OCTOBER 2017

EXPANDING SUBSIDIES FOR CO_2-ENHANCED OIL RECOVERY:

A NET LOSS FOR COMMUNITIES, TAXPAYERS, AND THE CLIMATE

This analysis explores the oil production, carbon emissions, and taxpayer cost implications of the proposed changes to Section 45Q in the U.S. tax code in S.1535 and H.R.3761.

EXECUTIVE SUMMARY

Legislation recently introduced in the U.S. House and Senate proposes to extend and expand the Section 45Q tax credit for carbon capture and sequestration (CCS) and carbon dioxide (CO_2)-enhanced oil recovery (EOR).

Generally speaking, this tax credit benefits coal- and gas-fired power plants (and industrial facilities) that capture waste CO_2 before it is emitted. The value of the tax credit that facilities receive depends on whether they decide to directly sequester the CO_2 underground (CCS) or sell it to oil companies that will pump the gas into wells to recover hard-to-get oil (EOR). If the proposed bills become law, the expansion of the existing 45Q tax credit could be the largest subsidy given to the fossil fuel industry by the United States government.

The key findings of the analysis include:

- **The proposed law would result in at least an additional 400 thousand barrels per day (kbpd) of CO_2-enhanced oil production** in the United States in 2035[1] – and possibly far more.
- This additional production of oil would **directly lead to as much as 50.7 million metric tons of net CO_2 emissions** annually that would otherwise not be emitted – and arguably more. **This is equal to the annual emissions from 12.5 coal-fired power plants.**
- **The portion of the bill that benefits the oil industry alone could cost American taxpayers as much as $2.8 billion every year.[2]**

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[1] Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

[2] This analysis focuses on the impact of the proposed legislation on the oil industry and oil production in particular. Additional research is needed to quantify the full amount of additional production that the credit would unlock, the billions of dollars in potential tax credits for coal or gas power plants to pump CO_2 directly into the ground, and the costs to local residents and American taxpayers from the public health impacts of extending and increasing coal- and gas-fired power generation enabled by 45Q.

- **The years of additional oil production and coal- and gas-fired power generation (using CCS technology) enabled by the expansion of the 45Q tax credit pose serious risks to the health of local communities and ecosystems.**

- **Subsidizing and expanding the fossil fuel industry is not – and will never be – a solution to the climate crisis.**

Our analysis shows that despite a veneer of green, the enhanced oil recovery portion of the proposed legislation will enable the production of more carbon than it will capture. In addition, the overall incentive for facilities to sell captured CO_2 to oil companies for use in extraction would be more lucrative than the incentive for facilities to directly sequester their carbon pollution. This suggests the legislation will primarily incentivize oil extraction and encourage direct sequestration only secondarily.

For these reasons, **the tax credit is doing little to address the problem it was intended to correct: reducing CO_2 emissions and limiting U.S. contributions to climate change.** By lowering the cost of production for the oil industry, this subsidy increases oil company profits, while raising revenue for facilities like coal and gas power plants that capture CO_2. This tax credit is a win for the fossil fuel industry, but a loss for the climate, for taxpayers, and for fenceline communities living in the shadow of fossil fuel infrastructure.

"This tax credit is a win for the fossil fuel industry, but a loss for the climate, for taxpayers, and for fenceline communities living in the shadow of fossil fuel infrastructure."

Reasonable people disagree about whether or not carbon capture and storage technology will be necessary in the coming decades to meet emissions and climate targets, and thus whether it deserves financial support now from taxpayers as a tool in the climate and energy policy fight. Regardless, we should take care not to design policies in a way that would trigger more carbon being emitted than captured or ignore health and safety impacts borne by local communities. Certainly, we should not leave taxpayers and local communities to foot the bill for increased oil profits and production.

In terms of the costs to American taxpayers, the climate, and communities living near coal and gas plants, CO_2 pipelines, oil fields, and refineries – this legislation is far too expensive.

Section 45Q Tax Credit

Section 45Q of the federal tax code currently allows a qualified facility to claim a credit of $20 per metric ton of CO_2 captured and disposed of in secure geological storage. It also allows a $10 per metric ton credit for CO_2 captured and used or sold as a tertiary injectant in enhanced oil or gas recovery. The existing tax credit expires when 75 million metric tons of CO_2 have been claimed as captured and stored or used as an injectant in enhanced oil recovery.[3]

The current 45Q credit is anticipated to expire in 2018.[4] However, legislation proposed in both the Senate (S.1535 - Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions (FUTURE) Act) and House (H.R.3761 - Carbon Capture Act) would extend and expand tax credits for CCS and EOR to $50 per metric ton of CO_2 sequestered and $35 per metric ton of CO_2 used as an injectant in EOR, respectively. Facilities that qualify would be able to claim the credit for their first 12 years of operation under the Senate bill and for their first 15 years under the House bill. The tax credit would apply to any EOR project that started construction before January 1, 2024 – creating a subsidy benefitting the oil industry that could

[3] Cornell Law School, Legal Information Institute, "26 U.S. Code § 45Q - Credit for carbon dioxide sequestration." https://www.law.cornell.edu/uscode/text/26/45Q

[4] Gheorghui, I., "Congress, White House Drag Feet on Support for Carbon Capture Expansion," Morning Consult, May 9, 2017. https://morningconsult.com/2017/05/09/congress-white-house-drag-feet-support-carbon-capture-expansion/

extend into the 2040s. Both bills eliminate the cap on the volume of CO_2 captured or used for which companies could claim tax credits.[5]

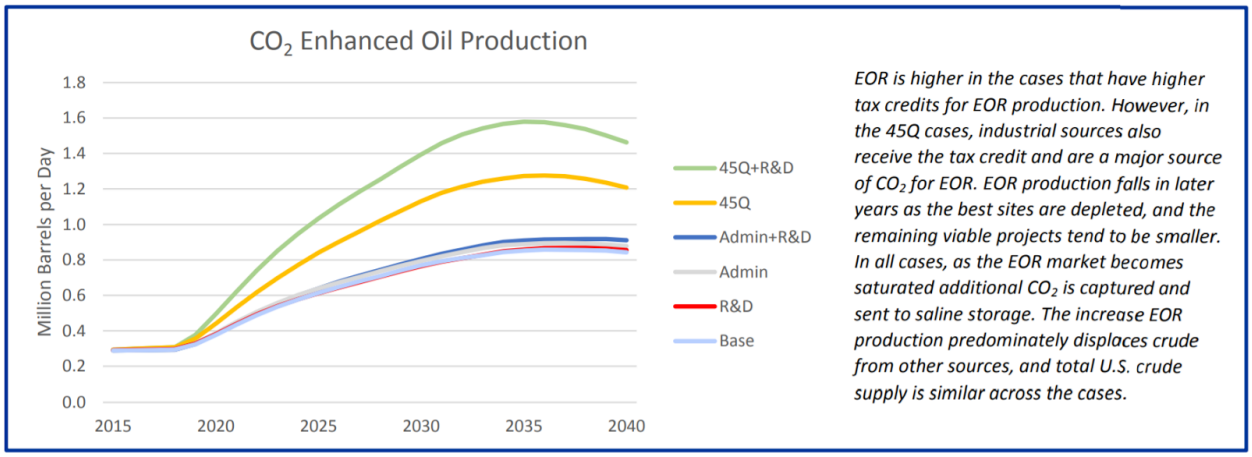
Concerns have been raised that the current and proposed 45Q tax credit do not primarily incentivize direct sequestration of climate-polluting emissions or promote the development of "better" CCS. The Department of Energy (DOE) suggests that for entities capturing CO_2, the market price of CO_2 for EOR plus the $35 per tCO_2 tax credit is more attractive than the $50 per tCO_2 credit for saline storage.[6] This means that, where possible, facilities capturing CO_2 would almost always prefer to use or sell it for CO_2-EOR until that market is saturated. One implication is that sequestration-only projects can be expected to see limited uptake through an expanded tax credit. This appears to reinforce a prior DOE-commissioned analysis suggesting that there is little evidence that increased CO_2-EOR deployment is a necessary or beneficial step towards the commercial deployment of CCS.[7]

Thus, leaving aside the question of what role CCS should have in climate change mitigation, the usefulness of expanding the 45Q tax credits as a climate policy that commercializes CCS technology still requires interrogation. A publicly disclosed analysis of which facilities have claimed the existing 45Q tax credit to date would help paint a clearer picture of how CO_2 market price, and the value of the subsidy, impact choices about CO_2 storage in practice.

Oil Production Impact of 45Q Expansion

According to the DOE, **the proposed changes to 45Q would result in an additional 400 thousand barrels per day (kbpd) of CO_2-enhanced oil production** in the United States in 2035.[8] (See Figure 1.)

Figure 1: CO_2-Enhanced Oil Production under Various Policy Scenarios



Source: Department of Energy[9]

[5] S.1535, "Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions (FUTURE) Act." https://www.congress.gov/bill/115th-congress/senate-bill/1535/text; H.R.3761, "Carbon Capture Act." https://www.congress.gov/bill/115th-congress/house-bill/3761/text

[6] Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

[7] Dooley, J., et al., "CO_2-driven Enhanced Oil Recovery as a Stepping Stone to What?" Pacific Northwest National Laboratory, prepared for the Department of Energy, 2010. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19557.pdf

[8] DOE estimates show a base case of approximately 850 kbpd from CO_2-enhanced oil production in 2035, and a total of 1250 kbpd with the 45Q tax credit. Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

[9] Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

This projection of additional production is likely highly conservative because it only considers incremental increases in CO_2-enhanced oil recovery (CO_2-EOR) resulting from the credit, not the potential increase in other oil production triggered by the 45Q subsidy. This subsidy to the oil industry changes the economics of production decisions for each new field that could, in the future, utilize this subsidy to extract more oil over the lifetime of a field and to generate more profit. Expanding the subsidy will impact investor decisions – based on internal rates of return for a given project – about whether or not to develop a new oil field in the first place.[10]

This analysis does not examine this effect. We have not estimated the additional lifetime production from oil fields that may only be drilled because of the projected additional value of the new tax credit. Further research is needed to understand the total potential volume of new oil production triggered by 45Q, beyond the 400 kbpd identified by the DOE analysis. This analysis only considers the CO_2-EOR-enabled oil production that begins at the final stage of a field's life.

Given the industry-friendly assumptions used in the DOE analysis, we believe that the true impact of the proposed subsidy on oil production, and thus emissions, could be far greater than the minimum of 400 kbpd. Indeed, some industry estimates suggest that up to 137 billion barrels of oil is technically recoverable using CO_2-EOR technology[11] – as much oil as the United States has produced in the last 50 years.[12]

Box 1: How 45Q Subsidizes the Oil Industry

Some oil company representatives argue that 45Q is not a subsidy to the oil industry because it is claimed by facilities that capture CO_2, not the companies that use it. They are wrong for at least two reasons.

First, the purpose of this tax credit is to encourage the capture and sequestration of more carbon, which it accomplishes by lowering the cost of capturing carbon. This, in turn, allows facilities to sell CO_2 at a reduced price to oil companies, while still increasing their own profits. The reduced cost of CO_2 as an input allows oil producers to increase their profits as well, which they can then recycle into more exploration, production, or political influence. Thus, 45Q makes both oil production and carbon capture more profitable.

Second, the proposed changes to 45Q would allow facilities capturing CO_2 to transfer their credits to companies using it to pump more oil. Companies could theoretically use the credit to lower their tax liability to zero and sell any remaining credits to other companies that use CO_2 for enhanced oil recovery. This behavior is seen across the industry, perhaps best illustrated by Exxon's well-documented avoidance of U.S. taxes in 2015.[13]

The proposed legislation is clearly a subsidy that benefits the entire fossil fuel industry: oil, gas, and coal.

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[10] Subsidies to oil companies really do impact investment. Recent research indicates that in the U.S., nearly half of new oil production will only get a green light from investors because of subsidies that lower company costs. Erickson, P., et al, "Effect of subsidies to fossil fuel companies on United States crude oil production," Stockholm Environment Institute & Earth Track, Nature Energy, October 2, 2017. https://www.nature.com/articles/s41560-017-0009-8

[11] U.S. Department of Energy, National Energy Technology Laboratory, "Improving Domestic Energy Security and Lowering CO_2 Emissions with "Next Generation" CO_2-Enhanced Oil Recovery (CO_2-EOR)," 2011. http://www.midwesterngovernors.org/documents/NETL_DOE_Report.pdf

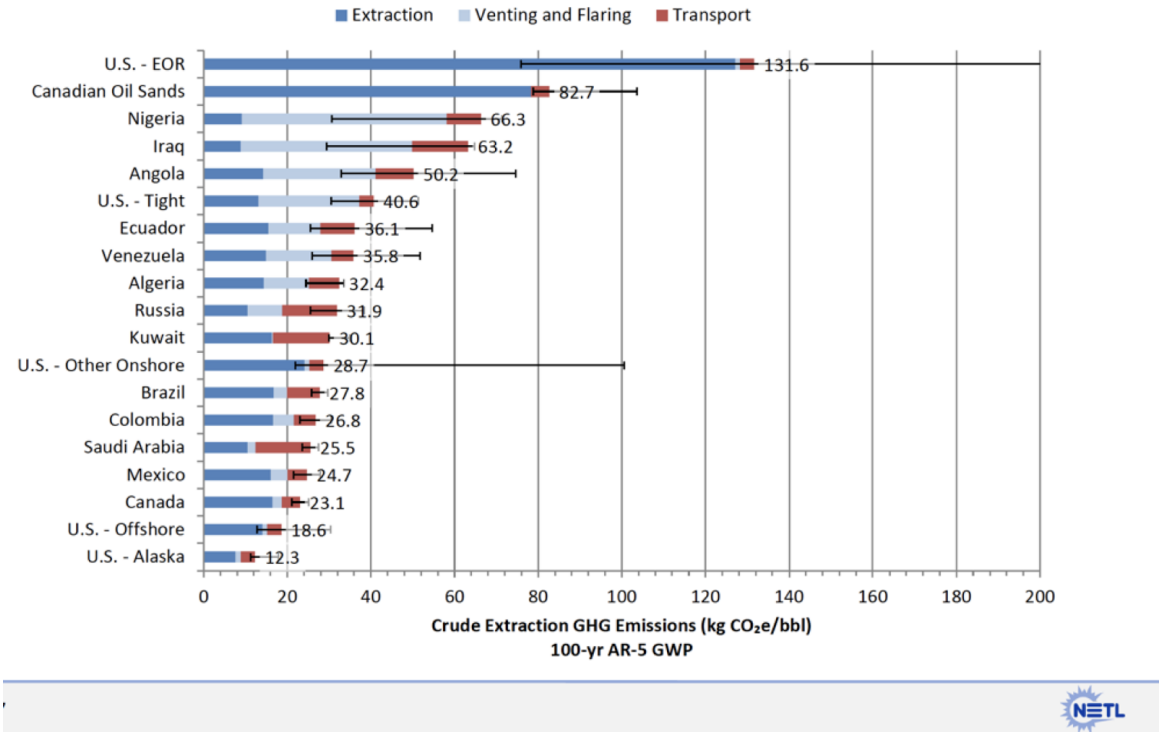
[12] Calculated using data from EIA (2017). U.S. Field Production of Crude Oil. https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrfpus2&f=a

[13] Gardner, Matthew, McIntyre Robert S., Phillips, Richard, "The 35 Percent Corporate Tax Myth
Corporate Tax Avoidance by Fortune 500 Companies, 2008 to 2015," Institute on Taxation and Economic Policy, March 2017, p.22. https://itep.org/wp-content/uploads/35percentfullreport.pdf

Climate Pollution Impact of 45Q Expansion

Cheaper and increased oil production in the United States will have consequences for the climate. Increased CO_2-EOR production is particularly concerning because it is clearly among the most carbon intensive oils on the market, as shown by the Department of Energy's National Energy Technology Lab (See Figure 2).

Figure 2: Cradle-to-Gate Comparison of Extracted and Delivered Crudes Consumed in the U.S.



Source: Department of Energy National Energy Technology Lab[14]

Despite this, proponents of expanding 45Q argue that oil production triggered by the tax credit will simply displace oil that would have otherwise been produced elsewhere. This scenario is not realistic in today's oil market, or, importantly, in any oil market that is aligned with levels of demand that are consistent with achieving the Paris Agreement climate goals of limiting global temperature rise to well below 2°C, and aiming for below 1.5°C.

Proponents of expanding 45Q base their claim that the bill will be good for the climate on an 80% production displacement assumption. There are many fundamental problems with using this assumption to calculate the potential climate benefits of the EOR portion of an expanded 45Q tax credit. In short, whether CO_2-enhanced oil production associated with the proposed modifications to Section 45Q would result in net damage to the climate or a net benefit hinges in large part on displacement assumptions, which depend on, among other factors, future oil price assumptions and availability of alternatives in end uses of oil.[15]

Under the Obama Administration, the U.S. government's own analysis reflected the evolving understanding that high rates of displacement should not be assumed in understanding the impacts of new supply on global markets. For example, a 2016 study of the 2017-2022 Outer Continental Shelf leasing program by the Bureau of Ocean Energy Management (BOEM) suggested that, for every barrel of oil left in the ground,

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[14] U.S. Dept of Energy, National Energy Technology Laboratory, "Developing an Approach for the Lifecycle Analysis of Conventional Petroleum Fuels: Outlook to 2040 – Crude Extraction and Transport" PowerPoint presentation dated October 7, 2014.

[15] International Energy Agency, "Storing CO_2 through Enhanced Oil Recovery," OECD/IEA, 2015, p. 32. https://www.iea.org/publications/insights/insightpublications/Storing_CO2_through_Enhanced_Oil_Recovery.pdf

Box 2: Don't Assume CO_2-EOR Oil will Simply Displace Oil Produced Elsewhere

Some proponents of scaling up CO_2-EOR rely on one key, highly uncertain assumption in asserting that CO_2-EOR would produce net climate benefits. This is the assumption that at least 80% of oil produced using CO_2-EOR would simply displace other oil production elsewhere. This assumption comes from a 2015 International Energy Agency (IEA) report, which clearly states "oil supply is assumed to have to meet annual oil demand as specified in the 6DS (6 Degree Scenario) for the time period up to 2050."[15] It may be true that in a world awash in oil and on its way to a 6°C global temperature rise, extending the 45Q tax credit in 2017 would have made very little difference. But we should not be forecasting failure in climate action, rather we should consistently evaluate proposals in relation to our achievement of the Paris Agreement goals.

One reason a Paris Agreement-compliant future diverges from the future modeled by IEA is the availability of alternatives – electric vehicles – as their market penetration increases. As alternatives become more readily available, the elasticity of demand increases, which results in a decrease in the elasticity of supply.

It is also worth noting that in the IEA scenario in question, the model predicted that oil prices would currently be over $110 per barrel and that the price would rise to $150 by 2050. Whether CO_2-EOR incentives deliver a net climate benefit or actually increase net emissions depends in large part on these highly uncertain future assumptions. For people concerned about climate change, this deep uncertainty should be cause for concern.

global consumption is reduced by 0.53 barrels as a result of incrementally higher prices (i.e. approximately 50% displacement).[16]

For the purposes of this analysis, we use the two scenarios described below.[17] The CO_2 emissions outcomes of these scenarios are illustrated in Figure 3.

Scenario 1: Total emissions impact of oil produced as a result of the tax credit (no market adjustment): This scenario quantifies the emissions of the additional oil produced as a direct result of the 45Q tax credit without considering market impact. This allows us to examine the full production, emissions, and cost impacts of the tax credit per metric ton of CO_2.

Scenario 2: Market-adjusted emissions impact (50% displacement): Drawing from the outputs of the BOEM study's modelling, this scenario assumes that only half of every barrel of production directly triggered by 45Q translates into additional oil burned globally. The resulting net emissions are attributable to the tax credit.

If the 45Q tax credit is expanded as proposed, the additional oil produced (400 kbpd) would, through its life cycle, emit 81.9 million metric tons (Mt) of CO2 emissions annually in 2035.. To enable this oil to be extracted,

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[16] Department of Interior, BOEM, "OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon," 2016. https://www.boem.gov/OCS-Report-BOEM-2016-065/
Elasticity of demand and supply in this analysis suggest a net effect of 0.53 barrels would not be consumed for every barrel not extracted. For simplicity, we have used 0.5 (50%) for the second scenario in this analysis.

[17] A separate analysis would be required to more accurately estimate the proportion of production that would occur elsewhere in the absence of production triggered by the CO_2-EOR credit. This is particularly challenging for CO_2-EOR because the technology could be used on wells that are at any point on the cost curve for oil. Whether or not the subsidy would make a difference for production, depends both on the breakeven price for each field in which it is used, and the price of crude oil at any given time. This concept is well explained and explored in a recent report by Stockholm Environment Institute and Earthtrack, which found that at current oil prices, 47% of future oil drilling in the U.S. was dependent on Federal subsidies to be profitable. https://www.sei-international.org/press/press-releases/3767

31.2 $MtCO_2$ would be pumped into wells annually. This means that for every barrel of oil produced through EOR, ultimately **0.347 tCO_2 are emitted**.[18,19] This does not account for the fact that CO_2-EOR is more carbon intensive than other oil production in the same field, and thus is very likely a conservative estimate of net emissions per barrel produced.[20]

> **Scenario 1: Total emissions impact (no market adjustment):** Without adjusting for the oil market, and considering the lifecycle emissions of the oil produced minus the CO_2 injected, the 45Q tax credit will result in **annual net emissions of 50.7 $MtCO_2$** above baseline CO_2-EOR levels by 2035, equivalent to the emissions from almost 11 million cars or the annual emissions of 12.5 coal-fired power plants.[21]
>
> **Scenario 2: Market-adjusted emissions impact (50% displacement):** Under this scenario, the same amount of CO_2 is injected per barrel of oil produced, but only half of the emissions from burning that barrel are additional (50% is assumed to simply be displacing production that would have happened elsewhere). The result is **net annual emissions of 9.7 $MtCO_2$ above the baseline.**[22] In other words, even assuming 50% supply displacement, the EOR component of the proposed 45Q tax credit would result in net additional CO_2 emissions.[23]

Some proponents of CO_2-EOR have claimed that, in aggregate, CO_2-EOR technology could increase recoverable domestic reserves of oil by 67 to 137 billion barrels.[24] Using the upper end of this range, the carbon in 137 billion barrels of oil (which cannot be captured from the tailpipe when combusted) equals 70.7 billion tons of CO_2.[25] This is equal to more than 12 years of U.S. greenhouse gas emissions at 2015 levels,[26] or more than one third of the world's remaining energy-related carbon budget to maintain a 50% chance of limiting warming to 1.5°C.[27]

"[The carbon in oil made recoverable by CO2- EOR technology could be] equal to more than 12 years of U.S. greenhouse gas emissions at 2015 levels, or more than one third of the world's remaining energy- related carbon budget to maintain a 50% chance of limiting warming to 1.5°C."

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[18] Net CO_2 emissions is equal to the lifecycle emissions from a barrel of oil produced (0.561 tCO_2) minus the emissions injected to recover that barrel of oil (0.214 tCO_2). Emissions values are the sum of a CO_2-EOR cradle-to-gate emissions average reported in a presentation commissioned by DOE NETL (131kg CO_2 / barrel), plus the EPA emissions factor for combustion of a barrel of oil (430kg CO_2), for a total of 561kg CO_2 / barrel. DOE NETL presentation available at https://www.netl.doe.gov/File%20Library/Research/Energy%20Analysis/Life%20Cycle%20Analysis/LCA-XIV-Petro-Baseline-Projections--Cooney-.pdf; EPA emissions factor available at https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references).

[19] Some have argued that EOR technology will evolve over time to inject more CO_2 per barrel of oil lifted than at present. However, it is clear that oil companies would still be paying for CO_2 (albeit at a reduced rate due to the subsidy). The idea that oil companies would willingly inject more CO_2 per barrel lifted, making the process less efficient and therefore increasing the cost of production per barrel, is difficult to reconcile with the real-world behavior and financial motivations of oil producers.

[20] Nagabhushan, D., "The Emission Reduction Benefits of Carbon Capture Utilization and Storage using CO_2 Enhanced Oil Recovery," Clean Air Task Force. http://catf.us/resources/factsheets/files/CO2_EOR_Life_Cycle_Analysis.pdf

[21] (CO_2 emissions per barrel combusted) - (CO_2 injected per barrel extracted) = net tax credit emissions impact per barrel // (0.561 tCO_2) - (0.214 tCO_2) = 0.347 tCO_2 per barrel // (Net emissions per barrel) x (400 kbpd) x (365 days) = annual net tax credit emissions // (0.347 tCO_2) x (400 kbpd) x (365 days) = 50,662,000 tCO_2

[22] In a 50% leakage scenario, net CO_2 emissions is equal to life-cycle emissions from barrel of oil produced (0.561 tCO_2) minus the emissions injected to produce the oil (0.214 tCO_2), minus emissions not otherwise produced due to market effects (0.561 tCO_2 x 50%).

[23] (CO_2 emissions per barrel combusted) - (CO_2 injected per barrel extracted) - (CO_2 emissions per barrel combusted x 50% displacement) = market-adjusted emissions per barrel // (0.561 tCO_2) - (0.214 tCO_2) - (0.561 tCO_2 x 50%) = 0.0665 tCO_2 per barrel (market-adjusted emissions per barrel) x (400 kbpd) x (365 days) = annual market-adjusted emissions // (0.0665 tCO_2) x (400 kbpd) x (365 days) = 9,709,000 tCO_2

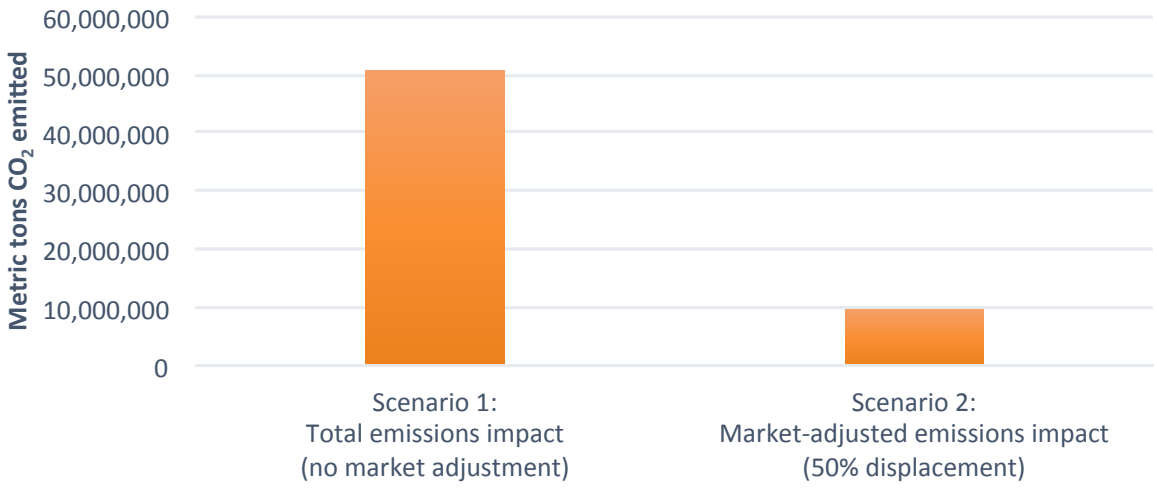
[24] Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

[25] Assuming lifecycle emissions of 0.561 tCO_2 per barrel of oil.

[26] EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks," https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

[27] Energy-only portion of 1.5 degree C carbon budget assumed to be 210 $GtCO_2e$, adapted from Oil Change International, "The Sky's Limit," 2016. http://priceofoil.org/2016/09/22/the-skys-limit-report/

Figure 3: Comparison of Net CO_2 Emissions Resulting from the EOR Component of 45Q Expansion under Total Emissions Impact and Market-Adjusted Emissions Impact Scenarios



Source: Oil Change International Analysis

Box 3: Debunking the Myth: CO_2-EOR Does Not Limit Expansion of Destructive Drilling

Some proponents of the 45Q tax credit argue that using CO_2 to get the 'last barrel' of oil from existing wells has the environmental benefit of reducing the need to drill new wells to meet oil demand. They claim that this means less drilling in offshore or protected areas and less environmentally destructive and carbon intensive oil, like that coming from Canadian tar sands. This is a deeply misleading argument.

First, there is nothing in the proposed legislation that limits the use of this tax credit to existing oil fields. The subsidy is a sweetener for any CO_2-EOR operation that qualifies. So when oil producers are deciding whether to develop a new oil field, they will consider whether 45Q will benefit their bottom line – regardless of whether that new production is on the Outer Continental Shelf or in Oklahoma. The credit will have impacts on internal rates of return that could mean the difference between a decision to invest and develop, or not.

In addition, nothing in the proposed changes to the tax code puts environmentally sensitive areas or the dirtiest fuel sources off limits. Instead, the changes would result in quite the opposite: the Trump Administration is trying hard to expand offshore drilling and rescind the protected status of public lands and waters. And, as the U.S. National Energy Technology Laboratory finds, EOR actually emits more climate pollution per barrel – cradle-to-gate – than Canadian tar sands.[28] An expanded 45Q simply makes drilling oil a better deal for producers.

Finally, the extension of the 45Q tax credit will improve cashflow not only for fields with CO_2-EOR, but in fact across the entire industry, as less money used for one field can mean more spent on another. Alternatively, the increased profits generated from 45Q could be used for lobbying and campaign finance activities designed to delay and weaken any regulatory action targeting the oil and gas industry.

Annual Transfer of Wealth from Taxpayers to the Fossil Fuel Industry

In its proposed form, the 45Q tax credit could be the largest single subsidy to the fossil fuel industry in the United States.[29] The EOR component alone of the proposed 45Q tax credit expansion would cost American taxpayers between $1.1 billion and $2.8 billion by 2035, regardless of assumptions about production displacement.[30]

We examine a range of possible scenarios based on the portion of overall CO_2-enhanced oil production eligible for the credit (See Table 1 and Figure 4).[31] Given that only anthropogenic sources of CO_2 (for example, coal-power plants or industrial facilities) are eligible to claim the $35 per metric ton tax credit under 45Q, the ultimate cost would depend on the proportion of CO_2-EOR using human-made versus natural sources of CO_2.

Table 1: Estimates of Annual Cost of 45Q Tax Credit, EOR Component Only

	Description	Annual Cost of Subsidy
Constant level scenario (likely)	Assumes constant absolute levels of CO_2-EOR using CO_2 from natural sources from present to 2035. This scenario is seen as plausible because the $35/t$CO_2$ credit and transferability of credits would provide a significant incentive for the capture and injection of anthropogenic CO_2 (or injection of CO_2 already being separated) and because natural reserves of CO_2 are not evenly dispersed geographically.	**$2,761,188,500**
Proportional level scenario	Assumes same proportion of natural versus anthropogenic sources for CO_2 used in CO_2-EOR in 2035 as today. This scenario is seen as plausible, but a conservative estimate, because it assumes that CO_2-EOR production using anthropogenic CO_2 would remain proportionally static, despite a significant increase in the tax incentive promoting the use of CO_2-EOR using anthropogenic CO_2.	**$1,544,625,250**
Increment-only scenario	Assumes that in 2035 only the incremental 400,000 barrels per day resulting from 45Q use anthropogenic CO_2, and the remainder uses CO_2 from natural sources. This scenario is very unlikely, as it would mean none of the more than 800,000 barrels per day of "baseline" CO_2-EOR production that the DOE estimates will occur in 2035 would be using anthropogenic CO_2. In reality, natural CO_2 sources are limited and may not be proximate to production that can benefit from CO_2 injection.	**$1,093,540,000**

Source: Oil Change International Analysis

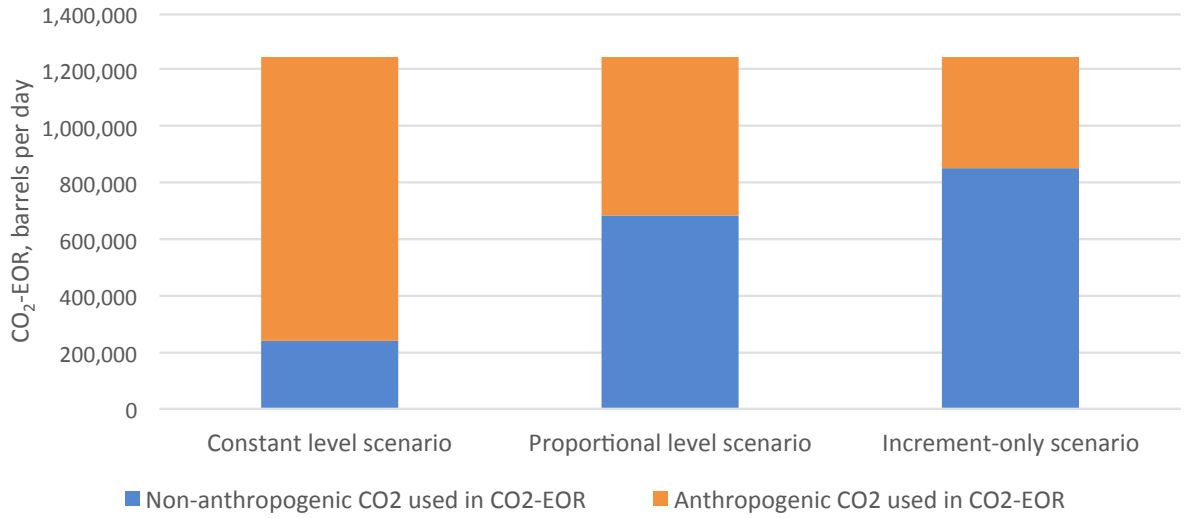
[28] Department of Energy, National Energy Technology Laboratory, "Developing an Approach for the Lifecycle Analysis of Conventional Petroleum Fuels: Outlook to 2040 - Crude Extraction and Transport," presented by Cooney, G., Booz Allen Hamilton, October 7, 2014.

[29] For an comprehensive inventory of U.S. federal and state fossil fuel subsidies, see Oil Change International, "Dirty Energy Dominance: Dependent on Denial," 2017. http://priceofoil.org/2017/10/03/dirty-energy-dominance-us-subsidies/

[30] For full calculations of these cost estimates, see https://goo.gl/YXXeTj

[31] These scenarios do not reflect the cost to taxpayers of the 45Q tax credit as applied to CCS.

Figure 4: CO_2-EOR Barrels Produced in 2035 Using Natural CO_2 vs. Anthropogenic CO_2, under Different Scenarios



Source: Oil Change International Analysis

Cost to Taxpayers per Ton of CO_2

Much has been said about putting a price on carbon. In theory, a carbon price would raise the cost of carbon-intensive energy production and disadvantage fossil fuel producers by making their energy more expensive for consumers. The expected outcome would be a shift in behavior that drives demand toward low(er) emissions sources of energy. At present, the per-ton value of CO_2 emissions is not the driving force behind oil and gas companies choosing to use EOR to increase oil production. However, it is useful to conceptualize that with a bigger 45Q tax credit, we could be paying oil companies between $24 and $429 for each metric ton of CO_2 pollution they emit as a result of newly-enabled CO_2-enhanced oil production by 2035.[32]

Impacts of 45Q on Local Communities and Ecosystems

There is valid ongoing debate about whether the world will need carbon capture technologies to avoid climate chaos in the coming decades. At the same time, we cannot ignore the fact that CO_2 is far from the only negative externality resulting from the operation of coal-fired power plants. Residents living in the vicinity of these facilities face significant health impacts, particularly from criteria air contaminants. It is important to understand the implications of expanding the 45Q tax credit for the viability of coal-fired power plants – either by reducing the cost of building new facilities or extending the life of existing plants through retrofits.

The levels of some solid, liquid, and atmospheric pollutants may stay the same or even increase from facilities using CCS. Also, because carbon capture requires additional energy inputs, lifecycle emissions of some upstream and downstream pollutants may increase.[33] Because coal power plants tend to be disproportionately located in low-income communities and communities of color, 45Q expansion is necessarily an environmental justice issue.[34] The efficiency penalty resulting from post-combustion capture

[32] Calculations can be found at https://goo.gl/YXXeTj

[33] Koornneef, J., et al., "Chapter 2: Carbon Dioxide Capture and Air Quality," in Mazzeo, N., Ed., "Chemistry, Emission Control, Radioactive Pollution and Indoor Air Quality", Environmental Sciences, July 27, 2011, ISBN 978-953-307-316-3. https://www.intechopen.com/books/chemistry-emission-control-radioactive-pollution-and-indoor-air-quality/carbon-dioxide-capture-and-air-quality

[34] Wilson, A., "Coal Blooded: Putting Profits before People," NAACP, Indigenous Environmental Network, Little Village Environmental Justice Organization, November 2012. http://www.naacp.org/wp-content/uploads/2016/04/CoalBlooded.pdf

of CO_2 at coal plants has been estimated to be between roughly 10% and as high as 40%, meaning that units retrofitted with CCS may need to combust far more coal to produce the same amount of electricity (with an associated increase in non-CO_2 pollutants affecting local communities).[35,36,37] This also means that a commensurate volume of the CO_2 captured at coal-fired power plants and injected or utilized for EOR would never have been produced in a baseline scenario, so a portion of the carbon sequestered or injected would, in fact, be CO_2 that was created only because of the additional coal combusted as a result of the efficiency penalty of the carbon capture process. This factor is not accounted for in the EOR portion of this analysis, and the net emissions per barrel estimates in that section would be even higher if this factor were taken into account.

The Department of Energy projects that 36 billion kWh of electricity would be generated annually from roughly 10 GW of coal-fired power capacity benefiting from the proposed expansion of 45Q by 2035.[38] This equates to over 18 average sized coal-fired power plants.[39] **If a number of coal-fired power plants are kept alive by the more generous 45Q provisions, impacts on communities near these plants, coal ash disposal sites, transportation routes, and coal mines will be exacerbated as a result.**

On the EOR side, the injection of CO_2 into aging oil fields to increase production has helped extend the life of some fields by more than 25 years.[40] Expanding the tax credit for CO_2-enhanced oil recovery (EOR) is an environmental justice issue because people of color disproportionately live by oil and gas development where pollutants released into local air and water can have severe negative health impacts.[41] In California, nearly 92 percent of the population living within one mile of oil and gas development and in communities identified as most vulnerable by the California Environmental Protection Agency, are people of color.[42]

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Finally, enhanced oil recovery presents real threats to drinking water, yet oversight of these practices has lagged. Both federal and state regulations on EOR activities under the Safe Drinking Water Act fall short of providing sufficient safeguards for groundwater. Even before the push from the current administration to roll back environmental, health, and safety regulations, state and federal regulators lacked the proper funding and staffing levels for adequate oversight, and significant data and monitoring gaps impeded their ability to detect problems.[43]

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[35] Supekar, S., et al., "Reassessing the Efficiency Penalty from Carbon Capture in Coal-Fired Power Plants," Environmental Science and Technology, 2015, v.49, p.12576–12584. http://www.ieca-us.com/wp-content/uploads/Reassessing-the-Efficiency-Penalty-from-Carbon-Capture-in-Coal-Fired-Power-Plants_12.03.15.pdf

[36] House, K., et al., "The energy penalty of post-combustion CO_2 capture & storage and its implications for retrofitting the U.S. installed base," Energy and Environmental Science, 2009, v.2, p.193-205. http://pubs.rsc.org/-/content/articlehtml/2009/ee/b811608c

[37] Goto, K., et al., "A review of efficiency penalty in a coal-fired power plant with post-combustion CO_2 capture," Applied Energy, November 2013, v.111, p.710-720.http://www.sciencedirect.com/science/article/pii/S0306261913004212

[38] Department of Energy, "Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security," August 2016. https://energy.gov/sites/prod/files/2016/09/f33/DOE%20Issue%20Brief%20-%20Carbon%20Capture%20Utilization%20and%20Storage_2016-08-31.pdf

[39] The average size of a US coal plant in 2012 was 547 MW, according to Union of Concerned Scientists (http://www.ucsusa.org/clean_energy/coalvswind/c01.html). 10 GW / 547 MW = ~18 coal plants.

[40] IHS Energy, "CO_2 EOR Potential in North Dakota—Challenges, policy solutions, and contribution to economy and environment," June 2016. http://www.legis.nd.gov/files/committees/64-2014%20appendices/IHS%20Energy%20-%20Final%20Report.pdf

[41] McCabe, D., et al., "Health Risks in Texas from Oil and Gas Industry Air Pollution," Clean Air Task Force and EarthWorks, June 2017. http://www.catf.us/resources/factsheets/files/HealthEffectsTX.pdf; Johnston, J., et al., "Wastewater Disposal Wells, Fracking, and Environmental Injustice in Southern Texas," American Journal of Public Health. 2016 March; 106(3): 550–556. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4816143/; Geraci, M., et al., "The Environmental Risks and Oversight of Enhanced Oil Recovery in the United States," Clean Water Action, August 2017. https://www.cleanwateraction.org/publications/EOR-risks

[42] Srebotnjak, T., et al., "Drilling in California: Who's at risk?" National Resources Defense Council, October 2015, https://www.nrdc.org/sites/default/files/california-fracking-risks-report.pdf

[43] Geraci, M., et al., "The Environmental Risks and Oversight of Enhanced Oil Recovery in the United States," Clean Water Action, August 2017. https://www.cleanwateraction.org/publications/EOR-risks

CONCLUSION AND RECOMMENDATIONS

Expanding the 45Q tax credit for capturing carbon that is sequestered or utilized in enhanced oil recovery is not a climate solution. This subsidy would drive increased oil production, result in climate-polluting emissions, and lock in decades of fossil fuel infrastructure. Nor is this a wise use of taxpayer dollars. At an annual cost of as much as $2.8 billion for the EOR portion of the tax credit alone, 45Q would constitute the single largest subsidy given to the fossil fuel industry. An expanded 45Q would be an environmental justice catastrophe, potentially increasing non-CO_2 pollution of local communities' land, water, and air – resulting in public health impacts and significant financial and social costs.

Instead of expanding the 45Q tax credit, lawmakers should act on the following:

- Allow the existing 45Q tax credit to expire, as intended;
- Request a congressional investigation of which entities have availed themselves of the existing 45Q tax credit to date, to determine what proportion of the subsidy has been used for permanent CO_2 storage as opposed to enhanced oil production, and make those findings publicly available;
- Request a full lifecycle analysis of the potential public health and ecosystem impacts of co-pollutants emitted from additional coal-fired power generation and oil production enabled by 45Q;
- Eliminate the remaining approximately $15 billion in annual federal subsidies to fossil fuel production;
- Finance a just recovery in communities impacted by climate-exacerbated disasters and a just transition to a clean energy economy centered on frontline grassroots climate solutions and community resilience;
- Put in place incentives to promote clean renewable power and reduce energy consumption.

Attempts to address climate change must not be built on the backs of communities at the frontline of the fossil fuel industry and the unfolding climate crisis. Policy "solutions" that hand billions of taxpayer dollars to the fossil fuel industry, extending the life of coal power plants and incentivizing companies to pump more oil, are false solutions.

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Oil Change International is a research, communications, and advocacy organization focused on exposing the true costs of fossil fuels and facilitating the coming transition towards clean energy.

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