CARBON PRICING FOR A JUST TRANSITION

JEFF TODD*

The legal tools to avoid the potential disasters of climate change are already available, at least according to economists. Economists overwhelmingly prefer carbon pricing tools like carbon taxes and cap-and-trade programs to combat climate change and guide the energy transition. Carbon pricing is more cost effective at lowering carbon and other greenhouse gases (GHGs) than other legal options such as efficiency standards, renewable portfolio standards, subsidies, and tax credits and deductions. Unlike those other options, carbon pricing targets both the supply of and the demand for GHG-emitting products and services; moreover, it gives firms and consumers flexibility in how best to respond to the tax or the cap, whether by conserving more or switching to alternatives. For the most part, however, U.S. lawmakers have eschewed carbon pricing in favor of the less-effective and more-costly non-pricing alternatives. The preference is due in large part to concerns over the distributive implications of carbon pricing, namely that it would result in an unjust energy transition. Many scholars, policymakers, and environmental justice advocates worry that since carbon pricing by design raises energy prices, it will disproportionately burden the poor, who spend a greater share of their budget on energy. They also worry that carbon pricing will disproportionately benefit the rich, such as through capital tax swaps or grandfathered emissions permits.

Numerous recent economic studies have addressed the distributional implications of pricing and non-pricing climate policy instruments, yet those studies have received limited attention from legal scholars. Nor have economists compared and contrasted the distribution of pricing with non-pricing policies. This Article therefore surveys those economic

* Associate Professor of Business Law, Department of Finance & Economics, Texas State University.

analyses to show that a just transition is possible with carbon pricing. First, the United States currently relies on non-pricing policies that are themselves unjust: performance standards add costs that impose a disproportionate burden on the poor while subsidies and tax expenditures primarily benefit the rich. Carbon pricing can displace many of these laws and thereby eliminate their unjust impact. Second, the cost burden and regressivity of carbon pricing are overstated, so the impact on the poor will likely be much lower than commonly assumed—and might even be progressive for the poorest households because of the indexing of government transfers. Third, the ways in which revenues raised from carbon pricing are recycled play an important role: lowering other distortionary taxes like those on capital while allocating some money for government transfer programs and lump-sum rebates to the poorest households can balance efficiency and equity. This Article therefore argues that concerns over a just transition should not be a barrier to implementing carbon pricing, which is the most efficient and effective means for lowering GHGs and thus avoiding the harms of climate change.

INTRODUCTION

For economists, the best legal option to combat climate change and guide the energy transition is carbon pricing.[1] The debate is no longer over whether to implement carbon pricing, but instead over which of the two carbon pricing options is better: a carbon tax or cap and trade.[2] The reason economists prefer carbon pricing is that it targets both supply and demand and is therefore more cost-effective than the approaches currently favored by lawmakers, such as efficiency standards, renewable portfolio standards ("RPS"), subsidies, and tax credits and deductions.[3]

1. *See* Rory Gillis, *Carbon Tax Shifts and the Revenue-Neutrality Dilemma*, 23 FLA. TAX. REV. 293, 295 (2019) (citing, *inter alia*, WILLIAM D. NORDHAUS, A QUESTION OF BALANCE: WEIGHING THE OPTIONS ON GLOBAL WARMING POLICIES 48–64 (2008); Richard S.J. Tol, *The Structure of the Climate Debate*, 104 ENERGY POL'Y 431, 432 (2017); Frederick van der Ploeg & Cees Withagen, *Growth, Renewables, and the Optimal Carbon Tax*, 55 INT'L ECON. REV. 283 (2014)).

2. Joseph E. Aldy et al., *Designing Climate Mitigation Policy*, 48 J. ECON. LIT. 903, 918 (2010); *see also* Robert N. Stavins, *The Relative Merits of Carbon Pricing Instruments: Taxes Versus Trading*, 16 REV. ENV'T ECON. & POL'Y 62 (2022) (comparing and contrasting carbon taxes with cap and trade).

3. Carolyn Fischer & Richard Newell, *Environmental and Technology Policies for Climate Mitigation*, 55 J. ENV'T ECON. & MGMT. 142, 160 (2008) (calling emissions pricing, whether via taxes or cap and trade, "the most efficient single

Legal scholars have not reached a similar consensus on carbon pricing, however. Many have voiced concerns about distributive injustice: carbon pricing raises the costs of energy (as well as of energy-intensive products and services). These costs are passed onto consumers, and low-income households spend a larger share of their income on energy.[4] Relying on economic studies from the early 2000s on the distributional effects of environmental policies,[5] some legal scholars have argued that low-income persons would not be disproportionately burdened by carbon pricing. For example, even without considering how revenues raised from a carbon tax or auctioned permits would be spent, one study showed that carbon pricing would have a mildly progressive effect on households in the bottom half of the income distribution (in other words, lower-income households would fare better than higher-income households).[6] The impact is even more progressive when revenues are recycled to reduce other taxes or to pay lump-sum

policy for reducing emissions" because it gives incentives for reducing emissions, conserving energy, and expanding renewables); *id.* at 152–53 (ranking RPS, renewable production subsidies, and research-and-development subsides as the fourth, fifth, and sixth best climate change policies out of six); Dieter Helm, *Economic Instruments and Environmental Policy*, 36 ECON. & SOCIAL REV. 205, 207 (2005) ("Whereas the planner may need a demand side policy for energy efficiency, and supply side policies for managing renewables, nuclear and other non-carbon sources, putting a price on carbon signals to both sides of the market, and delegates the choices to individuals and firms, seeking out the lowest marginal costs.").

4. *See* Brigham Daniels, Michalyn Steele & Lisa Grow Sun, *Just Environmentalism*, 37 YALE L. & POL'Y REV. 1, 36 (2018) (discussing how carbon taxes can be regressive since they raise the costs of energy, on which low-income households spend a larger share of their income); Alice Kaswan, *Greening the Grid and Climate Justice*, 39 ENV'T L. 1143, 1154–55 (2009) (writing that policies that put a price on carbon will increase energy costs and have a regressive effect "since the poor spend a larger portion of their budgets on basic needs, like heating and power," and since "the poor spend more of their income on goods and services, the price of which could increase as a result of higher energy prices").

5. *See* Geoffrey Heal & Bengt Kriström, *Distribution, Sustainability and Environmental Policy*, *in* HANDBOOK OF SUSTAINABLE DEVELOPMENT 155, 175–76 (Giles Atkinson et al. eds., 2d ed., 2014) (noting the "surge of interest in environment and distribution" among economists).

6. *See, e.g.*, Gilbert Metcalf, *Paying for Greenhouse Gas Reductions: What Role for Fairness?*, 15 LEWIS & CLARK L. REV. 393, 411–14 (2011) (citing Sebastian Rausch et al., *Distributional Implications of Alternative U.S. Greenhouse Gas Control Measures*, (Nat'l Bureau of Econ. Rsch., Working Paper No. 16053, 2010)) (summarizing an economic study of a counterfactual where the government does not return revenue from carbon pricing that found that "[c]arbon pricing is modestly progressive over the lower half of the income distribution and essentially neutral in the upper half").

rebates.[7] Nevertheless, many environmental and energy justice advocates and scholars continue to oppose carbon taxes and cap-and-trade programs.[8] This opposition is part of the reason federal and state lawmakers largely eschew carbon pricing in favor of other approaches, such as performance standards and tax expenditures.[9]

Before embracing these other approaches, lawmakers, legal academics, and justice advocates should consult the economic literature. After all, the "just transition" framework demands that the laws that will lead to a decarbonized economy be structured to account for the needs of low-income households, including the need that both costs and benefits be equitably distributed.[10] Legal scholars have begun to address the possible

7. *See, e.g.*, Gilbert E. Metcalf & David Weisbach, *The Design of a Carbon Tax*, 33 HARV. ENV'T L. REV. 499, 513–14 (2009) (citing GILBERT E. METCALF, A PROPOSAL FOR A U.S. CARBON TAX SWAP: AN EQUITABLE TAX REFORM TO ADDRESS GLOBAL CLIMATE CHANGE (2007)) (arguing for a carbon tax that includes adjustments to income or payroll taxes to address distributive impacts in a way that maintains progressivity); Chad Stone, *Addressing the Impact of Climate Change Legislation on Low-Income Households*, 40 ENV'T L. REP. NEWS & ANALYSIS 10,555, 10,558–59 (2010) (citing SHARON PARROTT, DOTTIE ROSENBAUM & CHAD STONE, HOW TO USE EXISTING TAX AND BENEFIT SYSTEMS TO OFFSET CONSUMERS' HIGHER ENERGY COSTS UNDER AN EMISSIONS CAP 2–3 (2009), https://www.cbpp.org/sites/default/files/atoms/files/4-20-09climate.pdf [https://perma.cc/H4C3-RCSY] (urging a cap-and-trade scheme that refunds money to low-income families to restore lost purchasing power)).

8. *See* Uma Outka, *Fairness in the Low-Carbon Shift: Learning from Environmental Justice*, 82 BROOK. L. REV. 789, 793, 818 (2017) (surveying environmental justice advocacy groups that criticized the Clean Power Plan (which allowed states to institute cap and trade) in part because of concerns about the distribution of costs and benefits); Richard L. Revesz, *Regulation and Distribution*, 93 N.Y.U. L. REV. 1489, 1494–95 (2018) (writing that environmental justice advocates opposed Washington State's proposed carbon tax because revenues would be used to lower sales taxes rather than to address conditions in communities most impacted by pollution and climate change); *see also* Alice Kaswan, *Energy, Governance, and Market Mechanisms*, 72 U. MIA. L. REV. 476, 480, 560 (2017) (opposing carbon pricing as the primary means of decarbonization and arguing that it should serve only to supplement direct governmental decarbonization policies, due in part to concerns about "allocative efficiency").

9. *See, e.g.*, James K. Boyce, *Carbon Pricing and Climate Justice*, *in* ROUTLEDGE HANDBOOK OF THE POLITICAL ECONOMY OF THE ENVIRONMENT 243, 252 (Éloi Laurent & Klara Zwickl eds., 2022) (opining that politicians fear public backlash if they implement more stringent carbon pricing that impacts "the more immediate demands of day-to-day survival" like manageable fuel prices); Arik Levinson, *Energy Efficiency Standards Are More Regressive Than Energy Taxes: Theory and Evidence*, 6 J. ASS'N ENV'T & RESOURCE ECONOMISTS S7, S7–9 (2019) (opining that the reason the United States prefers efficiency standards over carbon taxes is that taxes "would be regressive").

10. Melissa Powers, *Zero-Sum Climate and Energy Politics Under the Trump Administration*, 49 ENV'T L. REP. NEWS & ANALYSIS 10,870, 10,882 (2019) ("Energy

unjust distributional effects of policies like RPS, subsidies, and tax incentives.[11] Because both pricing and non-pricing policies raise concerns about distributional inequity, a deeper exploration by scholars of the inherent differences between these policy instruments is warranted.[12] Such exploration can be aided by economic studies which elucidate the efficacy of proposed solutions and can thereby "play an essential role in

and environmental justice advocates have rightly begun to advocate for more inclusive energy transition policies that will both shield them from unaffordable rate hikes and provide them with some of the direct economic benefits associated with clean energy development."); Joseph P. Tomain, *Bridging Troubled Water: Clean Energy 50 Years After the Greening of America*, 69 U. KAN. L. REV. 713, 767 (2021) (claiming that, for a just transition, "the social and economic costs and benefits involved with climate change and transitional policies must be equitably distributed"); *see also* Alex Raskolnikov, *Distributional Arguments, in Reverse*, 105 MINN. L. REV. 1583, 1587 (2021) (arguing that the government should consider distributional issues in designing legal rules and during legal transitions). The just transition framework also recognizes the impact of climate policies on jobs and communities; *e.g.*, Ann M. Eisenberg, *Just Transitions*, 92 S. CAL. L. REV. 273, 275–76 (2019) (articulating one meaning of a "just transition" as a "call[] for protecting workers and communities who depend on high-carbon industries from bearing an undue burden of the costs of decarbonization," and arguing that a "labor-driven concept of a just transition is not only justified but is key to overcoming many of the obstacles that plague climate reform"). While beyond the scope of this article's treatment of the distribution of monetary costs and benefits, economists have also studied the impact of various climate policies on employment. Kenneth A. Castellanos & Garth Heutel, *Unemployment, Labor Mobility, and Climate Policy* (Nat'l Bureau of Econ. Rsch., Working Paper No. 25797, Mar. 2021) (considering the impact on employment of a carbon tax and of command-and-control regulation); *see, e.g.*, Luca Spinesi, *The Environmental Tax: Effects on Inequality and Growth*, 82 ENV'T & RES. ECON. 529 (2022) (weighing the impact on jobs and on human capital accumulation of taxes and of command-and-control instruments).

11. Lynsey Gaudioso, *A Billion Grains of Truth: Distributional Impacts of Household-Level Climate Change Tax Subsidies in the United States*, 18 VT. J. ENV'T L. 666, 669 (2017) ("Many incentives have regressive distributional consequences based on their structure: they preferentially accrue to the affluent and not the poor."); *see, e.g.*, Felix Mormann, *Clean Energy Equity*, 2019 UTAH L. REV. 335, 338–40 (arguing that RPS and subsidies primarily benefit people with higher incomes while costs fall on those with lower incomes and urging scholars to probe "into the relative equity of the primary tools of public policy support for clean energy").

12. *See* Shelley Welton & Joel Eisen, *Clean Energy Justice: Charting an Emerging Agenda*, 43 HARV. ENV'T L. REV. 307, 325 (2019) ("[A]ll clean energy policies—including tax credits, renewable portfolio standards, and cap-and-trade programs—have distributional consequences, some of which are potentially regressive."); *see also* Gilbert E. Metcalf, *The Distributional Impacts of U.S. Energy Policy*, 129 ENERGY POL'Y 926 (2019) (arguing that focusing on the distribution of energy taxes is too narrow because most energy laws are standards or incentives, which studies have shown to be distributionally unjust).

advancing the 'just transition.'"[13] This is because economists have continued their distributional analyses not only of carbon pricing but also of other legal approaches to climate change.[14] Legal scholars recognize the importance of "economic design" in ensuring a just transition,[15] with many citing some of the more recent economic analyses,[16] yet no legal article has undertaken a comprehensive treatment of those analyses.

This Article therefore appends the legal literature on a just transition by surveying economic studies to argue that rather than force a choice between efficiency and justice, carbon pricing—whether via a tax or cap-and-trade program—has the potential to "advance the transition to a clean energy economy in a manner that is both effective and equitable."[17] This Article

13. Éloi Laurent & Klara Zwickl, *Introduction: Political Economy of the Environment in the Century of Ecological Crises*, *in* ROUTLEDGE HANDBOOK OF THE POLITICAL ECONOMY OF THE ENVIRONMENT, *supra* note 9, at 1, 5; *see also* H. Spencer Banzhaf et al., *Environmental Justice: Establishing Causal Relationships*, 11 ANN. REV. RES. ECON. 377, 378 (2019) (calling economics "particularly valuable" for understanding the causal mechanisms of environmental injustice and the efficacy of policy solutions).

14. *See, e.g.*, Tatyana Deryugina, Don Fullerton & William A. Pizer, *An Introduction to Energy Policy Trade-Offs Between Economic Efficiency and Distributional Equity*, 6 J. ASS'N ENV'T & RES. ECONOMISTS S1 (2019) (summarizing articles in special issue that show how energy policies like efficiency standards, renewable energy mandates, and subsidies are no less regressive than a carbon tax); William A. Pizer & Steven Sexton, *The Distributional Impacts of Energy Taxes*, 13 REV. ENV'T ECON. & POL'Y 104 (2019) (surveying studies on the distributional impacts of carbon taxes).

15. Powers, *supra* note 10, at 10882; *see also* Shalanda H. Baker & Andrew Kinde, *The Pathway to a Green New Deal: Synthesizing Transdisciplinary Literatures and Activist Frameworks to Achieve a Just Energy Transition*, 44 ENVIRONS: ENV'T L. & POL'Y J. 1 (2020) (arguing that transdisciplinary approaches that include the social sciences and empirical studies are important to guide a just energy transition).

16. *See, e.g.*, Gary M. Lucas, Jr., *Voter Psychology and the Carbon Tax*, 90 TEMP. L. REV. 1, 7 (2017) (citing Aparna Mathur & Adele C. Morris, *Distributional Effects of a Carbon Tax in Broader U.S. Fiscal Reform*, 66 ENERGY POL'Y 326, 333 (2014)) ("[E]conomists estimate that the government could eliminate the burden on the poor—for example, by mailing them rebate checks or increasing the earned income tax credit—using only a small fraction of carbon tax revenue."); Welton & Eisen, *supra* note 12, at 341 (citing Severin Borenstein & Lucas W. Davis, *The Distributional Effects of US Clean Energy Tax Credits*, *in* TAX POLICY AND THE ECONOMY 191, 191–92 (Jeffrey R. Brown ed., 2016)) (describing economic study that found that the highest income quintile disproportionately benefitted from clean energy and electric vehicle tax credits compared to lower income quintiles).

17. Boyce, *supra* note 9, at 254; *see also* James K. Boyce, *Political Economy of the Environment: A Look Back and Ahead*, *in* ROUTLEDGE HANDBOOK OF THE POLITICAL ECONOMY OF THE ENVIRONMENT, *supra* note 9, at 13, 22 (writing that policymaking should be driven by multiple analyses like efficiency and justice because sometimes these different frames can "lead to the same results").

is structured in three parts. Part I summarizes the legal options for combatting climate change and guiding the transition away from fossil fuels. Part II explains why carbon pricing is superior on efficiency grounds but raises concerns about an unjust transition. Part III surveys economic studies on the distributional impacts of different climate policy instruments. To enable comparison among the legal options, Part III opens by showing how efficiency standards, RPS, subsidies, and tax expenditures disproportionately burden low-income households or benefit high-income households. Part III then addresses several ways in which the costs and regressivity of carbon pricing are overstated, so the burden on low-income households would be much lower than commonly assumed—and carbon pricing may even be progressive once one accounts for the indexing of government transfers.[18] Part III closes by describing the primary mechanisms for recycling carbon pricing revenue—tax swaps and lump-sum rebates—before explaining the need to balance mitigating the impact of carbon pricing on the economy with concerns about vertical and horizontal equity. A hybrid approach that reduces capital taxes while paying rebates to the lowest-income households can achieve this balance. This Article then briefly concludes.

I. GUIDING THE TRANSITION TO A DECARBONIZED ECONOMY: A CONTINUUM OF LEGAL OPTIONS

Commentators have argued that a robust legal response is necessary to attain a meaningful reduction in greenhouse gases (GHGs) within the next several decades and to hasten the transition to a decarbonized economy.[19] State and federal lawmakers can respond in numerous ways.[20] One common

18. The impact of a law is considered regressive "if the welfare loss increases as the household income decreases," meaning that lower-income households suffer more of a welfare loss than higher-income households. Govinda R. Timilsina, *Carbon Taxes*, 60 J. ECON. LITER. 1456, 1472 n.18 (2022). If the reverse is true—welfare loss decreases as household income decreases—then the law has a progressive impact. *Id.*

19. *See* Christopher Serkin & Michael P. Vandenbergh, *Prospective Grandfathering: Anticipating the Energy Transition Problem*, 102 MINN. L. REV. 1019 (2018) (claiming that carbon taxes or regulation are required to achieve a reduction in GHGs by 2050); *see also* Tomain, *supra* note 10, at 724 (writing that the energy transition requires "innovative approaches to energy regulation").

20. *See, e.g.*, Gary M. Lucas, Jr., *Behavioral Public Choice and the Carbon Tax*, 2017 UTAH L. REV. 115, 125 (2017) ("Aside from a carbon tax, the government has

method of categorizing these various options is to situate them along a continuum from more to less government control or, phrased in the alternative, from less to more market freedom.[21] This Part summarizes those options by placing them within three groups along that continuum: command-and-control regulation, subsidies and tax expenditures, and carbon pricing.

A. *Command-and-Control Regulation: The Mandate of Performance Standards*

Command-and-control regulations require certain entities to take specific actions.[22] In the United States, environmental regulation has traditionally materialized via governmental command and control, such as limits on emissions of pollutants and mandates for the use of technology to reduce pollution.[23] In the climate context, emissions controls can be in the form of outright prohibitions. Some high-profile examples include California's ban on the sale of gasoline-powered vehicles starting

three primary options for addressing global warming—cap-and-trade, command-and-control regulation, and green subsidies."); Shelley Welton, *Electricity Markets and the Social Project of Decarbonization*, 118 COLUM. L. REV. 1067, 1083 (2018) ("States are using cap-and-trade programs; renewable-energy procurement requirements; rebates and tax incentives for individuals, businesses, and communities; and novel electricity pricing schemes.").

21. Michael A. Livermore & Richard L. Revesz, *Environmental Law and Economics, in* 2 OXFORD HANDBOOK OF LAW AND ECONOMICS: PRIVATE AND COMMERCIAL LAW 509, 521–22 (Francesco Parisi ed., 2017) (citing MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM TWENTY YEARS OF EXPERIENCE (J. Freeman & C. Kolstad eds., 2006)) (writing that environmental regulations have "many alternatives along a command-to-market continuum"); *see also* Amy Sinden, *The Tragedy of the Commons and the Myth of a Private Property Solution*, 78 U. COLO. L. REV. 533, 551 (2007) (writing that "government regulation takes a variety of forms, each of which contains elements of command and elements of economic incentive," so "regulation can be conceptualized on a continuum").

22. Janet E. Milne, *Environmental Taxation in the United States: The Long View*, 15 LEWIS & CLARK L. REV. 417, 421 (2011).

23. Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax is a Better Response to Global Warming than Cap and Trade*, 28 STAN. ENV'T L.J. 3, 21 (2009) ("Historically, the United States has imposed regulatory controls to curtail pollution through a combination of regulatory emission controls, technology-forcing requirements, and permit limits.").

in 2035[24] and Massachusetts' law that allows cities to ban fossil fuel infrastructure in major construction projects.[25]

More common, however, are performance standards, which "require that a firm's *output* meet certain standards" such as "maximum emissions rates per kilowatt-hour of electricity, energy efficiency standards for buildings or household appliances, and fuel economy requirements for new cars."[26] For example, the federal Corporate Average Fuel Efficiency ("CAFE") standards mandate a minimum average fuel efficiency across a manufacturer's fleet of vehicles.[27] Similarly, the Energy Policy and Conservation Act empowered the Department of Energy to establish conservation standards for both household and commercial appliances like furnaces, air conditioners, refrigerators, dishwashers, and clothes washers and dryers.[28] Likewise, "many states have adopted building codes for new construction aimed at reducing electricity consumption."[29] One goal of these standards is to reduce GHG emissions.[30] While performance standards may drive up the costs of regulated products and buildings, performance standards are typically justified on the ground that increased efficiency results in cost savings over the life of the product or building.[31]

Renewable Portfolio Standards ("RPS") and Clean Energy Standards ("CES") are types of performance standards that

24. Mike Colias & Christine Mai-Duc, *California Approves Rules to Ban Gasoline-Powered Cars by 2035*, WALL ST. J. (Aug. 25, 2022, 5:30 PM), https://www.wsj.com/articles/california-set-to-approve-rules-to-ban-gasoline-powered-cars-by-2035-11661457578 [https://perma.cc/TX7R-WW97].

25. Allyson Chiu, *Massachusetts Just Passed a Massive Climate and Clean Energy Bill*, WASH. POST, (Aug. 11, 2022, 4:41 PM), https://www.washingtonpost.com/climate-solutions/2022/08/11/massachusetts-climate-clean-energy-bill-charlie-baker [https://perma.cc/J29M-M7QB].

26. Lawrence H. Goulder & Ian W. H. Parry, *Instrument Choice in Environmental Policy*, 2 REV. ENV'T ECON. & POL'Y 152, 158 (2008).

27. Gilbert E. Metcalf, *Market-Based Policy Options to Control U.S. Greenhouse Gas Emissions*, 23 J. ECON. PERSPECTIVES 5, 6 (2009).

28. Sofie Miller & Brian Mannix, *One Standard to Rule Them All: The Disparate Impact of Energy Efficiency Regulations*, *in* NUDGE THEORY IN ACTION 251, 253–54 (Sherzod Abdukadirov ed., 2016).

29. Jim Rossi, *Carbon Taxation by Regulation*, 102 MINN. L. REV. 277, 303 (2017).

30. Lucas, *supra* note 16, at 9 ("In the climate context, command-and-control regulations mandate that regulated firms . . . achieve a minimal level of performance in reducing emissions.").

31. *See* Miller & Mannix, *supra* note 28, at 255 (writing that Department of Energy conservation standards for consumer goods are intended in part to address the inability of consumers "to trade off upfront price increases against long-term energy savings").

target inputs rather than outputs.[32] States with RPS mandates require that a minimum percentage of the electricity sold to consumers by utilities be from renewable sources like wind and solar.[33] CES is similar except that it broadens the types of low-emission sources that can be included to the meet the minimum percentage, such as nuclear power.[34] At least twenty-nine states (as well as the District of Columbia and three U.S. territories) have implemented RPS for the purpose of promoting "the large-scale deployment of renewable energy technologies."[35] The goal is to push the energy industry toward greater sustainability by increasing the percentage of required renewables over time.[36] Although many jurisdictions have technology-neutral RPS, more and more are starting to require—or at least incentivize—certain types of renewable technologies.[37]

B. Subsidies and Tax Expenditures: Incentivizing Climate-Friendly Purchases by Lowering Their Cost

One barrier to the immediate and widespread adoption of low- and no-carbon energy sources and products is the considerable upfront expense of purchasing renewable energy equipment and electric vehicles ("EVs"). Even though solar panels, energy-efficient appliances, and EVs might pay for themselves over the life of the product, firms and consumers may not be able to afford the initial investment.[38] One way that federal and state governments have attempted to lower the cost

32. Goulder & Parry, *supra* note 26, at 158 n.7; Lawrence H. Goulder, Marc A. C. Hafstead & Roberton C. Williams III, *General Equilibrium Impacts of a Federal Clean Energy Standard*, 8 AM. ECON. J.: ECON. POL'Y 186, 186–87 (2016); *see* Lucas, *supra* note 16, at 9 (calling "regulations that require power companies to produce electricity from renewable sources" an example of command-and-control laws).

33. Mormann, *supra* note 11, at 353; *see* Metcalf, *supra* note 27, at 6 (writing that state RPS mandates "set a target that some share of electricity be produced by renewable sources").

34. *See* Kelsey L. Hanson, *New York's Clean Energy Standard: Can Renewable Energy Development Revitalize Upstate New York's Economy?*, 26 BUFF. ENV'T L.J. 55, 57–61 (2019) (describing New York State's CES, which includes nuclear power); Burcin Unel, Cheryl A. LaFleur & Andrew G. Place, *Advancing Energy Policy*, 28 N.Y.U. ENV'T L.J. 17, 21 (2020) ("Clean energy standards require that a certain percentage of electricity delivered to a state comes from resources that do not emit carbon dioxide, such as solar, wind, and nuclear.").

35. Mormann, *supra* note 11, at 354.

36. Thomas P. Lyon & Haitao Yin, *Why Do States Adopt Renewable Portfolio Standards? An Empirical Investigation*, 31 ENERGY J. 131, 131 (2010).

37. Mormann, *supra* note 11, at 354.

38. Gaudioso, *supra* note 11, at 677–78.

barrier is through subsidies and tax expenditures.[39] Rather than the stick of regulatory mandates, the government offers the carrot of the public purse to entice private entities to engage in activities preferred by the government.[40]

Both the federal and many state governments have directly and indirectly subsidized climate-friendly investments. While some subsidies are targeted toward firms—such as the Methane Emissions Reduction Program and the Clean Energy and Sustainability Accelerator (or "Green Bank," as it is commonly called) under the Inflation Reduction Act—others cater to individuals. Under the Inflation Reduction Act, for example, individuals may receive up to $14,000 in rebates for electing to use electric heat pump water heaters, electric induction cooktops, and energy efficiency home improvements.[41] Indeed, hundreds of programs have been established to provide individuals with loans, grants, and rebates for energy efficiency and renewable energy purchases.[42] One prominent example is the California Solar Initiative which provided direct cash rebates for residential solar installation and has been credited with "the massive expansion of solar."[43]

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39. *Id.* at 667 ("[F]ederal and state governments spend billions of dollars each year on renewable-energy, energy-efficiency, and alternative-vehicle tax incentives designed to encourage our transition to a low-carbon future."); Lucas, *supra* note 16, at 9 ("Green subsidies . . . attempt to encourage low-carbon activities and clean technologies.").

40. James E. Holloway, *The Effectiveness and Environmental Impact of Economic Development Incentives as Measures to Respond to Environmental Harm*, 24 VILL. ENV'T L.J. 225, 231–32 (2013) (categorizing "[m]ixed command-and-control regulations" as those which "promote voluntary participation by providing tax benefits and subsidies to businesses that perform activities beneficial to a city, county, or state's economy or environment"); Daniel N. Shaviro, *Rethinking Tax Expenditures and Fiscal Language*, 57 TAX L. REV. 187, 188 (2004) (equating tax expenditures with the allocative function of government like paying for police or building roads); Linda Sugin, *Tax Expenditures, Reform, and Distributive Justice*, 3 COLUM. J. TAX L. 1 (2011) (explaining how tax expenditures encourage private parties to do preferred government policy).

41. Jeff Stein et al., *How the Inflation Reduction Act Might Impact You—and Change the U.S.*, WASH. POST (Aug. 29, 2023, 9:24 AM), https://www.washingtonpost.com/us-policy/2022/07/28/manchin-schumer-climate-deal [https://perma.cc/TQ5P-7WSC].

42. Gaudioso, *supra* note 11, at 705–06 (citing *Programs*, DSIRE N.C. CLEAN ENERGY TECH. CTR., http://programs.dsireusa.org/system/program?state=US [https:perma.cc/SJ72-ETC9]) (stating that hundreds of programs have been established, although many of them have expired).

43. Severin Borenstein, *The Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax Incentives, and Rebates*, 4 J. ASS'N ENV'T & RES. ECONOMISTS S85, S86, S90 (2017).

In addition to direct rebates, the government also offers tax credits or allows tax deductions for climate-friendly projects and products.[44] For industry, federal examples include accelerated depreciation rates and tax credits, with the latter available for the production of electricity from renewable sources and for capital expenditures related to renewable energy investment.[45] More recently, the Inflation Reduction Act provided $260 billion in new and expanded tax credits for the production of renewable energy as well as the manufacture of wind turbines and solar panels.[46] The Inflation Reduction Act also provides tax credits for consumers who purchase EVs: $7,500 for new vehicles or $4,000 for used vehicles.[47] Consumers can also benefit from a raft of other federal and state tax incentives, both credits and deductions, that reward EV purchases, residential solar installation, and energy efficiency home improvements.[48]

C. Carbon Pricing: Letting the Market Address the Negative Externality of GHGs

Carbon pricing is based on the premise that climate change is a market failure: fossil fuel production and consumption create a "negative externality," a byproduct—GHGs—that exacerbates climate change.[49] Climate change imposes massive social costs that are not included in the prices that producers

44. Milne, *supra* note 22, at 440–41 (describing how President George W. Bush saw tax expenditures as "a way to achieve energy goals, including reduced reliance on fossil fuels," and how federal legislation under Presidents Bush and Obama rewarded clean coal, energy efficiency, alternative-fuel vehicles, renewable energy, and low-carbon technologies).

45. Tracey M. Roberts, *Picking Winners and Losers: A Structural Examination of Tax Subsidies to the Energy Industry*, 41 COLUM. J. ENV'T L. 63, 95–101 (2016).

46. Stein et al., *supra* note 41.

47. Allyson Chiu, *Buy Now or Wait? What the New Electric Vehicle Credits Mean for You*, WASH. POST (Aug. 10, 2022, 12:09 PM), https://www.washingtonpost.com/climate-solutions/2022/08/10/electric-vehicle-ev-ira-credit-bill [https://perma.cc/TU93-SV9A].

48. Gaudioso, *supra* note 11, at 681–97.

49. Donald B. Marron & Eric J. Toder, *Tax Policy Issues in Designing a Carbon Tax*, 104 AM. ECON. REV. PAPERS & PROC. 563, 563 (2014) (calling business, consumer, and governmental GHG emissions a "classic externality" because those "emissions accumulate in the atmosphere, alter the climate, and impose potential economic and environmental costs including property damage from increased storm risks, threats to human health, changes to agricultural productivity, and ecosystem deterioration"); Lucas, *supra* note 16, at 6 ("By contributing to global warming, people who consume carbon-intensive goods impose a cost, or negative externality, on society.").

charge and consumers pay for GHG-emitting activities.[50] Correcting the market failure therefore requires pricing the externality, which forces producers (and ultimately consumers) to pay the true social cost for GHG emissions; phrased differently, they will have to internalize the externality.[51] These higher costs lead to reduced GHG emissions by influencing firms and households to consume fewer fossil fuels, invest in more carbon-abatement technology, and pursue the substitutes of renewable and other carbon-free energy.[52]

The two primary methods to price the externality of GHGs are carbon taxes and emissions cap-and-trade programs.[53] Calculating the social costs of carbon (the monetary value to the economy of each ton of emitted carbon dioxide) is the first step for setting a carbon tax.[54] The government then forces producers

50. Avi-Yonah & Uhlmann, *supra* note 23, at 30 ("[E]missions occur at no cost to the emitting facility, but at an enormous cost to society as a whole.").

51. *Id.* at 30 ("A central feature of the market-based approaches, therefore, is developing a price signal for carbon that incorporates the costs of that externality and drives the market toward finding acceptable alternatives."); Yoram Margalioth, *Tax Policy Analysis of Climate Change*, 64 TAX L. REV. 63, 63–64 (2010) (writing that imposing a private cost equal to the social cost of GHG emissions forces firms and individuals to internalize the externality); Marron & Toder, *supra* note 49, at 563 (writing that a tax equal to the marginal social cost of GHG emissions "would internalize the externality").

52. Margalioth, *supra* note 51, at 64 ("Setting a price on GHG emissions is necessary in order to transmit their social costs to the day-by-day decisions of all firms and individuals, thereby bringing their activity to an efficient level."); Stone, *supra* note 7, at 10,555 (calling the "price signal" resulting from cap and trade "an incentive for businesses and households to pursue greater energy conservation, and investments in energy efficiency and alternative clean energy technologies, in effect reducing total emissions to the amount allowed under the cap"); Deryugina et al., *supra* note 14, at S2 (writing that raising the price of fossil fuels encourages substitution toward renewable sources and EVs and encourages conservation measures like buying energy-efficient appliances and better insulating homes).

53. *See* Stavins, *supra* note 2, at 62–63; *About Carbon Pricing*, U.N. REGIONAL COLLABORATION CTRS., https://unfccc.int/about-us/regional-collaboration-centres/the-ciaca/about-carbon-pricing [https://perma.cc/D8B2-894W] (listing emissions trading systems (cap and trade), carbon taxes, and emission reduction funds (which are only operable in Australia) as methods of carbon pricing).

54. Robert S. Pindyck, *Coase Lecture—Taxes, Targets and the Social Cost of Carbon*, 84 ECONOMICA 345, 346 (2017); *see* William D. Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PROC. NAT'L ACAD. SCI. 1518, 1518 (2017) (writing that the social cost of carbon "designates the economic cost caused by an additional ton of carbon dioxide emissions or its equivalent. In a more precise definition, it is the change in the discounted value of economic welfare from an additional unit of CO_2-equivalent emissions"); *id.* at 1521–22 (estimating the social cost of carbon in 2020 to be about $32 per ton); *see* Richard L. Revesz & Max Sarinsky, *The Social Cost of Greenhouse Gases: Legal, Economic, and Institutional Perspective*, 39 YALE J. ON

to pay that cost via a tax, preferably upstream (such as on the owners of coal mines and wellheads or of processing facilities).[55] Several countries as well as subnational governments like the Canadian province of British Columbia have enacted carbon taxes, though these tend to be fairly modest (ranging from US$2 to $30 per ton) and subject to numerous exemptions and exclusions.[56] In the United States, neither the federal nor any state governments have a carbon tax, although some local governments like Boulder, Colorado and Montgomery County, Maryland have carbon taxes.[57]

Cap-and-trade programs, on the other hand, create a market for the right to emit GHGs.[58] Lawmakers set an overall limit (or cap) on the amount of GHGs that producers can emit, and then the government issues permits, each of which allows for the emission of a certain amount of carbon, such as one ton per permit.[59] The government then distributes these permits, either by giving them away freely or via auction (or a combination of the two).[60] These programs also include a market for the trading of permits, so firms that can abate emissions costs effectively can sell their permits to firms that cannot.[61] The cap (along with the number of permits) decreases over time,

REG. 856, 873 (2022) (stating that the social cost of carbon can be broadened to include other GHGs and "integrated into all areas of policymaking").

55. Jack Calder, *Administration of a US Carbon Tax*, *in* IMPLEMENTING A US CARBON TAX: CHALLENGES AND DEBATES 38 *passim* (Ian Parry, Adele Morris & Roberton C. Williams III eds., 2015); Aldy et al., *supra* note 2, at 918–19.

56. Shi-Ling Hsu, *A Complete Analysis of Carbon Taxation: Considering the Revenue Side*, 65 BUFF. L. REV. 857, 866–70 (2017).

57. Revesz, *supra* note 8, at 1494–95; *see* William G. Gale, Samuel Brown & Fernando Saltiel, *Carbon Taxes as Part of the Fiscal Solution*, *in* IMPLEMENTING A US CARBON TAX: CHALLENGES AND DEBATES 1, 7 (stating that Boulder, Colorado and Montgomery County, Maryland have carbon taxes). *See* Boulder, Colo. Rev. Code, tit. 3, § 12 (2007); Montgomery Cnty., Md. Expedited Bill 29–10 (2010).

58. *See* TOM TIETENBERG, EMISSIONS TRADING: PRINCIPLES AND PRACTICE 3–4 (2006) (explaining how a property-rights-based approach to regulation allows the market rather than the government to value emissions permits).

59. Ann E. Carlson, *Designing Effective Climate Policy: Cap-and-Trade and Complementary Policies*, 49 HARV. J. ON LEGIS. 207, 209 (2012) ("The idea of cap-and-trade is straightforward. A total amount of allowable pollution is set (the cap). Those subject to the cap are allocated allowances (in sum equal to the cap) that allow them to pollute (typically one ton of pollutant per allowance, with the total number of allocated allowances equal to the cap).").

60. Metcalf, *supra* note 27, at 12 ("The government can issue the permits for free to regulated firms or other entities (for example, like state governments), auction the permits, or use some combination of free distribution and auctions.").

61. Jeff Todd, *Climate Cap and Trade and Pollution Hot Spots: An Economics Perspective*, 39 GA. ST. UNIV. L. REV. 1003, 1009 (2023).

thereby driving up the cost of permits as they become scarcer.[62] In addition to federal and state cap-and-trade programs that have targeted GHG co-pollutants like sulfur dioxide and nitrous oxides,[63] the United States has implemented two major climate-specific cap-and-trade programs.[64] One is the Northeastern U.S. Regional Greenhouse Gas Initiative ("RGGI"), a coalition of eleven northeastern states that target downstream power producers.[65] The other is California's Assembly Bill 32, which imposed efficiency standards, RPS, and a cap-and-trade system that covers electricity, large-scale manufacturing, and fuels.[66] Though not widely used in the United States, these two carbon pricing options have the potential to combat climate change more cost effectively than existing approaches, as discussed in the next Part.

II. THE SEEMING TRADE-OFF OF EQUITY FOR EFFICIENCY

To address climate change, economists prefer carbon taxes and cap-and-trade programs because they are the most cost-effective means to achieve the goal of transitioning the economy away from fossil fuels.[67] By contrast, command-and-control

62. Joseph E. Aldy, *Evaluating Regulatory Performance: Learning from and Institutionalizing Retrospective Analysis of EPA Regulations*, 70 CASE W. RSRV. L. REV. 971, 976–77 (2020) ("The cap creates scarcity in the right to pollute, which drives the allowances' prices on the secondary market where firms buy and sell the allowances."); Avi-Yonah & Uhlmann, *supra* note 23, at 33 ("The cap would decline over time to achieve the desired level of carbon dioxide emission reductions.").

63. *See* Aldy, *supra* note 62, at 982–88 (describing cap-and-trade schemes under the federal Clean Air Act as well as California's Regional Clean Air Incentives Market ["RECLAIM"]).

64. The Clean Power Plan of the Obama Administration included a cap-and-trade scheme. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electricity Utility Generating Units, 80 Fed. Reg. 64662, 64731–32, 2015 WL 6384905 (Oct. 23, 2015). The Clean Power Plan was later ruled unconstitutional under the major questions doctrine. *See* West Virginia v. EPA, 142 S. Ct. 2587, 2614–16 (2022).

65. Richard Schmalensee & Robert N. Stavins, *Lessons Learned from Three Decades of Experience with Cap and Trade*, 11 REV. ENV'T ECON. & POL'Y 59, 66 (2017). The RGGI is a nonprofit corporation that supports cooperation among the eleven state members, and the individual states retain sovereignty to enact laws to support its efforts. *See* RGGI, Inc. (2023), https://www.rggi.org/rggi-inc/contact.

66. *Id.* at 67–68; *see* Kaswan, *supra* note 8, at 569–78 (citing Cal. Health & Safety Code § 38500 *et seq.* (2006)) (discussing California's Assembly Bill 32).

67. *See* Ian Parry, *Summary for Policymakers, in* IMPLEMENTING A US CARBON TAX: CHALLENGES AND DEBATES, *supra* note 55, at xxiii, xxv ("[T]here is near-universal agreement among economists that [carbon pricing] will be essential if US emissions are ultimately to be rolled back at reasonable cost.").

regulations, subsidies, and tax incentives "are at best insufficient and at worst inefficient and counterproductive."[68] Policymakers nevertheless pursue these latter options at least in part because of equity concerns arising from the very structure of carbon pricing. By design, taxes and cap-and-trade programs raise consumer costs for energy and fuel,[69] and these increased costs could disproportionately burden the lowest-income households. This Part therefore addresses how carbon pricing is more efficient than other legal approaches before discussing its potential inequity.

A. *Carbon Pricing Is More Cost-Effective than Other Legal Options*

Each approach to environmental regulation has some advantage over others. For example, technology mandates and performance standards work well when regulators have perfect information and regulated firms are homogenous.[70] One study concluded that, in some situations, CES can be more cost-effective than cap and trade: where the goal is modest GHG emissions reductions, CES imposes a smaller implicit tax on the factors of production.[71] Subsidies and tax incentives encourage innovation in and the adoption of clean-energy technology by lowering its costs.[72] In addition, subsidies and incentives are

68. Lucas, *supra* note 16, at 5; *see* WILLIAM NORDHAUS, THE CLIMATE CASINO: RISKS, UNCERTAINTY, & ECONOMICS FOR A WARMING WORLD 272 (2013) (acknowledging that, while regulations can play a complementary role, regulations alone are insufficient, plus they "can be very costly or even counterproductive if they are not carefully designed").

69. *See* DONALD MARRON, ERIC TODER & LYDIA AUSTIN, URBAN-BROOKINGS TAX POLICY CTR., TAXING CARBON: WHAT, WHY, AND HOW 12 (2015) (writing that "the whole point of a carbon tax" is to "raise the prices of selected goods and services, causing consumers to switch to less preferred options"); Terry Dinan, *Offsetting a Carbon Tax's Burden on Low-Income Households*, *in* IMPLEMENTING A US CARBON TAX, *supra* note 55, at 120, 121 (calling price increases under a carbon tax "essential to the success of the program because they provide incentives for businesses to produce goods in a manner that result [sic] in lower emissions and for households to reduce consumption of energy-intensive goods that cause high emissions").

70. Cameron Hepburn, *Regulation by Prices, Quantities, or Both: A Review of Instrument Choice*, 22 OXFORD REV. ECON. POL'Y 226, 228–29 (2006).

71. Goulder, Hafstead & Williams, *supra* note 32, at 215.

72. José-Luis Cruz & Esteban Rossi-Hansberg, *The Economic Geography of Global Warming* 23, 37 (Nat'l Bureau of Econ. Research, Working Paper No. 28466, 2021) (writing that clean energy subsidies "make clean energy less expensive, thereby creating incentives for agents to produce energy with clean sources" and that the subsidy "encourages innovation"); *see* Borenstein, *supra* note 43, at 72

politically attractive to lawmakers since voters prefer tax credits over tax bills.[73] Even advocates for carbon pricing concede that command-and-control regulation, subsidies, and tax incentives can be complementary policies to overcome potential issues like the uncertainty of the optimal tax rate or emissions cap.[74] When evaluated on their own merits, however, carbon pricing emerges as the most cost-effective—and even as a necessary—policy for achieving a meaningful reduction in GHGs.[75]

Command-and-control regulation is beneficial when regulators have access to perfect information and firms are homogenous. Neither situation is present with climate change and the energy transition. Instead of perfect information, regulators have too little information relative to plant managers, who have no incentive to accept responsibility voluntarily or to transmit unbiased cost information.[76] Regulators therefore lack specific information about each firm's operations, emissions, and costs.[77] Firms are heterogenous, so some can abate GHGs more efficiently than others; however, one size does not fit all, meaning that the uniform standards imposed by command-and-control regulations are inefficient.[78] Another source of

(calling the "significant barriers" to adoption of renewable energy like wind, solar, and biomass the "cost of generation, cost of transmitting the power to where demand is, and the value of the power generated").

73. *See* Roberta F. Mann, *Federal, State, and Local Tax Policies for Climate Change: Coordination or Cross-Purpose?*, 15 LEWIS & CLARK L. REV. 369, 381 (2011) ("For a member of Congress, voting to support cap-and-trade or a carbon tax that would increase energy costs on constituents requires considerable courage. On the other hand, voting to lower taxes by adding a tax expenditure that benefits a constituent is easy.").

74. NORDHAUS, *supra* note 68, at 272 (acknowledging that regulations can play a complementary role to carbon pricing); Boyce, *supra* note 9, at 247 (recognizing the "considerable uncertainty as to the relationship between quantity and price" and describing methods to price and reprice carbon such as emissions caps, adjusting tax rates, and a tax-and-cap combination).

75. Stavins, *supra* note 2, at 63 ("There is widespread agreement among most economists that economy-wide carbon pricing will be a necessary (although not sufficient) component of any effective policy that can achieve meaningful and cost-effective CO_2 reductions in large and complex economies.").

76. TIETENBERG, *supra* note 58, at 26; Goulder & Parry, *supra* note 26, at 157.

77. *See* Lucas, *supra* note 16, at 10 ("[S]electing the most cost-effective abatement technology or the optimal performance standard for a particular industry requires detailed information that the government cannot easily obtain, and obtaining that information is much more difficult than simply estimating the appropriate carbon tax rate.").

78. Aldy et al., *supra* note 2, at 918 n.14; Tol, *supra* note 1, at 432; *see* Richard Schmalensee & Robert N. Stavins, *Policy Evolution under the Clean Air Act*, 33 J. ECON. PERSP. 27, 31–32 (2019) (arguing that, in the context of air pollution, the

information uncertainty—especially for RPS laws that mandate particular renewable sources—is whether the technology behind those sources will be effective.[79] Carbon pricing overcomes the information problem by offering firms flexibility: they can pay the tax or trade for permits (depending on the type of carbon pricing adopted), or they can lower their GHG emissions (and choose the means by which they do so).[80] Carbon pricing therefore has lower compliance costs per unit of abatement compared to mandates and performance standards.[81] According to one economist, the "typical finding is that using inefficient regulations or approaches [would] double the costs" of climate change mitigation.[82]

While CES and its cousin RPS might be more cost-effective if policymakers seek modest emissions cuts, the challenge presented by climate change requires bold action. Even with a seemingly distant target of net-zero emissions by 2050, significant GHG reductions must begin now.[83] If the policy

EPA cannot tailor pollution abatement on a firm-by-firm basis and instead imposes a one-size-fits-all technology or performance standard that risks a high cost per unit of pollution abated).

79. Severin Borenstein & Ryan Kellogg, *Challenges of a Clean Energy Transition and Implications for Energy Infrastructure Policy*, *in* REBUILDING THE POST-PANDEMIC ECONOMY 234, 251 (Melissa S. Kearney & Amy Ganz eds., 2021).

80. Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENV'T L. REV. 293, 329–30 (2008) (explaining the "what, where, and when" flexibility possible with both carbon taxes and cap and trade).

81. Goulder & Parry, *supra* note 26, at 158–59; Lawrence H. Goulder et al., *The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting*, 72 J. PUB. ECON. 329, 339 (1999); *see* Richard G. Newell & Robert N. Stavins, *Cost Heterogeneity and the Potential Savings from Market-Based Policies*, 23 J. REGUL. ECON. 43, 57–58 (2003) (concluding that cost heterogeneity among firms makes market-based environmental policies more cost-effective than emissions standards).

82. NORDHAUS, *supra* note 68, at 179; *see, e.g.*, Meredith Fowlie, Michael Greenstone & Catherine Wolfram, *Do Energy Efficiency Investments Deliver? Evidence from the Weatherization Assistance Program*, 133 Q.J. ECON. 1597, 1599–1601 (2018) (studying homes in Michigan that were eligible for free federal home efficiency upgrades and finding that upfront costs were twice the savings and that (even accounting for broader social effects) the average rate of return was -7.8 percent).

83. *See* Shelley Welton, *The Bounds of Energy Law*, 62 B.C. L. REV. 2339, 2368–69 (2021) (detailing how, to meet net-zero carbon emissions by 2050, the United States will have to pursue aggressive 5 to 7 percent annual reductions in GHG emissions while simultaneously developing the infrastructure for decarbonization via electrification). *See* Matthew Dalton, Stacy Meichtry, & Shua Hua, *Nations at COP28 Agree for First Time to Transition from Fossil Fuels*, WALL ST. J. (Dec. 13, 2023, 11:46 AM), https://www.wsj.com/business/energy-oil/cop28-leaders-call-for-transitioning-away-from-fossil-fuels-in-final-push-at-climate-talks-48f4b1c3

choice is carbon taxes, many economists argue for the immediate implementation of a high tax rate due to uncertainty regarding future damage and climate tipping events.[84] Moreover, setting high, early prices incentivizes earlier technological innovation, which then reaps benefits for a longer time.[85] If the policy choice is cap and trade, then short-term emissions caps may start modestly but must increase in stringency over the medium and long terms—particularly if the goal is to lower and not just stabilize GHG emissions.[86] To attain meaningful rather than half-hearted reductions in GHGs, carbon pricing is more cost-effective than CES or RPS.[87]

Subsidies and tax incentives also have several shortcomings. As with command-and-control regulation, the government may lack sufficient information about which

[https://www.wsj.com/business/energy-oil/cop28-leaders-call-for-transitioning-away-from-fossil-fuels-in-final-push-at-climate-talks-48f4b1c3?reflink=desktopwebshare_permalink] (describing agreement by members of the U.N. Framework Convention on Climate Change to transition away from fossil fuels by 2050 and the need for national governments to implement plans for meeting this goal).

84. *See, e.g.*, Roberton C. Williams III, *Setting the Initial Time-Profile of Climate Policy: The Economics of Environmental Policy Phase-Ins*, *in* THE DESIGN AND IMPLEMENTATION OF U.S. CLIMATE POLICY 245, 246 (Dan Fullerton & Catherine Wolfram eds., 2012) (arguing that it is more efficient to phase in carbon tax policies immediately); Kent D. Daniel, Robert B. Litterman & Gernot Wagner, *Applying Asset Pricing Theory to Calibrate the Price of Climate Risk* 43 (Nat'l Bureau of Econ. Research, Working Paper No. 22795, Oct. 2018) (arguing for a high optimal carbon price today that declines over time as uncertainty about climate change damages is resolved); Roberton C. Williams III, *Environmental Taxation* 70–71 (Nat'l Bureau of Econ. Research, Working Paper No. 22303, 2016) [hereinafter Williams, *Environmental Taxation*] (concluding that most studies recommend raising the carbon tax rate more quickly than the social cost of carbon).

85. Nicholas Stern & Joseph E. Stiglitz, *The Social Cost of Carbon, Risk, Distribution, Market Failures: An Alternative Approach* 22 (Nat'l Bureau of Econ. Research, Working Paper No. 28472, 2021).

86. Robert N. Stavins, *Addressing Climate Change with a Comprehensive US Cap-and-Trade System*, 24 OXFORD REV. ECON. POL'Y 298, 303–04 (2008).

87. Goulder, Hafstead & Williams, *supra* note 32, at 215 ("When the emissions-reduction target is more ambitious, however, the [cap-and-trade] policy becomes more cost-effective."); *see* Felix Mormann, *Requirements for a Renewables Revolution*, 38 ECOLOGY L.Q. 903, 929 (2011) ("[E]conomic theory suggests that pricing emissions provides the most efficient incentives for the development and dissemination of lower-emission technologies, such as renewable energy technology."); Aldy et al., *supra* note 2, at 918 n.14 (calling renewable mandates inefficient because "[s]ome opportunities at the firm level (e.g., substituting natural gas and nuclear power for coal), are not exploited; marginal costs will differ across heterogeneous power companies; household electricity prices will not reflect the cost of the remaining (unpriced) emissions; and abatement opportunities outside of the power sector are unexploited").

activities and technologies to subsidize.[88] Take as an example subsidies for renewable power generation, which must be committed in advance.[89] This commitment will not necessarily account for the heterogeneity of the brown power sources being displaced; for example, if solar energy replaces natural-gas-fired electricity generation, it lowers GHGs only half as much as if it replaces coal-fired electricity generation.[90] This information problem does not arise with a direct tax on carbon or with the issuance of emissions permits since the regulated entity makes abatement decisions based on its individual knowledge and capacities.[91] It is therefore "more economically efficient to increase the cost of emitting GHGs rather than reduce the costs of technologies that have varying effects on GHG emissions via tax incentives."[92]

Another shortcoming with subsidies and tax expenditures is that they target only GHG inputs and not outputs. They therefore "provide the wrong incentives regarding the level of output, which leads to excess entry" and results in "too much abatement from input substitution . . . and too little from reduced output."[93] Further, subsidies and tax expenditures depress the price of power, which discourages energy efficiency and leads to an overconsumption of electricity.[94] By contrast, carbon pricing targets both the supply and demand side because producers have a cost incentive to use less carbon and seek

88. Lucas, *supra* note 16, at 11.

89. Severin Borenstein, *The Private and Public Economics of Renewable Electricity Generation*, 26 J. ECON. PERSP. 67, 80 (2012).

90. *Id.*; *see* Mann, *supra* note 73, at 381 ("The GHG-reduction potential of wind generated electricity, for example, depends on the GHG emissions of the technology it replaces. Yet providing a federal incentive for wind generated electricity has the same effect on the price of the electricity whether the replaced source is GHG intensive coal or less GHG intensive natural gas.").

91. Borenstein, *supra* note 89, at 80.

92. Mann, *supra* note 73, at 380–81.

93. Goulder & Parry, *supra* note 26, at 155–57; *see* Williams, *Environmental Taxation*, *supra* note 84, at 53 ("[S]ubsidizing a less-polluting alternative (such as subsidies for ethanol) provides an incentive only for switching to that alternative, not for any other way to reduce emissions.").

94. Borenstein, *supra* note 89, at 79–80 (writing that subsidies depress the price of power and discourage efficient consumption, which results in the overconsumption of electricity and disincentives for energy efficiency); Cruz & Rossi-Hansberg, *supra* note 72, at 4 ("Clean energy subsidies have only a modest effect on carbon emissions and the corresponding evolution of global temperature since, although they generate substitution towards clean energy, they also lead to a reduction in the price of energy which results in more production and ultimately more energy use. These effects tend to cancel each other out.").

alternatives to it, and if they instead pass costs along to customers, then customers will consume less or seek their own alternatives like renewables and EVs.[95]

A third problem with subsidies and tax expenditures is how to pay for them. Subsidies must be funded somehow, while tax credits and deductions reduce revenue that the government would otherwise collect.[96] The government must therefore either increase other taxes or its budget deficit,[97] both of which are bad for the economy.[98] By contrast, carbon taxes and cap-and-trade programs where permits are auctioned would raise significant revenue. For example, one study found that carbon taxes of $25 to $30 per ton could result in net revenues of $1.2 to $1.7 trillion over ten years.[99]

The superiority of carbon pricing over other legal approaches is affirmed by numerous economic studies, which have concluded that carbon pricing, whether via taxes or cap and trade, "is the most efficient single policy for reducing emissions, since it simultaneously gives incentives for fossil energy producers to reduce emissions intensity, for consumers to

95. Helm, *supra* note 3, at 207 ("[P]utting a price on carbon signals to both sides of the market, and delegates the choices to individuals and firms, seeking out the lowest marginal costs."); *see* Lucas, *supra* note 16, at 6 ("Fossil fuel suppliers would then pass on most of the cost to consumers, thereby increasing the prices of carbon-intensive goods, which would encourage emissions reduction across all sectors of the economy and avoid the inefficient reallocation of resources from taxed to untaxed sectors."); Andrea Baranzini et al., *Carbon Pricing in Climate Policy: Seven Reasons, Complementary Instruments, and Political Economy Considerations*, 8 WIREs CLIMATE CHANGE 1, 3 (2017) (writing that both firms and consumers face higher prices and thus "are motived to purchase the cheaper input, product or service" or shift "to options with relatively low direct and indirect emissions").

96. *See, e.g.*, Baranzini et al., *supra* note 95, at 6 (writing that subsidies "generate a burden for public finances").

97. Lucas, *supra* note 16, at 11 ("[S]ubsidies are costly because the government must pay for them by increasing distortionary taxes like the income tax or by increasing its budget deficit."); Gilbert E. Metcalf, *Federal Tax Policy Towards Energy*, *in* TAX POLICY AND THE ECONOMY 145, 168–74 (2007) (surveying federal renewable tax credits and finding them "costly" because they must be funded by raising distortionary taxes).

98. *See* Jon Hilsenrath, *New Climate, Tech Bills Expand Role of Government in Private Markets*, WALL ST. J. (Aug. 12, 2022, 12:59 PM), https://www.wsj.com/articles/new-legislation-expands-role-of-government-in-private-markets-11660321784 [https://perma.cc/Q8AR-YDCD] (writing that climate tax expenditures could make the economy less efficient and slow its overall growth rate, leaving households worse off in the long run).

99. Williams, *Environmental Taxation*, *supra* note 84, at 22–24 (citing JARED C. CARBONE ET AL., RESOURCES FOR THE FUTURE, DEFICIT REDUCTION AND CARBON TAXES: BUDGETARY, ECONOMIC, DISTRIBUTIONAL AND ECONOMIC IMPACTS (2013)).

conserve, and for renewable energy producers to expand production and to invest in knowledge to reduce their costs."[100] For example, one study evaluated six GHG policies and ranked carbon pricing as the most efficient, while RPS, renewable production subsidies, and research-and-development subsides ranked as fourth, fifth, and sixth best, respectively.[101] A more recent study found that for a 10 percent reduction in emissions, carbon taxes cost on average $12 per ton of carbon compared to $78 per ton for RPS.[102] The results are similar for fuel efficiency standards, which cost three to six times more than a gasoline tax that achieves the same result.[103]

Economists have also found that cap-and-trade programs are "environmentally effective and economically cost effective relative to traditional command-and-control approaches."[104] The authors of one survey wrote that "less flexible systems would not have led to the technological change that appears to have been introduced by market-based instruments or the induced process innovations that have resulted."[105] One study found that the costs for cap and trade would be $82 per ton of carbon abated compared to $126 per ton for an equivalent RPS program and $144 per ton for renewable energy production credits.[106] Another study of hypothetical federal climate change programs found that cap and trade would lead to far greater GHG emissions reductions for the same (or even lower) cost than fuel efficiency standards or a CES or RPS program.[107] These results are bolstered by the fact that, unlike carbon taxes,

100. Fisher & Newell, *supra* note 3, at 160.

101. *Id.* at 152–53.

102. Mar Reguant, *The Efficiency and Sectoral Distributional Impacts of Large-Scale Renewable Energy Policies*, 6 J. ASS'N ENV'T & RES. ECONOMISTS S129, S132 (2019); *see* Warwick J. McKibbin, Adele Morris & Peter Wilcoxen, *Subsidizing Energy Efficient Household Capital: How Does It Compare to a Carbon Tax?*, 32 ENERGY J. 105, 119117–18 (2011) (finding that a carbon tax that started at $30 per metric ton achieved a 60 percent reduction in carbon by 2040, compared to only a 1.5 percent reduction for household tax credits for energy efficiency investments).

103. Mark R. Jacobsen, *Evaluating U.S. Fuel Economy Standards in a Model with Producer and Household Heterogeneity*, 5 AM. ECON. J.: ECON. POL'Y 148, 150 (2013).

104. Schmalensee & Stavins, *supra* note 65, at 73–74 (citations omitted).

105. *Id.* (citations omitted).

106. Karen Palmer & Dallas Burtraw, *Cost-Effectiveness of Renewable Electricity Policies*, 27 ENERGY ECON. 873, 890–91, 890 tbl. 7 (2005).

107. Sebastian Rausch & Valerie J. Karplus, *Markets Versus Regulation: The Efficiency and Distributional Impacts of U.S. Climate Policy Proposals*, 35 ENERGY J. 199, 205–07 (2014).

climate cap-and-trade programs already exist in the United States and have already been analyzed by economists. Consider a study finding that the Regional Greenhouse Gas Initiative accounted for half of the region's GHG reductions from 2009 to 2012.[108] By isolating the impact of several factors on emissions (including complementary RPS policies), they concluded that the RGGI led to a 19 percent reduction in GHG emissions while those other factors each accounted for only 12–14 percent.[109] Whether via a tax or cap-and-trade program, carbon pricing is effective at lowering GHG emissions—and doing so for the lowest costs.

B. Carbon Pricing Raises Concerns About an Unjust Transition

As discussed above, carbon pricing encourages less consumption of fossil fuels and promotes the adoption of greener alternatives by forcing firms to pay the social cost of the unpriced externality of GHGs. These costs are huge: economists estimate that even modest federal carbon pricing policies could raise $100 billion in annual governmental revenue.[110] Firms would not simply absorb all of these costs but instead pass them on to firms further downstream and ultimately to consumers.[111] Moreover, the tax or emissions permits would apply directly to sources of energy like coal, oil, and natural gas, but they would also indirectly raise the costs of products that are produced using that energy—which is virtually all products.[112] While carbon pricing is a short-term approach that should necessarily end

108. Brian C. Murray & Peter T. Maniloff, *Why Have Greenhouse Gas Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors*, 51 ENERGY ECON. 581, 588 (2015).

109. *Id.*

110. *See* Anders Fremstad & Mark Paul, *The Impact of Carbon Tax on Inequality*, 163 ECOLOGICAL ECON. 88, 90 (2019) (calculating that a $50-per-ton carbon tax would have "impose[d] $138 billion in taxes and $12 billion in abatement costs on U.S. households" in 2020).

111. Boyce, *supra* note 9, at 244 ("When these permits are auctioned, the firms will bid what they expect to recoup from higher prices paid by consumers."); Goulder & Parry, *supra* note 26, at 155 (writing that, with taxes or cap-and-trade programs, "both the costs of abatement and the emissions price are reflected in higher prices of consumer products").

112. Williams, *Environmental Taxation*, *supra* note 84, at 65 ("Every good in the economy has some energy use somewhere in its production process, and almost certainly some associated carbon emissions, so one would expect a carbon tax to influence the prices of all goods.").

when the economy has transitioned away from fossil fuels, "short" is relative since a carbon tax or cap-and-trade program will likely be in place for decades.[113] Accordingly, assessing the efficacy of carbon pricing means considering not only its overall cost-effectiveness but also how the increased costs (as well as any concomitant benefits) will be distributed during the energy transition.[114]

A common assumption is that carbon pricing is regressive because it would disproportionately "burden[] the poor more than the rich."[115] Several factors contribute to this assumption. By raising the cost of everything, carbon pricing affects real wages and thus acts like an implicit tax on labor.[116] Lower-income households, which generate a greater share of their income from wages, would therefore be impacted more adversely than rich ones.[117] Further, in the United States, the average household in the lowest income decile devotes nearly 15 percent of its annual budget to purchases of electricity, natural gas, gasoline, and other fuels.[118] Each higher income decile spends a declining percentage of its annual budget on energy, with the highest decile spending only 5 percent.[119] In addition, low-income individuals may not be able to curtail energy use because of the inelasticity of energy consumption needs, such as keeping

113. *Compare* Fremstad & Paul, *supra* note 110, at 90 (calling a carbon tax "a relatively short-run policy" based on the assumption that carbon emissions must be reduced 45 percent by 2030), *with* MEI YUAN ET AL., MIT JOINT PROGRAM ON SCIENCE AND POLICY OF GLOBAL CHANGE, THE REVENUE IMPLICATIONS OF A CARBON TAX (2017) (calling a carbon tax "a dependable source of revenue to finance federal fiscal initiatives over at least the thirty-year horizon").

114. *See* Alan Krupnick & Ian Parry, *What Is the Best Policy Instrument for Reducing CO_2 Emissions?*, *in* FISCAL POLICY TO MITIGATE CLIMATE CHANGE: A GUIDE FOR POLICYMAKERS 1, 16–17 (Michael Keen ed., 2012) (noting that costs are passed to consumers and that households with the lowest incomes spend more of their income on essentials like energy and fuel, so these costs need to be considered when measuring the effectiveness of carbon pricing against other policy instruments).

115. Pizer & Sexton, *supra* note 14, at 106 (citations omitted) ("Energy taxes [which includes permit trading programs] are commonly assumed to be regressive, burdening the poor more than the rich."). *See, e.g.*, N. Gregory Mankiw, *Smart Taxes: An Open Invitation to Join the Pigou Club*, 35 E. ECON. J. 14, 22 (2009) (citing the "common fear" that carbon and gasoline taxes "will fall disproportionately on the poor").

116. Lawrence H. Goulder, *Climate Change Policy's Interactions with the Tax System*, 40 ENERGY ECON. S3, S4 (2013).

117. Pizer & Sexton, *supra* note 14, at 106.

118. *Id.* (citing *Consumer Expenditure Surveys*, BUREAU OF LAB. STATS. (2014), https://www.bls.gov/cex [https://perma.cc/P58W-UZY7]).

119. *Id.* at 106–07.

the lights on, running appliances, and fueling cars.[120] Compounding the problem is the reality that people of limited means are more likely to own older, less energy-efficient appliances and automobiles,[121] and they lack the discretionary income and creditworthiness to purchase more efficient appliances and vehicles.[122]

A sampling of studies shows that carbon pricing will increase costs—and do so disproportionately for lower-income compared to higher-income households. For example, one recent study concluded that a $50-per-metric-ton carbon tax would claim 2.8 percent of the lowest decile's household expenditures but only 1.9 percent of the top decile's, meaning that increased costs (when measured as a share of expenditures) are about 50 percent more for the lowest compared to the highest decile.[123] The disparity is more pronounced when annual income is considered and households are divided into deciles rather than quintiles. For example, one 2011 article found that a $15-per-ton tax, if all costs are passed to consumers, would be "quite regressive" because the "lowest income decile pays a tax of nearly 4% of their annual income while the top decile pays a tax

120. Xavier Labandeira, José M. Labeaga & Xirol López-Otero, *A Meta-Analysis on the Price Elasticity of Energy Demand*, 102 ENERGY POL'Y 549, 556 (2017) (performing regression analysis on meta-analysis of energy policies to conclude that energy products are price inelastic so that there is less than a proportional reduction in their demand in the short and long term); *see* Pizer & Sexton, *supra* note 14, at 109–10 (writing that transportation fuel taxes are regressive in the United States compared with other nations because people with lower incomes are more likely to own cars and to commute long distances to work).

121. Pizer & Sexton, *supra* note 14, at 106.

122. Francesco Vona, *Managing the Distributional Effects of Climate Policies: A Narrow Path to a Just Transition*, 205 ECOLOGICAL ECON. 1, 4 (2023) (writing that consumers respond to an increase in the price of carbon-intensive goods by switching to cleaner inputs, like scraping old equipment and purchasing, but that it is difficult for low-income persons to do so because of financial constraints and a lack of credit). Moreover, lower-income persons are more likely to be renters than homeowners, and renters are significantly less likely to have energy-efficient appliances than homeowners, in part because landlords have little incentive to upgrade appliances if renters pay the electricity bill. Lucas W. Davis, *Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to have Energy Efficient Appliances?*, *in* DESIGN AND IMPLEMENTATION OF US CLIMATE POLICY, *supra* note 84, at 301, *passim*.

123. Fremstad & Paul, *supra* note 110, at 92. The disparity was similar though the effect less for a $20 tax, which would lead to a 0.8 percent reduction of pre-tax income for the lowest quintile but only a 0.3 percent reduction for the highest quintile. MARRON, TODER & AUSTIN, *supra* note 69, at 15.

of less than 1%."[124] The results would be similar under a cap-and-trade program with fully auctioned permits where all costs are passed to consumers.[125]

Another concern specific to cap and trade is the distribution of benefits to the wealthy. When allocating emissions permits, the government can auction them, give them away for free (also called "grandfathering" when they are given to existing GHG emitters), or do a combination of the two.[126] Grandfathering of emissions permits "gives a scarcity rent to wealthy individuals who own those firms."[127] This leads to distributive injustice because grandfathered permits "create windfall gains for shareholders, who tend to be relatively wealthy; firms receive emissions permits for free and the market value of the permits is reflected in higher firm equity values."[128] Moreover, grandfathered permits can lead to windfall profits for firms that do not sell their permits on the market but nevertheless pass costs along to consumers.[129] One economic study of grandfathered emissions permits under a cap-and-trade scheme

124. Metcalf, *supra* note 6, at 404. The same author in an earlier article had calculated similar effects of a $15 carbon tax, with the lowest income decile facing a 3.4 percent reduction in income while the highest decile faced only a 0.8 percent reduction. Gilbert E. Metcalf, *Designing a Carbon Tax to Reduce U.S. Greenhouse Gas Emissions*, 3 REV. ENV'T ECON. & POL'Y 63, 71 (2009). A 2011 study found that a $30 carbon tax would increase the burden of output prices on the lowest income decile by 3.4 percent compared with only 0.18 percent for the highest decile, plus the results were monotonic across all income deciles. Dan Fullerton, Garth Heutel & Gilbert E. Metcalf, *Does the Indexing of Government Transfers Make Carbon Pricing Progressive?*, 94 AM. J. AG. ECON. 347, 351 (2011). The authors also claimed that their results were consistent with two prior studies, one of a carbon tax and the other of cap and trade. *Id.* (citing Kevin A. Hassett, Aparna Mathur & Gilbert E. Metcalf, *The Incidence of a U.S. Carbon Tax: A Lifetime and Regional Analysis*, 30 ENERGY J. 155 (2009); Dallas Burtraw, Richard Sweeney & Margaret Walls, *The Incidence of U.S. Climate Policy: Alternative Uses of Revenues from a Cap-and-Trade Auction*, 62 NAT'L TAX J. 497 (2009)).

125. *See* Corbett A. Grainger & Charles D. Kolstad, *Who Pays a Price on Carbon?*, 46 ENV'T RES. ECON. 359, 360, 367–68 (2010) (finding that the lowest-income quintile would pay about 3.2 times more than the highest-income quintile under a $15-per-ton carbon tax and claiming that the results would be equivalent under a cap-and-trade program).

126. *See* Metcalf, *supra* note 27, at 12 ("The government can issue the permits for free to regulated firms or other entities (for example, like state governments), auction the permits, or use some combination of free distribution and auctions.").

127. Vona, *supra* note 122, at 3.

128. Ian W.H. Parry, *Are Emissions Permits Regressive?*, 47 J. ENV'T ECON. & MGMT. 364, 365 (2004).

129. Lucas, *supra* note 16, at 8–9 (citing MICHAEL J. GRAETZ, THE END OF ENERGY: THE UNMAKING OF AMERICA'S ENVIRONMENT, SECURITY, AND INDEPENDENCE 236–37 (2011)).

found that the lowest income quintile would be worse off by $353 to $524 per year (costing 4.2 percent to 6.2 percent of their income) while the top quintile would be better off by $525 to $1,243 per year (adding 0.5 percent to 1.2 percent to their income) because the increased value of stockholdings compensates for any increase in energy prices.[130] Further, revenue recycling might actually make cap-and-trade programs more regressive, as was shown by one study of a 10 percent emissions reduction, which found that the highest income quintile made a net gain while the lowest quintile suffered a loss.[131] In short, "[g]randfathered permits enact an income transfer towards higher-income groups at the expense of other households."[132] While carbon pricing has the potential to be regressive, a more complete survey of economic studies undermines any conclusion that carbon pricing necessarily makes for an unjust transition. This survey is taken up in the next Part.

III. THE DISTRIBUTIVE JUSTICE IMPLICATIONS OF CLIMATE CHANGE LAWS: A SURVEY OF ECONOMIC STUDIES

A fuller picture of the impact of carbon pricing begins by considering the distribution of costs and benefits under the alternative, non-pricing approaches to climate change. All environmental regulation increases firms' compliance costs, and those costs are passed to consumers,[133] but without the benefit

130. Terry Dinan & Diane Lim Rogers, *Distributional Effects of Carbon Allowance Trading: How Government Decisions Determine Winners and Losers*, 55 NAT'L TAX J. 199, 212–15 tbl. 6 (2002). Another study found that grandfathered permits in a hypothetical cap-and-trade program that imposed a 10 percent emissions reduction were "highly regressive," with the top income quintile better off "while the bottom income quintile [was] much worse off." Parry, *supra* note 128, at 366. Specifically, the program cost to the top quintile was $36 (an initial burden of $406 offset by profit income of $370) while the cost to the bottom quintile was $82 (an initial burden of $106 offset by profit income of $24). *Id.* at 377–78.

131. Parry, *supra* note 128, at 377–78 (noting that the differences depend on whether revenues are recycled lump sum or proportionally).

132. *Id.* at 365; *see* Hepburn, *supra* note 70, at 237 (characterizing grandfathered permits as "a regressive instrument, transferring wealth from poor to rich").

133. *See* Tracey M. Roberts, *Mitigating the Distributional Impacts of Climate Policy*, 67 WASH. & LEE L. REV. 209, 219–21 (2010) (claiming that firms pass the costs of complying with design and performance standards on to consumers); Antonio M. Bento, *Equity Impacts of Environmental Policy*, 5 ANN. REV. RES. ECON. 181, 183 (2013) (writing that the literature on the increased costs of environmental regulation goes back to the 1970s and the Clean Air Act Amendments); *see also*

of revenue to offset the impact on the low-income households. Accordingly, as Section I explains, economists have found that efficiency standards and RPS are more regressive than carbon pricing. Further, as Section I also explains, even if subsidies and tax expenditures do not impose direct costs on low-income households, economists have nevertheless found them unjust because they disproportionately benefit high-income households.

The picture comes into sharper detail through an expanded survey of economics scholarship. As discussed below, several studies have addressed factors that reduce carbon pricing's overall cost burden on low-income households and, thus, its regressivity.[134] Moreover, economists have shown that a carbon tax or a cap-and-trade program with auctioned permits can be structured to recycle revenues in a way that makes carbon pricing progressive, namely through lump-sum rebates.[135] Indeed, many of the economists cited above who found a disproportionate impact on low-income households actually advocate for carbon pricing because of the potential benefit to those households from revenue recycling.[136] Of course, lawmakers need to balance distributional concerns against the impact that carbon pricing will have on the economy, which is best mitigated by using revenues to reduce other taxes (in particular those on capital) but which may also be regressive. As this Part reveals, however, a hybrid approach of capital tax reductions coupled with targeted rebates allows carbon pricing to have a minimal economic impact while fostering a just transition.

Stephen Kim Park, *Legal Strategy Disrupted: Managing Climate Change and Regulatory Transformation*, 58 AM. BUS. L.J. 711, 726–27 (2021) (writing that firms may incur "substantial or even catastrophic losses due to compliance with regulation" enacted to address climate change).

134. *See* Vona, *supra* note 122, at 2–3 ("A voluminous empirical and theoretical literature finds that the spending effect of climate policies is regressive as the share of energy consumption (a necessity) decreases with income. However, since energy represents a small share of total consumption and since some behavioural adjustments are cheap to implement, empirical research finds that the regressive effect of carbon and energy taxation is quite modest.").

135. Williams, *Environmental Taxation*, *supra* note 84, at 66 ("[T]he use of the carbon tax revenue is more important than the effect of the carbon tax itself in determining the overall distributional effect of the policy.").

136. *See, e.g.*, Dinan & Rogers, *supra* note 130, at 212–13, 213 tbl. 6 (finding that cap and trade with auctioned permits and lump-sum rebates is progressive); Fremstad & Paul, *supra* note 110, at 90, 93 tbl. 2 (finding that returning revenue as lump-sum rebates is both vertically and horizontally equitable).

A. *The Added Costs and Regressivity of Non-Pricing Climate Laws*

The first step in overcoming opposition to carbon pricing is considering whether non-pricing alternatives will lead to a more just transition to clean energy alternatives. After all, as discussed in Part I, to the extent that U.S. lawmakers have addressed the energy transition, they have done so almost exclusively through non-pricing mechanisms. This means that the distribution of their costs and benefits can be, and has been, studied by economists. Accordingly, this Section surveys economic studies on efficiency standards, RPS, subsidies, and tax expenditures to show that they are distributionally unjust; thus, they are no more progressive—and may even be more regressive—than carbon pricing.[137]

1. Performance Standards Increase Costs Disproportionately on Low-Income Households

Consider the federal CAFE standards, which are average vehicle fuel efficiency standards mandated by the federal government: one recent study characterized these as an implicit subsidy for fuel-efficient vehicles and an implicit tax on fuel-inefficient vehicles.[138] When both new and used vehicles are considered, the study's authors found the standards to be mildly regressive.[139] Further, they found that a carbon tax that recycles revenues would be more progressive than the CAFE standards.[140] Another study modeled an inefficiency tax that is revenue equivalent to CAFE standards and compared it to a proposed carbon fuel tax of $0.29 per gallon.[141] The study found that efficiency standards have a greater impact on low-income households because those with high incomes already purchased more fuel-efficient vehicles (when controlling for car size and

137. *See* Deryugina et al., *supra* note 14, at S1–S2 (writing that a "key theme that emerges" in studies on "the distributional properties" of fuel efficiency standards, EV subsidies, RPS, and building energy codes is that these "standards are not progressive, nor even less regressive than a carbon tax").

138. Lucas W. Davis & Christopher R. Knittel, *Are Fuel Economy Standards Regressive?*, 6 J. ASS'N ENV'T & RES. ECON. S37, S38 (2019).

139. *Id. See* Jacobsen, *supra* note 103, at 182 ("[I]ncreased prices and changes in fleet composition for used cars [due to CAFE standards] lead to larger proportional welfare losses for low-income households.").

140. Davis & Knittel, *supra* note 138, at S38–S39.

141. Levinson, *supra* note 9, at S8–S9.

engine power), but a fuel tax affects high-income households more because they consume more fuel, so the tax would be less regressive than efficiency standards.[142] One economist expects that zero-emission vehicle ("ZEV") mandates—such as the California law that requires manufacturers to sell a certain percentage of ZEVs—will have the same regressive impact as fuel economy standards.[143]

This same reasoning applies to housing and appliance efficiency standards: high-income individuals already purchase more efficient homes and appliances and use more energy than low-income individuals.[144] Mandating efficiency standards like double-paned glass or Energy Star appliances would therefore fall more heavily on low-income households.[145] Another study looked at home characteristics before and after California introduced building energy codes.[146] The authors found that these codes resulted in lower-income households having fewer square feet and bedrooms and lower home values, while higher-income households had very small distortions in square footage and bedrooms and overall increased home values.[147] Moreover, these regressive standards did not result in a proportional reduction in emissions: energy use on a per-square-foot basis actually increased for the lowest-income quintile, likely because some energy demand (like the electricity needed to run appliances) is independent of home size.[148]

The majority of states have adopted another performance standard—namely, RPS. RPS mandates that a minimum share of electricity be generated from renewable sources, which can cost more than fossil fuels.[149] These more expensive inputs

142. *See generally id.* at S9.

143. Lori Snyder Bennear, *Energy Justice, Decarbonization, and the Clean Energy Transformation*, 14 ANN. REV. RES. ECON. 647, 657 (2022).

144. Levinson, *supra* note 9, at S31–S32 (listing seven different household energy efficiency features and showing that the average income of households that own them was significantly higher than those that do not).

145. *Id.* at S32.

146. Chris Bruegge, Tatyana Deryugina & Erica Myers, *The Distributional Effects of Building Energy Codes*, 6 J. ASS'N ENV'T & RES. ECONOMISTS S95, S96 (2019).

147. *Id.* at S99.

148. *Id.* at S98.

149. Borenstein, *supra* note 89, at 72 (writing that the "cost of generation, cost of transmitting the power to where demand is, and the value of the power generated" are "significant barriers" to wind, solar, and biomass); *see id.* at 71–72 (summarizing the results of different studies to show that levelized costs for coal and natural gas production are low, onshore wind is comparable, and solar is far

translate into higher prices for consumers: one study comparing prices for utilities subject to RPS to those not subject to it found that residential electricity prices were 3 percent higher for RPS utilities.[150] The author also noted that a higher percentage of required renewables under RPS would likely not affect prices, but she cautioned that the average RPS requirement in her study was quite low (with a mean of 7.1 percent and a median of 5 percent).[151] This is important because other studies have found that increasing the share of renewables results in a dramatic, nonlinear price increase, from roughly flat with 5 percent and 10 percent shares of mandated renewable sources to a 2.1 percent price increase for a 15 percent share—but to an 8.5 percent price increase for a 20 percent share.[152] As discussed above, many state RPS laws require ever-increasing shares of power be generated by renewables,[153] so a concomitant and dramatic rise in prices would likely have a disproportionate effect on low-income households since energy makes up a larger share of their budget. This result has been shown in studies that have modeled hypothetical federal RPS mandates. For example, a federal RPS that started at a 20 percent share and increased in stringency would cost the lowest-income households over twice as much a proportion of their income as the highest income.[154] In another study where the RPS share started at 20 percent in 2020 and increased in stringency each decade, the result was also regressive, with households earning below $100,000 incurring proportionally more costs than households earning above $100,000.[155] These two studies found that federal

more expensive); *id.* at 73 (noting that connection costs for wind are usually not included in levelized cost estimates).

150. Constant I. Tra, *Have Renewable Portfolio Standards Raised Electricity Rates? Evidence from U.S. Electric Utilities*, 34 CONTEMP. ECON. POL'Y 184, 187–88 (2015).

151. *Id.* at 188–89.

152. Palmer & Burtraw, *supra* note 106, at 882; *see* Carolyn Fischer, *Renewable Portfolio Standards: When Do They Lower Energy Prices?*, 31 ENERGY J. 101, 114–15 (2010) (finding an increasing rise in retail prices as RPS shares "enter the 10 to 20 percent range").

153. Lyon & Yin, *supra* note 36, at 133.

154. Sebastian Rausch & Michael Mowers, *Distributional and Efficiency Impact of Clean and Renewable Energy Standards for Electricity*, 36 RES. & ENERGY ECON. 556, 571, 573–74 (2014). A federal CES would be less regressive but lead to a higher price impact. *Id.*

155. Rausch & Karplus, *supra* note 107, at 215–16. The authors listed the costs to households but not the impact as a share of income or of consumption, but

cap-and-trade programs with lump-sum rebates, however, would not only be progressive but would also result in low-income households having a net gain.[156]

2. The Benefits of Subsidies and Tax Expenditures Flow Primarily to the Rich

While subsidies and tax expenditures may not result in higher costs to low-income households, they primarily benefit high-income households and therefore "exacerbate (rather than reduce) the regressivity of climate policies."[157] High-income households can take advantage of rebates because they have sufficient resources to co-finance investments in green technology, while low-income households suffer from financial constraints, including a lack of credit.[158] For example, wealthier households benefit more from subsidies to purchase new vehicles, thus rendering such subsidies regressive.[159] Likewise, homes with solar panels are more prevalent in higher-income neighborhoods.[160] This means that in a state like California, wealthier households have taken disproportionate advantage of state rebates for installation (which have since been phased out).[161]

Tax expenditures are also regressive since many lower-income households do not have any tax liability and therefore

households earning less than $10,000 annually would have $314 in increased costs while those earning more than $150,000 would have only $136. *Id.* at 216.

156. *Id.* at 216 (listing increases for households making less than $25,000 per year that ranged from $95 to $546); Rausch & Mowers, *supra* note 154, at 574 (listing, for two different cap-and-trade proposals, increases for households making less than $25,000 that ranged from 0.29 percent to 1.5 percent of annual income).

157. Vona, *supra* note 122, at 4.

158. *Id.* ("Green subsidies are often insufficient for low-income households to pass the income threshold above which the purchase is feasible, while high-income households have the resources to co-finance investments in green technology.").

159. Sarah E. West, *Distributional Effects of Alternative Vehicle Pollution Control Policies*, 88 J. PUB. ECON. 735, 752, 755 (2004).

160. *See* Samuel R. Dastrup et al., *Understanding the Solar Home Price Premium: Electricity Generation and "Green" Social Status*, 56 EUR. ECON. REV. 961, 965–66 (2012) (finding that the mean income for neighborhoods in San Diego with at least one solar panel system was almost $56,000 compared to about $30,000 for neighborhoods without one).

161. Borenstein, *supra* note 43, at S113 (finding in study of California that "the income distribution of solar PV installations remains heavily skewed toward the wealthy"); *id.* at S86 (writing that the California subsidy program ran from 2007 to 2013).

cannot claim credits.[162] For example, one study examined tax credits for residential energy efficiency improvement—such as for high-efficiency heating and cooling equipment and better windows, doors, and insulation—under the Energy Policy Act of 2005.[163] Its empirical evidence showed that the credits were vertically inequitable because lower-income, lower-tax liability taxpayers claimed fewer credits—and for lower amounts per credit claimed—than higher-income taxpayers.[164] Similar results were found in another study, which examined tax returns to determine who benefitted from nonrefundable environmental tax credits for weatherizing homes, installing solar panels, and purchasing hybrids and EVs.[165] The authors found that, on average, the bottom three income groups (those with an adjusted gross income of $40,000 or less) claimed only about 10 percent of the credits while households with an AGI above $75,000 received about 60 percent of them.[166] The most extreme example was tax credits for EV purchases, 90 percent of which went to the highest-income group.[167]

One benefit of expanding carbon pricing laws is that they can displace non-pricing laws—and thus their regressive effects. Commentators have argued that carbon pricing should be matched with the suspension, repeal, or preemption of other laws that target the same emissions.[168] The rationale is that an appropriate carbon tax rate or sufficiently stringent emissions cap will perform the same tasks as efficiency standards, RPS, subsidies, and tax expenditures (namely, reduce emissions and

162. Andre R. Neveu & Molly F. Sherlock, *An Evaluation of Tax Credits for Residential Energy Efficiency*, 42 E. ECON. J. 63, 66–69 (2016) (describing how far more households with low adjusted gross incomes have their tax liability eliminated before being able to claim energy efficiency tax credits). Higher-income households are also better able to claim home-related efficiency credits since they are more likely than lower-income households to own their homes. *Id.* at 66.

163. *Id.* at 63.

164. *Id.* at 66 (finding that 84 percent of the value of tax credits went to households making over $50,000, which account for only 40 percent of all households); *id.* at 67 tbl. 2 (breaking down households by income and showing that lower-income households claim far fewer credits compared to the number of returns filed and receive lower amounts per credit).

165. Borenstein & Davis, *supra* note 16, at 192, 194–200.

166. *Id.* at 192.

167. *Id.* at 202–09 (explaining the study and its results and providing graphics).

168. MARRON, TODER & AUSTIN, *supra* note 69, at 20; ADELE C. MORRIS, BROOKINGS INST., PROPOSAL 11: THE MANY BENEFITS OF A CARBON TAX 4 (2013); Lawrence H. Goulder & Robert N. Stavins, *Challenges from State-Federal Interactions in U.S. Climate Change Policy*, 101 AM. ECON. REV. PAPERS & PROC. 253, 255 (2011).

encourage the adoption of new technology) and do so at a lower overall cost.[169] An additional rationale suggested by this Section is that, since non-pricing policies are regressive, replacing them with carbon taxes or cap-and-trade programs may lead to less regressive effects[170]—or, as discussed in the next two Sections, may even be progressive.

B. Carbon Pricing Has Lower Costs and Regressivity than Commonly Assumed—and May Be Progressive

Without even considering whether and how revenues are recycled, economic studies have found that, contrary to "conventional wisdom," carbon pricing "may not have a disproportionate effect on poor households."[171] This Section lists some of the reasons why carbon pricing is not as regressive as assumed and why its costs are likely overstated: (1) firms (and ultimately consumers) can save on costs if carbon pricing displaces redundant command-and-control policies; (2) the regressivity of direct energy costs is mitigated by the neutral distribution of indirect costs; (3) both costs and regressivity are much lower when households are sorted by expenditures rather than annual income; and (4) rather than pass all costs to consumers as economic models often assume, firms (and the high-income households that own them) will absorb some of the costs. These four factors, combined with increased payments from government transfer programs that are indexed to inflation, reduce (or even eliminate) the cost burden on the lowest-income households and make carbon pricing potentially progressive.

169. MARRON, TODER & AUSTIN, *supra* note 69, at 19–20 (writing that a "sufficiently high and broad carbon tax would reduce the benefit" of other climate policies, so that they "may become redundant or impose more costs than benefits"); MORRIS, *supra* note 168, at 4 ("A price on carbon will lower GHG emissions and spur innovation in low-GHG technology, and, therefore, a carbon tax will make many other, less-efficient energy and environmental regulations unnecessary."); Stavins, *supra* note 2, at 69 (writing that, "if the complementary policies target CO_2 sources that are covered by a carbon pricing regime," then those policies "achieve[] no additional emission reductions" while "aggregate abatement costs are higher").

170. *See* Levinson, *supra* note 9, at S10 ("If efficiency standards are more regressive, then energy taxes would be both more efficient and more equitable."); *id.* at S35 (finding, for fuel efficiency standards, that "energy taxes are both more cost-effective and more progressive than efficiency standards" so that "[t]here is no efficiency-equity trade-off").

171. Pizer & Sexton, *supra* note 14, at 105.

The first reason why carbon pricing may lead to lower costs flows from the discussion in the previous Section, namely that carbon pricing can displace other laws, thereby saving the costs that those laws impose. While eliminating subsidies or tax credits saves the government money,[172] eliminating command-and-control regulations lowers the compliance costs of firms and (potentially) the amount they pass on to consumers.[173] A non-climate example is the federal cap-and-trade Acid Rain Program, which covered emissions that were also targeted by state-specific performance standards for sulfur dioxide.[174] These overlapping standards added $300 million in costs[175] because they prevented power companies "from exploiting the flexibility intrinsic to the cap-and-trade program."[176] Moreover, as lawmakers design new carbon pricing legislation, they should avoid saddling them with redundant and costly complementary laws.[177] For example, one study modeled a cap-and-trade program that would bring emissions down 50 percent below 2005 levels by the year 2050, and then contrasted it with various regulatory approaches like more stringent fuel economy standards, carbon capture and storage, and RPS.[178] The study found that, for roughly the same costs, cap and trade resulted in about four times more reductions than the command-and-control approaches.[179] Further, when cap and trade was combined with

172. MORRIS, *supra* note 168, at 4–5 (calculating that suspending or repealing federal laws like efficiency standards and tax expenditures for clean energy would save the federal government $6 billion annually).

173. *See* Stavins, *supra* note 2, at 70 (claiming that, because complementary policies impose different marginal abatement costs across sources, it is cheaper to abandon those complementary policies and achieve the same aggregate emissions by increasing the carbon tax rate).

174. Aldy, *supra* note 62, at 993 (citing Elaine F. Frey, *Technology Diffusion and Environmental Regulation: The Adoption of Scrubbers by Coal-Fired Power Plants*, 34 ENERGY J. 177, 178, 180 (2013) (claiming that firms covered by the sulfur dioxide (SO_2) cap-and-trade program had to invest in scrubbers that were required by state-specific performance standards for SO_2)).

175. Curtis Carlson et al., *Sulfur Dioxide Control by Electric Utilities: What Are the Gains from Trade?*, 108 J. POL. ECON. 1292, 1318–19 (2000) (finding that compliance in the SO_2 market resulted in $300 million more in costs than estimated in a least-cost compliance scenario).

176. Aldy, *supra* note 62, at 993.

177. Schmalensee & Stavins, *supra* note 65, at 73 (concluding that, in practice, command-and-control policies intended to complement cap-and-trade programs merely "address[] emissions under the cap, thereby relocating rather than reducing emissions, driving up abatement costs, and suppressing allowance prices").

178. Rausch & Karplus, *supra* note 107, at 205.

179. *Id.* at 206–07.

the command-and-control approaches, there was no improvement in reducing emissions even though costs doubled.[180]

Roughly half of U.S. carbon emissions relate to direct energy goods like electricity and gasoline while the other half are indirect: the energy inputs required to manufacture goods or provide services.[181] Some early studies found that low-income households are more affected by the direct impact of environmental taxes because energy makes up a larger share of their budget (compared to high-income households) than non-energy expenditures.[182] Accordingly, accounting for "indirect effects is likely to increase the perceived progressivity" of carbon pricing.[183] One study of a hypothetical U.S. carbon tax of $15 per ton found that the direct component of the tax was more regressive than the indirect—and that, in its early years, the indirect component was "mildly progressive."[184] The indirect component therefore partially offsets the regressivity of the direct burden so that, for the total burden, the highest and lowest deciles pay a more equal share.[185]

Basing calculations on household expenditures or consumption rather than annual income results in a lower burden from carbon pricing, both in terms of regressivity and

180. *Id.* at 205–07; *see* Carlson, *supra* note 58, *passim* (arguing that RPS is not a cost-effective complement to cap and trade).

181. *See* Williams, *Environmental Taxation*, *supra* note 84, at 26 ("Direct energy goods account for only about half of all carbon emissions in the US.").

182. Pizer & Sexton, *supra* note 14, at 111 (citing Dan Fullerton, *Why Have Separate Environmental Taxes?*, 10 TAX POL'Y & ECON. 33 (1996); Gilbert E. Metcalf, *A Distributional Analysis of Green Tax Reforms*, 52 NAT'L TAX J. 655 (1999)).

183. *Id.*; *see* Nicholas Bull, Kevin A. Hassett & Gilbert E. Metcalf, *Who Pays Broad-Based Energy Taxes? Computing Lifetime and Regional Incidence*, 15 ENERGY J. 145, 146, 161 (1994) (finding that direct impacts are regressive but that indirect effects are progressive, so the lifetime effect is "roughly flat when the total effect is taken into account"); Williams, *Environmental Taxation*, *supra* note 84, at 26 ("[T]he effects on the prices of other goods are spread much more evenly through the income distribution.").

184. Hassett, Mathur & Metcalf, *supra* note 124, at 156–57; *see id.* at 164 (reporting the incidence of indirect effects in 1987 as 0.51 percent for the bottom decile but 0.57 percent for the highest decile).

185. *Id.* at 164 tbls. 2, 3, 167. Another study that applied a $15 carbon tax likewise found that the indirect burden was roughly equal across deciles. Mathur & Morris, *supra* note 16, at 329–30 (characterizing the indirect burden as "roughly proportional between the top and bottom deciles," which were 0.61 percent and 0.69 percent, respectively).

actual cost.[186] Annual expenditures is a better proxy for lifetime (or permanent) income because households smooth their consumption over a lifetime.[187] Lifetime income in turn is a better measure of the burdens of carbon pricing than annual income, which includes individuals who are otherwise financially secure, such as many retirees or households that experience a temporary shock (like a period of unemployment or a health problem).[188] One study found that carbon taxes were more regressive when the authors sorted households by annual income rather than by consumption.[189] The lowest income decile faced a burden four times that of the highest decile under annual income, but the ratio shrank by half when the deciles were ranked by current consumption and by about two-thirds when ranked by lifetime consumption.[190] Other studies have likewise found that sorting households by expenditure rather than income makes the carbon tax burden "significantly less regressive."[191] Notably, not only did these studies find a smaller regressivity gap, but they also found that the added costs of carbon pricing (when considered as a fraction of income, expenditure, or consumption) were lower when households were sorted by expenditure or consumption.[192]

The percentage of increased costs that firms ultimately pass on to consumers may also be lower than assumed, thereby

186. *See* Pizer & Sexton, *supra* note 16, at 112 (explaining how calculations based "on annual income rather than annual consumption tend to exhibit greater regressivity of electricity, gasoline, and broad-based energy taxes").

187. Don Fullerton, *Six Distributional Effects of Environmental Policy*, 31 RISK ANALYSIS 923, 925 (2011).

188. Hassett, Mathur & Metcalf, *supra* note 124, at 157; Pizer & Sexton, *supra* note 14, at 112; *see* Bull, Hassett & Metcalf, *supra* note 183, at 148 (writing that failing to measure lifetime income creates "substantial measurement problems, particularly at the low end of the income distribution").

189. Hassett, Mathur & Metcalf, *supra* note 124, at 156–57.

190. *Id.* at 162–65, tbls.1–3. *See id.* at 167 (concluding that the regressivity of a carbon tax decreases when households are sorted based on lifetime-corrected consumption).

191. Fullerton, Heutel & Metcalf, *supra* note 124, at 352; *id.* at 351–52 tbls.1–2. *See* Mathur & Morris, *supra* note 16, at 328–29, 328 tbl.1, 330 tbl.2 (finding that the direct burden ratio decreases from 7.6 to less than 3 while the indirect burden decreases from 3.7 to about 1).

192. *See* Fullerton, Heutel & Metcalf, *supra* note 124, at 351–52 tbls.1-2 (finding a uses-side burden of 2.936 percent for the lowest-income decile but of 0.316 percent for the lowest-consumption decile); Hassett, Mathur & Metcalf, *supra* note 124, at 162 tbl.1, 164 tbl.3 (finding, for 2003, a total burden ratio of 3.74 for the lowest-income decile but of 1.16 for the lowest-consumption decile); Mathur & Morris, *supra* note 16, at 328 tbl.1, 330 tbl.2 (finding a total burden ratio of 3.54 for the lowest-income decile but of 2.14 for the lowest-consumption decile).

lowering the burden on low-income households and decreasing the regressivity of carbon pricing. One common assumption in economic models of carbon pricing is that firms will pass all increased costs to consumers.[193] In reality, much of the cost is shifted back to the factors of production, such as owners of natural resources and capital.[194] For example, one study found that about two-thirds to three-quarters of the costs of a carbon tax on crude oil would be passed on to consumers.[195] There is a similar result with indirect goods, with one study concluding that manufacturers in different industries pass on about 70 percent of the increased costs from an energy tax, which results in costs to consumers of intermediate goods being anywhere from 25 to 75 percent smaller than models of complete pass-through.[196] In addition, a carbon tax causes a drop in capital demand relative to the demand for labor because carbon-intensive goods are also capital-intensive in production, resulting in a decline in returns to capital and natural resource ownership.[197] Accordingly, a carbon tax might fall disproportionately on capital income and so be borne more by wealthy households since they own capital.[198]

These four factors combined with the indexing of government transfer programs are enough to make carbon

193. Metcalf, *supra* note 6, at 409 (discussing several economic studies that "assume that the burden of carbon pricing is shifted forward to consumers in the form of higher energy prices and higher prices of energy consumption intensive goods and services"); Williams, *Environmental Taxation*, *supra* note 84, at 26 (claiming that most studies of the distributional effects of carbon taxes "assume that the entire carbon tax is passed forward into product prices"); *see, e.g.*, Grainger & Kolstad, *supra* note 125, at 360 ("[W]e assume all costs are passed on to consumers, with workers and capital owners bearing none of the costs.").

194. Sebastian Rausch, Gilbert E. Metcalf & John M. Reilly, *Distributional Impacts of Carbon Pricing: A General Equilibrium Approach with Micro-Data for Households*, 33 ENERGY ECON. S20, S21 (2011) (citing Sebastian Rausch et al., *Distributional Impacts of a U.S. Greenhouse Gas Policy: A General Equilibrium Analysis of Carbon Pricing*, *in* U.S. ENERGY TAX POLICY 52 (Gilbert E. Metcalf ed. 2011)).

195. Gilbert E. Metcalf et al., *Analysis of U.S. Greenhouse Gas Tax Proposals* 20 (Nat'l Bureau of Econ. Rsch., Working Paper No. 13980, 2008).

196. Sharat Ganapati, Joseph S. Shapiro & Reed Walker, *Energy Cost Pass-Through in US Manufacturing: Estimates and Implications for Carbon Taxes*, 12 AM. ECON. J.: APPLIED ECON. 303, 304–05 (2020).

197. Pizer & Sexton, *supra* note 14, at 112; Williams, *Environmental Taxation*, *supra* note 84, at 27.

198. Williams, *Environmental Taxation*, *supra* note 84, at 27 ("Together, these effects cause the carbon tax to fall disproportionately on capital income relative to labor income, and capital income goes disproportionately to higher income people.").

pricing progressive[199]—and possibly eliminate the cost burden on the least financially secure households altogether. Government transfers like Social Security, state welfare payments, unemployment compensation, and veterans' benefits make up as much as 60 percent and 80 percent of the income for the two lowest income classes under the U.S. Regional Energy Policy model.[200] Many of these programs are indexed to inflation, so when carbon pricing causes prices to rise, recipients will automatically receive cost-of-living adjustments.[201] At a minimum, these adjustments will offset some of the cost of carbon pricing, and do so more for lower-income households.[202] Several studies have found that indexing goes even further. Three concluded that, without even considering how revenues will be recycled, the indexing of government transfers makes carbon pricing progressive.[203] In addition, another study

199. Julie Ann Cronin, Don Fullerton & Steven Sexton, *Vertical and Horizontal Redistributions from a Carbon Tax and Rebate*, 6 J. ASS'N ENV'T & RES. ECON. S169, S174 (2019) ("(1) [O]nce consumption is adopted as the measure of well-being, then a uniform consumption tax is not regressive but proportional; (2) as shown below, our calculated family total carbon consumption is not clearly concentrated in high or low consumption deciles, which, with the first point, makes a carbon tax nearly proportional; (3) transfers in the United States are indexed to correct for increases in consumer prices that accompany a carbon tax; and (4) transfers are a larger fraction of income for lower deciles."); Rausch et al., *supra* note 6, at 37 (finding that the burden on capital, which falls more heavily on the rich, combined with government transfers indexed to inflation makes a carbon tax progressive).

200. Sebastian Rausch et al., *supra* note 6, at 37–38, 38 tbl.8.

201. Fullerton, Heutel & Metcalf, *supra* note 124, at 347, 349–51 (writing that a realistic scenario is for only some transfer programs to be indexed to price increases related to carbon pricing but that these programs constitute the largest amounts of transfer, such as Social Security, Supplementary Security Income, and Workers' Compensation and Veterans' Benefits); Lawrence Goulder et al., *Impacts of a Carbon Tax Across U.S. Household Income Groups: What Are the Efficiency-Equity Trade-Offs?*, 175 J. PUB. ECON. 44, 60 (2019) ("Under current US policy, nearly all government transfers are indexed to inflation.").

202. *See* Dinan, *supra* note 69, at 123–26 (showing that the indexing of transfers with a $28-per-ton carbon tax lowers the cost burden on the bottom quintile from $425 to $385 and on the second-lowest quintile $555 to $505); Ian W.H. Parry & Roberton C. Williams III, *What Are the Costs of Meeting Distributional Objectives for Climate Policy?*, 10 B.E. J. ECON. ANALYSIS & POL'Y art. 9, 23 (2010) (finding that inflation indexing offsets one-seventh of the cost burden for the lowest income quintile but only one-eleventh of the cost burden for the highest).

203. Cronin, Fullerton & Sexton, *supra* note 199, at S189–90 (concluding that, even without revenue recycling, a carbon tax of $25-per-metric-ton of CO_2 would be progressive because of government transfers indexed to inflation); *id.* at S189 tbl.5 (showing that the cost burden on the three lowest consumption deciles drops by roughly half when accounting for the indexing of government transfers); Fullerton, Heutel & Metcalf, *supra* note 124, at 352, 352 tbl.5 (finding, for a carbon tax of $30 per ton, that the ratio of expenses to income decreased less than the average by

concluded that the indexing of transfers results in a net gain for the lowest-income households, so those households not only avoid the cost burden of carbon pricing but come out ahead (again, before even considering how additional revenues will be recycled).[204]

C. *Recycling Revenues to Balance Efficiency and Equity*

While the factors discussed in the previous Section lower the regressivity and cost burden of carbon pricing, overall costs are still likely to increase.[205] Further, even if the indexing of government transfers makes carbon pricing progressive *between* income or consumption classes, it heightens the disparity *within* those classes,[206] a horizontal inequity that "can loom much larger than vertical equity ones for environmental policy" since a third or more of low-income households receive no transfer payments.[207] Moreover, carbon pricing will have a negative impact on the broader economy, which can lead to lower employment and suppressed wages.[208] Yet it would be "seriously

0.034 with partial indexing and 0.060 with full indexing for the lowest expenditure decile, and that the results were progressive for the lower half of the expenditure distribution); Rausch et al., *supra* note 6, at 37, 40 (finding that cap and trade, even without revenue recycling, was "neutral to modestly progressive," assuming that government transfers are held constant).

204. Goulder et al., *supra* note 201, at 58, 60 (finding that, even in the absence of revenue recycling, the lowest income quintile has an increase in wealth of 0.35 because of the indexing of transfers).

205. *See, e.g.*, Krupnick & Parry, *supra* note 114, at 13 ("[T]he overall costs of carbon taxes, as well as cap-and-trade systems with allowance auctions, are likely to be positive.").

206. Fullerton, Heutel & Metcalf, *supra* note 124, at 352 (claiming that a significant portion of people with lower incomes "clearly lose" under carbon pricing even with the indexing of government transfers).

207. Carolyn Fischer & William A. Pizer, *Horizontal Equity Effects in Energy Regulation*, 6 J. ASS'N ENV'T & RES. ECONOMISTS S209, S215 (2019); *see* Cronin, Fullerton & Sexton, *supra* note 199, at S177 (reporting that only 32 percent of families in the lowest decile receive EITC benefits, 19 percent SNAP benefits, and 16 percent Social Security income); Dinan, *supra* note 69, at 125 (claiming that, for the lowest income quintile, 40 percent receive Social Security and 9 percent receive SSI); Fullerton, Heutel & Metcalf, *supra* note 124, at 352 (reporting that a third of the lowest consumption decile receive no transfer income).

208. Krupnick & Parry, *supra* note 114, at 13 ("[A]as carbon taxes and cap-and-trade systems drive up energy prices, they tend to contract (albeit very slightly) the overall level of economic activity, which in turn has a (slightly) depressing effect on employment and investment."); Pizer & Sexton, *supra* note 14, at 106 (claiming that there will be "a decline in wages relative to capital returns caused by capital-intensive pollution abatement").

misleading" to dwell on these impacts without also considering how revenues collected from carbon pricing will be spent.[209] The two recycling options that have received the most attention from economists are tax swaps (where other taxes that distort the economy, like those on capital, income, and payroll, are reduced) and lump-sum rebates to individuals or households.[210] In general, the two options involve a tradeoff: reducing taxes on capital has the best impact on the economy but may exacerbate regressivity since the wealthy benefit the most, while lump-sum rebates are progressive because they lead to a negative cost burden for the least well-off but do nothing to mitigate harm to the economy. These general observations are subject to numerous specific qualifiers, however, that blunt the extreme effects of either option. Accordingly, some economists recommend that lawmakers consider a hybrid approach of a carbon-for-capital tax swap plus rebates targeted toward the lowest-income households to balance efficiency and equity.

1. Preliminary Considerations: Generating and Directly Recycling Revenue

Before the government can recycle revenue by returning it in the form of reductions to other taxes or direct payments to households, carbon pricing must generate revenue. A carbon tax or a cap-and-trade program with fully auctioned permits allows the government to collect roughly equivalent amounts.[211] A cap-and-trade program where permits are grandfathered, however, would lead to much less revenue (namely corporate taxes from windfall profits).[212] One rationale in support of grandfathering

209. Rausch, Metcalf & Reilly, *supra* note 194, at S20 ("Analyses that focus solely on the impacts of carbon pricing without considering the use of revenues can lead to seriously misleading results.").

210. Timilsina, *supra* note 18, at 1470 ("The most common revenue recycling approaches discussed in the literature are lump-sum transfers to households and cutting existing taxes.").

211. Aldy et al., *supra* note 2, at 920 ("[T]hrough allowance auctions, cap-and-trade systems can generate comparable revenues to a tax."); Stavins, *supra* note 2, at 65 ("[B]oth pricing mechanisms can be nearly equivalent in their ability to raise revenue."); *see* Lawrence H. Goulder & Andrew Schein, *Carbon Taxes vs. Cap and Trade: A Critical Review*, 4 CLIMATE CHANGE ECON. 1, 12–16 (2013) (describing how permit auctions are subject to greater price volatility than a carbon tax but that policy features like intertemporal banking, borrowing of allowances, and price floors and ceilings can stabilize prices).

212. Dinan & Rogers, *supra* note 130, at 200.

is that earnings on existing capital in sectors affected by the cap will fall.[213] Researchers have found, however, that less than 15 percent of the allowance value is necessary to offset net losses in stock values.[214] Because grandfathering only a fraction of allowances addresses this concern, and because allocating more would overcompensate firms for their financial losses,[215] a cap-and-trade program should auction the "lion's share" of permits[216] to raise revenue and thereby avoid a regressive impact. For example, one study found that a cap-and-trade program with fully auctioned permits was not only "highly progressive" but that the bottom two income quintiles had a negative cost burden.[217] By contrast, grandfathering all permits "does nothing to offset the regressive effect of higher energy prices—in fact, the distribution of rent income is itself regressive" because "for better off households[,] capital is typically a larger share of their income."[218] Similarly, another study found that grandfathered permits were regressive but that auctioned permits combined with lump-sum rebates made the lowest income quintile better off by $294 and the highest quintile worse off by $1,661.[219]

Assuming that carbon pricing leads to revenue, the government could put that money to any number of uses. One possible use is funding the increased government transfer payments that was discussed in Section III.B since (1) this is

213. TERRY DINAN, TRADE-OFFS IN ALLOCATING ALLOWANCES FOR CO_2 EMISSIONS, CONG. BUDGET OFF. 5, 8 (Apr. 25, 2007); *id.* at 3 (citing Lawrence H. Goulder, *Mitigating the Adverse Impacts of CO_2 Abatement Policies on Energy-Intensive Industries* tbl.3 (Res. for the Future, Discussion Paper No. 02-22, Mar. 2002)).

214. *Id.* at 5.

215. Stavins, *supra* note 86, at 306–07.

216. Lawrence H. Goulder, Marc A.C. Hafstead & Michael Dworsky, *Impacts of Alternative Emissions Allowance Allocation Methods under a Federal Cap-and-Trade Program*, 60 J. ENV'T ECON. & MGMT. 161, 162 (2010). For example, one study recommended freely allocating 13 percent of permits to the fossil-fuel extraction sector in perpetuity. A. Lans Bovenberg & Lawrence H. Goulder, *Confronting Industry-Distributional Concerns in US Climate-Change Policy* 34 (Les Séminaires e l'IDDRI, Discussion Paper no. 6, 2003). Another economist found that an initial 50-50 allocation that moved to 100 percent auction over 25 years was equivalent in terms of present discounted value. Stavins, *supra* note 86, at 307.

217. Parry & Williams, *supra* note 202, at 23.

218. *Id.* at 26.

219. Dinan & Rogers, *supra* note 130, at 212–13, 213 tbl.6.

required by law,[220] and (2) without indexing, carbon pricing will likely be vertically regressive and impose a greater cost burden on low-income households.[221] One article estimates that funding increases in transfer payments will require less than a quarter of the revenue raised.[222] Another understandable use is for the government to keep a portion of the funds since its energy costs will rise just as they will for the private sector, which again requires only a fraction of revenue.[223] Other proposals for using the remaining revenues are climate-related, such as financing green development and adaptation projects in disadvantaged communities or funding technology or energy efficiency programs,[224] but others are not, like paying down debt, reducing the deficit, or initiating new spending on any number of programs.[225] In weighing the potential economic and distributional impacts of carbon pricing, however, economists have focused on two uses where revenues are returned directly

220. *See* Cronin, Fullerton & Sexton, *supra* note 199, at S187 n.34 ("Statutes require such indexing for SNAP, social security benefits, workers' compensation, and veteran's benefits.").

221. *See* Goulder et al., *supra* note 201, at 60 (considering a counterfactual where transfer programs are not indexed and finding that carbon pricing becomes regressive unless accompanied by lump-sum rebates).

222. *See* Cronin, Fullerton & Sexton, *supra* note 199, at S186–87 (assuming that the government would fund transfer payment increases with revenue from carbon pricing and claiming that the indexing would cost $23.6 billion for a carbon tax that raised $100 billion in revenue).

223. Boyce, *supra* note 9, at 253–54 (arguing that using a portion of carbon pricing revenue for public investment is justified since governments account for a substantial amount of GHG emissions); *see* JOSHUA BLONZ, DALLAS BURTRAW & MARGARET A. WALLS, CLIMATE POLICY'S UNCERTAIN OUTCOMES FOR HOUSEHOLDS: THE ROLE OF COMPLEX ALLOCATION SCHEMES IN CAP-AND-TRADE 2 (2010) (estimating that the government's increased energy costs would constitute 14 percent of the revenues collected under the 2009 Waxman-Markey bill).

224. Aldy et al., *supra* note 2, at 921 (listing revenue uses that include "funding technology programs, climate adaptation projects, [and] energy efficiency programs"); *see, e.g.*, Maxine Burkett, *Just Solutions to Climate Change: A Climate Justice Proposal for a Domestic Clean Development Mechanism*, 56 BUFF. L. REV. 169, 222–31 (2008) (proposing using auction revenues to finance green development and adaptation projects in disadvantaged communities); *see also* Metcalf & Weisbach, *supra* note 7, at 514 (proposing transitional assistance for coal workers displaced by carbon pricing).

225. *See* MARRON, TODER & AUSTIN, *supra* note 69, at 11 (listing revenue uses that include reducing the budget deficit and "new spending programs unrelated to offsetting the cost of the tax or promoting environmental objectives"); Dale Jorgenson et al., *Carbon Taxes and Fiscal Reform in the United States*, 68 NAT'L TAX J. 121, 122 (2015) (writing that carbon tax revenues could be used for "tax rate reductions, increases in expenditures, and decreases in government deficits").

to firms and individuals: reducing other distortionary taxes and paying lump-sum rebates.[226]

2. The Relative Merits and Detriments of Tax Swaps and Lump-Sum Rebates

Taxes like those on capital and personal income distort the economy by inducing "undesirable behavioral adjustments" that reduce investment or the supply of labor.[227] Introducing carbon pricing would add an additional distortion that lowers gross domestic product (GDP) and general household welfare.[228] Lump-sum rebates do nothing to address the distortions caused by other taxes.[229] Reducing those other taxes by the amount of revenues raised from a carbon tax or permit auction, however, would mitigate the economic impact of carbon pricing.[230] Economists have concluded that reducing income taxes, in particular those on capital and corporate income, is most beneficial for the economy.[231] Though results differ based on the

226. Jorgenson et al., *supra* note 225, at 126–27 (charting how using carbon tax revenue that is used to increase government spending, reduce debt, or reduce the deficit causes significant losses for U.S. gross domestic product while using the revenue to reduce other taxes can result in far less loss or even gains); *see, e.g.*, Fremstad & Paul, *supra* note 110, at 89 ("[T]the distributional literature focuses on devoting carbon tax revenue to three purposes: cutting taxes on capital income, cutting taxes on labor income, and rebating revenues in equal carbon dividends."); *see also* MORRIS, *supra* note 168, at 6 ("In no case should the revenue be used to directly offset higher energy prices to consumers because that would blunt the incentive to conserve energy and would undermine the environmental performance of the tax.").

227. *See* Don Fullerton, Andrew Leicester & Stephen Smith, *Environmental Taxes* 11 (Nat'l Bureau of Econ. Rsch., Working Paper No. 14197, 2008).

228. *See* Roberton C. Williams III & Casey J. Wichman, *Macroeconomic Effects of Carbon Taxes*, *in* IMPLEMENTING A US CARBON TAX: CHALLENGES AND DEBATES, *supra* note 55, at 83, 85 (writing that a carbon tax acts as an implicit tax on labor and capital and thus "leads to somewhat lower levels of GDP, employment, and other measures of economic activity"); Timilsina, *supra* note 18, at 1470–71 ("[W]hen a carbon tax is introduced to an economy where existing taxes, such as income taxes, have already created distortions in the factor markets, the carbon tax further exacerbates the distortions.").

229. *See* MARRON, TODER & AUSTIN, *supra* note 69, at 13 (observing that lump-sum rebates do not remove the distortions of other taxes).

230. Timilsina, *supra* note 18, at 1471 ("Revenues from the carbon tax can be used to partially reduce these marginal distortions (i.e., incremental distortions caused by the carbon tax) by recycling it to cut marginal rates of factor tax in a way that total government revenue remains neutral.").

231. MARRON, TODER & AUSTIN, *supra* note 69, at 13 (surveying economic studies and concluding that reducing tax rates on capital income, such as by

amount of carbon pricing, the time horizon considered, and whether welfare or GDP is measured, a number of articles have found that the economic harm with rebates will be about twice as much as with capital tax reductions[232]—if not ten times greater or even more.[233] Consider the findings of one 2015 study: for a carbon tax of $15 and of $25 per ton, capital tax reductions will cause average welfare losses in 2053 of only 0.1 percent and 0.25 percent of household wealth (or 0.15 percent and 0.3 percent with personal income tax reductions) while lump-sum rebates cause welfare losses of 0.6 percent and 0.9 percent.[234] Other economists have concluded that capital tax swaps can lead to a "double dividend," where carbon pricing not only reduces harmful GHGs but also leads to an increase in GDP.[235] Again, results depend on the amount of carbon pricing and the time

reducing tax rates on returns to investment or cutting corporate tax rates, does the most to offset the efficiency cost of carbon taxes on the economy) (citations omitted).

232. Goulder et al., *supra* note 201, at 51, 54–55, 55 tbl.8 (finding, for a $40-per-ton carbon tax that increases over time, that cuts for corporate income taxes result in GDP costs of 0.19 percent and household welfare costs of 0.06 percent while lump-sum rebates result in GDP costs of 0.28 percent and household welfare costs of 0.43 percent); Rausch et al., *supra* note 194, at S23, S25–26 (finding, for carbon tax or permit auction equivalent to $20 per ton of carbon, that average welfare costs in five-to-ten years are 0.18 percent of household income for income tax reduction but 0.46 percent for per-capita rebates); Martin T. Ross, *Regional Implications of National Carbon Taxes*, 9 CLIMATE CHANGE ECON. 1840008-1, 1840008-28 (2018) (finding, for the year 2030 and a $25 carbon tax, that average household welfare declines around 0.3 percent with lump-sum rebates but less than 0.15 percent with a reduction in capital tax rates); *see, e.g.*, LAWRENCE H. GOULDER & MARC A.C. HAFSTEAD, TAX REFORM AND ENVIRONMENTAL POLICY: OPTIONS FOR RECYCLING REVENUE FROM A TAX ON CARBON 5, 20 tbl.5 (Res. for the Future, Ctr. for Climate & Electricity Pol'y, 2013) (finding, for a $10-per-ton carbon tax rate that rises over time, that using revenues to cut the corporate tax rate reduces GDP in 2040 by only 0.24 percent compared with 0.33 percent for cutting personal income taxes and 0.56 percent for paying lump-sum rebates).

233. *See* Dale W. Jorgenson et al., *The Welfare Consequences of Taxing Carbon*, 9 CLIMATE CHANGE ECON. 1840013-1, 1840013-3, 1840013-37–38 (2018) (finding, for different carbon pricing scenarios from 2015 to 2050, a welfare loss per ton abated of $0.19 to $3.90 for capital tax reduction compared to $37.15 to $43.61 for lump-sum recycling).

234. Sugandha D. Tuladhar, W. David Montgomery & Noah Kaufman, *Environmental Policy for Fiscal Reform: Can a Carbon Tax Play a Role?*, 68 NAT'L TAX J. 179, 185–91, 189 fig.5 (2015); *see id.* at 181 (calling lump-sum rebates "the least efficient use of carbon tax revenue by a significant margin").

235. *See* MARRON, TODER & AUSTIN, *supra* note 69, at 14 box 4 (explaining the two dividends of a carbon tax as "reduc[ing] environmental damage by encouraging producers and consumers to cut back on activities that release greenhouse gases" and "improv[ing] economic efficiency by using the resulting revenue to reduce distortionary taxes, such as those on income or payroll" with a double dividend occurring when distortions of the carbon tax are less than the taxes it replaces).

horizon considered,[236] but one study provides a sense of the different outcomes of a capital tax swap compared to rebates: for carbon tax options ranging from $10 to $50 per ton, capital tax recycling results in a *gain* for real GDP by 2050 that ranges from $29 to $19 per ton abated, while lump-sum rebates lead to GDP *losses* that range from $115 to $182 per ton abated.[237] Notably, the long-term economic benefits of reducing taxes on capital are not limited to owners of capital but also extend to workers because returning money for capital investment also drives growth in employment and wages.[238]

When it comes to the distribution of costs, however, the better recycling method is lump-sum payments, with some of the same authors who preferred income or capital tax reductions on efficiency grounds finding that lump-sum rebates are the most progressive while tax reductions are the most regressive.[239] Although their findings depend upon the amount of tax and the time horizon considered, many economists have found that the lowest-income households actually see a net welfare gain with

236. Warwick J. McKibbin et al., *Carbon Taxes and U.S. Fiscal Reform*, 68 NAT'L TAX J. 139, 141, 150 (2015) (finding, for a carbon tax that starts at $15 per ton and rises annually, that a capital tax reduction results in a GDP that is above the baseline in the short term and 1 percent higher than the baseline in the long-term while a lump-sum rebate raises GDP slightly, but only in the short term); Parry & Williams, *supra* note 202, at 8, 27 (finding, for a hypothetical cap-and-trade program, that an income tax cut that is proportional across brackets results in a negative cost burden of $12 per ton of carbon); Ross, *supra* note 232, at 1840008-28 fig.16 (finding, for the year 2030 and a $25 carbon tax, that using revenue to cut capital income increases U.S. GDP slightly while lump-sum rebates decrease GDP by about 0.4 percent); CARBONE ET AL., *supra* note 99, at 7–8, 8 fig.1 (finding that using revenues from a $30 carbon tax to cut taxes on capital income leads to a 1.3 percent higher level of GDP by 2050 but that lump-sum rebates lead to a GDP that is 3.5 percent lower).

237. Jorgenson et al., *supra* note 225, at 126–27.

238. *See* MARRON, TODER & AUSTIN, *supra* note 69, at 13 (reducing tax rates on capital income "will increase living standards in the long run by raising the amount of capital per worker, thereby raising worker productivity and wages"); McKibbin et al., *supra* note 236, at 153 (writing that, if revenue from a $15-per-ton carbon tax that rises over time is used to reduce capital taxes, "investment rises, employment and wages rise, and overall GDP is significantly above baseline through year 25").

239. *See* Jorgenson et al., *supra* note 233, at 1840013-29–31, 1840013-37–38 (finding capital tax recycling the best for overall social welfare but regressive, while lump-sum redistributions are the worst for overall social welfare but progressive, with the lowest quintile receiving a net benefit under different carbon tax proposals); Parry & Williams, *supra* note 202, at 26 (finding "a clear tradeoff between efficiency and distribution" because cutting "marginal income tax rates is highly efficient, but leads to a regressive distribution of the net burden" while "the cap-and-dividend approach has a far higher overall cost, but leads to a highly progressive distribution").

lump-sum rebates, middle-income households break roughly even, and higher-income households incur a loss.[240] For example, one study that modeled a $50-per-ton carbon tax with lump-sum rebates found that, in the short term, the results were monotonic (consistently decreasing as income increases), with the lowest two expenditure deciles benefitting 5.06 percent and 2.63 percent, which shrinks to 0.62 percent and 0.18 percent for the two middle deciles, and then turns negative for the two highest deciles at -0.63 percent and -0.91 percent.[241] By contrast, the benefits of cuts to taxes on capital and income accrue to those who own capital and have higher incomes.[242] Accordingly, several studies have found that tax swaps that reduce income taxes, in particular taxes on capital, are regressive, with all but the highest-income households incurring a loss—and the lowest-income households being the hardest hit.[243] Consider one study that examined the initial incidence of

240. Joshua Blonz, Dallas Burtraw & Margaret A. Walls, *How Do the Costs of Climate Policy Affect Households? The Distribution of Impacts by Age, Income, and Region* 21–23, 23 tbl.5.1 (Res. for the Future, Discussion Paper No. 10-55, 2011) (finding, for a cap-and-trade program with an allowance price of $18.57 per ton, that paying 75 percent of revenues as dividends resulted in a short-term net benefit for the two lowest income quintiles (0.74 percent and 0.13 percent of income) and then burdens that increased with income (up to 0.60 percent for the highest quintile)); James K. Boyce & Matthew Riddle, *Cap and Dividend: How to Curb Global Warming While Protecting the Incomes of American Families* 10–11, 11 tbl.7 (Pol. Econ. Res. Inst., Working Paper No. 150, 2007) (finding that a cap-and-trade program with a $200 auction value and full rebates would result in a 24.0 percent net benefit for the lowest-expenditure decile and a 2.7 percent net loss for the highest); *see, e.g.*, Burtraw et al., *supra* note 124, at 497, 507–08, 508 fig.3 (finding, in the sixth year of a cap-and-trade program with an allowance price of $20.91 per ton, that lump-sum rebates resulted in a welfare gain of roughly 4 percent for the lowest income decile (and gains for the four lowest deciles), roughly flat in the middle deciles, and then welfare losses that increase with income); Goulder et al., *supra* note 201, at 51, 57 fig.6 (showing, for short-, medium- and long-term intervals with a $40-per-ton carbon tax that increases over time, that lump-sum rebates result in welfare gains for lowest expenditure quintiles, roughly flat results for the middle quintile, and welfare losses for the two highest quintiles).

241. Fremstad & Paul, *supra* note 110, at 90, 93 tbl.2.

242. *See* Goulder et al., *supra* note 201, at 57 ("[A] corporate income tax cut is especially beneficial to higher-income households on the source side."); *see also* Williams, *Environmental Taxation*, *supra* note 84, at 27 ("[C]apital income goes disproportionately to higher income people.").

243. Mathur & Morris, *supra* note 16, at 330, tbls.3–5 (finding, for carbon tax revenues used to reduce taxes on capital, labor, or on both capital and labor, that the top two or three income deciles have a net benefit while the lower deciles have a net burden); *see, e.g.*, Burtraw et al., *supra* note 124, at 497, 510–11, 511 fig.5 (finding, in the sixth year of a cap-and-trade program with an allowance price of $20.91 per ton, that equal income tax reductions across households resulted in an

a $30-per-ton carbon tax and found that lump-sum transfers make the bottom three income quintiles better off and the top two worse off while using carbon tax revenues to cut capital income taxes made the top quintile better off and bottom four worse off.[244] Further, the results were monotonic, with lump-sum rebates benefitting the lowest quintile the most (increasing income by 3.36 percent) and the highest quintile the least (costing them 1.93 percent of income), while capital tax recycling imposed increasing costs as income decreased (costing from 0.43 percent to 0.87 percent of income from the fourth highest to the bottom quintile).[245]

While lump-sum rebates are progressive in a vertical sense—more benefit for lower as compared to higher income or expenditure deciles—one article cautions that "focusing on averages across income groups obscures important variation within income groups that may swamp the variation in average effects across income groups."[246] Consider two studies that explore the horizontal equity of different revenue recycling options: despite widely different tax amounts ($50 versus $20 per ton) and lump-sum rebates ($413 versus $229) that result in different average amounts of gain for the two bottom deciles (as ranked by expenditure or consumption, not income),[247] both seem to reach the same conclusion: nearly every household in the two lowest consumption deciles benefits.[248] One of the

income loss of about 4.5 percent for the lowest income decile, with losses decreasing as income increased, but the top two deciles had an income gain).

244. Roberton C. Williams III et al., *The Initial Incidence of a Carbon Tax Across Income Groups*, 68 NAT'L TAX J. 195, 197–98, 206–07, 207 tbl.2 (2015).

245. *Id.* at 206, 207 tbl.2; *see* David Klenert & Linus Mattauch, *How to Make a Carbon Tax Reform Progressive: The Role of Subsistence Consumption*, 138 ECON. LTRS. 100, 101–03 (2016) (constructing a model that shows that uniform lump-sum rebates are progressive but linear income tax cuts are regressive). One article found that all of the recycling methods resulted in an overall burden, but that lump-sum rebates had the lowest burden on people with lower incomes and so was progressive. Rausch, Metcalf & Reilly, *supra* note 194, at S25–26.

246. Rausch, Metcalf & Reilly, *supra* note 194, at S27.

247. *Compare* Fremstad & Paul, *supra* note 110, at 92–93, 93 tbl.2 (finding a gain of 5.06 percent and 2.63 percent for the two lowest expenditure deciles), *with* Cronin, Fullerton & Sexton, *supra* note 199, at S186 n.32, S187, S192 tbl.7 (finding a gain of 2.59 percent and 1.86 percent for the two lowest consumption deciles).

248. *Compare* Fremstad & Paul, *supra* note 110, at 93 tbl.2 (finding that 98 percent of households in the lowest expenditure decile and 93 percent of households in the second-lowest decile benefit with a lump-sum dividend), *with* Cronin, Fullerton & Sexton, *supra* note 199, at S192 tbl.7 (finding that 100 percent of households in the lowest consumption decile and 99.7 percent of households in the second-lowest decile benefit).

studies, however, also measures the distribution of the *amount* of gain *within* those deciles: while the lowest decile has a tax cut that averages 2.59 percent of consumption, about a third of those households have a cut of only 2 percent, but roughly one-fifth of those households have a cut of 4 percent or more.[249] For the second-lowest decile, the majority of families have a 2 percent tax cut, but over a tenth have a cut of only 1 percent, while roughly a third have a cut of 3 percent or more.[250] The authors attribute the disparity to variations in family size: per capita rebates disproportionately benefit larger households in low-consumption deciles.[251]

Some economists have considered whether reducing taxes in a way that targets lower-income persons can achieve a middle ground of balancing economic and distributional impacts. For example, instead of reducing each marginal tax rate proportionally, larger reductions for lower tax brackets could result in a revenue-neutral distribution—or possibly a benefit for those in the lowest brackets.[252] Similarly, some economists have found that using carbon pricing revenue to reduce taxes on labor—such as those on payroll (Old Age, Survivor, and Disability Insurance), income taxes on employment, or both—results in a roughly flat distribution.[253] But these attempts at a compromise are not appealing because they result in a lower

249. Cronin, Fullerton & Sexton, *supra* note 199, at S192–S193, S194 fig.1(a).

250. *Id.* at S194 fig.1(a); Rausch, Metcalf & Reilly, *supra* note 194, at S26, S28 fig.9 (finding that lump-sum rebates result in about 17 percent of households in the bottom decile (and 12 percent in the second decile) suffering losses greater than 1 percent, which is far larger than the mean for these two deciles of about 0.4 percent or less); *see* Fischer & Pizer, *supra* note 207, at S227–29 (finding that a cap-and-trade program with lump-sum rebates resulted in one quarter of households within the lowest four deciles being worse off, in part because of variations in household electricity use).

251. Cronin, Fullerton & Sexton, *supra* note 199, at S193.

252. Parry & Williams, *supra* note 202, at 8, 25–26 (proposing to change marginal income tax rates by different amounts to equalize the net burden across all income quintiles and thus "exactly offset the regressive burden of higher energy prices"); David Klenert et al., *Environmental Taxation, Inequality and Engel's Law: The Double Dividend of Redistribution*, 71 ENV'T & RES. ECON. 605, 620–21 (2018) (modeling non-linear income tax reductions to show that lower-income quintiles have a net gain while upper-income quintiles a net loss).

253. *See, e.g.*, Williams et al., *supra* note 244, at 198, 207 tbl.2 (finding, for the first year of $30-per-ton carbon tax, that reducing payroll taxes results in a loss for all income quintiles, though the loss is modest as a percentage of income and roughly equal across quintiles); *see also* CARBONE ET AL., *supra* note 99, at 4 (defining labor tax reductions as targeting payroll and personal income taxes on labor).

GDP and are vertically and horizontally regressive. For example, while reducing capital taxes has the potential for a double dividend, cutting labor taxes results in a lower GDP (as well as mean household welfare).[254] Moreover, some economists have found that labor tax reductions are vertically regressive and leave the lowest-income households with an increased cost burden.[255] Finally, many low-income individuals do not work, such as retirees or the unemployed, so they are not covered by the tax system.[256] Cutting taxes for the employed, even if aided by increases in government transfers beyond indexing them for inflation, would be horizontally inequitable—and more so than lump-sum rebates.[257]

3. A Hybrid Approach: Capital Tax Reduction with Targeted Rebates

Several factors temper drawing the conclusion that recycling the revenue from carbon pricing either forces a choice between efficiency and equity or requires settling for an unappealing middle ground. Regarding economic impact,

254. *See* Jorgenson et al., *supra* note 225, at 125–27 (finding, for carbon tax amounts that range from $10 to $50 per ton, that the decline in GDP by 2050 with labor tax recycling ranges from $36 to $15 per ton abated); *see also* Williams et al., *supra* note 244, at 198, 204–05 (finding, for the first year of a $30-per-ton carbon tax, that mean household welfare decreases $291 under capital tax recycling but $407 under labor income tax recycling).

255. *See, e.g.*, Burtraw, Sweeney & Walls, *supra* note 124, at 497, 511–12, 512 fig.6 (finding, for the sixth year of a $20.91 emissions permit price, that a payroll tax cut was regressive, with slight gains for the top three income deciles but losses increasing as income decreases, with a 4 percent loss for the lowest decile); Fremstad & Paul, *supra* note 110, at 92–93, 93 tbl.2 (finding that a 1.8 percent labor income tax cut "effectively redistributes resources from low-income people to high-income people" while a 2.2 percent OASDI payroll tax reduction "cost[s] the mean person in the poorest decile 1.45 percent of expenditures" and "the mean person in the wealthiest decile nothing").

256. Goulder, *supra* note 116, at S8 (claiming that, even by focusing marginal tax cuts toward the households with lower incomes, it would be difficult to reach "many of the lowest-income households [that] are not part of the tax system").

257. Cronin, Fullerton & Sexton, *supra* note 199, at S194 fig.1(c), S197 tbl.9 (finding that devoting half of carbon tax revenue to a payroll tax reduction and half to Social Security benefits leads to a gain for only 31.6 percent households in the lowest consumption decile, with over two-thirds of those households incurring a cost burden of 1 percent or more); Fremstad & Paul, *supra* note 110, at 92–93, 93 tbl.2 (finding that only 40 percent of individuals in the bottom half of the expenditure distribution, and only 10 percent in the bottom decile, benefit from a labor tax cut, while 34 percent of individuals in the bottom half, and only 13 percent in the bottom decile, benefit from a payroll tax cut).

remember that study results vary depending on the amount of carbon pricing, so in general, the lower the price, the smaller the economic impact.[258] Plus, as the economy adjusts to the imposition of carbon pricing, the long-term economic impact may be relatively small,[259] which makes recycling revenues via lump-sum rebates more feasible.[260] Similarly, although the lowest-income households spend about 15 percent of their budget on electricity and fuel, the pre-recycling cost burden on them may be small in light of the efficiency gains from carbon pricing and the indexing of government transfers.[261] Finally, distributional studies tend not to consider the environmental benefits of carbon pricing, such as the reduction of harmful co-pollutants in disadvantaged neighborhoods that could lead to improved health and thus lower healthcare costs.[262]

Further, many of the same issues that lead to the cost burden and regressivity of carbon pricing being overstated (as

258. Williams & Wichman, *supra* note 228, at 88–89 (surveying several economic studies and noting that "[t]he higher the carbon tax rate, the more substantial the effect on the economy"). At very high prices, however, recycling options become less effective at mitigating the economic impact. *See* Jorgenson et al., *supra* note 225, at 126 ("As carbon tax policies become more aggressive, it becomes more difficult for any recycling option to insulate the economy from adverse effects.").

259. *See* Williams & Wichman, *supra* note 228, at 85–86 (citing GOULDER & HAFSTEAD, *supra* note 232) (explaining how a 0.6 percent reduction in GDP levels after 20 years of a $10-per-ton carbon tax equates to less than a 0.03 percent decline in average annual GDP growth rates, which means that the economy will be 55 percent higher than today without the carbon tax but 54 percent higher with it); Ross, *supra* note 232, at 22–23 (finding that the economy grows at 2.27 percent per year without a carbon tax and 2.25 percent per year with a $50-per-ton carbon tax, "leaving the economy in essentially the same position after 30 years of the carbon tax policy").

260. *See* Ross, *supra* note 232, at 23 tbl.2 (finding, after thirty years, that lump-sum rebates result in a U.S. GDP that is 0.26 percent below baseline for a $25 tax and 0.75 percent below baseline for a $50 tax).

261. Pizer & Sexton, *supra* note 14, at 106 (writing that U.S. households with the lowest incomes spend about 15 percent of their budget on energy and fuel); *id.* at 105 ("[D]istributional impacts—whether regressive or not—may be small enough to be far outweighed by the efficiency argument for energy taxes."); *see, e.g.*, Cronin, Fullerton & Sexton, *supra* note 199, at S189 tbl.5 (finding, before revenues are recycled, that a $20-per-ton carbon tax results in a burden of 0.45 percent and 0.54 percent for the two lowest consumption deciles when the indexing of government transfers is accounted for).

262. *See* Todd, *supra* note 61, Part III (surveying economic studies to conclude that cap-and-trade programs can lead to a reduction of harmful co-pollutants in low-income and minority communities); *see, e.g.*, Cronin, Fullerton & Sexton, *supra* note 199, at S174 (noting that their article "do[es] not account for the distribution of carbon policy benefits," such as "reductions in local pollution emissions"); Parry & Williams, *supra* note 202, at 17 (noting that their study does not estimate climate benefits from CO_2 reductions).

articulated in Section III.B) also result in the regressivity of tax swaps being overstated. For example, many studies classify households by annual income rather than expenditures or consumption, or they fail to account for the offsetting effect of sources-side impacts.[263] These factors can change results dramatically, as shown in one study that found that a proportional income tax cut, while regressive, becomes much less so when households are grouped by consumption (with a burden of about 1.2 percent for the lowest quintile and gain of about 0.3 percent of the highest) rather than income (with a burden of about 3.5 percent for the lowest quintile and gain of about 0.7 percent for the highest).[264] Many revenue-recycling studies also assume that all carbon pricing costs are passed forward to consumers, which one author concedes likely overstates the regressivity of the results.[265] Professor Robert N. Stavins, however, opines that the burden of the carbon price will fall more on capital, so lowering corporate tax rates would result in a progressive distribution (though admittedly not as progressive as rebates).[266] This opinion was backed by the findings in one recent article. Assuming the indexing of government transfers and sorting households by expenditure, the authors found that, in the short, medium, and long terms, reducing capital taxes resulted in a small net gain for the lowest quintile and a small net loss for the highest.[267] Finally, even if capital tax reductions do disproportionately benefit owners of capital in the short term, workers and consumers may benefit in

263. *See, e.g.*, Klenert & Mattauch, *supra* note 245, at 101 (excluding sources-side impacts from their model while acknowledging that those impacts are likely to be progressive); Mathur & Morris, *supra* note 16, at 328–30, 328 tbl.1, 330 tbl.2 (finding that sorting households by consumption results in a far less regressive distribution than sorting them by income, but then grouping households only by income for the remainder of their article on the distribution of tax swap options).

264. Parry & Williams, *supra* note 202, at 20–25, 21 fig.2(a), 24 fig.3(a).

265. *See* Metcalf, *supra* note 124, at 70 (conceding that an "assumption of complete forward shifting likely biases [the study's] results toward less progressivity than would occur with some backward shifting").

266. Stavins, *supra* note 2, at 66.

267. Goulder et al., *supra* note 201, at 57 fig.6. Other studies have found that, even if households with the lowest incomes do not see a net gain with reductions in capital or labor taxes, those reductions nevertheless lower their cost burden. *See, e.g.*, Mathur & Morris, *supra* note 16, at 333 (finding that capital, labor, and a combined capital-labor tax swap all reduce the cost burden of a $15 carbon tax on the two lowest deciles as a share of income).

the long term through higher wages and lower prices because of a stronger economy.[268]

The fact that economists have found that the revenue-recycling options do not lead to extreme differences aids lawmakers, who for political reasons are more likely to merge approaches than to choose only tax reductions or only rebates.[269] Several economists recognize that balancing efficiency and distributional concerns may require a hybrid recycling mechanism that reduces taxes (particularly on capital) while allocating some revenue toward rebates for those households that are most adversely affected by price increases.[270] For example, Professor Lawrence H. Goulder advocates "devot[ing] a portion of the gross revenues toward some form of a rebate to the neediest households (thereby addressing distributional concerns), while devoting another share toward cuts in marginal income tax rates (thereby achieving some of the benefits in terms of cost-effectiveness)."[271] In a later article, Professor Goulder and three co-authors model different tax swap options that include lump-sum rebates for the bottom two and three income quintiles.[272] They found that the former option with capital tax reductions results in a welfare gain for the lowest quintile and a neutral result for the second-lowest while only increasing the average welfare cost from $380.99 to $468.40.[273] Another factor

268. Williams et al., *supra* note 244, at 210 ("[T]he initial benefit of the capital tax cut goes to owners of capital, but over time as the capital stock grows, some of that benefit is passed through to workers and consumers in the form of higher wages and lower consumer prices.").

269. Beilei Cai, Trudy Ann Cameron & Geoffrey R. Gerdes, *Distributional Preferences and the Incidence of Costs and Benefits in Climate Change Policy*, 46 ENV'T & RES. ECON. 429, 432 (2010) (finding that a person's willingness to pay for climate change mitigation policies is higher when distributional concerns are addressed); Fischer & Pizer, *supra* note 207, at S234 (determining "how much to weight the equity penalty versus concerns about efficiency . . . is a question of ethical and societal preferences"); Parry & Williams, *supra* note 202, at 3 ("Policymakers are more likely to choose combinations of the bounding cases studied here, rather than using 100 percent of rents for one purpose alone.").

270. KRUPNICK & PARRY, *supra* note 114, at 18 ("[T]he ideal approach would be to start with a market-based instrument but provide the needed compensation to adversely affected groups.").

271. Goulder, *supra* note 116, at S9.

272. Goulder et al., *supra* note 201, at 59.

273. *Id.* at 59–60, 61 fig.9(a), 62 tbl.9. They also find that increasing rebates to make the middle quintile no worse off makes "the cost of compensation . . . an order of magnitude higher" at $1,222.72 average welfare cost, an increase of over 220 percent compared to capital tax cuts with no recycling. *Id.* at 59–60, 61 fig.9(b), 62 tbl.9.

is horizontal equity, which might be addressed by paying rebates per household rather than per capita or by scaling them to address consumption.[274] One final article is also noteworthy: for a $25-per-ton tax that increases 5 percent per year for twenty years, the authors found that a capital tax reduction that diverts roughly 10 percent of revenue toward rebates for the lowest-income-quintile households sacrifices only 4.7 percent or 6.5 percent (depending on the model) of the tax swaps' efficiency gains while neutralizing the impact on those households.[275] The authors modeled different hybrid scenarios to "show that various points on the efficiency-equity frontier are attainable" and concluded that "it is possible to protect low-income households with a modest share of revenues, while using the remainder of revenues on capital tax reductions."[276]

CONCLUSION

Carbon pricing, whether via carbon taxes or a cap-and-trade program, is more cost-effective than performance standards, RPS, subsidies, and tax expenditures for reducing GHG emissions and spurring the adoption of alternative energy sources. Carbon pricing has nevertheless played a limited role in U.S. climate policy, in part because of concerns about an unjust transition. This article surveyed economics scholarship to show several reasons why these concerns should not prevent the adoption of carbon pricing.

First, the United States currently relies on non-pricing policies that are themselves unjust: performance standards add costs that impose a disproportionate burden on low-income households while subsidies and tax expenditures primarily benefit high-income households. Carbon pricing can displace

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274. Cronin, Fullerton & Sexton, *supra* note 199, at S193 ("An alternative to per capita rebates could be the same rebate per family, or rebates that use equivalence scales to offset the burden measured in effective consumption for each person.").

275. Justin Caron et al., *Distributional Implications of a National CO_2 Tax in the U.S. Across Income Classes and Regions: A Multi-Model Overview*, 9 CLIMATE CHANGE ECON. Art. 180004–1, 4, 19–21 (2018). Also, the models show average consumption losses of $21 to $171 per year with capital tax reductions, but paying half of the revenues toward capital reductions and half as rebates results in a neutral (or even slightly progressive) distribution while the losses increase to $99 to $250. *Id.* at 4. *See* DINAN, *supra* note 69, at 121, 135 (finding that 12 percent of gross revenues from a $28-per-ton carbon tax could fully offset the impacts on the lowest income quintile).

276. Caron et al., *supra* note 275, at 25–26.

many of these laws and thereby eliminate their unjust impact. Second, the cost burden and regressivity of carbon pricing are overstated. As such, the impact on low-income households will likely be much lower than assumed—and might even be progressive thanks to the indexing of government transfers. Third, the ways in which revenues raised from carbon pricing are recycled play a vital role: lowering other distortionary taxes, like those on capital, while allocating some money for government transfer programs and lump-sum rebates to the lowest-income households can balance efficiency and equity.

Understanding that this balance is possible can increase the political viability of carbon pricing to form the foundation of a U.S. climate policy that fosters not only an effective, but also a just, transition.