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Abstract: *Proposals for carbon pricing have met with criticism from environmental justice advocates on the grounds it (i) fails to reduce emissions significantly, (ii) fails to reduce the disproportionate impacts of hazardous co-pollutants on people of color and low-income communities; (iii) hits low-income households harder than richer households; and (iv) commodifies nature. This paper discusses how carbon pricing can be designed to address these very real concerns.*

Introduction

"Carbon pricing" refers to policies that raise the price of fossil fuels by charging money for emitting carbon dioxide into the Earth's atmosphere. This can be done directly by means of a carbon tax (a fixed price per ton of CO2) or indirectly by means of a carbon cap (a direct limit on the total amount of CO2 that can be emitted, with permits issued up to that limit). In both cases, the simplest and most comprehensive point at which to levy the price is where the fossil fuels first enter the economy – at pipeline terminals, tanker ports, coal mine heads – with firms required to surrender one permit (or pay the tax) per ton of CO2 that will be emitted when the fuel is burned. This charge then enters the prices that are ultimately paid by consumers.

Economists advocate carbon pricing on the grounds that it provides incentives to curb emissions both in the short run (consumers buy less fossil fuel, and less fuel-intensive goods and services, when their price rises) and in the long run (incentivizing investments and innovation in energy efficiency and clean energy).

Opposition to carbon pricing has come not only from the fossil fuel lobby, as might be expected, but also from environmental justice (EJ) advocates who seek to end the disproportionate environmental harms imposed upon people of color and low-income communities, and who fear that carbon pricing could reinforce rather than remedy pollution exposure disparities. This paper focuses on the objections to carbon pricing that EJ advocates have raised.

In brief, critics have argued that carbon pricing (i) fails to reduce carbon emissions significantly, (ii) fails to reduce the disproportionate impacts of hazardous co-pollutants on people of color and low-income communities; (iii) harms the purchasing power of low-income households; and (iv) commodifies nature. Proponents of carbon pricing often, and in our view hastily, have dismissed these criticisms as baseless.

Here we chart a middle path between dismissal of carbon pricing and dismissal of its critics. The foundation for our position is a basic moral principle: we believe that the gifts of Nature should be shared in equal measure by all. These gifts include the right to a clean and safe environment and the right to share in revenue that is generated by limiting the use of scarce resources. From this perspective, we have a moral imperative both to eliminate the disparate pollution burdens that poison the air and water of vulnerable communities and to halt destabilization of the Earth's climate to protect future generations as well as vulnerable present-day populations.

Halting the disparate pollution imposed on EJ communities requires, first and foremost, that we take seriously the extent of the problem and recognize the complicity of government policies together with market forces in creating and perpetuating environmental injustice. Solutions require rectifying systemic failures of both the market and the state. EJ and climate stabilization are complementary goals – indeed, climate change itself exacerbates environmental injustice – but we argue here that advancing both goals together requires that explicit EJ provisions be built into the design of climate policy. At a bare minimum, climate policy should guarantee that existing pollution disparities are not exacerbated. Going further, well-designed design policies can advance the more ambitious goal of reducing environmental disparities.

Halting climate destabilization requires, first and foremost, that we keep fossil fuels in the ground. Carbon dioxide emissions from fossil fuel combustion represent roughly three-quarters of total greenhouse gas emissions (expressed as CO2-equivalents). To curb these emissions, we must leave fossil carbon where it has lain since before the era of the dinosaurs: securely buried beneath Earth's surface. Carbon pricing is not the only policy that is needed to keep fossil fuels in the ground, but we argue here that it is an essential part of the climate policy mix.

To address the concerns raised by EJ advocates, and to broaden support for carbon pricing as one strategy alongside others for confronting the climate crisis, carbon pricing policy must be organized around five key principles.

PRINCIPLE #1: Keep fossil fuels in the ground: beyond single-policy politics

To meet the Paris Agreement's objective of holding average surface temperatures to 1.5–2 °C (3–4 °F) above pre-industrial levels, the U.S. and other major consuming countries must cut their emissions to roughly 10 percent of their current level by the middle of the century.[1] Cutting emissions by 90 percent over the next 28 years translates into reductions at the rate of 8 percent per year (the math is the logic of compound interest operating in reverse), a trajectory shown in Figure 1.

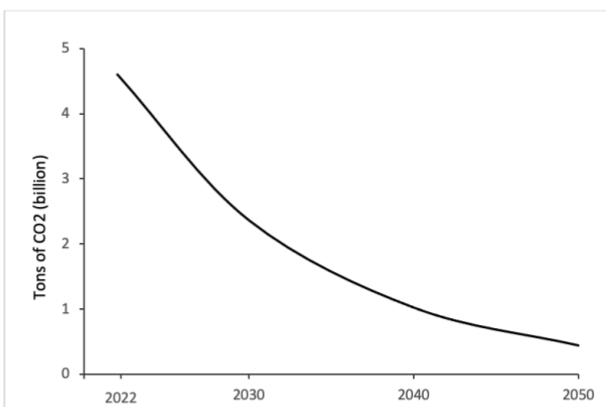

Figure 1: Keeping fossil fuels in the ground

Cutting emissions by 90% over 28 years is equivalent to reductions at the rate of 8% per year.

[1] Coupled with measures to sequester atmospheric carbon through improved land management and related practices, this target is consistent with the goal of "net-zero" carbon emissions by mid-century. See, for example, IPCC (2018) and IEA (2021).

Many policies can help in reaching this goal. Measures to reduce demand for fossil fuels (at any given price) by expanding alternative energy sources and improving energy efficiency play an important role. Carbon pricing typically is introduced alongside such policies, complementing them rather than replacing them. California's cap-and-trade program, for example, aimed to achieve about 15% of the total emission reductions mandated by the state's Global Warming Solutions Act of 2006, with the remaining 85% coming from other policies to promote clean energy (like renewable portfolio standards for electric power plants) and energy efficiency (like low-carbon standards for motor vehicles). Carbon pricing does not rule out other climate policies. Neither do other policies rule out carbon pricing.

Climate policy proponents sometimes insist that their own favored policy as the only good one – as if climate policies were mutually exclusive rather than mutually reinforcing.[2] In our view, single-policy politics is a mistake: it is unwarranted in principle and it can be counter-productive in practice, fostering rivalry among potential allies rather than cooperation for the shared goal of protecting the planet.

A similar either-or position espouses the use of "carrots" (like subsidies and tax credits) to reward clean energy and energy efficiency, while ruling out "sticks" (like carbon prices) that would penalize fossil fuels. The political logic is that carrots are more palatable to the public.[3] Apart from the fiscal issue that these inducements come at a cost to the public exchequer – carrots do not, as it were, grow on trees – this stance ignores the possibility that revenue from carbon pricing can be recycled directly to the public, as discussed below, effectively turning sticks into carrots for most households.

Judging from past experiences, demand-side policies by themselves are not likely to curb emissions swiftly and steeply enough to attain the Paris goal for climate stabilization. For example, the landmark climate bill that President Biden signed into law in August 2022, an investment and tax credit package hailed as "the most ambitious climate action undertaken by the U.S.," aims to cut emissions 40 percent below their 2005 level by 2030.[4] This is equivalent to a 30 percent reduction below their current level, whereas the Paris-consistent trajectory shown in Figure 1 requires a reduction of roughly 50 percent.[5] Moreover, part of this reduction is expected to come via carbon capture and sequestration (CCS) technologies that are supposed to inject industrial CO2 emissions underground, the efficacy and EJ impacts of which have been controversial.[6] Although the bill is not quite as inadequate as "losing 20 pounds when you need to lose 100 pounds," as one critic complained, it falls well short of the mark set by the Paris Agreement.[7]

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[2] Some have suggested, for example, that carbon prices ought to supplant regulations on CO2 emissions (Baker et al., 2017), while others have argued that regulatory standards and public investment ought to supplant carbon pricing (Stokes and Mildenberger, 2020).

[3] See, for example, Lavalle (2022).

[4] See Friedman and Plumer (2022) and Larsen et al. (2022). The use of 2005 a baseline year can be traced to climate legislation debated under the Obama administration in 2009; it also happens to be a peak year for U.S. carbon emissions (Hulac, 2022).

[5] The use of 2005 a baseline year can be traced to climate legislation debated under the Obama administration in 2009; it also happens to be a peak year for U.S. carbon emissions (Hulac, 2022).

[6] See, for example, Harvey and House (2022). The EJ and co-pollutant concerns about CCS underscore the fact that these issues are relevant to a variety of climate policies, not only to carbon pricing.

[7] Quoted in Friedman and Davenport (2022).

Because demand-side policies alone are likely to be insufficient, we also need policies that operate on the supply side to limit directly the total amount of fossil fuels that are burned. One such strategy, widely endorsed climate justice advocates, is to halt further extraction by blocking new pipelines and new drilling for oil and gas. A more comprehensive variant of this strategy is the call for a "managed decline" of fossil fuel production to be led by the governments of wealthy countries.[8] Yet even Norway, where this has been considered more seriously than elsewhere, so far has declined to commit to reduced extraction.[9]

If efforts to curtail fossil fuel extraction were to succeed, one consequence of reduced supplies would be higher prices of fossil fuels. In this respect, *any policy that restricts supply is a carbon pricing policy*. The effect would be comparable to that of OPEC-led cuts in oil production. If the higher prices lure other suppliers to step up production to fill the resulting breach, dampening or eliminating the price effect, this strategy will fail to protect the climate. If the supply restriction does have a lasting impact on output and emissions, a side-effect of the higher prices will be a substantial transfer of wealth from consumers to those producers that continue extracting fossil fuels. Neither outcome can be regarded as a triumph for climate justice.

An alternative supply-side strategy is to put a hard ceiling on the total amount of fossil carbon allowed to enter the economy – in other words, a cap. One attraction of this strategy is that it can be implemented by any nation, consumer countries (which may have a stronger incentive to act) and producer countries alike. In this respect, a cap is akin to a boycott. The managed decline in fossil fuels here results not from an agreement to limit extraction but from the decision to limit purchases. A carbon cap is usually characterized as a carbon pricing policy since its effect is similar that of a carbon tax. A tax raises fuel prices directly; a cap raises them indirectly by limiting supply. In this respect, a cap is akin to a curb on extraction – with the difference that the extra money paid by consumers can be channeled back to the public or to other, more climate-friendly uses than higher profits for firms that continue to produce fossil fuels.

We advocate carbon pricing via a cap not because it is an "elegant" policy, nor because we regard a carbon price as an end in itself. Rather we do so because we recognize that supply restriction – and the *de facto* carbon pricing that accompanies it – is a necessary piece of the policy mix required for climate stabilization. If, contrary to past experiences, demand-side policies were to prove sufficient to achieve emissions reductions at the necessary scale and speed, the supply-side cap would only provide a backstop, an insurance policy that is never called upon.[10] But if other policies do not prove sufficient, the supply-side restriction anchored to the required emissions trajectory will be crucial in attaining the climate stabilization goal.

A predictable corollary of any restriction on supply is higher fossil fuel prices. We have crucial choices, however, as to where the money goes. We argue below that the bulk of the revenue from carbon permit auctions (or alternatively from a carbon tax) should be recycled directly to the public as equal per person dividends, a type of universal income funded by the protection of Earth's climate.

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[8] See the Lofoten Declaration (2017), which has been signed by more than 600 organizations from across the world. For more on managed decline, see also Trout (2020), Le Billon and Kristofferson (2020), and Van Asselt and Newell (2022).
[9] See, for example, BBC (2021).
[10] See Boyce and Paul (2021). For discussion of the complementarity between carbon pricing and other climate policies, and the need for both, see Kaswan (2018, 2020).

PRINCIPLE #2: First quantity, then price: a hard cap on carbon consumption

Carbon pricing policies today cover more than one-fifth of fossil fuel emissions worldwide, but they have not made a significant dent in the growth of emissions, let alone brought about the rapid decreases that are needed to achieve the Paris goal. The main reason is that carbon prices have been set too low. Only four relatively small countries – Sweden, Finland, Switzerland, and Lichtenstein – currently have prices above the range of USD 40-80 per ton that many economists consider the minimum needed to begin to make a serious dent in emissions.[11]

The 40-to-80 dollar price range is best seen as a starting point. A helpful rule of thumb is that one dollar per ton of carbon dioxide emissions translates into one cent per gallon of gasoline. A price of USD 40-80 per ton thus would raise gasoline prices at the pump by 40-80 cents. Prices rose by considerably more than this in the first six months of 2022, but few claimed this meant we were safely on the road to resolving the climate crisis.

It is hard (impossible, really) to predict what carbon price trajectory will be needed to meet the Paris target. The answer depends, among other things, on the full mix of climate policies that are adopted and on how rapidly technological and institutional changes bring down the cost of clean energy alternatives. For example, stricter fuel-economy standards for automobiles coupled with investments in EV charging stations would reduce demand for gasoline, and thereby lower the carbon price needed to meet the emissions reduction pathway.[12]

Uncertainties as to what other policies will be adopted and how prices will affect fuel demand underscore the importance of a hard ceiling on total fossil carbon consumption. The number of permits issued would decline over time as shown in Figure 1. Rather than allocating permits to corporations free-of-charge and then allowing firms to buy and sell them in a "cap and trade" system, the permits can be auctioned, eliminating the need for permit trading. Only fossil fuel firms would be eligible to buy permits at the auctions; they would then be required to surrender one permit for each ton of CO_2 that will be emitted when the fuel they bring into the economy is burned. Implementing this policy at the point where fossil fuels first enter the U.S. economy would involve fewer than 2,000 firms nationwide, so the administrative cost would be modest (Congressional Budget Office, 2001).

In theory, a carbon tax that adjusts over time – the tax rate rising automatically whenever emissions fail to decline enough – could keep the economy on the required emissions reduction path. But a hard cap with auctioned permits is a more straightforward and proven way to achieve the targeted result.[13] That said, certainty that the carbon price will rise steadily in future years can help incentivize long-term investments in energy efficiency and alternative energy, too. For this reason, the ideal carbon pricing policy would combine both a cap and a tax, with the latter serving as the floor price in permit auctions, and the price allowed to rise further whenever demand at the floor price exceeds the supply fixed by the cap.[14]

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[11] For a review of carbon pricing policies across the world, see World Bank (2022).

[12] For critiques of efforts to prescribe the right carbon price via the "social cost of carbon," see Ackerman and Stanton (2014, ch. 11) and Boyce and Bradley (2018).

[13] Quarterly auctions of carbon permits for power plants have been held since 2009 in the northeastern U.S. states, for example, in the Regional Greenhouse Gas Initiative.

[14] The UK government introduced a carbon price floor in permit auctions for power plants in 2013. For discussion, see Newbery et al. (2019) and Fischer et al. (2019).

To be certain that the carbon pricing policy achieves the emissions reduction trajectory, it must rule out "offsets." Offsets allow firms to evade the carbon cap (or tax) by taking steps that ostensibly compensate for their continuing emissions, like planting trees, refraining from cutting existing forests, or paying others to do so in a "carbon credit" market. Offsets suffer from the problems of additionality (is the offsetting action genuinely a new reduction in emissions or is it an exercise in labeling for profit?), verifiability (did the action really happen?), and perishability (will the offsetting action endure as long as atmospheric CO2?).

Policies to sequester carbon and to reduce greenhouse gas emissions from other sources are certainly needed. But these should be undertaken in addition to cutting fossil fuel emissions, not instead of doing so. Keeping fossil fuels in the ground is not the only thing we must do to address the climate crisis: it is simply the most important.

As EJ advocates and other critics have observed, past carbon pricing programs have not been terribly effective in reducing the use of fossil fuels.[15] But this need not be the case. Here we have outlined the basic requirements for an effective carbon pricing policy. First, it includes a hard cap that tightens over time (not simply a price mechanism). Second, it enforces the cap by means of permits that are auctioned at regular intervals to first sellers of carbon fuels (one permit to be surrendered for each ton of CO2 that will be released when the fuel is burned), with no permit trading necessary. Third, the policy is free from offsets or other loopholes. Carbon pricing based on a hard cap can be implemented alongside other decarbonization policies. But no combination of policies is guaranteed to be effective in ensuring a steep and swift reduction in emissions unless it includes an enforceable mechanism to keep fossil fuels in the ground. The policy outlined above does this.

PRINCIPLE #3: Protect the air: target emissions of hazardous co-pollutants

Because the impacts of carbon dioxide and other greenhouse gases are global, carbon pricing proponents sometimes argue that "carbon is carbon" and insist that it doesn't matter where emissions reductions occur. This claim ignores the fact that fossil fuel combustion simultaneously releases a host of "co-pollutants" that impact nearby communities, including particulate matter, sulfur dioxide, nitrogen oxides, and other hazardous air pollutants.[16]

	Minority share	Poverty share
Petroleum refineries	59.5	24.0
Power plants	38.3	15.8
Nationwide population	34.2	13.5

Table 1: Particulate matter exposure from refineries and power plants[17]
(emissions weighted by population living within 2.5 miles)
Minorities and households below the poverty line are disproportionately exposed to air pollution.

[15] For EJ-based critiques of carbon pricing, see for example Climate Justice Alliance and Indigenous Environmental Network (2017) and NAACP (2021).
[16] For discussion, see Boyce and Pastor (2013) and Shindell et al. (2018). For comprehensive data on EJ population shares in communities located near greenhouse gas-emitting industrial facilities in the U.S., see the Greenhouse 100 Index, an annual database published by the Corporate Toxics Information Project of the Political Economy Research Institute, University of Massachusetts Amherst.
[17] For details, see Boyce and Pastor (2013, Table 5).

EJ communities are disproportionately affected by pollution, including harmful air pollutants released by fossil fuel combustion.[18] As shown in Table 1, the exposure of racial and ethnic minorities (black, Hispanic, Asian-Pacific Islanders, and Native Americans) and low-income households to particulate matter emissions from refineries and power plants, for example, is considerably higher than their shares in the total U.S. population.

Policies to address climate change affect the activities and location of much of the polluting part of the economy. This realignment may involve large, one-time changes with repercussions that last for decades. If the policies governing this transition fail to guarantee tangible environmental gains in EJ communities, they are not likely to win enthusiastic support from EJ activists and advocates. And they will miss an important opportunity to redress longstanding environmental injustice.

The World Health Organization has identified ambient (outdoor) air pollution as a leading cause of premature mortality. A recent *Lancet* study concludes that this pollution is responsible for more than four million deaths each year across the world (Fuller et al., 2022). Fossil fuel combustion is the largest source of this pollution (Lelieveld, 2015). The death toll is especially high in China, India, and other newly industrializing countries, but air pollution causes hundreds of thousands of deaths in high-income countries, too, including 38,000 per year in the U.S. according to WHO (2016) estimates, and possibly more.[19]

The central objection to carbon pricing voiced by EJ advocates has been that by permitting polluters to decide whether and where to curtail their emissions – a flexibility seen by economists as one of the policy's main attractions, since low-cost options for emissions reductions can be expected to be chosen first – the policy allows continued or even increased emissions of co-pollutants in EJ communities, perpetuating and possibly widening exposure disparities. If, for example, carbon pricing encourages a shift from coal-fired electricity generation in one location to gas-fired power generation (which produces less carbon per megawatt hour) in another, emissions in the latter locality will go up. Reductions in overall emissions can be accompanied by increases in specific locations. The risk of continued or higher emissions in EJ communities is compounded if the policy allows offsets.

Possible adverse impacts on local air pollution – known as the "hot spot problem" in the environmental economics literature – was the main concern raised by EJ advocates who opposed the introduction of California's cap-and-trade system for carbon emissions one decade ago. At the time, their fears were dismissed by many of the policy's proponents, who assumed that lower carbon emissions would be accompanied by lower co-pollutant emissions across-the-board, despite local variations in the extent of reductions.

Subsequent events have shown that the EJ concerns were well-founded. Comparing the socio-economic characteristics of neighborhoods near facilities regulated in California's cap-and-trade program, Pastor et al. (2022) found that those that showed "least improvement" in greenhouse gas emissions – in fact, seeing absolute increases – generally had higher percentages of people of color

[18] For evidence on pollution exposure disparities in the United States in relation to race, ethnicity, and income class, see, for example, Bryant and Mohai (1992), Bullard (1994), Pastor (2007), Bullard et al. (2011), Zwickl et al. (2014), Mohai and Saha (2015), Mikati et al. (2018), Ash and Boyce (2018) and Liu et al. (2021). For evidence specifically on co-pollutants from fossil-fuel combustion, see Boyce and Pastor (2013) and Diana et al. (2019).

[19] Mailloux et al. (2022) estimate that the eliminating emissions of fine particulate matter, sulfur dioxide, and nitrogen oxides from electricity generation, transportation, buildings, and industrial sources in the U.S. would prevent more than 50,000 premature deaths annually and provide more than $600 billion in health benefits.

and low-income households.[20] To illustrate, Table 2 reports the changes at facilities that experienced large increases in GHG emissions (more than 200,000 metric tons) in the first five years of the program and are located in densely populated areas (with more than 100,000 people living within five miles of the facility). The two facilities with the largest percentage increases are gas-fired electricity generation plants; the other three are refineries. Four are located in metro Los Angeles and one in the San Francisco Bay area. The share of people of color in the surrounding population ranges from 61% to 88%, and all five have been the subject of EJ concerns.[21] California's relatively stringent air pollution controls led to decreased co-pollutant emissions in some cases, notwithstanding increased carbon emissions, an outcome that illustrates the potential for regulatory remedies. But all five facilities showed increases in emissions of at least one major co-pollutant: nitrogen oxides (NOx), sulfur dioxide (SO2), or fine particulate matter (PM2.5).

Facility	GHG emissions change	Demographics within 5-mi radius		Co-pollutant emissions change		
		Population	People of color	NOx	SO2	PM2.5
NRG Energy, El Segundo	119.5%	349,481	61%	28.7%	0.0%	-77.8%
LADPW Scattergood, Playa del Rey	49.2%	336,664	58%	12.0%	-64.3%	-37.4%
Tesoro Los Angeles Refinery, Carson	41.2%	595,242	88%	138.8%	17.0%	50.8%
Chevron Refinery, El Segundo	7.4%	399,940	63%	12.5%	-22.2%	19.8%
Chevron Refinery, Richmond	5.9%	161,146	80%	-14.0%	-3.0%	23.5%

Table 2: California facilities with increased carbon emissions under cap-and-trade[22]
All the facilities experienced increased emissions of at least one major co-pollutant.

[20] See also Cushing et al. (2018) and Boyce and Ash (2018). A recent analysis of power plant emissions in the Regional Greenhouse Gas Initiative of the northeastern states found that electricity generation from gas-fired plants has risen faster in EJ communities (Declet-Barreto and Rosenberg, 2022). A simulation study comparing outcomes from a 20% reduction in carbon emissions from power plants across regions of the U.S. found that in most regions co-pollutant damages decline for black, Hispanic, and low-income populations, but that they rise in California (Diana et al., 2021).
[21] The controversies have continued. In 2013, when its Scattergood generating station was modernized, the Los Angeles Department of Public Works (2013) hailed it as "a clear example of the kind of innovation driven by AB32" (the California Global Warming Solutions Act that led to the cap-and-trade program), but in 2019 Los Angeles mayor Eric Garcetti, responding to EJ concerns, announced plans to close it and two other gas-fired plants (Lappen, 2019; Roth, 2019). In 2020, an explosion and major fire occurred at the Tesoro refinery (which is now owned by Marathon following a corporate merger) (Gregory, 2020).
[22] GHG = greenhouse gases (CO2-equivalent). Changes computed from 2011/2012 average to 2016/2017 average. The facilities all had at least 250,000 mt CO2-e GHG emissions initially, experienced increases of at least 200,000 mt CO2-e over the regulated period, and had populations exceeding 100,000 people living within five miles.
GHG data from California Mandatory Reporting of Greenhouse Gas Emissions; co-pollutant data from California Air Resources Board CEIDARS inventory; demographics from California Office of Environmental Health Hazard Assessment, CalEnviroScreen, v3, 2021. For details, see Pastor et al. (2022).

At first glance, these findings may appear to contradict those of a working paper authored by two researchers at the University of California Santa Barbara that concluded that pollution exposure gaps between EJ communities and others narrowed as a result of the state's cap-and-trade program (Hernandez-Cortes and Meng, 2020, 2022). The UCSB paper recognizes that the reallocation of emissions induced by price-based policies "spatially alters who is harmed by pollution." The authors excluded refineries and electric power plants from their analysis, despite the fact that these accounted for three-quarters of the GHG emissions regulated under the program.[23] They also excluded any other facilities that ranked in the top 25% of emitters. The UCSB paper thus omitted precisely those facilities of greatest concern to EJ advocates. In their remaining sample, moreover, rather than investigating the demographic characteristics of communities impacted by facilities where emissions increased, the authors applied a "common percentage effect" to assess the impact of the cap-and-trade program: by comparing changes in emissions at facilities regulated and not-regulated by the program, they estimated the program's average impact in percentage terms and then applied this percentage to all regulated facilities.[24] Because facilities impacting EJ communities generally started out with higher emissions than other facilities before the program began, this common percentage assumption yields larger purported reductions. In other words, the conclusions of the UCSB study refer to what its authors consider to be the general rule, rather than to variations in pollution at specific locations. Yet variations are an intrinsic feature of carbon pricing systems, and it is those places where pollution burdens go from bad to worse rather than improving that are the focus of EJ concerns.

To address EJ concerns about localized co-pollutants, carbon pricing policy at a minimum should mandate real-time monitoring of pollution levels in vulnerable communities and provide for corrective measures to be implemented whenever adverse impacts are found. More robustly, an EJ Guarantee could be built into the policy by mandating that the USEPA (or equivalent agencies in other jurisdictions):

- Use EJ screening tools to identify vulnerable communities where co-pollution emissions from fossil fuel combustion are responsible for a significant share of their environmental health risks.
- Monitor ambient air quality in these communities and co-pollutant emissions from sources in or near these communities that impact their pollution burden.
- Record and report these data at the level of monitor and pollutant, making this information available to the public via the Internet in real time to help empower communities to participate in the environmental policy-making.
- Implement measures to ensure that co-pollutant emissions impacting vulnerable communities are reduced by at least 8% per year, matching the mandated overall carbon emissions reduction.

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[23] As the reason for this exclusion, the authors note that facilities in these sectors may have been impacted by other regulatory measures, such as renewable portfolio standards for electricity generators. But other regulatory measures are part of the typical setting within which carbon pricing programs are introduced. Moreover, they would have contributed to lower emissions rather than the opposite: the increases at facilities reported in Table 2 occurred *despite* other policies, not because of them.

[24] Thus "a 10% abatement effect implies 10 tons of abatement for a facility with 100 tons of average annual emissions and 5 tons of abatement for a facility with 50 tons of average annual emissions" (Hernandez-Cortes and Meng, 2022, p. 12). See also Pastor et al. (2022) for discussion of further data quality problems in the UCSB study.

If EJ concerns about co-pollutant hot-spots prove to be unwarranted (as some proponents of carbon pricing continue to maintain), then the EJ Guarantee would turn out to be a precautionary measure that has no effect on the policy's outcome. This is not a good reason to oppose the guarantee, any more than being confident that your house will not burn down is a good reason to forego fire insurance.

If the EJ Guarantee does alter the outcome – changing the spatial pattern of emissions from what would have been the case in its absence – then this mandate will serve as an effective guardrail for advancing environmental justice. Whatever its effect on the location of emissions, the EJ Guarantee would not diminish the efficacy of the policy in reducing carbon emissions. And in straightforward efficiency terms – even apart from the justice rationale – the added benefits from improved air quality and public health would be likely to outweigh any added costs.[25]

Co-pollutant issues are relevant not only to carbon pricing but also to many other climate policies. Similar issues regarding the perpetuation or exacerbation of co-pollutant hot-spots would arise, for example, in Clean Energy Standards that mandate a rising share of renewables in electricity generation. Co-pollutant concerns are not an argument against carbon pricing or other climate policies; rather they are an argument for explicitly incorporating clean air and EJ objectives into policy design.

PRINCIPLE #4: Protect household incomes: climate dividends for all

The most politically damaging criticism of carbon pricing – from across the political spectrum, from EJ advocates and others on the left to conservative lawmakers on the right – is that higher fuel prices would harm consumers by raising their cost of living. This is the main reason why carbon pricing policies, when implemented, usually establish a price too low to have much impact. It also helps explain why carbon pricing has practically disappeared from the U.S. policy debates under the Biden administration.

As a share of household income, the harshest impact of carbon pricing tends to be felt by lower-income families. Even though they consume much less fossil fuel than richer families in terms of absolute quantities, the share of fuel expenditure in household budgets is relatively higher for lower-income families.[26] In other words, in the absence of countervailing measures carbon pricing is regressive, hitting the poor harder than the rich. In a cruel irony, those who bear the greatest harm from climate destabilization and air pollution also bear the heaviest burden from increases in the price of fossil fuels.

There is a crucial difference, however, between price increases that boost the profit margins of energy corporations and the price increases that would result from either a hard cap on emissions or a carbon tax: where the money goes. With auctioned permits under a carbon cap (in contrast to OPED price hikes or permit giveaways under cap-and-trade), or with a carbon tax, the extra money paid by

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[25] Diana et al. (2019) find that the adding clean air and EJ goals to decarbonization in the U.S. electric power sector would add no more than 5% to total implementation costs and that the resulting health benefits would be more than double the additional cost.

[26] This includes not only direct energy consumption but also indirect consumption via the use of fossil fuels in producing other goods and services. For U.S. data on variations in carbon footprints by income class, see Fremstad and Paul (2019).

consumers winds up as government revenue. With a stringent cap or a robust tax, the amount of revenue is likely to be substantial.[27]

If all or most of this revenue is recycled directly to households on an equal per-person basis as climate protection dividends (also known as "carbon dividends"), akin to stimulus checks, the impact of carbon pricing on family incomes would be transformed.[28] Instead of a regressive effect, the outcome would be strongly progressive. Most low-income households would come out well ahead in purely financial terms, receiving more in dividends than they pay in higher fuel costs, without even counting benefits from protecting the environment. The purchasing power of most middle-class households would be kept whole. High-income households, because they consume above-average amounts of carbon (via expenditures on items such as jet travel, outsized homes, yachts and helicopters), would pay more than they receive in dividends – but they can afford it.

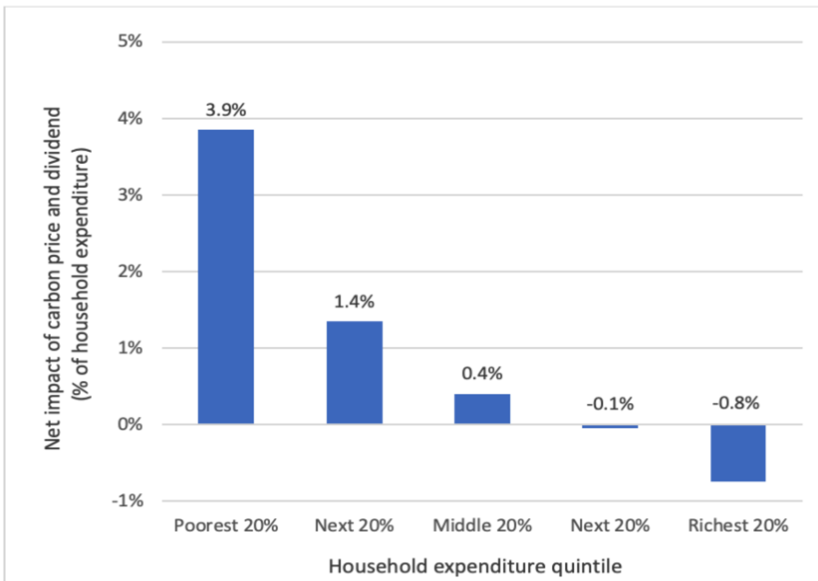

Figure 2: Net effect of $50/ton CO_2 price coupled with dividends in U.S.[29]
Dividends transform the distributional impact of carbon prices from regressive to progressive.

The net distributional impact in the U.S. is shown in Figure 2. At a price of $50/ton, returning 100% of the carbon revenue as dividends paid equally to all individuals would lift disposable incomes for the poorest 60% of households after paying the higher price for fuel. Only the richest one-fifth of households would pay a noticeable net cost. At the higher prices that would be likely to result from a hard cap tied to a Paris-consistent trajectory, the distributional pattern would be the same, with the net benefit for working families (and net cost to the most affluent households) being larger.

Of course, one can think of other uses, some worthy and others not-so-worthy, for carbon revenues apart from dividends. High on the list of worthwhile uses are public investments in the clean energy transition and environmental protection, particularly in disadvantaged communities; transitional

[27] For illustrative calculations for the U.S., see Boyce (2019).
[28] To ensure both transparency and universal coverage, dividends should be paid via electronic bank transfers (or checks in the mail) rather than as an adjustment to income taxes or other government benefits or payments.
[29] Calculated from data in Fremstad and Paul (2019).

adjustment assistance for the workers and communities who have depended in the past on fossil fuel extraction and processing; and assistance to local governments, including school boards, that like consumers would feel the impact of higher fuel prices. Some lawmakers have proposed dedicating a fraction of the total revenue, say 25%, to these and other uses, with the remainder to be paid to individuals as dividends.[30] We fully support public investments for environmental health and equity, but we would prefer to see them funded primarily by progressive taxation with most carbon revenue returned directly to the people.

Climate dividends paid to everyone would be a source of universal income based on environmental protection. Why pay these dividends to everyone, instead of only to the low-income households who need them most? In our view, there are compelling reasons for universality, both philosophical and political. From a philosophical standpoint, universal dividends embody the ethical principle that all people own the gifts of Nature in equal and common measure.[31] From a political standpoint, universality can help safeguard the durability of the policy of keeping fossil fuels in the ground throughout the decades needed to complete the clean energy transition, much as universality has protected Social Security and Medicare in the U.S.[32] Environmental justice advocates likewise invoke the ethic of universality when they rebut accusations of NIMBYism (not-in-my-back-yard insularity) with the reply, "Not in anybody's back yard."

Let us be clear: Climate dividends are not a substitute for steps to ensure cleaner air in EJ communities (see Principle #3). Money is not a substitute for a healthy environment, or for the power to have a say in environmental outcomes in one's community. But dividends would effectively counter the objection that carbon pricing would hit low-income households harder than the rich, turning the policy's distributional impact on its head.

PRINCIPLE #5: Value nature, don't commodify it

Another objection sometimes raised against carbon pricing is that it "commodifies" nature, reducing something that ought to be treated as sacred – the integrity of the planetary ecosystem – into something prosaic, or even profane, that can be bought and sold like soybeans or pork belly futures.

There is a fundamental difference, however, between valuing nature and turning it into a commodity. When we fail to put a price on carbon and allow emissions free-of-charge, we effectively value the

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[30] This was proposed, for example, in the 2009 CLEAR Act co-sponsored by U.S. Senators Maria Cantwell and Susan Collins. For discussion, see Boyce (2019, chapter 4). Some economists have proposed using carbon revenues as a "budget neutral" way to cut income taxes or other taxes. Apart from the fact that carbon revenues are distributionally regressive (in the absence of dividends), hitting the poor harder than the rich as a percentage of their incomes, this tax shift would tie government revenue to a source that ultimately diminishes as the clean energy transition is completed (Prasad, 2022). For a synopsis of climate dividend policies that have been proposed in the U.S., see Dividends for America, 'Overview of Selected Past and Current U.S. Carbon Pricing Policy Options.'

[31] For more on common wealth and universal property, see Boyce (2020), Barnes (2021) and Ranalli (2021).

[32] A study based on surveys of residents in both U.S. and Switzerland found that climate dividends (a.k.a. "rebates") increase support for carbon taxes, but that the effect is dampened or eliminated when respondents are exposed to "political messages" (Fremstad et al., 2022). The messages tested in the study repeated conventional arguments on climate policy (focusing on protecting the climate and job creation in the case of groups inclined to favor climate policy; and on hurting the economy and ineffectiveness in reducing pollution in the case of skeptics). The authors call for future research to investigate "what political messages could counteract these effects." One fruitful avenue may be messages conveyed across the political spectrum, rather than to preselected audiences, that instead focus on *justice* and emphasize universality and the fairness of climate dividends.

resulting climate impacts on present and future generations at zero. This is not treating Nature as sacred; it is treating it as worthless.

Every commodity has a price, but not everything with a price is a commodity. Commodities can be bought *and* sold repeatedly. Putting a price on emissions need not turn Nature into a commodity, any more than installing parking meters on busy city streets turns the streets into a commodity. Rather, parking meters charge for use of a scarce resource, helping along with parking regulations to prevent overuse and congestion. A carbon price similarly charges for parking CO2 in the atmosphere.

The EJ-friendly carbon price policy we have outlined above – with a hard cap on emissions, safeguards against hot spots, and auctioned permits coupled with dividends – is markedly different from the "carbon markets" established by cap-and-trade and carbon credit (aka offset) systems that commodify carbon. Cap-and-trade systems often start with free permit giveaways to corporations, allocated by means of a formula based on historic emissions. In effect, firms that were responsible for more pollution in the past are rewarded with more permits in the present. Recipients are then free to trade permits with one another – firms that want more permits buying them from those that find it more profitable to cut their own emissions and sell their permits – a feature whose rationale is to allow each firm to decide how much carbon to emit at the prevailing price. If permits are auctioned, rather than allocated free-of-charge, no such trading is necessary. If we consider other, more familiar examples of permits – for parking, driving, hunting, fishing, building, use of landfills, and so on – none are tradeable; the permit has a price, but it is not a commodity that the purchaser can resell to anyone else.

Some cap-and-trade systems go further, allowing permits to be bought and sold not only by the firms that receive them but also by financial intermediaries seeking to profit by buying low and selling high. The ultimate source of any such arbitrage profits is the consumer, whose fuel bills now cover the traders' margins on top of the windfall profits of firms that received free permits. Such full-blown permit trading creates needless opportunities for market manipulation and speculation. This is not an intrinsic feature of carbon pricing; it is a feature of policies designed to meet the interests of powerful special interests as opposed to consumers.

A further step on the commodification path is taken when carbon pricing systems include offsets that allow firms to continue polluting without permits if pay for something else – like planting trees – that supposedly offsets their own emissions. In this set-up, those who plant trees get carbon credits that they can sell on the offset market. As we have noted, offsets effectively turn the carbon cap into a sieve. This does not mean that land stewards who take measures to improve carbon sequestration in soils and plant biomass should not be rewarded for this service. But these actions should be undertaken in addition to keeping fossil fuels in the ground, not instead of doing so.

Concluding remarks

A carbon price is not an end in itself. Rather it is a necessary consequence of imposing a binding constraint on the supply of fossil fuels – the price, that is, of any serious commitment to keep fossil fuels in the ground.

Starting from the moral premise that the gifts of Nature belong equally to all, this paper seeks to reconcile the twin goals of climate protection and environmental justice. We are convinced there is no intrinsic conflict between them. On the contrary, the two can and should go hand-in-hand. Translating this compatibility into practice, however, has proven difficult. Many economists and other proponents of carbon pricing regard it as a vital instrument in the climate policy toolkit, whereas many EJ advocates view the idea with suspicion or downright antipathy. Their reasons for their skepticism cannot be brushed aside lightly. And their fears about being dealt out in the coming energy transition, in a replay of past environmental injustices, are understandable.

The key to reconciling carbon pricing and environmental justice is to design climate policy with this objective firmly in mind. To this end, we have identified five design principles:

- First, to keep fossil fuels in the ground we should deploy a mix of policies not only to reduce demand for fossil fuels but also to restrict their supply. If demand-side policies were to prove sufficient to reduce emissions on a path consistent with the climate stabilization objective ratified by the Paris Agreement, the supply restrictions would serve merely as backstop insurance; if demand-side policies prove insufficient on their own, then the supply restrictions will ensure the necessary emissions reductions. Even the most sanguine of demand-side policy proponents should welcome this insurance.

- Second, to guarantee that carbon pricing is effective in meeting the climate stabilization goal, the policy must be anchored to a hard cap on emissions that declines steadily on a trajectory that is consistent with net-zero emissions by mid-century. Permits to bring fossil carbon into the economy should be auctioned, their number limited by the cap, with a floor price that rises predictably over time. The carbon price that emerges from a hard cap is not simply a way to curb emissions: it is a *result* of keeping fossil fuels in the ground by restricting their supply.

- Third, to ensure that carbon pricing reduces disparities in exposure to co-pollutants from fossil fuel combustion, rather than maintaining or exacerbating these disparities, decarbonization targets should be paired with mandates for improving local air quality in EJ communities burdened by fossil fuel emissions. These mandates could guarantee, for example, that co-pollutants will be reduced at a pace that is at least equivalent to the overall reduction in carbon emissions. If co-pollutant reductions occur simply as a side-benefit of carbon pricing, then this provision again will serve as backstop insurance; but if not, the EJ guarantee will ensure that environmental injustices are not perpetuated or worsened. Even the most sanguine of carbon pricing proponents should welcome this insurance.

- Fourth, to counter the regressive impact of carbon pricing on household incomes, most or all of the revenue from permit auctions should be returned directly to the public as equal per-person dividends. Most households will come out ahead from this carbon price-and-dividend policy in straight pocketbook terms. Low-income households generally reap the largest net benefits by virtue of their smaller-than-average carbon footprints. Climate dividends are a type of universal income derived from charging a price for use of a scarce resource that we own in common, namely the biosphere's limited ability to absorb carbon safely.

- Fifth, to guard against the risks that commodification would pose to effectiveness, equity, and public acceptance of carbon pricing, permits should not be tradeable, and offsets should be prohibited. Trading is unnecessary if permits are auctioned rather than given away, and would create needless opportunities for market manipulation and speculative activity. Offsets suffer from serious problems of additionality, verifiability, and perishability; they risk turning the cap into a sieve. Measures to sequester atmospheric carbon should be undertaken not as an alternative to keeping fossil fuels in the ground, but instead as another complementary part of the policy mix alongside public investment, regulatory standards, and carbon pricing.

In sum, the question is not whether carbon pricing is desirable or not, but whether carbon pricing policies can and will be designed to be both environmentally effective and environmentally just.

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References

Ackerman, F. and E.A. Stanton (2014) *Climate Change and Global Equity*. London: Anthem.

Ash, M. and J.K. Boyce (2018) 'Racial disparities in pollution exposure and employment at US industrial facilities,' *Proceedings of the National Academy of Sciences* 115, 10636-10641.

Baker, J.A., M. Feldstein, T. Halstead, N.G. Mankiw, H.M. Paulson, G.P. Shultz, T. Stephenson, R. Walton (2017) 'The Conservative Case for Carbon Dividends,' Washington, DC: Climate Leadership Council.

Barnes, P. (2021) *Ours: The Case for Universal Property*. London: Polity.

BBC (2021) 'Norway's oil and gas sector will not be dismantled, new government says,' October 13.

Boyce, J.K. (2019) *The Case for Carbon Dividends*. London: Polity.

Boyce, J.K. (2021) 'The Case for Universal Property,' *Scientific American,* November 28.

Boyce, J.K. and M. Ash (2018) 'Carbon pricing, co-pollutants, and climate policy: Evidence from California,' *PLoS Medicine* 15(7).

Boyce, J.K and R. Bradley (2018) '3.5 °C in 2100?' Amherst, MA: Political Economy Research Institute.

Boyce, J.K. and M. Pastor (2013) 'Clearing the air: Incorporating air quality and environmental justice into climate policy,' *Climatic Change* 120, 801-814.

Boyce, J.K, and M. Paul (2021) 'Does Biden's insurance policy for the climate go far enough?' *The Hill,* February 16.

Bryant, B. and P. Mohai, eds. (1992) *Race and the Incidence of Environmental Hazards: A Time for Discourse.* New York: Westview.

Bullard, R.D. (1994) *Unequal Protection: Environmental Justice & Communities of Color*. New York: Random House.

Bullard, R.D., G.S. Johnson and A.O. Torres (2011) *Environmental Health and Racial Equity in the United States*. Washington, DC: American Public Health Association.

Climate Justice Alliance and Indigenous Environmental Network (2017) 'Carbon Pricing: A Critical Perspective for Community Resistance,' October.

Congressional Budget Office (2001) 'An evaluation of cap-and-trade programs for reducing U.S. carbon emissions.' Washington, DC.

Cushing, L., D. Blaustein-Rejto, M. Wander, M. Pastor, J. Sadd, A. Zhu, and R. Morello-Frosch (2018) 'Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011-2015),' *PLoS Medicine* 15(7).

Declet-Barreto, J. and A.A. Rosenberg (2022) 'Environmental justice and power plant emissions in the Regional Greenhouse Gas Initiative states,' *PLoS One* 17(7).

Diana, B., M. Ash and J.K. Boyce (2021) *Green for All: Integrating air quality and environmental justice into the clean energy transition*. Amherst, MA: University of Massachusetts Amherst, Political Economy Research Institute.

Fischer, C., L. Reins, D. Burtraw, D. Langlet, Å. Löfgren, M. Mehling, S. Weishaar, L. Zetterberg, H, van Asselt, K. Kulovesi (2019) *The Legal and Economic Case for an Auction Reserve Price in the EU Emissions Trading System*. Munich: CESifo.

Fremstad, A., M. Mildenberger, M. Paul and I. Stadelmann-Steffen (2022) 'The role of rebates in public support for carbon taxes,' *Environmental Research Letters,* forthcoming.

Fremstad A. and M. Paul (2019) 'The impact of a carbon tax on inequality.' *Ecological Economics,* 163, 88-97.

Friedman, L. and C. Davenport (2022) 'As historic climate bill heads to Biden's desk, young activists demand more,' *New York Times,* August 12.

Friedman, L. and B. Plumer (2022) 'Surprise deal would be most ambitious climate action undertaken by U.S.,' *New York Times,* July 28.

Fuller, R. et al. (2022) 'Pollution and health: a progress update,'' *The Lancet,* published online May 17.

Gregory, J. (2020) 'Massive fire at Marathon refinery in Carson contained after raging flames light up night sky,' ABC7.com, February 27.

Harvey, C. and K. House (2022) 'Every dollar spent on this climate technology is a waste,' *New York Times,* August 16.

Hernandez-Cortes, D. and K.C. Meng (2020) 'Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market,' National Bureau of Economic Research, Working Paper No. 27205, May.

Hernandez-Cortes, D. and K.C. Meng (2022) 'Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market,' revised version, February.

Hulac, B.J. (2022) 'Why the U.S. looks back 17 years to set its climate goals,' *Roll Call,* February 10.

Intergovernmental Panel on Climate Change (IPCC) (2018) *Global Warming of 1.5 °C*. Geneva: IPCC.

International Energy Agency (IEA) (2021) *Net Zero by 2050: A Roadmap for the Global Energy Sector*. Paris: IEA.

Kaswan, A. (2018) 'Energy, Governance, and Market Mechanisms,' *University of Miami Law Review,* 72, 476-579.

Kaswan, A. (2020) 'Carbon Pricing, Essential but Insufficient,' *University of San Francisco Law Research Paper,* No. 2020-11.

Lappen, J. (2019) 'DPW is about to commit Los Angeles to a dirty natural gas power plant it doesn't want or need,' *Los Angeles Times,* August 25.

Larsen, J., B. King, H. Kolus, N. Dasari, G. Hiltbrand and W. Herndon (2022) 'A turning point for US climate progress: Assessing the climate and clean energy provisions in the Inflation Reduction Act,' New York: Rhodium Group, August 12.

Lavalle, M. (2022) 'After 25 years of futility, Democrats finally jettison carbon pricing in favor of incentives to counter climate change,' *Inside Climate News,* August 12.

Le Billon, P. and B. Kristofferson (2020) 'Just cuts for fossil fuels? Supply-side carbon constraints and energy transition,' *Environment and Planning A: Economy and Space,* 52, 1072-1092.

Lelieveld, J., J.S. Evans, M. Fnais, D. Giannadaki and A. Pozzer (2015) 'The Contribution of Outdoor Air Pollution Sources to Premature Mortality on a Global Scale', *Nature*, 525, 367–84.

Liu, J. et al. (2021) 'Disparities in Air Pollution Exposure in the United States by Race/Ethnicity and Income, 1990–2010,' *Environmental Health Perspectives,* 129.

Lofoten Declaration (2017) 'Climate Leadership Requires a Managed Decline of Fossil Fuel Production,' August.

Los Angeles Department of Public Works (LADPW) (2013) 'LADWP Begins Rebuilding Scattergood Power Plant to Eliminate Ocean Water Cooling, Reduce Emissions and Improve Reliability,' August 29.

Mailloux, N.A., D.W. Abel, T. Holloway and J.A. Patz (2022) 'Nationwide and Regional PM2.5-Related Air Quality Health Benefits from the Removal of Energy-Related Emissions in the United States,' *GeoHealth* 6(5).

Mikati, I. et al. (2018) 'Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status,' *American Journal of Public Health,* 108, 480-485.

Mohai, P. and R. Saha (2015) 'Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice,' *Environmental Research Letters,* 10.

NAACP (2021) 'Nuts, Bolts, and Pitfalls of Carbon Pricing: An Equity-Based Primer on Paying to Pollute,' Baltimore: National Association for the Advancement of Colored People, July.

Newbery, D.M., D.M. Reiner and R.A. Ritz (2019) 'The Political Economy of a Carbon Floor Price for Power Generation,' *Energy Journal* 40, 1-24.

Pastor, M. (2007) 'Environmental Justice: Reflections from the United States,' in J.K. Boyce, S. Narain, and E. Stanton, eds., *Reclaiming Nature: Environmental Justice and Ecological Restoration.* London: Anthem.

Pastor, M., M. Ash, L. Cushing, R. Morello-Frosch, E.M. Muña and J. Sadd (2022) *Up in the Air: Revisiting equity dimensions of California's cap-and-trade system*. Los Angeles: University of Southern California, Equity Research Institute.

Prasad, M. (2022) 'Hidden benefits and dangers of a carbon tax,' *PLoS Climate,* July.

Ranalli, B. (2021) *Common Wealth Dividends: History and Theory*. New York: Palgrave Macmillan.

Roth, S. (2019) 'Los Angeles is finally ditching coal – and replacing it with another polluting fossil fuel,' *Los Angeles Times,* July 16.

Shindell, D., G. Faluvegi, K. Seltzer and C. Shindell (2018) 'Quantified, localized health benefits of accelerated carbon dioxide emissions reductions,' *Nature Climate Change* 8, 291-295.

Stokes, L.C. and M. Mildenberger (2020) 'The Trouble with Carbon Pricing,' *Boston Review,* September 24.

Trout, K. (2020) 'Five reasons governments must act now to phase out oil and gas production,' Oil Change International, May 20.

Van Asselt, H. and P. Newell (2022) 'Pathways to an International Agreement to Leave Fossil Fuels in the Ground,' *Global Environmental Politics,* forthcoming.

World Bank (2022). *State and Trends of Carbon Pricing 2022*. Washington, DC.

World Health Organization (2016) *Ambient air pollution: A global assessment of exposure and burden of disease.* Geneva.

Zwickl, K., M. Ash and J.K. Boyce (2014) 'Regional Variation in Environmental Inequality: Industrial Air Toxics Exposure in U.S. Cities,' *Ecological Economics,* 107, 494-509.

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