

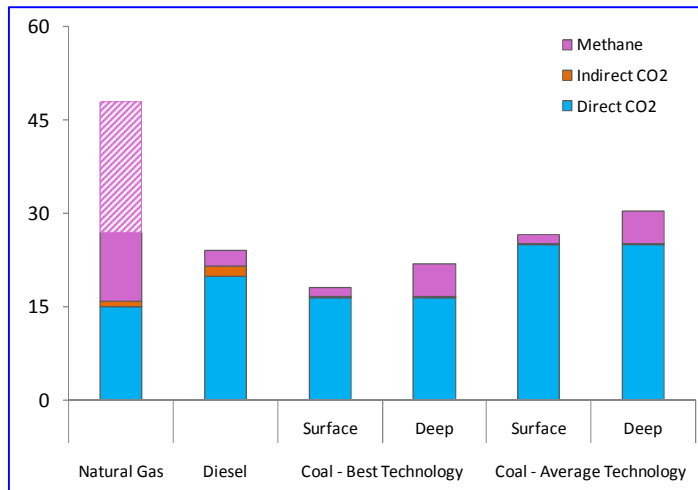
Assessment of the Greenhouse Gas Footprint of Natural Gas from Shale Formations Obtained by High-Volume, Slick-Water Hydraulic Fracturing

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Natural gas is widely advertised and promoted as a clean burning fuel that produces less greenhouse gas emissions than coal when burned. While it is true that less carbon dioxide is emitted from burning natural gas than from burning coal per unit of energy generated, the combustion emissions are only part of story and the comparison is quite misleading. With funding from the Park Foundation, my colleagues Renee Santoro, Tony Ingraffea, and I have assessed the likely footprint from natural gas in comparison to coal. We have now submitted a manuscript for publication in a peer-reviewed journal. A summary figure from the submission is shown here. Please note this should be treated tentatively, as changes or refinements in response to reviewer comments are likely. We nonetheless post the update now due to the tremendous

interest in the topic, and its importance in deciding the wisdom of viewing natural gas as a transitional fuel over the coming decades, with a lower greenhouse gas footprint than coal. The figure illustrates a comparison using a 20-year horizon for the relative importance of methane and carbon dioxide.



Comparison of greenhouse gas emissions from natural gas, diesel oil, and coal, including both direct emissions of CO₂ during combustion (blue bars), indirect emissions of CO₂ necessary to develop and use the energy source (red bars), and fugitive emissions of methane, converted to equivalent value of CO₂ for global warming potential assuming a 20-year time horizon (purple bars). For natural gas, the solid bar represents the low end estimate, and the stippled bar represents the high end. Units are grams carbon per million joules of energy.

We urge caution in viewing natural gas as good fuel choice for the future. Using the best available science, we conclude that natural gas is no better than coal and may in fact be worse than coal in terms of its greenhouse gas footprint when evaluated over the time course of the next several decades. Note that both the National Academy of Sciences and the Council of Scientific Society Presidents have urged great caution before proceeding with the development of diffuse natural gas from shale formations using unconventional technology. See:

National Research Council (2009). Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use. National Academy of Sciences Press; and

Letter to President Obama and senior administration officials, May 4, 2009, from the Council of Scientific Society Presidents. <http://www.eeb.cornell.edu/howarth/CCSP%20letter%20on%20energy%20&%20environment.pdf>