



A Black Carbon Emissions Inventory from Gas Flaring in Alberta, Canada's Upstream Oil and Gas Sector

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Recently proposed regulations by the Government of Canada seek to reduce the release of methane and other volatile organic compounds from the upstream oil and gas industry. Final regulations are to be published in 2018 with requirements being phased-in between 2020 and 2023. The province of Alberta is Canada's largest producer of oil and gas resources, with upstream production spread over thousands of individual sites. The distributed nature of these generally smaller production sites means economic options for mitigation can be limited. Consequently, the working assumption is that under proposed regulations many facilities will find it most economic to flare/incinerate their excess gas, leading to a potential increase in provincial flared/incinerated volumes and associated emissions. Most notably, these emissions would include black carbon (BC), a harmful pollutant that may be the second-most important direct climate forcer after carbon dioxide.

This work presents a BC emissions inventory for the upstream oil and gas industry of Alberta, Canada derived from reported natural gas flaring. An improved BC emission factor relation for gas flaring is employed, based on the recent work of Conrad and Johnson (2017), and augmented with recent controlled laboratory measurements combined with direct field measurements of BC yield from flares in Alberta. The latter were accomplished using sky-LOSA, an imaging technique for the quantification of BC emission rate from in-field flares (Johnson et al. 2013). This new emission factor relation is coupled with facility-level flared volume data and spatially explicit gas composition estimates to generate a first-ever robust BC emissions inventory for flaring in the Alberta upstream oil and gas sector. Past and present emissions are discussed alongside predicted implications of the forthcoming regulations.