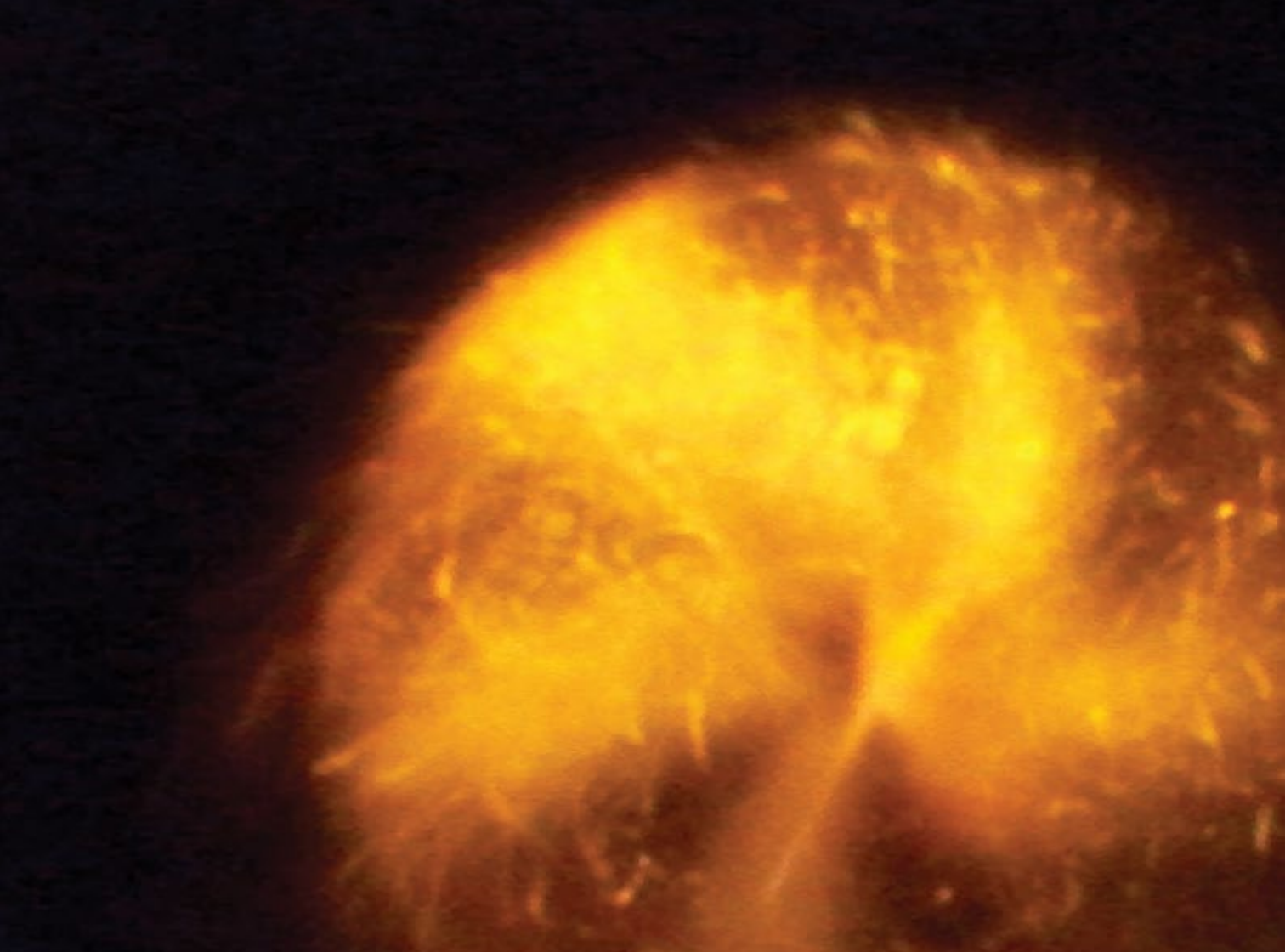

Meet the Combustion Expert

The NSERC CREATE Program in Clean Combustion Engines ignites

Image: Bio-oil and ethanol flame in a swirl burner.
Research image by graduate student Dylan Kowalewski.

The combustion of fuels provides 91 per cent of the world's energy supply. Such global demand causes many to predict that we will soon run out of oil, but Mechanical Engineering Professor **Murray Thomson** sees the future differently.

"The idea that we will soon run out of fuel is false. We are more than a hundred years away from running out of fossil fuels, and new, unconventional sources, are constantly being discovered," says Thomson. "The real issue is climate change. Reducing carbon emissions without economic disruption is a difficult challenge."

For Thomson, one smart, short-term action is to improve fuel efficiency as much as possible. Recently, the U.S. government mandated a 5 per cent increase each year in the fuel efficiency of cars until fuel efficiency has doubled. Engine designers are developing new strategies to achieve this goal while reducing pollutant emissions and keeping costs reasonable.

Another approach has been to convert biomass into biofuels such as ethanol and biodiesel. Currently

"The real issue is climate change. Reducing carbon emissions without economic disruption is a difficult challenge."

ethanol is produced from sugarcane or corn, and biodiesel is processed from vegetable oils and animal fats. As a member of the Research Management Committee and a Theme Leader of the BiofuelNet Canada NSERC National Centre of Excellence, Thomson notes that second-generation biofuels from waste cellulose — such as straw, saw dust and tree branches — are currently being developed, although they come with a cost.

Alternatively, natural gas prices have plunged as new reserves in Canada and eastern U.S. have been discovered. But, fracking — the process of extracting natural gas from shale — has raised concerns over groundwater contamination. Without government mandates for industry to switch to biofuels, the alternative, natural gas, remains a player in the combustion game. Thomson says it's dramatically cleaner, with lower smog and greenhouse gas emissions.

"There are no easy solutions," says Thomson. "The point of research is to create more, and hopefully better, options."

To help fuel Canadian research in engine development and alternative combustion fuels, the Natural Sciences and Engineering Research Council of Canada (NSERC) has injected $1.65 million over six years to support the Collaborative Research and Training Experience (CREATE) program in Clean Combustion Engines (CCE). NSERC CREATE programs provide a pathway for improved communication, collaboration and professional skills development for students, through coordinated mentoring and training opportunities in both academic and industry-based environments.

As CCE Director, Thomson is enthusiastic about collaborations between U of T and colleagues at the University of British Columbia, McGill, Ryerson, and the University of Windsor. Their industry collaborators include every major engine design company in Canada. Pratt & Whitney, based in Toronto, designs jet engines; Westport in Vancouver, BC, develops engines that run on natural gas; Rolls-Royce Canada in Montreal builds gas turbine engines for power generation; and Ford Canada builds and tests engines in Windsor, Ont., for the automotive sector.

New computer modelling and optical measurements have also let engine researchers look inside the engine, and advanced how researchers test alternative fuels, reduce emissions and improve efficiency.

"For example, using computational fluid dynamics modelling, pollutant emissions from gas turbine jet engine combustors can be predicted. This enables the engine designers to optimize the engine for low pollutant emissions," says Thomson, who says they can take a systems approach and no longer look at combustion alone.

"UBC is investigating fuel injection strategies and its effects on emissions. At Windsor, they're looking at developing new engine concepts that improve fuel efficiency while lowering emissions. And my Department colleague and CREATE co-applicant, Professor **Jim Wallace**, is directly measuring the health effects of engine exhaust," says Thomson, who also sits on the Board of Directors for the Canadian Section of the Combustion Institute.

A feature of the CREATE program is their annual week-long Combustion Summer School, which will include training in technical and professional skills, before trainees complete an internship at a combustion-related partner company.

"Students who register with CCE have an opportunity to connect with every major engine design company in Canada," says Thomson. The CCE program is an educational program under the Institute for Sustainable Energy (ISE), already home to the NSERC CREATE program in Distributed Generation for Remote Communities (DGRC), seeking to integrate clean energy technologies in remote areas of Canada.

"I've had the privilege to work with many graduate students who have gone on to do research and development in industry and government," says Thomson. "With the CREATE program funding, we have an excellent opportunity to provide collaborative, world-class training for Canadian students."