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Carbon Pricing

Essential But Insufficient

by Alice Kaswan

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Introduction

With federal climate legislation once again part of the national conversation, the role of carbon pricing continues to be a hot-button issue.[1] Some bipartisan initiatives center on a federal carbon fee,[2] while the Green New Deal resolution[3] introduced in the House is silent on market mechanisms, reflecting continuing policy debates among the diverse groups engaged in the initiative. This issue brief explains how carbon pricing is necessary, and then argues that it is both practically and politically insufficient for achieving a clean energy transition.

The challenge is not simply reducing a single pollutant at the margins. To avoid catastrophic climate impacts, a profound transition to a clean energy economy and away from a fossil-fuel dependent one is necessary. Without a larger vision for a green transition, and without mechanisms for planning and coordination, a carbon price, on its own, is likely to lead to fragmented and potentially short-sighted decisions that could fail to accomplish an effective, efficient, and fair transition. Market prices cannot address the systemic implications of relinquishing fossil fuels. From a political perspective, carbon prices look threatening, no matter how much their promoters tout the economic and environmental benefits they could engender. Moreover, a price mechanism puts private entities, not the public, in the driver's seat for change. As a practical matter, it is hard to properly calibrate a market-based system because we are politically unlikely to set prices high enough to induce the necessary change (nor should we), and both cap-and-trade programs and carbon taxes are inherently uncertain.

Key Takeaways

1. Carbon pricing has a vital role to play in a clean energy transition, but the invisible hand of the market will not and should not be the primary driver.

2. Solely relying on market actors to make critical choices about the character, structure, and distribution of energy would fail to achieve a coherent, effective, and equitable clean energy system.

3. A one-dimensional carbon price optimizes carbon reductions but cannot optimize the multi-dimensional features of a clean energy transition.

4. Uneven responses to a market signal could fail to spur transformative change across all emitting sectors.

5. Relying too heavily on markets would undercut democratic governance by lessening the role of government institutions and the public in making key public policy decisions.

6. Policies and planning processes that generate a vision for a reliable and equitable clean energy transition are likely to be more politically feasible than carbon prices alone.

This is not to say that there is an "ideal" alternative; all policy options have their strengths and weaknesses, and a mix of policy options are our best bet. U.S. climate policy should include a carbon price that maintains a steady background signal for innovation and that generates the revenue needed for an equitable transition and increasingly urgent climate adaptation.

Overall, however, to the degree policymakers hope that a carbon price will provide the primary impetus for needed change, it is important to recognize that a carbon price should supplement the more deliberative and coordinated mechanisms that will be essential to achieving a democratically accountable, effective, and equitable transition.

A Few Words on Carbon Pricing

Carbon pricing can take a variety of forms. A carbon tax places a direct price on carbon. In contrast, under a cap-and-trade program, the government sets a long-term goal and interim yearly caps, and then distributes emission allowances equal to the cap. If the government distributes the allowances by means of an auction, then the auction price establishes the carbon price. If the government gives away allowances, then allowance trading among regulated entities establishes the carbon price. Each type of program, tax and cap-and-trade, can take a variety of forms and operate pursuant to a wide range of parameters. Because this essay focuses on carbon pricing writ large, I do not parse through the details here.

> Notwithstanding its limitations, carbon pricing has a vital role to play. A carbon price would help internalize the societal costs of emitting carbon dioxide, incentivize reductions, and generate revenue to invest in an equitable transition and prepare for climate impacts.

Notwithstanding the limitations I articulate below, I want to make clear that carbon pricing has a vital role to play. As pricing advocates have explained in detail,[4] a carbon price would help internalize the societal costs of emitting carbon dioxide and would create at least some ongoing incentive for producers and consumers to reduce carbon consumption.

A carbon price, particularly a carbon fee or auctioned allowances in a cap-and-trade program, would also generate revenue that would help finance a clean energy transition, finance climate adaptation, and, for disadvantaged communities, help buffer higher costs and enable participation in a green transition. Carbon pricing could also spur regulatory innovation, as government entities consider how they can help their constituents – across all sectors – better avoid the cost of carbon.

I pointedly exclude one frequently articulated advantage of market mechanisms: their relative cost-effectiveness.[5] In the short term, market mechanisms save costs by allowing entities facing high emission-reduction costs to either pay the tax or, in a cap-and-trade program, buy allowances from lower-cost reducers. Collectively, then, reductions are done by those who can do them most cheaply, lowering the cost of achieving a collective goal. However, the downside to this dynamic is that it gives high-cost reducers an out[6] – and could reduce the incentive to invest now in a long-term, economy-wide green transition. That brings us to the limitations of market mechanisms.

The Limitations of Market-Based Mechanisms

Markets Can Nudge, but They Can't Plan

As noted, a carbon price is likely to have positive incentives: for example, a price on carbon will dampen demand for high-carbon coal and make it less likely to be dispatched in price-based electricity markets. Similarly, a carbon price will increase the cost of transportation fuels, potentially increasing demand for efficient transportation and reducing the amount people drive.

These incentives, while positive, will not necessarily lead to the most efficient or effective path to a full-scale transition. For example, a modest carbon price could lead to investments in natural gas, locking in fossil fuels for decades to come. While shifting from reliance on coal to natural gas would reduce carbon emissions in the short-term, it could divert investments away from more sustainable alternatives. And, if we invest in natural gas now but then come to terms with its harm in a decade or two, well before the end of the power plants' useful lives, having to decommission plants early would lead to "stranded assets" and increase the overall cost of transitioning.[7]

> Relying on market actors to make critical choices about the character, structure, and distribution of energy would fail to achieve a coherent, effective, and equitable clean energy system.

Moreover, electricity sector investments require considerable coordination. Building transmission for new renewable generators will require extensive planning and coordination with multiple existing and potential generators and, in many cases, interstate coordination. Distributed generation, like rooftop solar, presents new challenges to utilities attempting to manage grid reliability. If and when transportation ends up transitioning from internal combustion to electricity, that will place new demands on the electricity sector and require a nationwide investment in charging infrastructure.

Thus, while a carbon price sends an important signal, it will not necessarily lead to the investments, like renewable energy and associated infrastructure, that are most essential to ultimate decarbonization. And a market price will not generate the utility and cross-sector planning essential to effectively develop and coordinate alternative resources.

One-Dimensional Policy for a Multi-Dimensional Challenge

A carbon price is designed to optimize reductions in a single pollutant: carbon – or, if designed to reduce greenhouse gases, in a single type of emissions. However, given the ubiquitous nature of carbon – and other greenhouse gas emissions – incentives to reduce carbon will have wide-ranging impacts on our energy and economic systems. Once the full range of factors is considered, the best way to reduce greenhouse gas emissions might not be the best way to transition to a green economy.

For example, if biofuels are considered carbon-neutral, a carbon price is likely to incentivize biofuel production and combustion.[8] However, the ultimate wisdom of transitioning from fossil fuels to biofuels depends on a wide variety of factors, including the impact of biofuel development on food production, fertilizer use, and ecological systems, as well as the impact of biofuel combustion on air quality. This is not to pass judgment on the ultimate role for biofuels; instead, the point is that a carbon price creates incentives based solely on carbon emissions, without considering all of the other factors that could determine the overall wisdom of biofuels as a fossil fuel substitute.

A one-dimensional carbon price optimizes carbon reductions but cannot optimize the multi-dimensional features of a clean energy transition.

Similarly, future pathways will have pervasive socioeconomic impacts that a carbon price ignores. As fossil fuel use declines, the workers and regions that depend on them will experience significant disruption. At the same time, decarbonization options will create new opportunities in a greener economy. A carbon price will incentivize the most cost-effective reduction opportunities for regulated entities, like power generators and refineries, but those opportunities will not necessarily foster wider socioeconomic benefits and minimize socioeconomic harms. In other words, what is cost-effective for affected industries will not necessarily be optimal in light of the full range of costs and benefits flowing from decarbonization choices.

A carbon price optimizes only carbon reductions, and so misses the wide range of other considerations relevant to a clean transition. A more coherent approach would optimize costs and benefits by integrating environmental and socioeconomic implications into the policymaking process.

Markets and Achieving a Pathway to a Clean Energy

Not surprisingly, consistent with our standard approach to pollution control, most climate policy proposals focus on the goal of reducing greenhouse gas emissions. While that is unquestionably the end game, confronting climate change will require transformation in all emitting sectors. The goal, then, is not just "reducing greenhouse gases," but transitioning to a clean economy. How we frame the goal affects our assessment of carbon pricing as a policy mechanism.

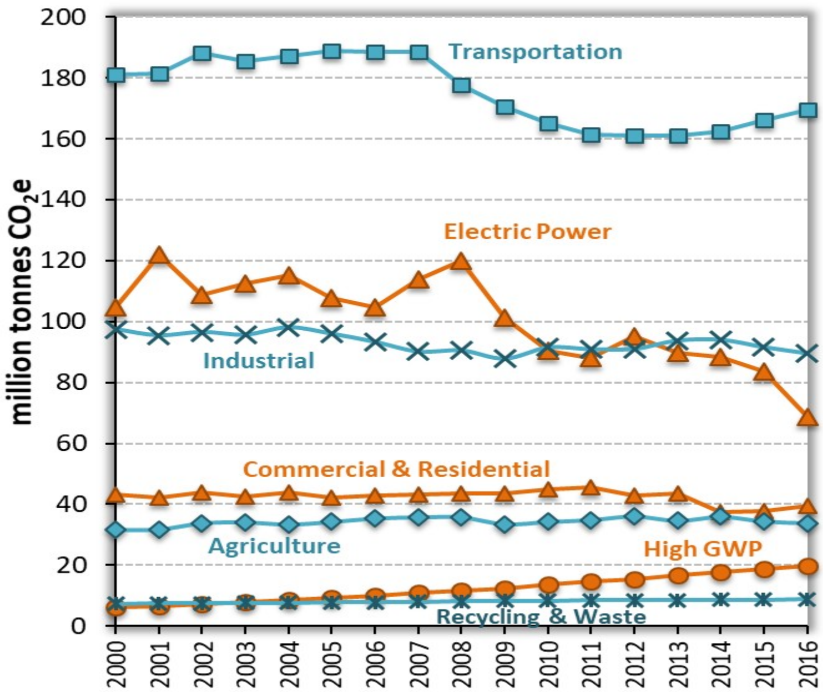
Carbon pricing does not dictate reductions; it lets regulated entities decide whether to reduce emissions or, instead, pay a carbon tax or purchase allowances or offsets. As a result, a carbon price does not ensure that change is occurring to the degree and in the sectors necessary for a transition to clean energy.

For example, in jurisdictions with comprehensive cap-and-trade programs, entities in some sectors might make the majority of the reductions, and entities in other sectors might disproportionately purchase allowances. In that case, even assuming the emissions cap is met, the allowance-purchasing sector would not be progressing toward decarbonization.

Uneven responses to a market signal could fail to spur transformative change across all emitting sectors.

This pattern may be playing out under California's cap-and-trade program. To date, most emissions reductions have occurred in the electricity and transportation sectors, driven, at least in part, by an increasingly stringent renewable portfolio standard, efficiency standards, and automobile sector requirements (although transportation emissions have recently increased). In contrast, industrial emissions have decreased quite modestly.[9] It is possible that industry is purchasing allowances, allowances that are readily available and inexpensive because the electricity and transportation sectors require disproportionately fewer allowances due to direct emission reduction requirements. As a consequence, the flexibility offered by a cap-and-trade program may be allowing industry to delay or avoid transitioning to clean technology. There may be legitimate concerns about pressuring industry, like the risk that expensive requirements would push industry out-of-state, resulting in economic harm with no environmental benefit. Nonetheless, an effective climate policy will need to take the measures necessary to prompt change in all sectors, whether through carrots or sticks, rather than accepting the status quo in certain sectors or industries.

Figure 1: Trends in California greenhouse gas emissions



Source: California Air Resources Board, California Greenhouse Gas Emissions for 2000 to 2016 (July 2018).

Moreover, some cap-and-trade programs allow regulated entities to cover their emissions with carbon offsets.[10] Assuming the validity and legitimacy of the offset, a utility or industrial facility using offsets would be properly accounting for its emissions, even if it did not directly reduce emissions. From a global carbon perspective, it is immaterial whether the regulated facility itself reduces its emissions or the offset-generating entity does so. In either case, the immediate emissions cap can, at least theoretically, be met. However, to the degree facilities, sectors, or nations rely on offsets, they are relying on others to reduce emissions, not transitioning themselves.

Market's Capacity to Manage Structural Change

Given utilities' structural incentives, a carbon price could fail to incentivize optimal results. For example, because most utilities depend on selling electricity to bring in revenue, utilities have an incentive to focus primarily on supply options, like low-carbon generation. They would be less likely to promote energy efficiency and other mechanisms to reduce consumer demand. A government role in requiring appliance and building efficiency, as well as other innovative demand management mechanisms,[11] could be necessary to counter utilities' institutional preference for supply-side options that maintain their revenue and business model.

And, going deeper, transitioning to clean electricity calls into question the structure of existing utilities and their regulation. Renewable energy and energy efficiency create new opportunities and possibilities for the structure of the electricity sector itself.[12] The existing system assumes centralized fossil-fuel combustion. Decentralized renewable energy, whether rooftop solar or community-based solar or wind generation, creates new opportunities. The role of utilities in the future of electricity, as well as the structure of utility regulation,[13] is contested and unclear. A carbon price, on its own, cannot address these institutional and regulatory issues.

The Price is Right – or Not?

Carbon prices in existing carbon cap-and-trade programs and carbon taxes have not been meaningless, but they have not been strong enough to induce necessary innovation. A recent economic analysis suggests that the carbon prices needed to meet the objectives of the Paris Agreement on Climate Change are in the range of $40 to $80 per ton of carbon dioxide by 2020, and $50 to $100 per ton by 2030.[14]

Carbon prices in existing cap-and-trade programs have not been strong enough to induce necessary innovation.

Most existing carbon pricing programs have fallen far short of that level. The European Union's Emissions Trading System has historically had very low prices, often under 10 euros (about $11) per ton, though prices increased into the low 20 euros per ton in 2018 and 2019.[15] Despite efforts to tighten allowance supply, allowance prices in the northeastern states' cap-and-trade program for electric utilities (the Regional Greenhouse Gas Initiative (RGGI) have been well under $10 per ton.[16] As of February 2019, the auction price for California allowances in its cap-and-trade program was just over $15 per ton.[17] These prices are unlikely to induce the necessary level of transformational innovation.

Canada's carbon pricing mechanisms are more ambitious. As of April 1, 2019, all provinces must have a carbon pricing mechanism. Provinces with preexisting mechanisms can continue their programs, while provinces without their own pricing programs are subject to a federal tax on oil, coal, and gas.[18] *The New York Times* reports that, in U.S. dollars, the current prices range from $15 to $30 per ton ($15/ton under the federal tax), and the price is expected to rise to $38/ton by 2022.[19]

Ultimately, it is not clear that injecting the high prices needed to spark innovation is politically feasible or desirable without substantial steps to address their socioeconomic consequences. The Canadian taxes address this concern by giving revenue back to residents and industries at risk of international competition. Even so, high taxes face intense political pressure. And, unless their impacts are addressed, they are regressive, affecting the poor, who pay a disproportionate share of their income on energy, more than the rich. Having a carbon price is important. But imposing an extreme price and forcing change through that price would be a risky and brutal mechanism for inducing the full measure of necessary change.

Endemic Uncertainty

Both a carbon tax and cap-and-trade create systemic uncertainties. With a carbon tax, on its own, only price is controlled, not emission reductions. Policy analysts can do their best to model the impacts of differing tax levels, but determining how a tax would affect actual emission levels will always be guesswork, subject to the vagaries of cost curves and demand. Policymakers could adjust the tax if it appears insufficient, but frequent adjustments would undermine the economic predictability considered one of a carbon tax's key virtues.

Carbon taxes generate uncertain carbon reductions, and cap-and-trade programs create uncertain carbon prices.

A cap-and-trade program provides more certain emission reductions, assuming the cap is met. But the transformative incentives created by the program are uncertain. If economic growth is strong and demand is high, then allowance demand and prices will be correspondingly high, creating strong incentives for low-carbon choices. But if economic growth is weak or decreasing, as was the case in the most recent recession, then emissions will be lower, and the cap could be met with little transformational effort.

Of course, more systematic measures to achieve a clean energy transition, including some level of planning for electricity, transportation, and land use shifts, do not guarantee results; the history of environmental law is a mixed bag, with great successes and its share of unmet goals. Nonetheless, deliberative planning and specific implementation measures could provide a structure for change that would be less uncertain than relying exclusively on a tax or a cap and then crossing ones fingers that the hoped-for transformation will occur.

Carbon Prices and the Political Process

Re-thinking Political Viability

For the last decade or two, some have considered market-based carbon policies as the "sweet spot" for climate policy, since environmentalists get emission reductions while industry gets an approach that is more flexible and considered more cost-effective than other reduction strategies. But, although some jurisdictions have been willing to adopt cap-and-trade programs, market-based programs may be less, not more, politically appealing than alternative mechanisms.

A carbon price is, after all, a "price." And while supporters may tout some of the ancillary benefits that accompany that price, like the promotion of cleaner renewable energy or new employment opportunities, those benefits stand behind the price tag; they are not front and center. In contrast, policies that focus on a larger vision, or a planning process for generating a larger vision, could be more politically appealing.

California adopted its comprehensive global warming act by setting a goal and then establishing a systematic planning process for achieving that goal. The state's multi-sector scoping plan integrates numerous laws and policies that, together, are designed to meet the state's multifaceted climate goals.[20] Although the state chose to include a cap-and-trade program as part of its overall plan, the trading program supplements a wide range of policies, including renewable energy requirements, energy efficiency programs, transportation measures, and agricultural measures. The cap-and-trade program has been one of the more controversial elements of the state's plan, facing opposition from environmental justice advocates as well as industry.[21] The political success of California's climate policies have thus rested on a wide range of visionary policies, not its cap-and-trade program.

Policies and planning processes that generate a vision for a reliable and equitable clean energy transition are likely to be more politically feasible than carbon prices alone.

Voters in Washington State have twice defeated carbon tax ballot measures, despite provisions to return value to ratepayers and assist low-income consumers.[22] In contrast, the legislature successfully passed a range of more substantive climate policies, including a 100 percent renewable energy goal and new standards for buildings and transportation.[23] In France, the widespread "yellow vest" protests against the central government were initially sparked by a national effort to impose a climate tax on gasoline.[24] Canada continues to move forward with an ambitious carbon tax, but the program appears to be prompting a political backlash, with politicians who supported the tax losing seats to those who oppose it.[25]

In economies dependent on fossil fuels, a carbon price presents a vague and threatening hit to standards of living, and a potentially devastating blow to those who are most dependent, like truck drivers, farmers, long-distance commuters, and others. Without carbon policies that provide a larger vision that helps citizens perceive a better future, and without demonstrating how those affected by the tax would cope, carbon prices, without more, are politically challenging.

Who Decides? Private versus Public Decision-Making

One of the purported advantages of market-based mechanisms is that they provide private entities with the flexibility and autonomy to make their own emission-reduction decisions. Though nudged by a carbon price, and, in the electricity context, subject to state utility commission oversight,[26] industries can decide when and how to reduce emissions and when and how to make new investments. Given industry and utility knowledge of their own business operations and their capacity to innovate, that flexibility has important policy advantages.

At the same time, however, market mechanisms lessen the role of government and citizens in decisions that will have enduring and widespread impacts. Decarbonization will bring significant risks and opportunities, as well as potential trade-offs, all on a scale that exceeds that of the average business decision. Complete reliance on market mechanisms that leave the key decisions to utilities, oil companies, auto companies, and emerging renewable energy companies risks short-changing deliberative debate and accountability.

Relying too heavily on markets would undercut democratic governance by lessening the role of government institutions and the public in making key public policy decisions.

The alternative to pure reliance on market mechanisms is not rigid "command and control." Policymakers can develop a portfolio of approaches that achieve specific goals and measures and push innovation in certain directions while still leaving room for flexibility and innovation. Policymakers might choose to meet certain specific goals, like greater reliance on distributed energy, and adopt specific rules furthering that form, like interconnection rules, net metering rules, and requirements or incentive programs for new buildings.[27] At the same time, policymakers could couple narrowly tailored programs with more general performance standards that encourage innovation, like requiring utilities to meet renewable portfolio standards and electricity storage requirements. Performance standards are more prescriptive than market mechanisms but still allow considerable flexibility.

Of course, we live in a market economy and recognize that markets, not just government institutions, can meet citizen preferences and needs. However, too much is at stake to rely solely on industry – even highly regulated industries like utilities – to make critical decisions about our clean energy transition. While some flexibility and room for innovation should remain an important component of transition policy, a role for public input – whether in legislative or administrative forums – would be more likely to serve the public interest than pure reliance on private actors in the marketplace.

Conclusion

Carbon pricing has a vital role to play in a clean energy transition. But the invisible hand of the market will not and should not be the primary driver of our transition to a clean energy economy. We face important choices about the character, structure, and distribution of a new energy system. Our options present a wide array of benefits and costs, and a wide array of mechanisms for enhancing benefits and mitigating costs. Relying too heavily on markets would sacrifice the democratic governance values of public decision-making.

Moreover, if we rely on markets to take care of the hard choices – and simply sit back to see what happens – we run the risk that we will fail to develop a coherent and effective system. The transition ahead will require significant planning and coordination to develop transmission capacity and infrastructure and to ensure the reliability and high-functioning systems we have come to expect. Moreover, a purely price-driven mechanism could be socially inequitable and, if set at the necessary levels, politically infeasible.

Carbon pricing has a vital role to play in a clean energy transition. But the invisible hand of the market will not and should not be the primary driver of our transition to a clean energy economy.

Democratic and administrative processes are not easy or fool-proof. But we cannot avoid the messy and contested process of governance by expecting a carbon price to do the work for us.

Endnotes

[1] This issue brief is drawn from a longer article: Alice Kaswan, *Energy, Governance, and Market Mechanisms*, 72 MIAMI L. REV. 476 (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3191433.

[2] H.R. 763 *Energy Innovation and Carbon Dividend Act* (116th Cong.), Congress.gov, https://www.congress.gov/bill/116th-congress/house-bill/763?r=27&s=1.

[3] H.R. 109, *Recognizing the Duty of the Federal Government to Create a Green New Deal* (116th Cong.), Congress.gov, https://www.congress.gov/bill/116th-congress/house-resolution/109/text.

[4] *See* Carbon Pricing Leadership Coalition, https://www.carbonpricingleadership.org/ (last visited March 6, 2019), Cite new carbon pricing book and other paper or two

[5] *See* Ann E. Carlson, *Designing Effective Climate Policy: Cap-and-Trade and Complementary Policies*, 49 HARV. J. ON LEGIS. 207 (2012).

[6] *See* David M. Driesen, *Does Emissions Trading Encourage Innovation?*, 33 ENVTL. L. REP. 10094 (2003).

[7] *See* JEFF DEYETTE ET AL., UNION OF CONCERNED SCIENTISTS, THE NATURAL GAS GAMBLE: A RISKY BET ON AMERICA'S CLEAN ENERGY FUTURE (2015), https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/natural-gas-gamble-risky-bet-on-clean-energy-future. This is not to say that natural gas will not have any role to play as states transition from coal; in some cases, shifting fuel sources in an existing plant or building small plants to complement less reliable sources could be an effective strategy. *See* David B. Spence, *Paradoxes of "Decarbonization,"* 82 BROOK. L. REV. 447, 462 (2017). The point is that the appropriate role for natural gas in a long-term decarbonization strategy is not something "the market" can coherently resolve.

[8] *See* U.S. EPA., *EPA's Treatment of Biogenic Carbon Dioxide (CO_2) Emissions from Stationary Sources that Use Biomass for Energy Production*, https://www.epa.gov/sites/production/files/2018-04/documents/biomass_policy_statement_2018_04_23.pdf (stating EPA policy to treat combustion of wood from forests as carbon-neutral).

[9] California Air Resources Board, *California Greenhouse Gas Emissions for 2000 to 2016* (Figure 2, Trends in California GHG Emissions, page 4), https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.

[10] *See* California Air Resources Board, *Compliance Offset Program*, https://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm (last visited March 8, 2019); The Regional Greenhouse Gas Initiative, *Offsets*, https://www.rggi.org/allowance-tracking/offsets (last visited March 8, 2019). At the international level, the Kyoto Protocol includes the "Clean Development Mechanism," which allows developed country parties (primarily European countries) to purchase emission reduction credits representing emission reductions from developed countries. *See* UNFCC, *The Clean Development Mechanism*, https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism (last visited March 8, 2019).

[11] Twenty states have energy efficiency resources standards that require utilities to achieve energy efficiency standards. DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY, U.S. DEP'T OF ENERGY, ENERGY EFFICIENCY RESOURCE STANDARDS (AND GOALS) (Oct. 2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2016/10/Energy-Efficiency-Resource-Standards.pdf. Numerous other state policies promote energy

efficiency. WESTON BERG, ET AL., AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, THE 2018 STATE ENERGY-EFFICIENCY SCORECARD (Oct. 2018).

[12] *See* JOSEPH TOMAIN, CLEAN POWER POLITICS: THE DEMOCRATIZATION OF ENERGY (2017).

[13] To counter this risk, just over half the states have adopted "Energy Efficiency Resources Standards," which require utilities to encourage greater consumer efficiency. American Council for an Energy Efficient Economy, *State and Local Policies: Energy Efficiency Resource Standards*, https://database.aceee.org/state/energy-efficiency-resource-standards. Slightly less than half the states have "decoupled" utility profits from electricity sales to reduce the disincentive to encourage energy efficiency. Center for Climate and Energy Solutions, *Decoupling Policies*, https://www.c2es.org/document/decoupling-policies/.

[14] CARBON PRICING LEADERSHIP COAL., REPORT OF THE HIGH-LEVEL COMMISSION ON CARBON PRICES 5 (2017).

[15] *CO_2 European Emission Allowances Price Chart*, MARKETS INSIDER, https://markets.businessinsider.com/commodities/historical-prices/co2-emissionsrechte/euro/7.3.2005_7.4.2019 (visited April 7, 2019).

[16] *The Regional Greenhouse Gas Initiative, Allowance Prices and Volumes*, https://www.rggi.org/auctions/auction-results/prices-volumes (visited April 7, 2019).

[17] California Air Resources Board, *California Cap-and-Trade Program, Summary of California-Quebec Joint Auction Settlement Prices and Results* (Feb. 2019), https://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf.

[18] Government of Canada, *Implementing Canada's Plan to Address Climate Change and Grow the Economy*, https://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf (visited April 7, 2019); Kathryn Harrison, *Here's What the Carbon Tax Means for You*, THE CONVERSATION (April 2, 2019).

[19] Brad Plumer & Nadja Popovich, *These Countries Have Prices on Carbon. Are They Working?* THE NEW YORK TIMES (April 2 2019).

[20] CALIFORNIA AIR RESOURCES BOARD, CALIFORNIA'S 2017 CLIMATE CHANGE SCOPING PLAN (Nov. 2017), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

[21] Alice Kaswan, *A Broader Vision for Climate Policy: Lessons from California*, 9 SAN DIEGO J. OF ENERGY AND CLIMATE LAW 83, 114-18 (2018).

[22] Justin Worland, *A Carbon Tax Proposal Failed This Week. But the Fight Is Just Beginning*, TIME (Nov. 8, 2018).

[23] Hal Bernton & Jim Brunner, *Clean Power is Now the Law; Inslee Signs Bill for Zero-Carbon Electricity by 2045*, THE SEATTLE TIMES (May 8, 2019).

[24] Rachel Donadio, *France's Fuel-Tax Protests Expose the Limits of Macron's Mandate,* THE ATLANTIC (Dec. 4, 2018).

[25] *See* Michael Bastasch, *Justin Trudeau Levies Carbon Tax on Rebellious Canadian Provinces,* WATTS UP WITH THAT? (April 2, 2019), https://wattsupwiththat.com/2019/04/02/justin-trudeau-levies-carbon-tax-on-rebellious-canadian-provinces/.

[26] *See* William Boyd & Ann E. Carlson, *Accidents of Federalism: Ratemaking and Policy Innovation in Public Utility Law*, 63 UCLA L. REV. 810 (2016).

[27] For example, the California Energy Commission has required all new homes to include solar power, beginning in 2020. Ivan Penn, *California Will Require Solar Power for New Homes*, THE NEW YORK TIMES (May 9, 2018).