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Oil and gas wellbore leakage in Canada: key reporting uncertainties and measurement knowledge gaps

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Depleted oil and gas formations and associated wells can be exploited for use as energy or carbon dioxide storage infrastructure. However, a loss of wellbore integrity can result in the uncontrolled migration of fluids out of the well, risking groundwater contamination and releasing greenhouse gases (e.g., methane, carbon dioxide, hydrogen) into the atmosphere. In Canada, emissions specifically related to wellbore integrity and subsurface-based leakage have been monitored, measured, and reported by the oil and gas industry for more than a decade, resulting in some of the largest datasets to track such wellbore emissions. While these reporting systems were not necessarily designed to track methane emissions, both the provincial and federal governments nevertheless use these data to estimate methane emissions associated with subsurface wellbore leakage. Moreover, incomplete reporting by the industry has resulted in highly uncertain methane emission magnitudes, and attempts by federal and provincial governments to resolve these issues yield emission estimates varying by more than a factor of two. Further, poorly understood emission mechanisms are likely to yield even more uncertainty in total emissions from wellbore leakage.

In this presentation, we illustrate the highly uncertain nature of methane emissions due to subsurface wellbore leakage in Canada using industry-reported data for the provinces of Alberta and British Columbia, regions covering more than 80% of crude oil and 95% of natural gas production nationally. We illustrate the sensitivity of these methane emission estimates using a variety of assumptions employed by the different governments for incomplete data, highlighting the key knowledge gaps for this source of emission. The different assumptions result in estimates varying by a factor of 3, and more troublingly, connotate fundamentally different understandings about wellbore leakage causes, sources of fluid, and progression of emission rates over time. We make initial recommendations for wellbore leakage monitoring and measurements to improve Canada's methane quantification but with more broad applicability for monitoring well fluid leakage more generally.