STOCKHOLM ENVIRONMENT INSTITUTE

POLICY BRIEF

How would eliminating subsidies to the U.S. oil industry affect potential oil production and CO_2 emissions?

The rapid growth of hydraulic fracturing and horizontal drilling technology has driven a dramatic rise in U.S. oil production in the past 10 years. The United States now produces as much crude oil as ever – over 3.4 billion barrels in 2015, just shy of the 3.5 billion record set in 1970. Indeed, the U.S. has become the world's No. 1 oil and gas producer.

While the recent drop in oil prices has slowed investment, the International Energy Agency (IEA) still finds that, absent further policy action (the New Policies Scenario), the U.S. will continue to lead the world in upstream oil and gas investment over the next two decades, averaging more than $150 billion per year.

This surge in U.S. oil production and investment occurred at the same time as the Obama administration was increasing its climate ambition, firmly committing the U.S. to the Paris Agreement goal of limiting warming to "well below" 2°C. While the administration tried to remove existing subsidies, the efforts were blocked by Congress. As a result, federal subsidies to the U.S. oil and gas industry continue to be at least $2–4 billion per year.

Subsidies from state governments to the oil and gas industry are also common. When looking at a more comprehensive list of state and federal subsidies, other researchers have estimated annual subsidies at about $18 billion.

This policy brief, based on an SEI working paper, examines how removing subsidies to U.S. oil producers would affect potential oil production and resulting global carbon dioxide (CO_2) emissions. By doing so, it provides a substantial new body of evidence with which to evaluate the possible effects of subsidy reform on U.S. oil production and climate commitments, should a new Congress seek to revisit this issue.

Why looking at investor returns matters

A recurring question in discussions about fossil fuel subsidy reform is how the subsidies affect oil production and oil industry profits. A common assumption is that, because subsidies are a small share of industry revenues, the impact on oil production is also small.

© Blake Thornberry / Flickr

Oil pump jacks in Eddy County, NM, on the Permian Field.

Key findings

- Billions of dollars in federal and state subsidies could enable large amounts of oil and gas production in the U.S. that would not otherwise be economic. At $50 per barrel, roughly the current oil price, nearly half of discovered (but not yet producing) U.S. oil would depend on subsidies to reach minimum returns acceptable to investors.
- The additional oil produced due to subsidies would emit 8 billion tonnes of CO_2 once combusted, about 1% of the world's remaining carbon budget to keep warming under 2°C, the goal the U.S. committed to under the Paris Agreement.
- At $50 per barrel, more than half of subsidy value would go directly to oil company profits, diverting considerable taxpayer resources from other possible uses. The share going to profits would increase to 98% if prices return to levels around $100 per barrel.
- Eliminating U.S. oil production subsidies would avoid inefficient spending while avoiding substantial climate harm, both directly (reducing oil production) and indirectly (reinforcing an emerging political norm away from fossil fuel development).

In reality, companies receive key subsidies early in oil project development, when they can play an outsize role in investment decisions. Like many other investors, oil companies generally seek annualized returns of 10% or more on their capital, so cash flow that comes sooner in the life of an oil project is much more valuable than the same amount years later.

Because it is these profits that drive investment, our study assesses how subsidies affect the return on investment in new U.S. oil production. We use similar tools as the oil industry: detailed field-level economic and production data and financial return metrics, assuming near-current oil prices.

By using project-level data, we can highlight the extent to which government support makes otherwise unprofitable projects profitable, leading to added oil production and CO_2 emissions. Project-level data also enables us to assess which projects were already profitable without subsidies, so that public support goes directly to profit as a transfer payment from taxpayers to industry.

Key U.S. oil basins depend heavily on subsidies to be profitable

New projects normally require a return adequate to compensate investors for the risk they have taken on. The internal rate of return (IRR) is a commonly used metric. It is calculated as projected revenues, minus projected expenditures, all discounted to the time of the investment decision. As noted above, the industry typically sets a target return (or "hurdle rate") of 10%.

We analyze whether and where subsidies are sufficient to tip a project from being uneconomic to economic. This happens when, thanks to a subsidy, a project's IRR exceeds the hurdle rate.

Projects for which this happens are considered "subsidy-dependent" – that is, they would proceed only with subsidies. By contrast, if a project is already profitable (i.e., IRR without subsidies is above 10%), we assume that it would have proceeded anyway. Similarly, we assume that if a project's IRR remains below the hurdle rate even after subsidies, it will not proceed.

We apply this rubric to the 800+ fields that have been discovered and proved but are not yet producing in the U.S. We assess state and federal subsidies in three major areas of U.S. crude oil production: the Permian Basin in Texas, the Williston Basin in North Dakota, and offshore, federally administered fields in the Gulf of Mexico. We also review federal subsidies for the rest of U.S. oil production.

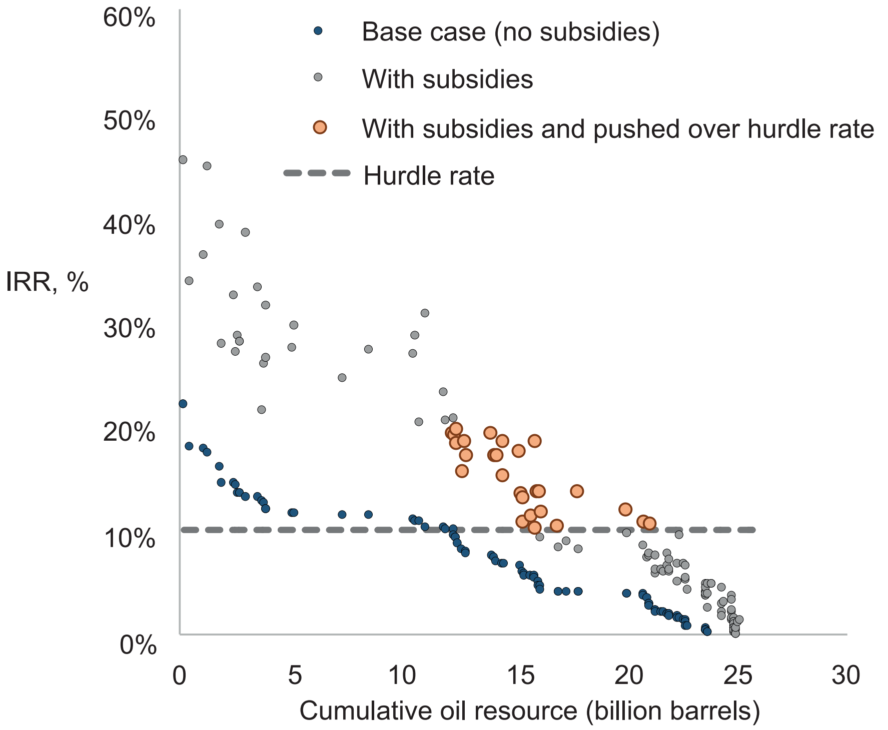

Figure 1: Effect of subsidies on project economics at $50 per barrel, for fields discovered but not yet producing in the Permian Basin of Texas

Source: SEI analysis based in part on data from Rystad Energy

Each blue dot represents a particular field in the base (no subsidies) case. Fields with an IRR above 10% at $50 per barrel are on the left, above the horizontal line. They represent about 12 billion barrels of oil. Fields with an IRR below 10% are on the right, below the hurdle rate line.

The gray and orange dots represent all the same fields, but with subsidies included. Since the projects on the left would be economic even without subsidies, the entire incremental value of the subsidy (the "bump" in IRR between each blue dot and the gray dot above it) goes to profit – in many cases adding 10 percentage points or more to IRR and doubling investor returns. The orange dots represent fields that subsidies push above the hurdle rate; they contain about 8 billion barrels of oil. Thus, out of 20 billion barrels of oil that are economic at $50 per barrel, about 40% depend on subsidies.

Figure 1 illustrates our analysis for the Permian Basin, the fastest-growing U.S. oil production region. It shows that of the roughly 20 billion barrels of oil that it contains in discovered but not-yet-producing fields, about 8 billion are only economic with subsidies. Across all U.S. oil fields considered,[1] we find that subsidies increase the IRR of most oil projects by 2–6 percentage points (median value of 3 points). Table 1 shows the effect of this bump in project return across the 800+ fields assessed, divided across the four areas considered.

At current prices of $50 per barrel, subsidies boost fields containing 20 billion barrels of oil from unprofitable to profitable. The proportion of fields tipped into profitability varies somewhat by basin, but all basins depend heavily on subsidies. The Permian contains the most subsidy-dependent barrels of oil, and the Gulf of Mexico has the largest share of total production that is subsidy-dependent. (Table 1 also displays CO_2 emissions that would be released from the oil once burned; we will return to the CO_2 implications further below.)

The overall impact of government subsidies on investment decisions depends on how all available supports affect the IRR. Looking at a very narrow set of subsidies risks missing important programs that add enough incremental return to move a project over its hurdle rate. To address this concern, we have assessed a much broader suite of subsidies than earlier studies.

Of the dozen subsidies considered, the immediate expensing of intangible drilling costs (IDCs) has the greatest effect on project IRRs – nearly 7 percentage points in the Permian of Texas, for instance (Figure 2), when tabulated on a production-weighted basis. This finding is consistent with early studies by both industry and researchers, and remains striking in that it nearly doubles the average return in the basin.

Other commonly discussed federal tax subsidies – percentage depletion and the manufacturers' 199 deduction – also affect IRRs by non-trivial amounts (at least three-tenths of a percentage point). Several state-level subsidies are important as well, but have not been considered in most other studies.

Table 1: Impact of subsidies on undeveloped oil resources and GHG emissions (at $50/bbl)

Area	Economic oil resources, discovered but not yet producing (billion barrels)	Percent subsidy-dependent	Increase in economic oil resources due to subsidies (billion barrels)	Increase in economic oil resources due to subsidies (Gt CO_2)
Williston Basin	4.1	59%	2.4	1.0
Permian Basin	20.3	40%	8.0	3.3
Gulf of Mexico	2.1	73%	1.5	0.6
Rest of U.S.	16.7	46%	8.2	3.1
Total U.S.	**43.3**	**45%**	**19.6**	**8.1**

Source: SEI analysis; economic oil resources from Rystad Energy.

1 We also account for subsidies for natural gas co-production at fields predominantly developed for their crude oil potential.

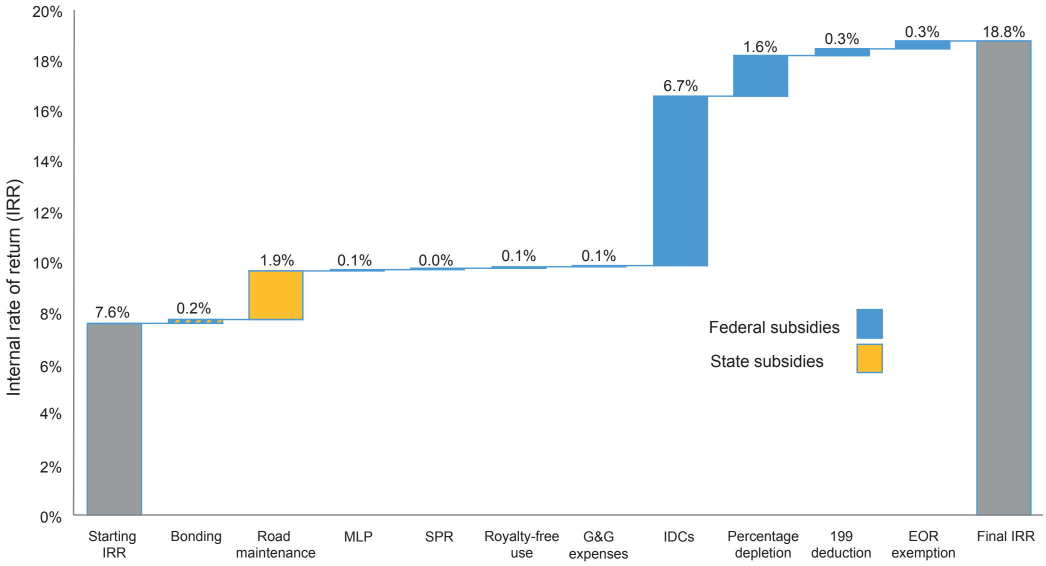

Figure 2: Average effect of each subsidy analyzed in the Permian Basin of Texas at $50 per barrel (average effect on a production-weighted basis across all fields) Source: SEI analysis.

This figure shows the incremental effect of the subsidies evaluated using on the average (production-weighted) impact on returns in the Permian Basin of Texas. Across all fields analyzed in the Permian, our analysis indicates a production-weighted average increase in project IRR of more than 10 percentage points. This can be seen by summing all the blue and orange bars.

Government provision of roadway maintenance at a cost far beyond what is recovered through user fees was particularly important in fracking regions with large numbers of heavy truck trips to support operations.

Subsidies increase both CO_2 emissions and industry profits

At $50 per barrel, the effect of subsidies is to increase potential U.S. production by 20 billion barrels, which once burned would emit about 8 billion tonnes (Gt) CO_2, as indicated in Table 1.[2] To put this in perspective, we consider the global carbon "budget." The Intergovernmental Panel on Climate Change (IPCC) has estimated that, for even a two-thirds chance of keeping warming below 2°C, global human-driven CO_2 emissions from 2016 onward cannot exceed 840 Gt CO_2.[3] That means that the CO_2 emissions associated with subsidy-dependent future U.S. oil production are equivalent to 1% of the remaining carbon budget *for the entire world*.

It can also be helpful to compare this added production to the amount of oil that the U.S. might produce in a scenario where the world holds warming within 2°C. Global cost-minimizing economic models suggest a cumulative carbon budget for U.S. oil production between 2016 and 2050 of 30–45 Gt CO_2. This range, which represents CO_2 emissions from combusting U.S.-produced oil, is likely on the high end, since it relies on scenarios that maintain only a 50–60% chance of meeting a 2°C target. The models also do not reflect equity considerations that might lead wealthier countries to produce less oil, to leave more "carbon space" for developing countries.

This comparison makes clear that, from a carbon budget perspective, subsidies may be responsible for up to a quarter (8 Gt of 30–45 Gt CO_2,) of the U.S. share of oil production through 2050 under a cost-efficient approach to limiting warming to 2°C.

There is also another way to look at the effect of subsidy-dependent oil on emissions: the *incremental* effect on global CO_2 emissions. When oil production from one source increases, it can lead to a small decrease in prices, leading other sources to reduce their production. This means that adding nearly 20 billion barrels of oil to the global oil market may not increase global production by that amount, but by a smaller amount.

Applying economic analysis tools to estimate these effects, we find that producing subsidy-dependent oil in the U.S. could lead to a cumulative net increase in global CO_2 emissions from oil consumption of 1.5–5.4 Gt CO_2. The range reflects uncertainty about the extent to which other oil producers would cut back, and whether other countries would remove subsidies.

We find that in addition to increasing CO_2 emissions, subsidies also have the effect of creating excess profit. For each oil price level, our analytic approach enables us to estimate the fraction of overall subsidy that flows only to profits with very little (if any) effect on production (or, by extension, CO_2 emissions).

We find that, at the current price of $50 per barrel, about half (53%) of subsidy value (in net present value terms) goes to projects that would have proceeded anyway. The share of subsidy value going to already-profitable projects is highest in the Permian Basin, at 61%.

This fraction of support leaking to profit rises to nearly all (98%) of subsidy value at $100 per barrel, reflecting what other researchers have suggested: that regardless of the oil price, the majority of taxpayer resources provided to the industry end up as company profits.

As oil prices rise, fewer fields depend on subsidies

Not surprisingly, higher commodity prices boost revenues to producers and allow more fields to achieve their return on investment targets. The sensitivity of returns to oil price could have important policy implications. Figure 3 shows how the effect of subsidies varies substantially by price.

Subsidies increase field development most strongly at lower prices. At $40 per barrel, almost all new U.S. oil investment depends on subsidies. At $50 per barrel, as discussed above, nearly half of discovered fields – 20 billion out of 43 billion barrels – would depend on subsidies.

As prices increase above $50 per barrel, already-discovered fields become less dependent on subsidies. For example, if future oil prices rise to $80 per barrel and beyond, less than

2 We use "tonnes" to denote metric tons.

3 Here, we adjust the IPCC's 1,000 Gt CO_2 budget from 2012 by the CO_2 emissions that have been released in the four years since, or 160 Gt CO_2.

Policy implications

For many years, the Obama administration and members of Congress have sought to repeal subsidies for oil and gas production. Most recently, the U.S. committed to the G20 to repeal these subsidies. The biggest tax breaks alone – including the expensing of IDCs, percentage depletion, and the manufacturing deduction – cost U.S. taxpayers $2–4 billion each year (more if oil prices were to rise). Researchers have estimated the total bill (including non-tax subsidies) at nearly $18 billion annually.

With a new administration taking office, it remains unclear if momentum for subsidy removal will continue or even grow. Early statements from President-elect Trump indicate an intention to expand oil and gas drilling, suggesting an altogether different direction for federal policy, even as he has also indicated an intention to eliminate corporate tax breaks.

Still, repealing these tax breaks may have strong appeal to both parties in Congress, as doing so offers the potential to:

- **Reduce inefficient and wasteful spending**, freeing up public resources for other needs. At $50 per barrel, half of subsidy value goes to projects that would have proceeded anyway, a proportion that rises substantially with oil prices. This excess industry profit could be put to better uses.
- **Demonstrate compliance with G20 commitments** to eliminate inefficient fossil fuel subsidies and with Paris commitments to keep global warming to well below 2°C, and send a signal to other world leaders that the transition away from fossil fuels is well under way.
- **Have a substantial impact on CO_2 emissions**, leaving an estimated 8 billion tonnes CO_2 worth of oil undeveloped at prices near $50 per barrel. This oil represents 1% of the world's remaining carbon budget for a two-thirds chance to keep warming within 2°C, and up to a quarter of U.S. oil production to 2050 that would be consistent with a cost-efficient pathway to maintain a lesser (50% to 60%) chance of meeting the 2°C goal. Leaving this oil undeveloped would also reduce global CO_2 emissions, as models indicate that other producers would only make up a portion of the avoided U.S. production. These CO_2 emission implications, assessed here for the first time, strengthen the case for subsidy reform.

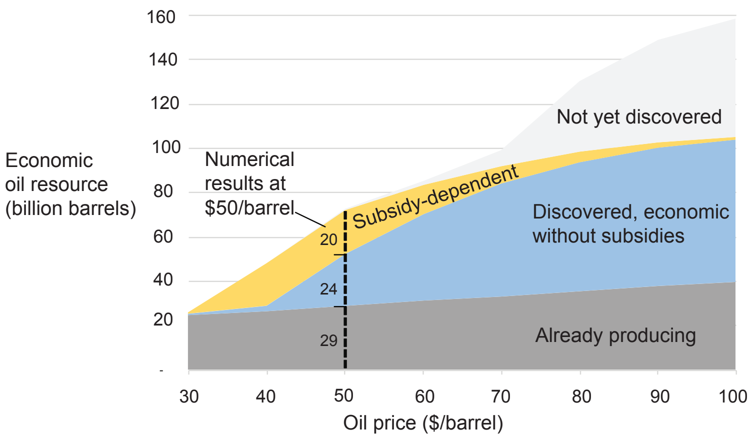

Figure 3: Share of U.S. oil resources that are subsidy-dependent as a function of oil prices

10% of production from discovered, yet-to-be-developed fields would be subsidy-dependent. At $100 per barrel – a price level seen as recently as 2014 but which may not return until 2030, according to the U.S. Energy Information Administration – subsidies might have very little effect on investment in currently discovered but undeveloped fields or on the resulting resource available. Instead, nearly all subsidy value would go to excess profits in the form of elevated project IRRs. While subsidies can be structured to phase out at high market prices, the largest subsidies to oil do not. In fact, the percentage depletion allowance subsidy actually grows as oil prices rise.

Figure 3 also displays (in pale grey) Rystad's estimates of the U.S. oil resources that may still be discovered, most of which would cost $70 per barrel or more to develop. These estimates are speculative, so we do not assess the fields' dependence on subsidies in detail here. Still, should they prove as subsidy-dependent as the fields we do assess, the impact of subsidies at higher prices would be greater than we currently estimate.

This policy brief is based on SEI Working Paper No. 2017-02, *Effect of Government Subsidies for Upstream Oil Infrastructure on U.S. Oil Production and Global CO_2 Emissions*, by Peter Erickson, Adrian Down, Michael Lazarus and Doug Koplow, available at https://www.sei-international.org/publications?pid=3036.

Both publications are outputs of the SEI Initiative on Fossil Fuels and Climate Change. To learn more, visit https://www.sei-international.org/fossil-fuels-and-climate-change.

Published by:
Stockholm Environment Institute
1402 Third Avenue, Suite 900
Seattle, WA 98101
USA
Tel: +1 206 547 4000

Author contact:
Peter Erickson,
pete.erickson@sei-international.org

Media contact:
Marion Davis,
marion.davis@sei-international.org

sei-international.org

2017

Twitter: @SEIresearch, @SEIclimate