

## OPINION

# An immediate, very low-cost method for reducing methane emissions from the US oil and gas supply chain

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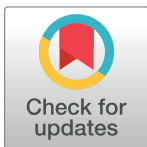
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Atmospheric methane concentrations have been rising at greater and greater rates in the past few years. This is particularly troubling because methane has a high global warming potential right after it is emitted, and because anthropogenic methane emissions could be leading to enhanced natural emissions from wetlands and soils [1].

There is no faster way to reduce warming and the effects of climate change than to reduce methane emissions. Methane is responsible for at least 25% of today's climate warming, and as methane emissions increase, so will this proportion [2]. Anthropogenic sources of methane include venting from coal mining activities, landfills and other waste sources, cattle and rice agriculture, and oil and gas production and use [3]. Recently, the international community realized the importance of reducing methane to keep global temperatures within reach of Paris Agreement goals, introducing the Global Methane Pledge for countries to develop plans for methane reduction in agriculture, waste, or energy sectors ([www.globalmethanepledge.org](http://www.globalmethanepledge.org)).

Methane emissions from the oil and gas sector are likely the easiest to mitigate [4]. A spate of studies investigating methane emissions from the oil and gas supply chain over the past decade identified that more than half (58%) of emissions are from producing wells, with an additional 20% from systems that gather oil and gas from these wells [5]. More recent work closely examined emissions from wells in different categories of production [6,7]. About 80% of the wells in the United States produce less than 15 barrels of oil (or the natural gas equivalent) per day [8]. Although these "marginal" wells are the most abundant type of well in the country, they produce less than 10% of annual oil and gas output [8]. Our research shows that, although marginal wells have very small production rates, they are emitting methane at levels disproportionate to their production. A recent synthesis indicated that, despite the low contribution of these wells to national energy, they are responsible for about 50% of emissions from oil and gas production [7].

I propose a policy or incentive to shut in marginal wells to reduce methane emissions. In oil and gas industry parlance, "shutting-in" refers to the process of turning off the production of a well; for marginal conventional wells through turning off a pump and/or closing a valve on the production line. Measurements from my own group have shown that shut-in wells have a methane emissions rate that is significantly lower than actively producing marginal wells (Fig 1). Data from my own research clearly show that shutting in marginally producing wells from the lowest production category (0 to 1 barrels of oil equivalent per day) will reduce methane emissions from these wells by 10 to 100 times (Fig 1). Marginally producing wells may be responsible for up to 4 Tg per year of methane emissions nationally [7]. EPA estimates oil and gas systems emit about 166 MMT of CO<sub>2</sub>-equivalent of methane annually, or about 6.6 Tg of methane [9].



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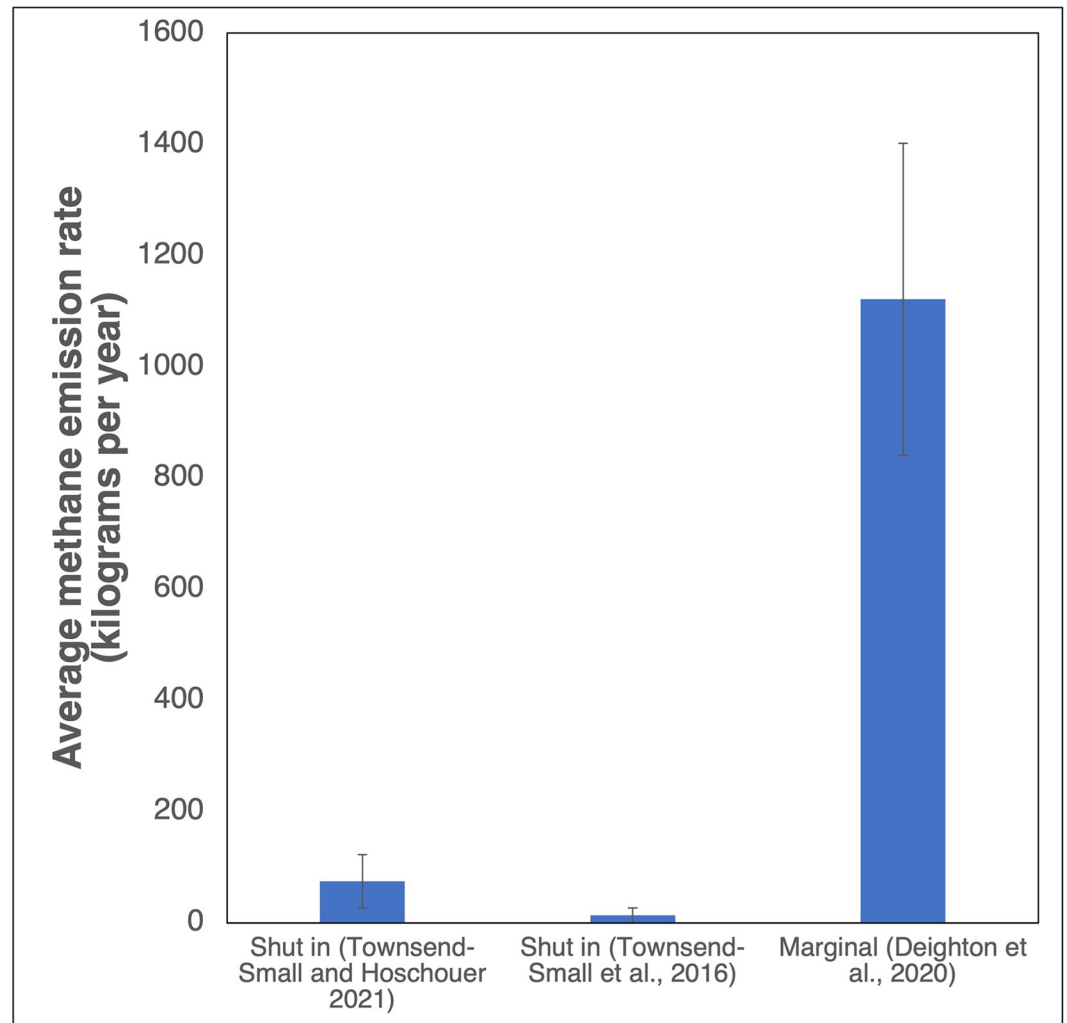
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**Fig 1. Methane emissions from shut in and marginally producing wells.** Data from shut in wells are from Texas [10], and Colorado, and Utah [11]. Data from marginal wells represent the production class of 0 to 1 barrels of oil equivalent per day and are from Ohio [6].

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Research from our group has also shown that the plugging process is effective in mitigating methane emissions from oil and gas wells [11]. Incentive programs to encourage plugging of orphaned wells without known owners are currently underway in the United States now, although orphaned wells account for less than 5% of methane emissions from the oil and gas supply chain nationally [5,11]. However, establishing these well plugging programs will help create a just transition for oilfield workers as oil and gas resources are exhausted and through the coming energy transition. It is important to establish a robust system for well plugging and restoration as marginal wells are abandoned so that these wells are not left behind to become orphaned. But the plugging process is slow, whereas shutting in wells can be accomplished quickly – with little to no infrastructure needed, at low cost, and with a very large reduction in methane emissions.

My work has shown there are marginal wells on federal land, which could be a preliminary target for this policy. There are marginally producing wells in every oil and gas producing state – they are by far the most abundant type of oil and gas well in our country. Because of the

very small production rate of marginal wells, any shortfall in oil and gas supply resulting from shutting-in marginal wells could be eliminated by drilling a much smaller number of new unconventional wells, which emit methane at much lower proportions [12]. Possible benefits for operators to shut in marginal wells could include tax credits or other incentives; marginal well production credits already exist at the state and federal level [13], which may help keep these wells operating past their viable lifespan.

We need an immediate solution to the global problem of growing methane emissions. We are also past the point of starting a global transition away from fossil fuels. The United States should show leadership in shutting in marginal wells right away, to rapidly reduce methane emissions and begin the energy transition.

## References

1. Nisbet EG, Jones AE, Pyle JA, Skiba U. Rising methane: is there a methane emergency? *Philos Trans R Soc Math Phys Eng Sci.* 2022 Jan 24; 380(2215):20210334. <https://doi.org/10.1098/rsta.2021.0334>.
2. Ocko IB, Sun T, Shindell D, Oppenheimer M, Hristov AN, Pacala SW, et al. Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming. *Environ Res Lett.* 2021 May; 16(5):054042. <https://doi.org/10.1088/1748-9326/abf9c8>.
3. Saunio M, Stavert AR, Poulter B, Bousquet P, Canadell JG, Jackson RB, et al. The Global Methane Budget 2000–2017. *Earth Syst Sci Data.* 2020 Jul 15; 12(3):1561–623. <https://doi.org/10.5194/essd-12-1561-2020>.
4. Nisbet EG, Fisher RE, Lowry D, France JL, Allen G, Bakkaloglu S, et al. Methane Mitigation: Methods to Reduce Emissions, on the Path to the Paris Agreement. *Rev Geophys.* 2020; 58(1): e2019RG000675. <https://doi.org/10.1029/2019RG000675>.
5. Alvarez RA, Zavala-Araiza D, Lyon DR, Allen DT, Barkley ZR, Brandt AR, et al. Assessment of methane emissions from the U.S. oil and gas supply chain. *Science.* 2018 Jun 21; eaar7204. <https://doi.org/10.1126/science.aar7204> PMID: 29930092
6. Deighton JA, Townsend-Small A, Sturmer SJ, Hoschouer J, Heldman L. Measurements show that marginal wells are a disproportionate source of methane relative to production. *J Air Waste Manag Assoc.* 2020 Oct 2; 70(10):1030–42. <https://doi.org/10.1080/10962247.2020.1808115> PMID: 32776822
7. Omara M, Zavala-Araiza D, Lyon DR, Hmiel B, Roberts KA, Hamburg SP. Methane emissions from US low production oil and natural gas well sites. *Nat Commun.* 2022 Apr 19; 13(1):2085. <https://doi.org/10.1038/s41467-022-29709-3> PMID: 35440563
8. U.S. Energy Information Administration (EIA). The Distribution of U.S. Oil and Natural Gas Wells by Production Rate [Internet]. U.S. Department of Energy, Office of Independent Statistics and Analysis; 2022 Jan [cited 2022 Dec 13]. Available from: <https://www.eia.gov/petroleum/wells/>.
9. United States Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2020 [Internet]. 2022. Available from: <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf>.
10. Townsend-Small A, Hoschouer J. Direct measurements from shut-in and other abandoned wells in the Permian Basin of Texas indicate some wells are a major source of methane emissions and produced water. *Environ Res Lett.* 2021 May; 16(5):054081. <https://doi.org/10.1088/1748-9326/abf06f>.
11. Townsend-Small A, Ferrara TW, Lyon DR, Fries AE, Lamb BK. Emissions of coalbed and natural gas methane from abandoned oil and gas wells in the United States. *Geophys Res Lett.* 2016; 43(5):2283–90. <https://doi.org/10.1002/2015GL067623>.
12. Omara M, Sullivan MR, Li X, Subramanian R, Robinson AL, Presto AA. Methane Emissions from Conventional and Unconventional Natural Gas Production Sites in the Marcellus Shale Basin. *Environ Sci Technol.* 2016 Feb 16; 50(4):2099–107. <https://doi.org/10.1021/acs.est.5b05503> PMID: 26824407
13. Potter K, Shirley D, Manos I, Muraoka K. Tax Credits and Incentives for Oil & Gas Producers in a Low-Price Environment. *J Multistate Tax Incent.* 2017; 27(2):31–5.