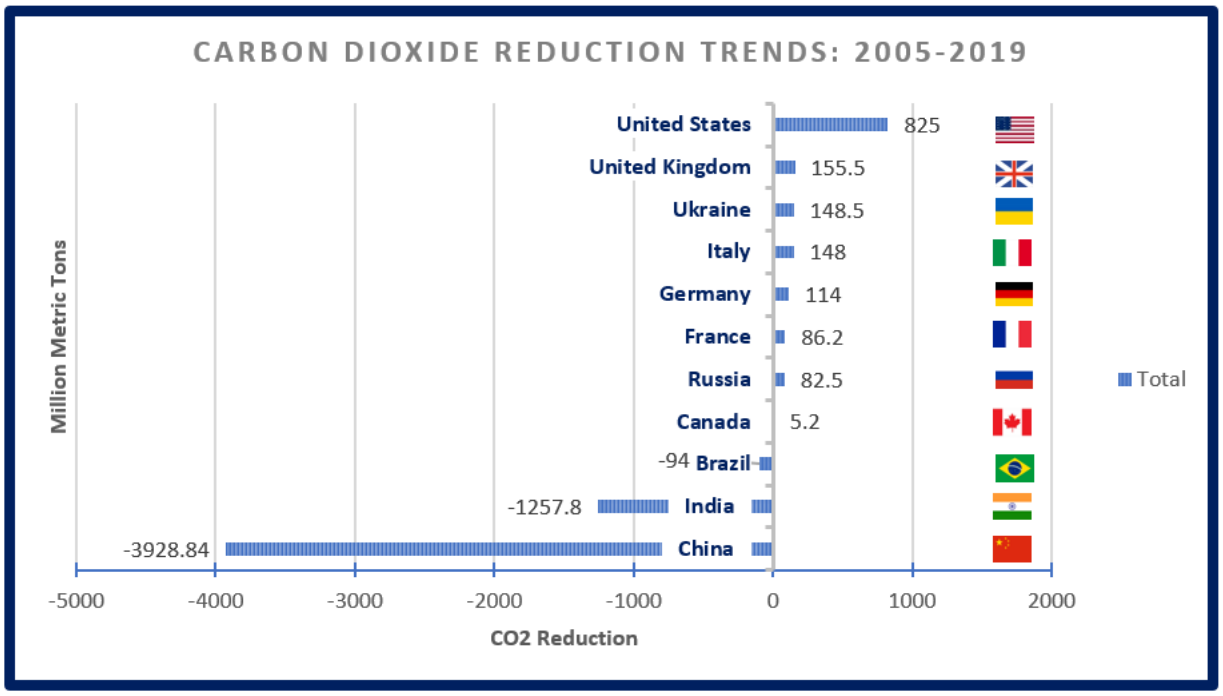
Natural Gas Climate Change Benefits

November 2020

The United States leads the world in greenhouse gas (GHG) emission reductions, and the primary reason is natural gas. The incredible progress has been made without the use of heavy-handed government policies like a carbon tax, cap-and-trade or international treaties. Rather, we've enabled the United States to reduce greenhouse gas emissions 10.2% below 2005 levels through a market-driven increase in natural gas electricity generation.[1]

Natural gas, as acknowledged by the U.S. Energy Information Administration (EIA) and the International Energy Agency (IEA), is the number one reason the United States has reduced more greenhouse gas emissions than any other country over more than a decade.[2]



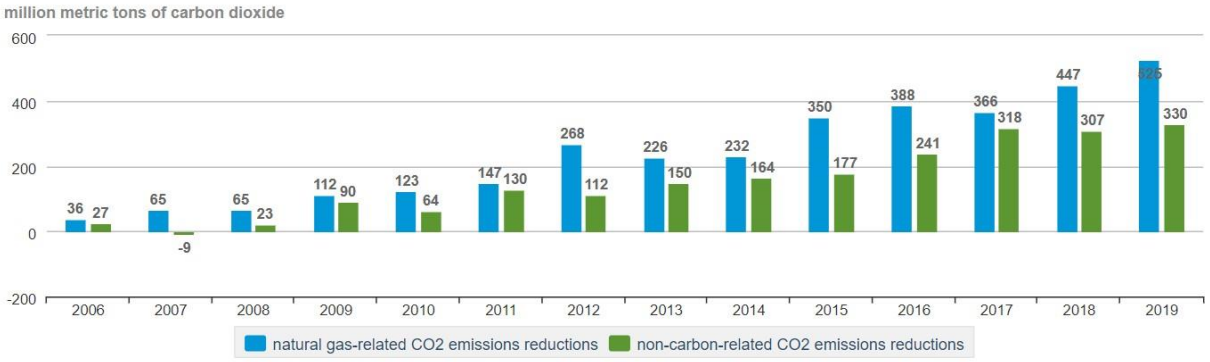
Source: *2020 BP Statistical Review of World Energy* data *and The World Bank CO2 Emissions*

Fuel switching from coal to natural gas in the electricity sector has reduced more greenhouse gas emissions than have wind and solar energy combined. Because natural gas has 55% lower carbon dioxide emissions than coal,[3] it delivers huge GHG reductions in the electricity sector, where emissions are nine times higher.[4] Natural gas has delivered 61% of the reduction in greenhouse gases resulting

[1] *Inventory of US Greenhouse Gas Emissions and Sinks,* Environmental Protection Agency (EPA), April 2020, p. ES-4.
[2] *Global CO2 Emissions in 2019*, IEA, Paris, February 2020; U.S. Energy-Related Carbon Dioxide Emissions, 2019, U.S. Energy Information Administration (EIA), September 2020.
[3] *Cost and Performance Baseline for Fossil Energy Plants*, Department of Energy, July 2015.
[4] *U.S. Energy-Related Carbon Dioxide Emissions, 2018*, U.S. Energy Information Administration (EIA), November 2019, p. 13.

from fuel switching in the electricity sector, removing 3,351 million metric tons of carbon dioxide equivalents (MMT CO_2 Eq) since 2005.[5] In contrast, wind and solar have only reduced GHG emissions by 2,125 MMT CO_2 Eq , or 39% of the total reduction. That trend continued from 2018 to 2019, as the United States led the world in reducing energy-related CO_2 emissions by 2.8%, largely due to the displacement of coal with natural gas power generation.[6]

Figure 10. CO2 emmissions reductions in electricity generation from changes in the fuel mix since 2005



Sources: U.S. Energy Information Administration, *Monthly Energy Review*, August 2020, Table 11.6, Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector and calculations made for this analysis based on Table 7.3c, Consumption of Selected Combustible Fuels for Electricity Generation: Commercial and Industrial Sectors (Subset of Table 7.3a). Distributed solar generation from Table 10.6, Solar Electricity Net Generation is added to generation values from Table 7.2a, Electricity Net Generation: Total (All Sectors). See Table 2 on page 16 for carbon dioxide values for the commercial and industrial sectors.

Note: This analysis includes estimated CO2 emissions from electricity generated in all sectors. Non-carbon electricity generation includes small-scale solar. CO2 refers to carbon dioxide.

Reducing Methane Emissions

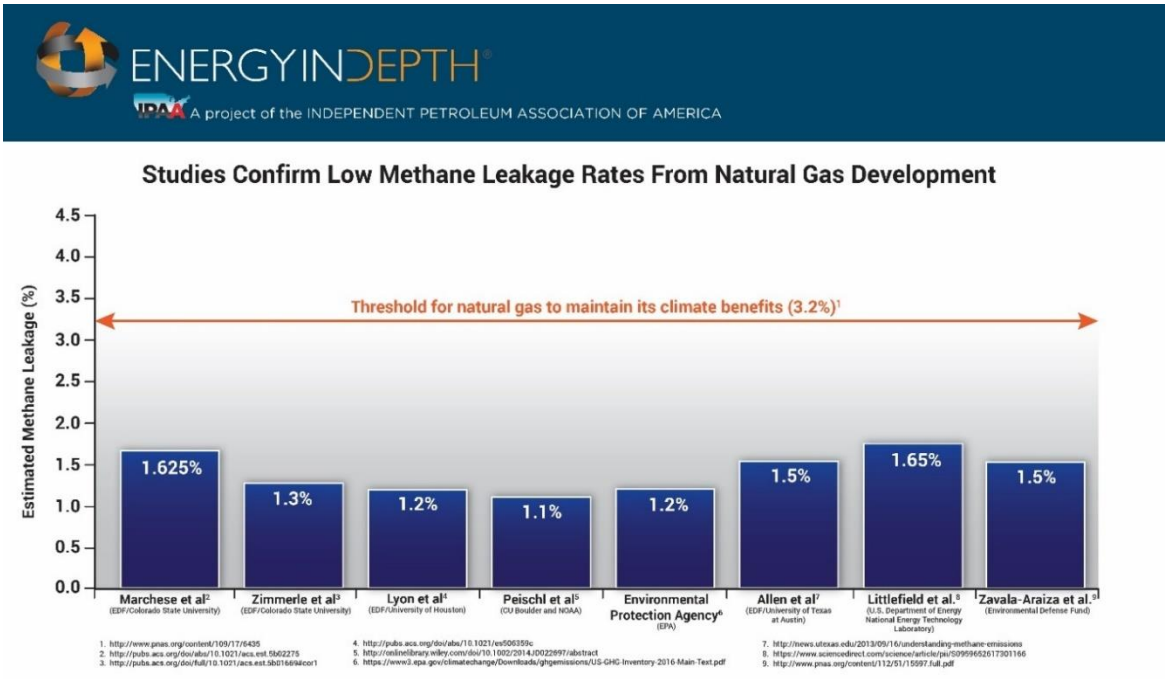
When looking at the full balance of emissions from development and production, EPA finds the entire oil and natural gas industry accounts for 2.64% (176.2 MMT CO_2 Eq) of total U.S. GHG emissions (6,676.6 MMT CO_2 Eq), with the upstream sector accounting for just 1.15% (76.6 MMT CO_2 Eq) of that. Of total U.S. GHG emissions, nearly 10% are from methane, with the vast majority (81.3%) being CO_2.[7] Oil and natural gas emits 27.8% of U.S. methane emissions while agriculture is the largest contributor of anthropogenic methane emissions at 39.9%.[8] On balance, annual greenhouse gas emissions from the entire oil and natural gas industry (176.2 MMT CO_2 Eq) were more than offset by the 525 MMT CO_2 Eq reduction in emissions our industry delivered in the electricity sector.[9]

But we're not satisfied even with that low relative contribution. In collaboration with universities and regulators, the oil and natural gas industry continues to develop and deploy new technologies such as remote sensing and airborne detection with satellites, aircraft and drones to more quickly detect and fix methane leaks in the field. We've decreased emissions from gathering lines, pipelines, and compressor stations, and replaced high- with low-bleed pneumatic controllers. This continual innovation has

[5] EIA, September 2020, p. 14.
[6] *Global CO2 Emissions in 2019*, International Energy Agency (IEA), February 11, 2020.
[7] EPA, April 2020, p. ES-9.
[8] Id., p. ES-7-8. Note that EIA and EPA use carbon dioxide equivalents in their inventories and analyses of GHGs. By doing so, the higher potency of methane is taken into account.
[9] EIA, November 2019, p.18.

enabled the American oil and natural gas industry to decrease methane emissions by 23% since 1990, even as oil and natural gas production have increased 49% and 71%, respectively.[10]

The body of scientific literature that measures actual leaks shows a 1.1% to 1.65% range of leakage rates.[11] EPA's estimate of a 1.2% leakage rate is right in line with this range.[12] Regardless, all estimated and measured leakage rates are well below the 3.2% recognized to be the threshold under which natural gas delivers a net benefit for the climate.[13]



[10] EPA, p. 2-15, p. 3-69, p.3-84.

[11] "Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Liquid Unloadings," *Environmental Science and Technology,* Allen et al., December 9, 2014. "Synthesis of Recent Ground-Level Methane Emission Measurements from the U.S. Natural Gas Supply Chain," *Journal of Cleaner Production,* Littlefield et al., April 2017. "Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region," *Environmental Science and Technology,* Lyon et al., July 7, 2015. "Methane Emissions from United States Natural Gas Gathering and Processing," *Environmental Science and Technology*, Marchese et al., August 18, 2015. "Quantifying Methane and Ethane Emissions to the Atmosphere from Central and Western U.S. Oil and Natural Gas Production Regions," *Journal of Geophysical Research: Atmosphere*, Peischl et al., July 24, 2018. "Reconciling Divergent Estimates of Oil and Gas Methane Emissions," *Proceedings of the National Academy of Sciences of the United States of America,* Zavala-Araiza et al., November 10, 2015. "Methane Emissions from the Natural Gas Transmission and Storage System in the United States," *Environmental Science and Technology,* Zimmerle et al., July 21, 2015.

[12] EPA, April 2020.

[13] "Greater Focus Needed On Methane Leakage From Natural Gas Infrastructure," *Proceedings of the National Academy of Sciences of the United States of America*, Alvarez et al., February 2012.