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Partnering to Measure and Reduce Pollution from Energy Production

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Matthew Johnson, PhD
Carleton University's Canada Research Chair in Energy and Combustion Generated Air Emissions

Matthew Johnson's Mission: Research to Measure and Reduce Soot and Pollution from Energy Production

Spring thaw in Canada always brings a residue of filthy black snow. The blackened film is soot or deposits of black carbon from the atmosphere. Soot has immense power to overheat the planet. Yet, soot reduction produces virtually immediate results since its lifetime in the environment is only about three weeks compared to up to 1,000 years for CO_2.

Gas flares that can sometimes shoot billowing plumes of black carbon clouds into the sky are a major source of soot around the world. Fugitive emissions in the form of leaking methane are another critical source of so-called 'climate forcing.' Matthew Johnson investigates both in Carleton University's Energy and Emissions Research Lab.

Johnson's research also focuses on technological options and provides economic analyses into how industry can reduce pollution by lessening flaring and venting, and capturing fugitive emissions. "For critical sources such as fugitive emissions and flares," says Johnson, "we lack practical technologies to measure their emissions with any significant precision." His research is essential not only to measuring and quantifying pollutants but to policy development and industrial strategic planning in the face of climate change.

Johnson is examining flaring at 6,391 oil production sites in Saskatchewan, in the first-ever analysis of data in partnership with Environment Canada, Natural Resources Canada and the provincial Ministry of Economy. His work also involves similar analyses in Alberta, which along with Johnson and Carleton are affiliated with the World Bank Global Gas Flaring Reduction partnership.

"We have large emissions throughout industry and around the world. This is an incredibly complex science where we need to provide the tools and quantify emission rates from sources so that we can develop effective strategies for reduction."

Johnson's earlier research, employing 'optical diagnostics' through advanced cameras, laser and imaging techniques to measure and examine flaring then soot reduction, was applied in Veracruz, Mexico and in Uzbekistan. His key tools include Carleton's Energy and Emissions Laboratory, which contains some of the most advanced equipment for emissions analysis and flow measurement in Canada.

THE RESEARCH

What I do

Develop tools with government and oil and gas industry to detect and measure greenhouse gas and black carbon (soot) emissions; analyze and design technological/economic models to reduce emissions and create viable options to flaring and venting.

Why it matters

An estimated 140 billion cubic metres of natural gas is lost to flaring and venting globally each year. That equates to about 30% the annual natural gas consumption for the entire European Union.

What it will change

Black carbon or soot is an important short-lived 'climate forcer,' with a warming impact in the atmosphere second only to carbon dioxide. Reducing soot has an immediate impact; its lifetime in the atmosphere is a few weeks compared to 500-1,000 years for carbon dioxide.

THE RESEARCHER

2013-2016 Natural Sciences and Engineering Research Council (NSERC) Discovery Accelerator Supplement Award.

2014 Carleton University Research Achievement Award.

2012 Carleton University Faculty Graduate Mentoring Award, awarded by the Carleton University Faculty of Graduate and Postdoctoral Affairs.

2011 Best Engineering Professor, Carleton Student Engineering Society.

PARTNERS

Partnerships and collaborations include Natural Resources Canada (NRCan), National Research Council, Clearstone Engineering Ltd., University of Alberta, Petroleum Technology Alliance of Canada (PTAC), Environment Canada, Canadian Association of Petroleum Producers (CAPP), World Bank Global Gas Flaring Reduction Partnership (GGFR), Saskatchewan Ministry of Economy, Alberta Energy Regulator (AER), and Petroamazonas (Ecuador).

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"To achieve success in this area, we need to marry measurements in the field with controlled investigations in the laboratory. Only then can we define the path towards cleaner air and a better environment."

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