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Social Cost of Fossil Fuels from US Public Lands

by Andy Kerr

Abstract

The extraction and burning of fossil fuels from federal public lands has a significant carbon footprint. The price of leases for such extraction should reflect the social cost of this carbon footprint, a concept introduced into the policymaking arena by the Obama administration. The government should set a carbon fee or adder that makes federal fossil fuels uncompetitive in the market and thus discourages fossil fuel exploitation of US public lands.

Figure 1. *A seam of coal on federal public lands in the American West, destined to send carbon into the atmosphere*. Source: Bureau of Land Management.

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Abbreviations Used in this Report

Btu	British thermal unit	Mcf	million cubic feet
CH4	methane	MMBtu	million Btu's
CO2	carbon dioxide	MMT	million metric tonnes
CO2e	carbon dioxide equivalent of another GHG	N2O	nitrous oxide
		SC-CH4	social cost–methane
EPA	Environmental Protection Agency	SC-CO2	social cost–carbon dioxide
GHG	greenhouse gas	SC-CO2e	social cost–carbon dioxide equivalent
GWP	global warming potential	SC-N20	social cost–nitrous oxide

Introduction

It has been suggested that the Biden administration impose a "carbon fee" or "carbon adder" on new mining leases that permit fossil fuel companies to drill on federal public lands. This fee would reflect the external costs of greenhouse gas emissions, typically based on what is termed the social cost of carbon. If this were done, depending on the amount of the fee or adder, the price of leasing federal public lands for fossil fuel extraction could become unattractive to industry. That would be an excellent result. Besides preventing undesirable social costs, it would reap the flip side of the social cost of carbon emitted into the atmosphere: the social benefit of carbon not emitted into the atmosphere.

The Carbon Footprint of Fossil Fuels from Federal Public Lands

As we consider the carbon price of fossil fuel leasing on US public lands, it's helpful to know just exactly how much greenhouse gas is being sent into the atmosphere by extracting and burning fuels from those lands. As it turns out, the carbon footprint of fossil fuel leasing on federal public lands is significant.

The most prevalent greenhouse gas (GHG) emitted by the combustion of fossil fuels is carbon dioxide (CO2), but methane (CH4) and nitrous oxide (N2O) are also emitted. According to the Environmental Protection Agency (EPA), CH4 "is emitted during the production and transport of coal, natural gas, and oil," and N2O "is emitted during [the] . . . combustion of fossil fuels." CH4 has a global warming potential (GWP) of 28 to 36 times that of CO2, and N2O of 265 to 298 times that of CO2. Emissions of CH4 and N2O can be expressed in terms of their carbon dioxide equivalent (CO2e) so that comparisons with CO2 emissions take into account the greater GWPs of CH4 and N2O.

Figure 2. *Storing federal crude oil.* Source: BLM.

First let's look at how much CO2 is emitted by the combustion of oil, gas, and coal. Note that this memorandum, like the rest of the world, expresses quantities in tonnes. A tonne (also called a metric ton) is 1,000 kilograms or 2,204.6 pounds This is not to be confused with the US ton (also called a short ton), which is 2,000 pounds.

A barrel of oil. The barrel (42 US gallons) is the standard measure for oil. (The large metal drums we actually encounter that transport industrial products hold 55 US gallons.) According to the EPA, burning the average US barrel of oil sends 0.43 tonnes of CO2 into the atmosphere.

A million cubic feet of "natural" gas (methane). In production and transmission, the standard unit of measure for methane (aka "natural" gas) is a million cubic feet (Mcf). Because the energy content of gas differs a bit, the natural gas sold to consumers is measured in therms (100,000 British thermal units, or Btu's). According to the EPA, burning natural gas emits 0.0548 tonnes of CO2 per Mcf and 0.0053 tonnes of CO2 per therm.

A railcar of coal. Coal is mostly shipped in railcars. According to the EPA, the average railcar contains 90.89 tonnes of coal, which when combusted emits 181.29 tonnes of CO2. Another way to say this is that burning 1 tonne of coal emits 1.99 tonnes of CO2.

With that as background, we can look at emissions from the share of these fuels extracted from US public lands.

The US Geological Survey reports that in 2014, extracting and burning fossil fuels from federal public lands resulted in total emissions of 1,332.1 million tonnes (abbreviated MMT for "million metric tons") of CO2e. This is the sum of 1,279 MMT of CO2, 47.6 MMT of CO2e generated from CH4, and 5.5 MMT of CO2e generated from N2O. We will come back to these numbers later.

Figure 3. *Oil and gas development on federal public lands in the American West. There goes the habitat.* Source: BLM.

These emissions from federal fossil fuels represented 25 percent of CO2 emissions, 18 percent of CH4 emissions, and 9 percent of N20 emissions from all US sources in 2015. (Worksheet from hell available upon request.)

The net emissions from all US sources in 2019 totaled 5,769 million tonnes of CO2e, so doing the math suggests that 23.2 percent of all US GHG emissions are attributable to fossil fuels extracted from federal public lands. That's nearly a quarter. That's a large footprint.

How Should a Carbon Fee or Adder Be Set?

The federal government could set a price on carbon associated with fossil fuel extraction from federal public lands based on either of two principles: (1) the polluter should pay society back for the damage caused, or (2) a price should be set that will adequately move the market in the intended direction and to the desired result. The principles are interrelated. In the case of GHG pollution, if the polluter pays, the markets will move.

The "Polluter Pays" Principle and the Social Cost of Carbon

According to the Grantham Research Institute on Climate Change and the Environment of the London School of Economics, "The 'polluter pays' principle is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment." The principle is more commonly accepted in Europe, but versions of the "polluter pays" principle are found in certain US laws, including the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and the Superfund (abandoned waste sites) law.

If the "polluter pays" principle is followed in the case of fossil fuels, prices for fossil fuels should reflect the "social cost of carbon" (SCC), a measure first developed in relation to federal policy by the Obama administration. Here is how the EPA defines it:

Figure 4. *The social benefit of carbon not emitted into the atmosphere thanks to not logging older (mature and old-growth) forests on federal public lands*. Source: BLM.

The SC-CO2 is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide (CO2) emissions in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO2 reduction).

The Trump administration effectively emasculated the SCC. The Biden administration has reintroduced the concept into policymaking.

Note that there are also social costs for other greenhouse gases—methane (SC-CH4) and nitrous oxide (SC-N2O). By linking carbon fee or adder pricing to CO2e, these other GHGs are included in this analysis.

The 2021 Social Cost of Carbon

The Cost of Carbon project of the Institute for Policy Integrity at the New York University School of Law offers a calculator that lets us figure out the social cost of carbon, "the present value of economic damages from a given amount of greenhouse gas emissions." It turns out that for 2021 it's either $15, $53, $78, $127, $155, or $423 per tonne CO2, depending on the discount rate chosen. These figures correspond, respectively, to discount rates of 5 percent, 3 percent, 2.5 percent, 2 percent, 95th percentile, and 1 percent.

The discount rate is "the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows." A "discounted cash flow" is "a valuation method used to estimate the value of an investment based on its expected future cash flows."

Lost yet? A discount rate recognizes that money today is worth more than money in the future. In the context of SC-CO2, the discount rate chosen determines how much it is worth to society to spend money today to avoid the costs of climate change to future society. A higher discount rate says it is worth less to society, a lower discount rate that it's worth more.

What's a discount rate of 95th percentile? Calculated at a 3 percent discount rate, the 95th percentile distribution is a proximate for the possibility of "higher than expected economic

impacts from climate change further out in the tails of the SC-CO2 distribution"—that is, the "what-if-it's-far-worse-than-we-thought-it-could-be" scenario.

The Appropriate Discount Rate

For reasons well explained by David Roberts in an article for Grist, the choice of a discount rate for the social cost of carbon is controversial because it reflects a moral or ethical judgment. Historically, SCC analyses have centered on a discount rate of 3 percent, which is still the basis for the interim revised SC-CO2 issued by the Biden administration in early 2021. According to *E&E News*, the 3 percent discount rate figure arose from a 2003 White House Office of Management and Budget (OMB) directive pertaining to government-wide cost-benefit analyses. At the time, 3 percent was the yield on a ten-year US Treasury bond, an indicator of a risk-free return on investment. As of this writing, the interest rate on such instruments is 1.44 percent.

Some commentators suggest that the discount rate for social cost analyses should be the growth rate of real per capita income (~2 percent). Federal agencies have used a variety of discount rates—sometimes different rates for different matters by the same agency—ranging from 3 percent to 10 percent. During the Trump administration, the SC-CO2 discount rate was set at 7 percent—and only climate damages specific to the United States were considered. The State of New York uses 1 percent. One economics Nobel recipient says 5.5 percent, while another such recipient says 3 to 6 percent. A noted British economist says 1.4 percent. The OMB says, "If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent."

Various economists have proposed setting the discount rate at the real growth rate per capita (1.7 percent), the rate of societal pure time preference (1.1 percent), the elasticity of marginal utility (1.35 percent), or the real risk-free interest rate (2.38 percent).

One survey of the opinions of experts on the appropriate "social discount rate" (SDR) found that older experts recommended higher SDRs. The paper noted: "One can only assume that younger academics have been influenced more by the emerging literature on social discounting, which has been through something of a revival this century." One might also assume that, as younger academics will live longer in a climate-disrupted world, they—perhaps subconsciously—give greater present weight to future costs.

It is important to distinguish the SDR from the private discount rate (PDR). PDRs are used by investors and corporations. The SDR I prefer for the good of society and future generations is far lower than I would accept on private investments.

Choosing a lower SDR would show that we the people give our descendants comparable weight to ourselves in the matter of having a climate similar to the one we have known and loved. But perhaps the best argument for choosing a lower discount rate is that the SC-CO2 (along with the SC-CH4 and SC-N2O) doesn't begin to include all the costs of climate change.

Costs Not Included in the Social Cost of Carbon

According to the New York University School of Law's Institute for Policy Integrity (IPI), the federal government's Interagency Working Group (IWG) on the Social Cost of Greenhouse Gases generally *includes* in its social cost analysis these climate-related drivers of impacts called out by the Intergovernmental Panel on Climate Change (IPCC):

- warming trend
- precipitation
- damaging cyclones
- carbon dioxide concentration
- sea level rise

The IPI notes that the IWG only *partially* factors in these drivers:

- flooding (while coastal flooding is included, inland flooding is not)
- storm surge (missing is the combined effect of sea level rise and increased coastal storm intensity)

The IPI further notes that the IWG *excludes* these drivers:

- extreme temperature
- drying trend
- extreme precipitation
- snow cover
- ocean acidification

More specifically, the IPI lists these consequences of climate disruption that are *not* included in the federal government's current social cost of carbon analysis:

- abrupt and irreversible regional-scale change in the composition, structure, and function of ecosystems
- change in food quality, including nutrition content
- changing water quality
- competing uses, including overexploitation of groundwater resources
- coral bleaching
- decrease in catch potential at some latitudes
- diverted R&D funds for adaptation research
- effects of ocean acidification on polar ecosystems and coral reefs
- flood and sea level impacts on food infrastructure and farmland
- food and water availability
- food price stability and price spikes
- food security
- increased displacement of people
- increased pest and disease damage
- increases in yield variability
- increasing risk of wildfire
- inequalities, including income
- inland property loss due to extreme weather events, including flooding
- labor productivity

- lost land, capital, and infrastructure
- melting permafrost
- melting snowpack
- mortality from inland extreme weather events
- national security
- non-climate stressors: habitat modification, over-exploitation, pollution, and invasive species
- prolonging and creating new types of poverty traps
- reduced growth and survival of shellfish and other calcifiers
- shifted geographic ranges, seasonal activities, migration patterns, abundances, and species interactions
- violence, civil war, and inter-group conflict
- water security and water prices
- wildfires

One can only conclude that the social cost assessments of greenhouse gases are severely undercounting. However, it is far better to count at least some things and be approximately right than to count no things and be precisely wrong.

Adequately Moving the Markets

The Biden administration is expected to revise the SC-CO2 discount rates (always presented as a range, but preferring one number) in early 2022. The practical result is that the lower the discount rate assumed in an SCC analysis is, the higher will be any carbon fee or adder imposed on federal fossil fuel production. The higher the fee or adder, the more expensive it becomes to extract fossil fuels from federal lands.

An alternative to properly accounting for all the social costs of greenhouse gases and then properly discounting them is to price carbon at a level "at which we will be able to reduce emissions enough to prevent the world from heating up dangerously," in the words of multiple-prize-winning economists Nicholas Stern and Joseph Stiglitz. If an arbitrary price is set, it should be high enough to discourage the pollution, rather than simply increase the cost of doing business (which is tax deductible for the company).

The Right Price on Carbon

Let's just accept that the economic, social, and environmental cost of climate change is as enormous as it is unacceptable and that the government needs to set a price on carbon that will result in limiting global warming to 1.5°C and fully decarbonizing the economy by 2050—if not earlier.

Table 1 shows the social cost, at various discount rates, of the carbon emitted from extracting and burning fossil fuels from federal public lands in 2014. Recall from the earlier discussion that the total emissions were 1,332.1 MMT of CO2e (1,279 MMT of CO2 + 47.6 MMT of CO2e generated from CH4 + 5.5 MMT of CO2e generated from N2O).

Table 1. The Social Cost of GHG Emissions from Federal Fossil Fuels in 2014 (US$billion)

Discount Rate	SC-CO2 (per tonne CO2)	CO2	CH4	N2O	GHG Total
1%	$423	$541.0	$20.1	$2.3	$563.5
2%	$127	$162.4	$6.0	$0.7	$169.2
2.50%	$78	$99.8	$3.7	$0.4	$103.9
3%	$53	$66.5	$2.5	$0.3	$69.3
5%	$15	$19.2	$0.7	$0.1	$20.0
95th Percentile (3%)	$155	$198.2	$7.4	$0.9	$206.5
Source: Cost of Carbon: https://costofcarbon.org/calculator (analysis year and pollution years: 2021). Federal Emissions: https://pubs.er.usgs.gov/publication/sir20185131.					

If fossil fuel use were inelastic and the oil and gas industry just paid the fee and passed it on to consumers, the amount in the last column would be the revenue raised annually by the federal government from a carbon fee or adder. Fortunately, the price of fossil fuels is not inelastic, and as the price is raised, demand will decrease. If a reasonable carbon fee or adder were chosen, it would result in the federal government no longer selling any new fossil fuels. This would be a very good thing.

Table 2 shows what fossil fuels extracted from federal public lands would cost if a carbon fee or adder based on various discount rates were levied. This table uses energy prices for December 16, 2021. The rather conservative 3-percent discount rate is highlighted.

Table 2. The Price of Federal Fossil Fuels with a Carbon Fee or Adder (US$)

SC-CO2 Discount Rate				*1%*	*2%*	*2.50%*	*3%*	*5%*	*95th Percentile*
SC-CO2: US$/Tonne CO2				$423	$127	$78	$53	$15	$155
Fossil Fuel	***Dec. 16, 2021 Price***	***Unit***	***Tonne CO2/ Unit***	***Federal Fossil Fuel Price with SC-CO2 Included***					
Oil	$72.59	barrel	0.43	$254.48	$127.20	$106.13	$94.95	$79.04	$139.24
Gas	$3.91	Mcf	0.0548	$27.09	$10.87	$8.18	$6.76	$4.73	$12.40
Coal	$146.50	tonne	1.99	$988.27	$399.23	$301.72	$249.98	$176.35	$454.95

Sources:
• Cost of Carbon: https://costofcarbon.org/calculator (analysis year and pollution years: 2021). Federal Emissions: https://pubs.er.usgs.gov/publication/sir20185131.
• Fossil Fuel Prices: https://markets.businessinsider.com/commodities

Note: A fee or adder for SC-CH4 or SC-N2O is not included here but should be in any policy change.

The likely effect of imposing a carbon fee or adder would be that the market would reject federal fossil fuels because the federal price would be significantly above the nonfederal price.

Where would the demand displaced by a carbon fee or adder on federal fossil fuels go? We can hope that it would just go away, with consumers using that much less fossil fuel (by either going without or investing in efficiency to use less). Perhaps more realistically, it could result in a switch to no-carbon fuels. (The levelized cost—which considers capital, operating, and fuel costs—of most forms of renewable energy is lower than that of fossil and nuclear fuels.) Or, least desirably, it could result in increased production on nonfederal lands.

Whatever the case may be, the data suggest that withdrawing the contribution of federal fossil fuels from the US-based supply will have significant effects, since 43 percent of the coal, 25.5

percent of the oil, and 11 percent of the natural gas produced in the United States in 2020 came from federal public lands.

Recommendation

The federal government should impose a fee on or an adder to the sale of fossil fuels from federal public lands. The fee should be large enough to dissuade any one from buying any additional fossil fuels from federal public lands and waters.

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About the Author

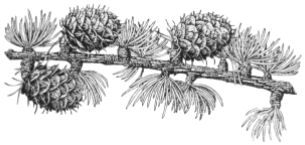
Andy Kerr (andykerr@andykerr.net) is the Czar of The Larch Company (www.andykerr.net) and consults on environmental and conservation issues. The Larch Company is a for-profit non-membership conservation organization that represents the interests of humans yet unborn and species that cannot talk. Kerr is best known for his two decades with Oregon Wild (then the Oregon Natural Resources Council), the organization that brought you the northern spotted owl. He received far more than his allotted fifteen minutes of fame (or, if you prefer, infamy) during the Pacific Northwest Forest Wars, which peaked in the mid-1990s and are still going on, though at a lower level of controversy.

Kerr began his conservation career during the Ford administration. He has been closely involved with the establishment or expansion of forty-seven wilderness areas, fifty-seven wild and scenic rivers, fourteen congressionally legislated special management areas, fifteen Oregon scenic waterways, and one proclaimed (and later expanded) national monument. He has testified before congressional committees on several occasions.

A dropout of Oregon State University, Kerr has lectured at all of Oregon's leading universities and colleges as well as Harvard and Yale. He has appeared numerous times on national television news and feature programs and has published many articles on environmental matters. He authored *Oregon Desert Guide: 70 Hikes* (Mountaineers Books, 2000) and *Oregon Wild: Endangered Forest Wilderness* (Timber Press, 2004). His articles on solar energy, energy efficiency, and public policy have appeared in *Home Power* magazine.

A fifth-generation Oregonian, Kerr was born and raised in Creswell, a recovered timber town in the upper Willamette Valley. He presently splits his time between Ashland, a recovered timber town in Oregon's Rogue Valley, and Washington DC, where the most important decisions affecting Oregon's wild lands, wildlife, and wild waters are made. A fuller biographical sketch can be found on his website.

Larch Occasional Papers



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22	2017	National Heritage Areas: Combining the Conservation of Nature, History, and Culture with Local Economic Development
21	2015	National *What-Have-You* Areas: Congressional Conservation of Our Public Lands
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11	2012	The National Wilderness Preservation System in Oregon: Making it Bigger and Better
10	2012	Oregon and Washington Raw Log Exports: Exporting Jobs and a Subsidy to Domestic Mills
9	2012	Pacific Northwest Offshore Oil and Gas Potential: At Best About A Month's National Supply; At Worse An Unnatural Disaster
8	2011	"Small" Wilderness: No Big Deal
7	2011	Overlapping Wilderness and Wild & Scenic River Designations Provide Optimal Conservation Protection for Federal Public Lands (co-authored with Mark Salvo)
6	2008	Establishing a System of and a Service for U.S. Deserts and Grasslands (co authored w/ Mark Salvo)
5	2007	Eliminating Forest Service Regional Offices: Replacing Middle Management with More On-the-Ground Restoration
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