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Insights into GHG emissions from faulty oil and gas wells in the Western Canada Sedimentary Basin

Gabriela Gonzalez Arismendi¹ and Karlis Muehlenbachs²

¹University of Calgary, Geoscience, Calgary, Canada (gdpgonza@ucalgary.ca)

²University of Alberta, Edmonton, Canada (kmuehlen@ualberta.ca)

Understanding the source of fugitive methane is key to any mitigation effort. Unwanted emissions from oil and gas wells are significant contributors to greenhouse gas (GHG) emission budgets in petroliferous regions. Here we examine in detail, parameters that may be controlling GHG emission rate of individual, faulty wells in the Western Canada Sedimentary Basin (WCSB). For several hundred wells, we compared the source depth of the leaks determined by isotope fingerprinting to publicly available surface casing vent shut-in pressures and gas emission flow rates in three different oil and gas fields of WCSB. About seventy-five percent of the leaks are from shallower and intermediate formations rather than the targeted formations in most areas. The depth of leaks does not vary between horizontal and vertical wells in a given region. The source depth of the leaking gas is not correlated with the age of the well. Most of the leaks in a region come from specific gas-charged intermediate formations. We observe that smaller leaks come from both the shallower intermediate and the target zones. Surprisingly, the higher shut-in pressure and larger surface casing flows tend to come from shallower depths. In these cases, it was observed that the drillers had used comparatively less cement. There are many thousands of faulty wells in the WCSB, and our observations can guide the prioritization of remediation to most quickly and economically reduce GHG emissions.