Toward a Future-Facing Climate Policy: Shifting the Focus from Emission Regulation to the Energy Transition

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This Article provides a systems analysis of climate change policy that links together subsystems relating to innovation, energy economics, interest group politics, and government regulation. It is easy but misleading to equate climate policy with emissions regulation. That is too narrow a frame. We urgently need a new energy system because of climate change, but regulating carbon emissions is only one part of a bigger project. We cannot assume that as carbon emissions decline a new energy system will build itself—nor will society be willing to eliminate fossil fuels without confidence in their replacements.

An effective climate policy requires much more than simply restricting fossil fuels and hoping the market will fill the gap. The energy transition requires incentives for energy research, development, and scaling up new energy technologies. For the energy transition to happen, we also need sufficiently large-scale deployment to trigger economies of scale and learning by doing. There is much to be gained, then, from shifting the paradigm from emissions reduction to the energy transition. To make a homely analogy: The reason for a kitchen renovation may be dry rot, and the first step is ripping out rotten wood. But the point of the remodeling is putting in a new kitchen, not just getting rid of the rot.

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I. INTRODUCTION

While on a moving airport walkway a few years ago, I saw a sign that said, "Please look in the direction you are traveling."[2] This Article has similar advice for climate policy: We should spend less time looking over our shoulders at the fossil fuel energy system we are trying to leave behind, and more time looking ahead toward the clean energy system we are trying to build.[3]

The standard approach to climate policy focuses on our current situation—present-day emissions—rather than the future energy system. Whether the problem is littering or climate change, traditional environmental policy approaches pollution as a problem of policing harmful behavior. Regulation of polluting firms is the main tool, and often the only tool, used to address the problem. But we might flip things: instead of a narrow focus on restricting facilities that emit

2. Unfortunately, apart from the fact that it was before COVID, I cannot recall the date or location, let alone provide a satisfactory citation for the existence of the sign. I meant to take a photo but was past the sign before I got my phone out.

3. In a recent essay, I explored some of the implications of the Inflation Reduction Act and argued for its importance, but the current article delves more deeply into the issues and puts forward a broader vision of climate policy. Daniel A. Farber, *Turning Point: Green Industrial Policy and the Future of U.S. Climate Action*, 11 TEX. A&M L. REV. 303 (2024).

carbon,[4] we might highlight the need to expand the role of clean energy.[5] Our central goal, then, would be constructing a new energy system with restrictions on emissions from legacy technologies as a tool for accelerating the transition.[6]

The choice between these visions matters because they imply different priorities and encourage reliance on different tools. Essentially, the older vision was the basis for the failed 2010 Waxman-Markey climate change bill,[7] which would have created a carbon trading system. The newer vision is the basis for a trilogy of recent spending bills that devote more than half a trillion dollars[8] to clean energy.[9] The new approach is less efficient in reducing emissions, according to recent economic modeling, but more effective in setting the stage for long-term progress.[10] That is not to say that regulation and subsidies are in conflict—they are actually synergistic—but a vision that is

4. In climate policy discussions, "carbon" is generally shorthand for carbon dioxide (rather than black carbon, which is also a warming agent). I will generally follow this usage. In places, however, such as the reference to "carbon emitters" in the text, I will use the term more loosely to also include emissions of other greenhouse gases such as methane.

5. As early as 2011, political scientist David Victor criticized what he called the environmentalist's myth that "global warming is a typical environmental problem." DAVID G. VICTOR, GLOBAL WARMING GRIDLOCK: CREATING MORE EFFECTIVE STRATEGIES FOR PROTECTING THE PLANET 49 (2011). In his view, thinking about climate change "as an environmental problem . . . led policymakers to focus on solutions that don't work." *Id.* at 50. Victor emphasized the critical need for radical technological improvements to bring down the cost of emission reductions and make them politically feasible. *Id*. at 127. Part III of this Article is dedicated to the subject of the innovation and deployment of clean energy technologies. Although I see a greater role for emissions regulation than Victor, I share his view that a different focus—the reconstruction of existing energy systems—is crucial.

6. To some extent, these approaches are two sides of the same coin. If our goal is to cut emissions from fossil fuels, substitute energy sources are needed. If the goal is a clean energy system, fossil fuels will have to be pushed aside. In other words, any climate policy is likely to involve a combination of strategic "pushes" away from fossil fuels and "pulls" toward a clean energy system. But how we define the core mission of climate policy is important for setting priorities and avoiding tunnel vision on emissions reductions. In addition, the public and advocacy groups need to understand that cutting fossil fuels is not a strategy that can stand on its own: building a new energy system is at least equally important.

7. American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong. (2009).

8. This number is derived from adding the spending figures in Part II(B).

9. Notably, these laws have substantial environmental justice components. *See* Nadia Ahmad et al., *Synthesizing Energy Transitions*, 39 GA. ST. U. L. REV. 1087, 1121 (2023).

10. Maya Domeshek et al., *Leveraging the IRA to Achieve 80x30 in the US Electricity Sector* 24 (Resources for the Future, Working Paper No. 23-42, Nov. 2023), https://media.rff.org/documents/WP_23-42_11.13.pdf [https://perma.cc/DC3E-RV77].

laser-focused on reducing present-day emissions misses opportunities that are apparent in a more future-facing strategy.[11]

To take a homely analogy, the reason for a kitchen renovation may be dry rot, and the first step is ripping out rotted wood. But the point of the project is putting in a new kitchen, not just getting rid of the rot. We cannot assume that, once the old boards are ripped out, the market will take care of building the new kitchen. Similarly, we urgently need a new energy system because of climate change, but eliminating carbon emissions is only one part of a bigger project. It is the "renovation" side of the project that will be the most complex. Emissions regulation is akin to tearing out the old kitchen, but the plan for building the new kitchen is at least as important.

In this Article, I argue in favor of making the clean energy transition[12]—not simply emission reduction—the conceptual frame for climate policy. There are several powerful arguments in favor of this framing. To begin with, although curbing climate change is a vital benefit of the energy transition, it is not the only one. Just as cars are a better form of transportation than horse-drawn carriages for reasons that go beyond reducing manure on the streets, clean energy is better than fossil fuels for reasons that go beyond reducing carbon emissions. The benefits of reducing conventional pollutants such as particulates and smog also loom large.[13] And as discussed later in the Article, clean energy technologies are increasingly appealing in purely economic terms. There are other benefits, such as reducing the

11. *See* John Bistline et al., *Climate Policy Reform Options in 2025, in Environmental and Energy Policy and the Economy* (Nat'l Bureau of Econ. Rsch., Working Paper No. 32168, 2024) (arguing that Inflation Reduction Act emission reductions would be enhanced by a modest carbon fee or a clean energy standard in the power sector).

12. This term could be considered an oversimplification, as a recent article explains:

> The world is in the process of far-reaching energy transitions as public policy and market forces increasingly shift the energy sector toward cleaner energy resources. What might be broadly conceived as a global clean energy transition is instead many multi-faceted and multi-contextual energy transitions combining to affect this ongoing and accelerating change, aligned with international commitments to reduce greenhouse gas emissions with increasing ambition.

Ahmad et al., *supra* note 9, at 1090. The authors add that "the energy transition is global, involves numerous technologies, and has different meanings for different communities. As a result, the range of substantive issues that arise beneath the umbrella concept of energy transition is far-reaching and highly varied." *Id.* at 1092–93. Despite these important qualifications, it seems undeniable that a coherent shift in energy is taking place at the global level.

13. These benefits are often overlooked and deserve more emphasis. *See* Ahmad et al., *supra* note 9, at 1128–29. For a recent estimate of those health benefits by researchers at Lawrence Berkeley National Laboratory, *see* Dev Millstein et al., *Climate and Air Quality Benefits of Wind and Solar Generation in the United States from 2019 to 2022,* 1 CELL REPORTS SUSTAINABILITY 100105 (2024) (finding reductions of one million metric tons in SO_2 and NO_x emissions).

economy's exposure to volatile international oil and gas markets. Converting to clean energy will also eliminate the risks of oil spills and damage from strip mining and coal ash disposal. Thus, the case for a new energy economy is multipronged and goes beyond the narrower, though urgent, goal of mitigating climate change. These are not merely incidental "co-benefits"—they are part and parcel of the case for transforming the energy system.

Replacing fossil fuels inherently involves systemic change, unlike the typical pollution problem that is addressed by facility-based actions. Conventional pollution strategies involve tamping down on pollution, not eliminating its sources. However, to keep climate change within manageable bounds, we will need to largely eliminate the use of fossil fuels in the next few decades. Accomplishing this goal will require coordinating huge changes in the national power grid; promoting a surge in innovative technologies; and financing major buildouts for energy storage, networks of charging stations for vehicles, and so forth. Those changes will not magically flow from measures to discourage fossil fuel use.[14] People will not buy electric vehicles without sufficient charging stations, and the market will not produce charging stations without electric vehicle owners to use them and an electricity system able to power them.

Finally, although federal regulation of fossil fuels will remain a crucial part of the tool kit, the energy-transition framing highlights the role of government spending and industrial policy—contrary to the conventional view that regulatory measures are ideal.[15] One key is clean energy research, development, and deployment, which a trilogy of blockbuster spending bills in 2021–2022 incentivized both directly and indirectly.[16] Spending and tax credits are not the only tools for supporting clean energy; mandates such as renewable portfolio

14. *See generally* Daniel E. Walters, *Lumpy Social Goods in Energy Decarbonization: Why We Need More Than Just Markets for the Energy Transition*, 93 U. COLO. L. REV. 541 (2022); *infra* notes 153–154 and accompanying text.

15. *See* Adam D. Orford, *Overselling BIL and IRA,* 51 ECOLOGY L. Q. 1, 9 (2024) ("The academic studies that have examined the question also have indicated that regulatory controls have been the most effective mechanism for real emissions reductions."). Except where the distinctions are significant, I will use the term "regulatory" for all mechanisms for directly limiting emissions, whether the mechanism is conventional regulation, cap and trade, or a carbon tax.

16. Driesen and Popp identify one of these bills, the Inflation Reduction Act, as the most ambitious climate legislation ever passed by Congress. David M. Driesen & David C. Popp, *The Law and Economics of Subsidies* (forthcoming 2025) (manuscript at 1), https://ssrn.com/abstract=4628750 [https://perma.cc/93YC-ZNLA]. They also observe that "[t]his shift of regulatory tools—from carbon pricing sticks to the carrots of significant subsidies requires a major change in thinking about how environmental law operates." *Id.*

standards are alternative tools.[17] Another key is constructing energy infrastructure, which needs more than project-by-project incentives to be effective. In this vision, government spending looms as large as emission regulation, not just because of its greater suitability for some purposes but also because of its political ramifications in stabilizing climate policy. These tools, including regulation, are mutually reinforcing. Indeed, measures to bolster green infrastructure are already playing a role in strengthening emission regulations.

A brief roadmap: In Part II, I contrast two different paradigms for climate policy, the 2010 Waxman-Markey bill's effort to cap emissions and the massive funding for the energy transition provided by the Inflation Reduction Act (IRA). Part III explores the benefits of the kind of future-facing policy embodied by recent spending legislation and particularly the ways in which such a policy can promote technological innovation and deployment. Part III also discusses how such policies can promote political entrenchment of climate action. Part IV turns to the synergies between funding mechanisms and emission regulation. Laws like the IRA can make more stringent regulation feasible and help bolster the likelihood that regulations will survive judicial review.[18] Part V offers brief conclusions.

In terms of strategies, the approach I advocate does not disavow standard tools to decrease emissions, such as conventional regulation, carbon trading systems, and carbon taxes. However, implementing these tools may be far more feasible once a strong, clean energy system has begun to take hold and grow. The traditional tools may also be less politically robust without the political momentum created by a growing clean energy sector. President Donald Trump's return to the presidency is a powerful reminder of how unstable the political environment can be and how significant political robustness is to climate policy and its implementation.

17. *See* Olivier Deschenes et al., *Causal Effects of Renewable Portfolio Standards on Renewable Investments and Generation: The Role of Heterogeneity and Dynamics* (Nat'l Bureau of Econ. Rsch., Working Paper No. 31568, 2023) (finding a large effect on wind generation capacity but not solar in states adopting renewable portfolio standards); Kathryne Cleary et al., *Clean Energy Standards* (Resources for the Future, 2019), https://media.rff.org/documents/CleanEnergy-Issue20Brief_2.pdf [https://perma.cc/8CCT-QZXH] (discussing benefits of clean energy standards as a second-best strategy to carbon pricing). On the effects of renewable portfolio standards on emissions, see RALPH WISER ET AL., NATIONAL RENEWABLE ENERGY LABORATORY, A RETROSPECTIVE ANALYSIS OF THE BENEFITS AND IMPACTS OF U.S. RENEWABLE PORTFOLIO STANDARDS (2016), https://www.nrel.gov/docs/fy16osti/65005.pdf [https://perma.cc/BJL6-HP9N].

18. In addition, according to recent research, subsidy laws can make it possible for cap-and-trade systems to achieve ambitious carbon targets with lower prices on carbon allowances than would otherwise be required. *See* Domeshek et al., *supra* note 10, at 2.

Given the urgency of the climate crisis, it is important not to get bogged down in disputes between advocates of different strategies. All efforts to avert the crisis are welcome. However, for some people, at least, the vision offered in this Article—creating a new and better system for powering our economy—may be more inspiring than a laser focus on cabining the fossil fuel sector. Whichever view we favor, however, we can all agree on the need for action.

II. CONTRASTING PARADIGMS

The two most important U.S. efforts at climate legislation to date illustrate the contrast between emissions regulation strategies and future-facing energy transition strategies. This section contrasts the Waxman-Markey bill and the IRA, and it then zooms in on the IRA as a case study of the benefits and potential drawbacks of the energy transition framing.

Briefly, the discussion begins with a look at one paradigmatic method of limiting emissions: cap and trade systems.[19] This approach was embodied in the Waxman-Markey bill, an iconic regulatory effort that passed the House but died in the Senate in 2010.[20] We then turn to the very different approach embodied in the IRA and companion funding legislation. Like the Waxman-Markey bill, the IRA went through a fraught legislative process but with a happier outcome.

The projected impact of the IRA and related funding laws on the level of carbon emissions, as well as experience with these laws in the first years of implementation, provide promising indications that these laws will succeed. The IRA has not, however, gone without criticism. Some criticisms seem to apply to a broad range of climate strategies rather than specifically to green industrial policy. Others involve features of the IRA that can be legitimately connected with the choice of green industrial policy as a strategy. Despite the criticisms, the upshot is that the green industrial policy embodied in recent laws deserves to be taken seriously as an alternative paradigm.

19. Lest readers misunderstand the thrust of my argument, I should reiterate my support for restrictions on carbon emissions, whether in the form of carbon pricing or conventional regulations. My argument is that the role of emission restrictions has been overemphasized to the exclusion of other promising strategies.

20. For background on the bill, *see* Jody Freeman, *The Environmental Protection Agency's Role in U.S. Climate Policy — A Fifty Year Appraisal,* 31 DUKE ENV. L. & POL'Y F. 1, 50–52 (2020).

A. Cap and Trade

Economists' favored approach to climate policy involves putting a price on carbon emissions and then allowing the market to determine where and how much to cut emissions,[21] the assumption being that clean energy substitutes will then arise spontaneously. One approach to carbon pricing involves the creation of an emissions trading system.[22] Briefly, an emissions trading program sets a ceiling on the total amount of emissions (the "cap") and establishes a market where firms trade the right to emit specified amounts (the "trade").[23] At the end of the year, each emitter must hold enough allowances to cover all its emissions that year. An emitter that needs to exceed its allotted emissions can buy unneeded allowances from other firms. Generally, if a firm's emission-reduction costs are above average, it can benefit from buying allowances. Similarly, a firm with below-average emission-reduction costs can benefit from selling allowances.

There were important precedents for the use of carbon trading systems at the time the Waxman-Markey bill was under consideration. The European Union began operating the world's first mandatory carbon trading scheme in January 2005.[24] The EU allotted emissions ceilings to its member states, allowing emissions in some countries to grow while others faced sharp reductions. EU members then established their trading programs, using a variety of schemes to allocate permits to their industries. Emissions trading also had precursors in the United States. In 2005, an interstate agreement among northeastern states launched the Regional Greenhouse Gas Initiative, which created a multistate trading system for power plant emissions with the goal of achieving a 10% reduction by 2019.[25] The following year,

21. For a discussion of the arguments in favor of carbon pricing methods versus conventional regulation, *see* DANIEL A. FARBER & CINNAMON P. CARLARNE, CLIMATE CHANGE LAW (2d ed. 2023). On carbon taxes specifically, *see id.* at 96–98. The choice between emissions trading and carbon taxes is discussed in *id.* at 100–03.

22. Experience with emissions trading systems in various settings is described in *id.* at 103–109.

23. Detailed information about the program can be found on the California Air Resources Board's website. *See* CAL. AIR RES. BD., OVERVIEW OF ARB EMISSIONS TRADING PROGRAM 1 (2015), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/guidance/cap_trade_overview.pdf [https://perma.cc/33DY-ZLH7].

24. *What is the EU ETS?*, EUROPEAN COMMISSION, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en [https://perma.cc/5TEV-NUT8] (last visited Dec. 28, 2024).

25. *Welcome*, REG'L GREENHOUSE GAS INITIATIVE, https://www.rggi.org/ [https://perma.cc/DQ8S-G5NP]. In 2013, the previous cap was cut almost in half to 91 million tons of carbon, down

Governor Arnold Schwarzenegger signed the California Global Warming Solutions Act (AB 32), which required California to reduce emissions to 1990 levels by 2020 and included authorization for a state cap and trade system.[26]

With the election of President Barack Obama and Democratic majorities in both Houses of Congress in 2008, many observers expected Congress to pass major climate change legislation,[27] especially because some key Republicans like John McCain had previously supported such legislation.[28] In 2009, the House responded by passing the Waxman-Markey bill, which would have established a national cap-and-trade system.[29]

The bill died in the Senate.[30] Senator McCain, who had endorsed an emissions trading program in 2008 while running for President, refused to support the bill, and support from other centrists and center-right senators also dissipated.[31] Republicans denounced the emissions trading scheme as a hidden tax.[32] Many things contributed to the bill's failure: the difficulty of enacting costly new regulations during a recession,[33] heightened political polarization over climate,[34]

from 165 million tons, requiring more substantial reductions in emissions. The cap is set to decline by 2.5% annually, with a further goal of reducing emissions 30% below 2020 levels by 2030. REG'L GREENHOUSE GAS INITIATIVE, SUMMARY OF RGGI MODEL RULE UPDATES (Dec. 19, 2017), https://www.rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Summary_Model_Rule_Updates.pdf [https://perma.cc/DQ8S-G5NP].

26. CAL. HEALTH & SAFETY CODE § 38500, 38530 (West 2007).

27. Regarding earlier efforts at federal cap and trade legislation, *see* Bruce Murray & Jonas Monast, *Carrots, Sticks, and the Evolution of U.S. Climate Policy*, 11 TEX. A&M L. REV. 431, 438–39 (2024).

28. McCain had taken a leadership role in Congress as well as on the campaign trail. He co-sponsored the Climate Stewardship Act of 2003 with Connecticut Democrat Joe Lieberman. During his presidential campaign McCain framed the issue in stark terms: "We stand warned by serious and credible scientists across the world that time is short and the dangers are great. The most relevant question now is whether our own government is equal to the challenge." Calle Jaffe, *Melting the Polarization Around Climate Change Politics*, 30 GEO. ENV. L. REV. 455, 456 (2018).

29. American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong. (1st Sess. 2009).

30. Jody Freeman's account describes the deep disappointment and frustration felt by the bill's supporters. Freeman, *supra* note 20, at 51.

31. *See* Nicholas S. Bryner, *The Once and Future Clean Air Act: Impacts of the Inflation Reduction Act on EPA's Regulatory Authority*, 65 B.C. L. REV. 1, 26 (2024).

32. *Id.* at 26.

33. *Lessons Learned from the Last Major U.S. Climate Bill: Lobbying Takes Its Toll,* UNIV. OF CHICAGO ENERGY POL'Y INST. (May 28, 2019), https://epic.uchicago.edu/news/lessons-learned-from-the-last-major-u-s-climate-bill-lobbying-takes-its-toll/ [https://perma.cc/D3PS-P3DF].

34. *Id.*

intense lobbying by fossil fuel interests,[35] opponents' success at branding cap and trade as a tax,[36] the bill's burgeoning complexity due to concessions to industry,[37] primary-election threats against sympathetic Republicans from an increasingly empowered right-wing base,[38] and missteps by the Obama White House.[39]

In November of that year, any chance for new legislation disappeared when the Republicans won control of the House; many believed the prospects for federal climate legislation were hopeless.[40] Thus, Congress—the major engine for large-scale policy development—was taken out of the game and remained almost entirely inactive for the rest of the Obama Administration, throughout the Trump Administration, and into the beginning of the Biden Administration.[41]

B. The Biden Spending Trilogy and Its Impacts

Congress did get "back in the game" during the Biden Administration but in an unexpected way. There is general agreement that the

35. Daniel J. Weiss, *Anatomy of a Senate Climate Bill Death,* CTR. FOR AM. PROGRESS (Oct. 10, 2010), https://www.americanprogress.org/article/anatomy-of-a-senate-climate-bill-death/ [On File with the Columbia Journal of Environmental Law].

36. John M. Bruder, *'Cap and Trade' Loses Its Standing as Energy Policy of Choice*, N.Y. TIMES (Mar. 24, 2010), https://www.nytimes.com/2010/03/26/science/earth/26climate.html [On File with the Columbia Journal of Environmental Law] ("Less than a year ago, cap and trade was the policy of choice for tackling climate change. . . . Today, the concept is in wide disrepute, with opponents effectively branding it 'cap and tax,' and Tea Party followers using it as a symbol of much of what they say is wrong with Washington.").

37. According to the *N.Y. Times*, "in trying to assemble a majority to pass it, Mr. Waxman and Mr. Markey dished out a cornucopia of concessions and exemptions to coal companies, utilities, refiners, heavy industry and agribusinesses. The original simplicity was lost, replaced by a bazaar in which those with the most muscle got the best deals." *Id*.

38. Ryan Lizza, *As the World Burns*, NEW YORKER (Oct. 3, 2010), https://www.newyorker.com/magazine/2010/10/11/as-the-world-burns [On File with the Columbia Journal of Environmental Law].

39. *Id.* Freeman, who had herself served in the Obama White House, recounts that the Administration had failed to prioritize climate change or take the initiative on the bill: "the Chief of Staff and other senior White House officials did not have the same fire in the belly on climate change that they had for health care." Freeman, *supra* note 20, at 51.

40. *See* RICHARD J. LAZARUS, THE MAKING OF ENVIRONMENTAL LAW 194 (2d ed. 2023) ("The partisan divide on environmental lawmaking so deepened during the Bush and Obama administration as to end Congress's ability to engage in any significant environmental lawmaking, especially on lawmaking.").

41. There is one notable though narrow exception. The American Innovation and Manufacturing Act of 2020, 42 U.S.C. § 7675, empowers EPA to regulate HFCs, which are super-powerful greenhouse gases that are covered by the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Oct. 15, 2016, S. Treaty Doc. 117-1. The United States ratified the Kigali Amendment in 2022. *See* Press Release, U.S. Dep't of State, U.S. Ratification of the Kigali Amendment (Sept. 21, 2022), https://www.state.gov/u-s-ratification-of-the-kigali-amendment/ [https://perma.cc/G552-BJWN].

Inflation Reduction Act (IRA)[42] is the most important piece of federal climate legislation ever passed and that its passage in August 2022 came as a surprise. Earlier that summer, even the most astute and experienced observers of environmental law lamented the impossibility of enacting major climate legislation.[43] Yet by the end of the summer, Congress had passed a bill providing enormous funding for emission reductions. The IRA followed the passage of two other funding laws in the previous twelve months: the Infrastructure Investments and Jobs Act (IIJA)[44] and the CHIPS and Science Act of 2022 (CHIPS).[45] Taken together, the three laws provided massive funding for clean energy infrastructure (IIJA), research and development (CHIPS), and clean energy deployment (IRA).

The IIJA, the earliest of the three statutes, focuses primarily on conventional infrastructure such as bridges and roads, but it also devotes very substantial funding to promoting clean technologies. One major area of spending is clean transportation. There was $66 billion for rail, $39 billion for mass transit, $7.5 billion for zero- and low-emission buses and ferries, $7.5 billion to build charging stations for electric vehicles, and $6 billion for energy storage.[46] The IIJA also provided $65 billion to expand the capacity of the nation's electric transmission system.[47]

42. Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1915 (2022). For an overview of the provisions of the IRA, *see* Bryner, *supra* note 31, at 44–50. On the difficulty of climate change as a policy issue, *see* Freeman, *supra* note 20, at 75–79. Freeman ended on an optimistic note, however, expressing confidence that American society is ready to tackle climate change. *Id.* at 79.

43. LAZARUS, *supra* note 40, at 194. The timing of the book is indicated by the fact that it does refer to *West Virginia v. EPA,* which was decided in June 2022, but not the Inflation Reduction Act ("IRA"), which passed in August. *See id.* at 286–87. Indeed, Lazarus found "little about Congress's conduct in the last thirty years to suggest it will suddenly become a responsible environmental lawmaker anytime soon." *Id.* at 349. While this was an eminently plausible assessment at the time (and one I shared), it turned out almost immediately to have been mistaken.

44. Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (2021). This statute is referred to as IIJA, the Bipartisan Infrastructure Act (BIL) or simply the Infrastructure Act.

45. CHIPS and Science Act of 2022, Pub. L. No. 117-167, 136 Stat. 1366 (2022).

46. Shawn Hubler et al., *This is Where the States Want Billions in Infrastructure Funding Spent*, N.Y. TIMES (June 22, 2023), https://www.nytimes.com/2021/11/06/us/states-infrastructure-bill-funding.html [On File with the Columbia Journal of Environmental Law]; Ethan Howland, *Biden Signs $1.2 Trillion Infrastructure Bill with Funding for EVs, Transmission, Hydrogen*, UTILITY DIVE (Nov. 16, 2021), https://www.utilitydive.com/news/congress-approves-infrastructure-bill-funding-transmission-hydrogen-ev/609649/ [https://perma.cc/5RQ4-GTN4].

47. *See*, *Updated Fact Sheet: Bipartisan Infrastructure Investment and Jobs Act*, THE WHITE HOUSE (Aug. 2, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/02/updated-fact-sheet-bipartisan-infrastructure-investment-and-jobs-act [https://perma.cc/V83P-58DG].

As its name indicates, the CHIPS Act was focused on the semiconductor and computing sectors, but it also had extensive provisions relating to energy and climate.[48] The gist is captured by the title of a magazine article: "Congress Just Passed a Big Climate Bill. No, Not That One."[49] While not the IRA, CHIPS authorizes $54 billion in total climate-related spending. The funding would support "a series of programs designed to help researchers commercialize their ideas, such as additional funding for the Advanced Research Projects Agency–Energy (ARPA-E), and establishing a new Directorate for Technology, Innovation, and Partnerships at the National Science Foundation."[50] This funding built on an earlier history of funding for renewable energy and energy efficiency at the Department of Energy (DOE), with those technologies absorbing about a third of the Department's energy research funding since its founding.[51] ARPA-E has been especially successful; it specializes in funding high-risk research and has resulted in over a thousand energy-related patents and billions of dollars in private investment.[52]

Of the three recent laws, the Inflation Reduction Act focused most heavily on climate change.[53] The IRA was the Senate version of the

48. For a detailed listing of the Act's energy and climate provisions, *see* Mariana Ambrose et al., *CHIPS and Science Act Summary: Energy, Climate, and Science Provisions*, BIPARTISAN POL'Y CTR. (Nov. 14, 2022), https://bipartisanpolicy.org/blog/chips-science-act-summary [On File with the Columbia Journal of Environmental Law].

49. Robinson Meyer, *Congress Just Passed a Big Climate Bill. No, Not That One.*, THE ATLANTIC (Aug. 10, 2022), https://www.theatlantic.com/science/archive/2022/08/chips-act-climate-bill-biden/671095/ [https://perma.cc/9LXC-KDMH].

50. Lachlan Carey & Jun Ukita Shepard, *Congress's Climate Triple Whammy: Innovation, Investment, and Industrial Policy*, ROCKY MOUNTAIN INST. (Aug. 22, 2022), https://rmi.org/climate-innovation-investment-and-industrial-policy [https://perma.cc/EY6U-BAFM]. For a listing of innovation-related provisions in the CHIPS Act relating to energy and climate, *see* Ambrose, *supra* note 48. Among the notable provisions are $10 billion for regional innovation hubs in § 110621, $14.7 billion for research and development in § 10102, $100 million through FY2027 for the Department of Energy's Office of Technology Transitions, and $600 million for research on microelectronics and energy innovation in § 10731.

51. CONG. RSCH. SERV., RS22858, RENEWABLE ENERGY R&D FUNDING HISTORY: A COMPARISON WITH FUNDING FOR NUCLEAR ENERGY, FOSSIL ENERGY, ENERGY EFFICIENCY, AND ELECTRIC SYSTEMS R&D 4 (2018). ARPA-E stands for Advanced Research Projects Agency-Energy.

52. *Our Impact*, ARPA-E, https://arpa-e.energy.gov/about/our-impact [https://perma.cc/8MCF-42KP] (last visited Nov. 2, 2024).

53. The IRA "includes $161 billion in new tax credits to incentivize clean electricity and about $80 billion to encourage consumers to purchase new or used electric vehicles and improve the energy efficiency of their homes," along with $1.5 billion to cut methane emissions. Tony Romm, *House Passes Inflation Reduction Act, Sending Climate and Health Bill to Biden*, WASH. POST (Aug. 12, 2022), https://www.washingtonpost.com/us-policy/2022/08/12/inflation-reduction-act-house-vote/ [On File with the Columbia Journal of Environmental Law]. For a comprehensive

Build Back Better bill, a $1.75 trillion social policy and climate change bill that passed the House in November of 2021 with $550 billion in climate funding.[54] That bill, in turn, had roots in the Green New Deal, an even more ambitious proposal supported by progressives in the House[55] along with none other than Senator Henry Waxman, of Waxman-Markey fame.[56]

Because of the Democrats' razor-thin margin in the Senate and unified opposition by Republicans, the bill could only be passed under the Senate's reconciliation rules. Reconciliation has the advantage of being filibuster-proof and requiring only a bare majority—but the disadvantage of being limited to fiscal measures rather than regulatory

guide to the IRA's provisions, *see generally* BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION, THE WHITE HOUSE, 5–6 (2023), https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf [https://perma.cc/MGW5-CQYL].

54. *See* Nik Popli & Abby Vesoulis, *The House Just Passed Biden's Build Back Better Bill. Here's What's in It,* TIME (Nov. 19, 2021), https://time.com/6121415/build-back-better-spending-bill-summary/ [https://perma.cc/XA39-ALGR]. Manchin had scuttled the Build Back Better bill, angering many Democrats. *Id.* For background on the passage of the IRA, *see* Bryner, *supra* note 31, at 41–44. The sudden shift in Manchin's position came as a surprise, since he had previously signaled immovable opposition. "And just like that, climate legislation went from being impossible to inevitable in roughly 2 weeks." Cinnamon P. Carlarne, *The Acceleration of Climate Creep: The Court Crashes, Congress Surges*, 52 ENV. L. REP. 1078, 1078 (Oct. 2022).

55. As originally introduced, the Green New Deal was more a statement of policy than a specific set of proposals:

> By calling for sweeping reforms that would reach multiple levels of government and industry – from generating 100 percent of the nation's electricity from clean, renewable sources and upgrading the energy grid, buildings, and transportation infrastructure, to investing in green technology and jobs in the new green economy – the deal would require multiple layers of new policy to be devised and implemented.

Daisy Simons, *Six Things About "Green New Deal"*, YALE CLIMATE CONNECTIONS (Jan. 15, 2019), https://yaleclimateconnections.org/2019/01/six-things-about-green-new-deal/ [https://perma.cc/XWP4-ELVL]. The cost was estimated as 1–2% of GDP. *Id.* On the role of House progressives in these developments, *see* Cinnamon P. Carlarne, *Climate Courage: Remaking Environmental Law*, 41 STAN. ENV. L.J. 125, 184–188 (2022). The moving force behind the bill was newly elected progressive Alexandra Ocasio-Cortez (often known as AOC), who, along with the Sunrise Movement activist group, publicized the idea with a sit-in in the office of House Speaker Nancy Pelosi. *Id.* Biden rejected the name but put forth a position that was "wildly more ambitious than anything Hillary Clinton had put out in 2016 and became even more so after he named AOC and Sunrise head Varshini Prakash to a committee charged with crafting his climate agenda." Ryan Grim, *The Rise and Rollout of AOC's Green New Deal*, THE INTERCEPT (Dec. 8, 2023), https://theintercept.com/2023/12/08/squad-aoc-green-new-deal/ [On File with the Columbia Journal of Environmental Law].

56. Markey's connection with the earlier legislation was no coincidence:

> Recalling Markey's service as chair of the previous special climate panel, and his authorship of Waxman-Markey — the American Clean Energy and Security Act of 2009 — the only major climate bill ever to clear a chamber of Congress, Ocasio-Cortez asked him to be her lead sponsor in the Senate. He eagerly accepted.

Grim, *supra* note 55.

ones,[57] which placed some policy tools out of reach.[58] Months of negotiation then followed between then-Senate Majority Leader Chuck Schumer of New York and Senator Joe Manchin of West Virginia, the crucial swing voter (and representative of a major coal-producing state). The deal that followed was the IRA.[59] Besides direct spending on clean energy, the IRA also includes substantial tax credits.[60]

These three laws were not the federal government's first foray into financial support for renewable energy. For example, the federal government sponsored NASA research into solar energy beginning in the 1950s and provided tax credits for firms and homeowners as early as 1978, but support faded away later in the century and returned only after 2007.[61]

C. Impacts on Carbon Emission Levels

The estimated potential emissions reductions from the IRA and its companion funding measures are impressive. Modeling the impact of these laws[62] demonstrated the scale of their potential effect on emissions.[63] These projections indicated that the IRA could cut annual

57. For an explanation of Senate reconciliation bills, including the requirement that fiscal impacts be more than incidental to a provision, *see* Jonathan Gould, *Law Within Congress*, 129 YALE L.J. 1946, 1961 (2020).

58. The Senate parliamentarian allowed a methane emission fee and a "prevailing wage" requirement as part of the bill, but not provisions that directly endorsed EPA regulations. *See* Jonathan Gould, *The Senate's Shadow Doctrine*, 61 HARV. J. ON LEGIS. 317, 358–59 (2024).

59. Tony Romm et al., *Manchin Says He Has Reached Deal with Schumer on Economy Climate Bill*, WASH. POST (July 26, 2022), https://www.washingtonpost.com/us-policy/2022/07/27/manchin-says-he-has-reached-deal-with-democrats-economy-climate-bill/ [On File with the Columbia Journal of Environmental Law].

60. The tax credits could amount to as much as three or four times the initial estimates depending on the uptake of clean technologies, but they would be cost-justified even at that level. For a description of the relevant tax provisions, *see* Mona Dajani, *Diving into the Inflation Reduction Act's Tax Credits and the Ambitious Plan to Reshape the US Energy Sector*, UTILITY DIVE (Aug. 9, 2022), https://www.utilitydive.com/news/diving-into-the-inflation-reduction-acts-tax-credits-and-the-ambitious-pla/629075/ [https://perma.cc/CYT4-KRXH].

61. Dan Brokesh, *Subsidies for Direct Air Capture: Lessons from the Solar Industry*, 53 ENV. L. REP. 10538, 20541–20545 (2023). Brokesh concludes that "[w]ithout subsidies, solar likely could not have established itself as a viable alternative energy as quickly as it has over the past 15 years," though he also criticizes funding for being too crisis driven. *Id.* at 10545.

62. As Orford observes, "[e]nergy-economic modeling is widely used as a tool by energy policy analysts to provide information to energy system decisionmakers about the possible impacts of alternative policy options." Orford, *supra* note 15, at 12.

63. *See* Ethan Howland, *Inflation Reduction Act Would Spur 42% US Carbon Emissions Cut by 2030: Princeton-Led Study*, UTILITY DIVE (Aug. 4, 2022), https://www.utilitydive.com/news/inflation-reduction-act-carbon-greenhouse-emissions-princeton/628849 [On File with the Columbia Journal of Environmental Law]. Notably, according to researchers at Resources for the

carbon emissions in 2030 by roughly one billion metric tons and reduce cumulative emissions by about 6.3 billion tons through 2032.[64] At a more granular level, recent research forecasts that the IRA and IIJA will increase the 2030 market share of electric vehicles by 18% and reduce U.S. carbon emissions by 80 million tons.[65]

These forecasts should be taken with a grain of salt. Energy markets are notoriously difficult to predict,[66] and at best, models only show what would happen if current trends continued. But of course, models are always oversimplifications, and there are always surprises: price spikes due to international crises, new technologies like fracking and lithium-ion batteries, recessions, and unexpected policy shifts. The

Future, these results would be achieved along with small reductions in consumer electricity costs, quite contrary to the view that decarbonization inevitably imposes burdens on consumers. *See* NICHOLAS ROY ET AL., RETAIL ELECTRICITY RATES UNDER THE INFLATION REDUCTION ACT OF 2022 1 (2022), https://media.rff.org/documents/IB_22-07_HcKDycO.pdf [https://perma.cc/6CBV-FPEH].

64. Early estimates included JESSE D. JENKINS ET AL., REPEAT PROJECT, PRELIMINARY REPORT: THE CLIMATE AND ENERGY IMPACTS OF THE INFLATION REDUCTION ACT OF 2022 6 (2022), https://repeatproject.org/docs/REPEAT_IRA_Prelminary_Report_2022-08-04.pdf [https://perma.cc/4ZRJ-T88N]; MEGAN MAHAJAN ET AL., ENERGY INNOVATION, MODELING THE INFLATION REDUCTION ACT USING THE ENERGY POLICY SIMULATOR 2 (2022), https://energyinnovation.org/wp-content/uploads/2022/08/Modeling-the-Inflation-Reduction-Act-with-the-US-Energy-Policy-Simulator_August.pdf [https://perma.cc/57S8-Y9DR] (forecasting 0.9-1.1 billion tons in reductions due to the bill in 2030, with a somewhat higher estimate of total emissions reductions during 2022–2025); JOHN LARSEN ET AL., RHODIUM GRP., A TURNING POINT FOR US CLIMATE PROGRESS: ASSESSING THE CLIMATE AND CLEAN ENERGY PROVISIONS IN THE INFLATION REDUCTION ACT 3 fig.3 (2022), https://rhg.com/research/climate-clean-energy-inflation-reduction-act/ [https://perma.cc/R95W-FP8J] (forecasting roughly 650 billion tons below emissions under prior policy); Mark Zandi et al., *Assessing the Macroeconomic Consequences of the Inflation Reduction Act of 2022*, MOODY'S ANALYTICS 4 chart 2 (Aug. 2022), https://www.moodysanalytics.com/-/media/article/2022/assessing-the-macroeconomic-consequences-of-the-inflation-reduction-act-of-2022.pdf [On File with the Columbia Journal of Environmental Law] (about a billion tons of reduction in 2050). In terms of the IRA's fiscal scope, initial estimates were that the IRA would pump $369 billion into the clean energy sector. *See* Dan Gearno, *The Most-Cited Number About the Inflation Reduction Act Is Probably Wrong, and That Could Be a Good Thing*, INSIDE CLIMATE NEWS (Apr. 20, 2023), https://insideclimatenews.org/news/20042023/inside-clean-enery-inflation-reduction-act-spending/ [https://perma.cc/5VE2-DEJH]. Because the IRA's tax credits are uncapped, some estimates of IRA funding are as much as two or three times that high. *Id.* Recent estimates of emissions reductions are roughly consistent with early estimates. For example, an article published in *Science*, a top scientific journal, used nine independent models to estimate the IRA's effect. The authors found that economy-wide emissions would be 33–40% below 2005 levels with the IRA. By 2035, emissions reductions will be 43–48% below 2005 levels. In the power sector, by 2035, emissions will be 66–87% below 2005 levels. *See* John Bistline et al., *Emissions and Energy Impacts of the Inflation Reduction Act,* 380 SCIENCE 1324, 1324 (2023).

65. Cassandra Cole et al., *Policies for Electrifying the Light-Duty Vehicle Fleet in the United States*, 113 AEA PAPERS AND PROCEEDINGS 316, 316 (May 2023).

66. *See* Orford, *supra* note 15, at 14 ("Experts have warned for years about overreliance on the top-line results of models like NEMS . . . .").

limitations of these models are a problem for many kinds of environmental and energy policies, not just funding policies like the IRA. Yet they remain the best modeling tools we have.

Early forecasts of the IRA's impact did not consider constraints on building new infrastructure, such as transmission lines and supply chain constraints.[67] Newer models have tried to take these constraints into account. Recent modeling efforts by researchers at the International Monetary Fund (IMF) considered two scenarios: one in which investment projects take four-and-a-half years to come online, and one in which projects take only a year and a half.[68] The IMF forecasted a reduction of 710 million tons of carbon emissions due to the IRA under the shorter timeline, but the longer timeline could delay a third of the reductions.[69] This result is consistent with other modeling that includes permitting delays.[70] However, permitting delays are a result of human institutions, not the laws of nature. Just as ignoring permitting delays is unrealistic, assuming that they are completely immune from reform is also unrealistic.[71]

67. *Id.* at 16.

68. Simon Voigts & Anne-Charlotte Paret, *Emissions Reduction, Fiscal Costs, and Macro Effects: A Model-Based Assessment of IRA Climate Measures and Complementary Policies* 12 (Int'l Monetary Fund, Working Paper No. 24/24, 2024), https://www.imf.org/en/Publications/WP/Issues/2024/02/09/Emissions-Reduction-Fiscal-Costs-and-Macro-Effects-A-Model-based-Assessment-of-IRA-Climate-544749 [On File with the Columbia Journal of Environmental Law].

69. *Id.* at 3–4.

70. *See* Orford, *supra* note 15, at 25.

71. For more on permitting issues, *see* J.B. Ruhl & James Salzman, *The Greens' Dilemma: Building Tomorrow's Climate Infrastructure Today*, 73 EMORY L.J. 1 (2023); James W. Coleman, *Permitting the Energy Transition*, 75 CASE W. RESERVE L. REV. (forthcoming 2024), https://ssrn.com/abstract=4742076 [https://perma.cc/4YCQ-THZH]. There have been some encouraging developments in streamlining the approval process for renewable-energy and related infrastructure. One important cause of delay is the process of approving the interconnection of renewables with transmission, but there are promising efforts to address this issue. *See* Herman K. Trabish, *Innovative Solutions Emerge to Reduce 2.5-TW US Clean Energy Interconnection Backlog,* UTILITY DIVE (July 22, 2024), https://www.utilitydive.com/news/clean-energy-renewables-storage-interconnection-backlog-caiso-spp-ercot/719665/ [On File with the Columbia Journal of Environmental Law]. Another sticking point is the construction of new transmission. The Department of Energy has adopted new planning processes to accelerate transmission approvals. *See* Coordination of Federal Authorizations for Electric Transmission Facilities, 10 C.F.R. § 900 (2024). States are also piloting improvements in transmission planning. *See* Ethan Howland, *CAISO Approves $6.1B Transmission Plan with Focus on Access to Clean Energy,* UTILITY DIVE (May 24, 2024), https://www.utilitydive.com/news/caiso-2023-transmission-plan-offshore-wind-sunzia/717093/ [On File with the Columbia Journal of Environmental Law]. There is significant potential to expand transmission capacity without constructing new lines through technological upgrades to existing lines. *See* Ethan Howland, *21 States, DOE Launch Initiative to Spur Grid-Enhancing Technologies, Advanced Conductors*, UTILITY DIVE (May 19, 2024), https://www.utilitydive.com/news/states-doe-modern-grid-deployment-initiative-

While it is quite possible that the models have overestimated the impact of the IRA and the other two major funding bills, it is also possible that they have underestimated it. In the past, similar types of models have badly overestimated emissions, energy demand, and renewable costs while repeatedly underpredicting the deployment of wind and solar.[72]

Putting aside uncertain modeling predictions, early indications are that the IRA has given a dramatic jolt to the clean energy sector.[73] The International Energy Agency (IEA) estimates that total 2024 investments in clean energy will be double those in fossil fuels.[74] Definitive proof of cause and effect is difficult, but clean energy has skyrocketed since the IRA was passed. A record number of cars sold in 2023 were EVs or plug-in hybrids, at the high end of previous post-IRA modeling forecasts.[75] The comparison with pre-IRA forecasts is dramatic. The government's 2020 prediction of 2023 EV sales turned out to be too

gets/717338/ [On File with the Columbia Journal of Environmental Law]. States are also seeking ways to streamline permitting for renewable energy. *See* Jeffrey Tomich, *Minnesota Legislature Passes Bill to Bolster Renewables*, E&E NEWS (May 22, 2024), https://www.eenews.net/articles/minnesota-legislature-passes-bill-to-bolster-renewables/ [On File with the Columbia Journal of Environmental Law]; Diana DiGangi, *Massachusetts Commission Recommends Faster Approvals of Clean Energy Projects, Infrastructure,* UTILITY DIVE (Apr. 3, 2024), https://www.utilitydive.com/news/massachusetts-commission-permitting-siting-clean-energy-infrastructure/712117/ [On File with the Columbia Journal of Environmental Law]. The effect of these reforms may be incremental but still significant, and they are likely to be followed by others.

72. Maya Domeshek & Nicholas Roy, *How Much Will the Inflation Reduction Act Reduce Emissions?, with Maya Domeshek and Nicholas Roy*, RESOURCES RADIO (Aug. 8, 2023), https://www.resources.org/resources-radio/how-much-will-the-inflation-reduction-act-reduce-emissions-with-maya-domeshek-and-nicholas-roy/ [https://perma.cc/4W7E-9JPB].

73. For example, according to a press report in the spring of 2023:

> [S]ee how far the country has come since the I.R.A. became law. Companies have announced at least 31 new battery manufacturing projects in the United States. That is more than in the prior four years combined. . . . In energy production, companies have announced 96 gigawatts of new clean power over the past eight months, which is more than the total investment in clean power plants from 2017 to 2021 and enough to power nearly 20 million homes.

Brien Deese, *The New Climate Law Is Working. Clean Energy Investments Are Soaring.*, N.Y. TIMES (May 30, 2023), https://www.nytimes.com/2023/05/30/opinion/climate-clean-energy-investment.html [On File with the Columbia Journal of Environmental Law].

74. Jillian Ambrose, *Investment in Clean Energy Likely to Be Double Figure for Fossil Fuels in 2024, IEA Says*, THE GUARDIAN (June 6, 2024), https://www.theguardian.com/business/article/2024/jun/06/investment-in-clean-energy-likely-to-be-double-figure-for-fossil-fuels-in-2024-iea-says [https://perma.cc/K5LW-Y9KL].

75. Brad Plumer, *Here's Where Biden's Climate Law Is Working, and Where It's Falling Short*, N.Y. TIMES (Feb. 21, 2024), https://www.nytimes.com/2024/02/21/climate/inflation-reduction-act-progress-climate.html [On File with the Columbia Journal of Environmental Law].

low by a factor of three.[76] Moreover, by March of 2023, the growth rate for U.S. energy storage capacity more than doubled since the preceding August when the IRA was passed.[77] Clean energy investments in 2024 took another significant leap beyond the 2023 figures.[78]

The U.S. also added a record amount of renewable energy capacity, though this amount was lower than forecasts due to permitting issues and supply chain issues.[79] Models that correctly predicted the growth of solar overestimated the growth of wind and vice versa.[80] It is clearly too soon to know whether long-term modeling predictions will bear out, which is likely to depend on overcoming barriers to deployment: delays in siting and permitting, supply chain problems, and backlogs in requests to connect generation to the grid.[81] These frictions will not be easy to address, but there will be strong pressure to

76. RHODIUM GRP., CLEAN INVESTMENT IN 2023: ASSESSING PROGRESS IN ELECTRICITY AND TRANSPORT 3 (Feb. 21, 2024), https://rhg.com/research/clean-investment-in-2023-assessing-progress-in-electricity-and-transport/ [https://perma.cc/VR6Z-R79J] [hereinafter RHODIUM 2024]. According to another analysis, "[i]n many ways, 2023 was a record-breaking year for clean energy deployment in the United States, including the escalating installation rate of solar and energy storage, growing EV sales and the number of planned manufacturing facilities." Lori Bird & Joseph Womble, *State of the US Clean Energy Transition: Recent Progress, and What Comes Next*, WORLD RES. INST. (Feb. 7, 2024), https://www.wri.org/insights/clean-energy-progress-united-states [https://perma.cc/AUP4-Z8SE].

77. Brian Martucci, *US Energy Storage Capacity Rises 4.2 GW in Q4 2023, Full-Year Additions up 90% over 2022*, UTILITY DIVE (Mar. 25, 2024), https://www.utilitydive.com/news/us-energy-storage-capacity-rises-42-gw-in-q4-2023-Wood-Mackenzie/711232/ [https://perma.cc/6BN7-7PCW].

78. According to Clean investment Monitor, a joint project by MIT and the Rhodium Group:

> There was $284 billion in new investment in the manufacture and deployment of clean energy, clean vehicles, building electrification and carbon management technology in the U.S. in the past year, up 36% from the previous year. A record $76 billion of this investment occurred in the second quarter of 2024, a 27% increase relative to the same period in 2023.

Clean Investment Monitor, RHODIUM GRP., https://www.cleaninvestmentmonitor.org [https://perma.cc/YN5D-K7C3] (last visited Nov. 2, 2024). Another 2024 study of the IRA's impact reported that:

> Sectors throughout the clean energy industry are expanding. Over the past two years, automakers and their suppliers have announced 132 new or expanded electric vehicle and battery plants and related factories in 23 states, including 39 clean vehicle manufacturing projects in the past year. Solar panel equipment manufacturers are building or expanding 53 factories in 23 states (24 projects in the past year). Renewable energy operators are planning 24 new large-scale wind and solar generation projects across 22 states (10 projects in the past year), while at least 51 new battery/storage projects are in development (19 in the past year, in nearly as many states).

Clean Economy Works: IRA 2-Year Review, E2 (Aug. 14, 2024), https://e2.org/reports/clean-economy-works-two-year-review-2024/ [https://perma.cc/DSM9-ENF6].

79. Plumer, *supra* note 75.

80. RHODIUM 2024, *supra* note 76, at 4.

81. *Id.* at 6.

find solutions from investors who collectively have billions of dollars at stake, as well as from supporters of climate action.

Compared with carbon pricing, the subsidy approach of the IRA has some disadvantages that are familiar to economists.[82] It is difficult for the government to ensure that subsidies are not wasted on clean energy projects that would have happened even without the subsidies.[83] Unlike regulations and carbon pricing, subsidies to producers do not raise consumer costs, which in some ways is a benefit but also decreases the incentive to conserve energy. And subsidizing clean energy disadvantages coal and natural gas equally, even though coal produces greater carbon emissions, whereas ideal measures would put greater pressure on coal than gas because of its higher carbon emissions.[84]

However, subsidies may have advantages as well as downsides. To begin with, subsidies may create a firmer basis for private investment than regulations. Investment in clean energy requires credible governmental commitments to cut emissions, but investors may be hesitant to rely on the longevity of fossil fuel regulations or carbon pricing because of the potential for rollbacks.[85] Infrastructure is more durable than executive orders or the Environmental Protection Agency's (EPA) regulations,[86] and is especially critical in a volatile political environment. As explained in Part III(D), subsidy programs create interest groups to beat back attacks on the programs. Following the 2024 elections, this resilience of subsidy programs will be put to the test, but it seems clear that regulatory programs would be even more vulnerable to rollbacks.

Also, modeling shows that carbon pricing, while more cost-efficient in reaching immediate emission goals, would leave more natural gas infrastructure intact and create less new clean energy infrastructure than subsidizing clean energy—and thus is less effective in laying the groundwork for deeper future emission reductions.[87] Consequently, although the IRA may produce emission reductions at a greater cost than a carbon pricing system or regulations with the same 2030 target, it may be better at moving the country toward the mid-century

82. Domeshek et al., *supra* note 10, at 1–2.
83. *Id.* at 1.
84. *Id.* at 2.
85. *Id.* at 4. *See also* DUSTIN TINGLEY & ALEX GAZMARARIAN, UNCERTAIN FUTURES: HOW TO UNLOCK THE CLIMATE IMPASSE (2023) (discussing the need for credible commitments in climate policy).
86. Domeshek et al., *supra* note 10, at 4.
87. *Id.* at 12.

goal of net zero.[88] As a final advantage, because new infrastructure is financed by taxpayers rather than utility ratepayers, the IRA's cost impacts may be more progressive.[89]

This is not to say that there is an either/or choice between IRA-like subsidies and regulation of carbon emissions. Modeling also shows that combining the IRA with an emission trading system may "substantially reduce the allowance price" necessary to reach U.S. climate pledges by President Joseph Biden.[90] I will discuss some possible synergies between subsidies and emissions regulation in Part III.

D. Critiques of the IRA and of Green Industrial Policy More Broadly

While there is much to admire about the IRA as a model for climate action, it would be unfair to ignore the law's critics. Much of the criticism of the IRA came from skeptics of climate action, whose views are not relevant here because they would apply equally to regulatory and carbon pricing strategies. Others involve design features of the IRA. Some of those design features could equally arise in the context of emission reduction regulations, but others are more common in green industrial policies like the IRA.

The criticisms that are most clearly specific to the IRA involve the provisions favoring fossil fuels that were added to gain Senator Manchin's support. These provisions have particularly concerned environmental justice advocates, who are not placated by the $40 billion in funding that the IRA devotes to disadvantaged communities.[91] In particular, the IRA contains provisions promoting federal oil and gas

88. *Id*. at 15.

89. *Id.* at 19. In addition, the IRA "insulates electricity consumers from increases in retail prices that could accompany carbon pricing or price fluctuations that could result from volatile fossil fuel markets." *Id*. at 24.

90. *Id.* at 23.

91. *See* Hannah Perls, *Breaking Down the Environmental Justice Provisions in the 2022 Inflation Reduction Act*, HARV. L. SCH. ENV'T & ENERGY L. PROGRAM (Aug. 12, 2022), https://eelp.law.harvard.edu/ira-ej-provisions/ [https://perma.cc/8CTA-M8SY] ("Several coalitions and organizations have argued that the Act's EJ benefits are outweighed by other provisions under the IRA, especially provisions that may drive investment in coal, oil and gas, nuclear, hydrogen, and biofuels that disproportionately impact frontline communities."). In an effort to assuage those concerns, advocates of the IRA detailed the IRA's environmental justice provisions. *See Environmental Justice in the Inflation Reduction Act*, SENATE DEMOCRATS, https://www.democrats.senate.gov/imo/media/doc/environmental_justice_in_the_inflation_reduction_act.pdf [https://perma.cc/BG6A-3KSW] (last visited Nov. 15, 2024). Excluding provisions that encourage but do not guarantee funding for disadvantaged communities, an environmental justice group arrived at a lower, $40 billion figure. Sylvia Chi, *IRA: Our Analysis of the Environmental Protection Act*, JUST SOLUTIONS COLLECTIVE, at 5 (Oct. 4, 2022), https://justsolutionscollective.org/solution/ira-our-analysis-of-the-inflation-reduction-act/ [https://perma.cc/GP67-H963].

leasing by tying it to the leasing of public lands for renewable energy.[92] In a side deal with Senator Manchin, President Biden agreed to support streamlining of environmental assessments to speed permitting of energy infrastructure and approval of a natural gas pipeline favored by Senator Manchin.[93] Some measures along those lines later became part of the debt-ceiling legislation.[94]

Other criticisms involve the IRA's agnosticism about clean energy technologies and, more specifically, its support for two controversial technologies: hydrogen use and carbon capture and sequestration. Hydrogen is a potentially useful substitute for fossil fuels because its combustion produces H_2O rather than CO_2.[95] However, producing hydrogen takes energy, and critics fear that producing the energy could produce more carbon than the use of hydrogen will save, as well as other air pollutants. The answer depends substantially on the rules governing the hydrogen tax credit,[96] which must balance the

92. *See* Sarah Hart, *Potential Impacts of the IRA's Onshore Energy Leasing Provisions*, HARV. L. SCH. ENV'T & ENERGY L. PROGRAM (Mar. 24, 2023), https://eelp.law.harvard.edu/ira-onshore-leasing/ [https://perma.cc/A7C8-3DEK]. As an article by the Sierra Club explains:

> Under the new law, the Department of the Interior cannot lease any offshore areas for wind energy development until it holds oil and gas auctions for at least 60 million offshore acres the preceding year. A similar deal was struck on land: The Department of Interior must lease at least 2 million acres of public land, or 50 percent of the acres nominated by industry groups, before expanding renewables like wind and solar.

Lindsey Botts, *The Dark Side of the Inflation Reduction Act,* SIERRA (Oct. 10, 2022), https://www.sierraclub.org/sierra/dark-side-inflation-reduction-act [https://perma.cc/V283-R3WA]. These requirements have led to bitterness among some communities who feel that they are being treated as "sacrifice zones." *Id.*

93. *See* Nina Lakhani, *Schumer and Manchin's 'dirty side deal' to fast-track pipelines faces backlash*, THE GUARDIAN (Sept. 22, 2022), https://www.theguardian.com/us-news/2022/sep/22/schumer-manchin-side-deal-pipelines-backlash [https://perma.cc/RJ6H-M8WR].

94. *See* Daniel A. Farber, *Rewriting NEPA: Statutory Continuity and Disruption in a Polarized Era* (Mar. 12, 2024), https://ssrn.com/abstract=4710933 [https://perma.cc/279T-2J32] (discussing the amendments to requirements for environmental impact statements); Appalachian Voices v. U.S. Dep't of the Interior, 78 F.4th 71 (4th Cir. 2023) (dismissing a challenge to the provision approving the pipeline).

95. *See* Bob Henson, *New Law Provides Hydrogen's Biggest Boost Yet*, YALE CLIMATE CONNECTIONS (Nov. 7, 2022), https://yaleclimateconnections.org/2022/11/new-law-provides-hydrogens-biggest-boost-yet/ [https://perma.cc/MVB6-3DET]. Hydrogen's greatest potential is as an energy source for industries that cannot readily electrify, including steel, cement, and long-distance transport. Hydrogen might also provide a way of storing power from renewables for longer times than current batteries are capable of. *Id.*

96. According to the NRDC:

> Treasury is set to issue guidance by summer to determine how lifecycle GHGs of hydrogen projects should be accounted for and determine their eligibility for the credit. Weak guidance could result in subsidizing hydrogen projects that have more than twice the emissions of today's status quo hydrogen and drive increased emissions of more than 100 million tons of carbon dioxide in this decade. This would send us further off course from our

promotion of hydrogen-related infrastructure with minimizing emissions from hydrogen production.[97] The IRA subsidizes another technology, carbon capture and sequestration (CCS), that has come under heavier fire.[98] Some environmental groups argue that the "buildout of CCS projects threatens to extend the life of fossil fuels and perpetuate the harms of pollution in overburdened communities."[99] During the legislative process, some environmental justice advocates contended that the "harms of the bill . . . outweigh its benefits" because of its support for CCS and hydrogen, along with other concessions made to Senator Manchin.[100]

Whatever their merits, these criticisms are not inherently connected with the strategy of using subsidies to promote clean energy. Similar issues could equally well arise in connection with other types of climate policies. In the setting of conventional emissions regulation, EPA must also determine whether to accept hydrogen and CCS as emission reduction methods.[101] Similarly, carbon tax legislation would need to consider whether to credit CCS in determining a

> climate goals, drive up air pollution and electricity prices, and tarnish the reputation of the nascent clean hydrogen industry that we need to decarbonize critical sectors like steelmaking.

Pete Budden & Rachel Fakhry, *IRA Clean Hydrogen Tax Credit: Debunking Five Myths*, NAT. RES. DEF. COUNCIL (Apr. 24, 2023), https://www.nrdc.org/bio/pete-budden/ira-clean-hydrogen-tax-credit-debunking-five-myths [https://perma.cc/QX8W-UV4Q].

97. *See* Jeff St. John, *'Green' Hydrogen Debate Heats Up Ahead of Tax-Credit Decision*, CANARY MEDIA (Dec. 6, 2023), https://www.canarymedia.com/articles/hydrogen/green-hydrogen-debate-heats-up-ahead-of-tax-credit-decision [https://perma.cc/XR7G-L434].

98. The relevant statutory provisions are discussed in detail in CARBON CAPTURE PROVISIONS IN THE INFLATION REDUCTION ACT OF 2022, CLEAN AIR TASK FORCE (2022), https://cdn.catf.us/wp-content/uploads/2022/08/19102026/carbon-capture-provisions-ira.pdf [https://perma.cc/9QRG-7R8C]. See *also* FACT SHEET: How the Inflation Reduction Act Helps Tribal Communities, THE WHITE HOUSE (Aug. 18, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/18/fact-sheet-how-the-inflation-reduction-act-helps-tribal-communities/ [https://perma.cc/7ZBP-QDG9].

99. *Carbon Capture: The Fossil Fuel Industry's False Climate Solution,* EARTHJUSTICE (Sept. 19, 2023), https://earthjustice.org/article/carbon-capture-the-fossil-fuel-industrys-false-climate-solution [https://perma.cc/PH9E-PLDN]. Carbon capture and sequestration (CCS) involves removal of carbon dioxide from a facility's emissions followed by storage of the gas deep underground or processing the gas for other uses. *Id.*

100. Manann Donoghoe et al., *The Inflation Reduction Act is Not a Climate Justice Bill*, CLIMATE JUSTICE ALLIANCE (Aug. 6, 2022), https://climatejusticealliance.org/the-inflation-reduction-act-is-not-a-climate-justice-bill/ [https://perma.cc/RGS8-SRWL]. Other environmental justice advocates called for scoring investments under the IRA based on their racial impacts. *See* Manann Donoghoe et al., *The US Can't Achieve Environmental Justice Through One-Size-Fits-All Climate Policy*, BROOKINGS (June 1, 2023), https://www.brookings.edu/articles/the-us-cant-achieve-environmental-justice-through-one-size-fits-all-climate-policy/ [https://perma.cc/5MXW-8XS7].

101. *See, e.g.*, *infra* text accompanying notes 246–252 (discussing the decision made by Biden's EPA to issue power plant emission regulations that rely upon CCS).

facility's taxable emissions, as would a cap-and-trade system. If Senator Manchin's vote had been vital for a carbon tax instead of a clean energy subsidy bill, he would still have been able to extract concessions in return for his support, such as counting coal plants with CCS or green hydrogen use as zero-emission.

Other criticisms of the IRA involve the effort to grow U.S. production of clean technologies, including components and key materials, rather than just their deployment.[102] These criticisms are more directly tied to the IRA's choice of green industrial policy rather than emission regulation. According to a European Union staffing paper, "[t]he IRA's protectionist elements in the form of local content requirements (LCRs) came as a shock."[103] The EU document complains that "this can be considered as a frontal attack on the World Trade Organization's (WTO) international trade order."[104] The IRA also contains provisions that condition some benefits on payment of prevailing wages

102. Briefly, those provisions of the IRA operate as follows:

> The drive to domesticate supply chains is most evident in the subsidies for electric vehicles, which apply to manufacturing in the United States or a country with a free trade agreement with the United States. There, half of the $7,500 tax credit is awarded for vehicles where battery components are manufactured or assembled in a qualifying country. The other half is awarded for a mineral supply chain that is extracted and processed through qualifying countries. For both credits, the required value percentage will steadily increase over the next 10 years, reaching 100 percent of battery value and 80 percent of mineral supply by 2032.

Joseph Majkut, *The Inflation Reduction Act: A Race to the Top or ends in High Gear?,* CTR. FOR STRATEGIC AND INT'L STUDIES (Mar. 1, 2023), https://www.csis.org/analysis/inflation-reduction-act-race-top-or-protectionism-high-gear [https://perma.cc/E4TH-B8Y3]. The tenor of another article is indicated by its title, Nina Lakhmani, *These Environmentalists Detest the Inflation Reduction Act*, MOTHER JONES (Aug. 10, 2022), https://www.motherjones.com/politics/2022/08/environmentalists-hate-inflation-reduction-act-climate-bill-fossil-fuels/ [PDF on file with the Columbia Journal of Environmental Law]. Advocates expressed similar concerns about impacts on tribal lands. *See* Anna V. Smith, *What the Inflation Reduction Act Means for Indian Country,* HIGH COUNTRY NEWS (Sept. 7, 2022), https://www.hcn.org/articles/indigenous-affairs-politics-what-the-inflation-reduction-act-means-for-indian-country/ [https://perma.cc/U5LA-JUNB] (quoting an environmental justice organizer as saying that the IRA could "create even more sacrifice zones that will disproportionately impact the lands and water of Indigenous and Black communities").

103. Christian Scheinert, *EU's response to the US Inflation Reduction Act (IRA)*, EUR. PARLIAMENT THINK TANK (June 2, 2023), https://www.europarl.europa.eu/thinktank/en/document/IPOL_IDA(2023)740087 [On File with the Columbia Journal of Environmental Law]. For discussion of the tension between green industrial policy and international trade law, *see* Garrett Donnelly, *Green Industry, Procurement, and Trade: Refining International Trade's Relationship with Green Policy*, 98 NYU L. REV. 282 (2023) (arguing for disclosure requirements to temper protectionist excesses).

104. SCHEINERT, *supra* note 103.

and operation of apprenticeship programs,[105] which, like the local content requirements, are designed to serve ends extraneous to emission reduction.[106]

Discussion of the IRA's geopolitical and trade impacts is beyond the scope of this Article, as is labor policy. The labor and local production provisions adversely impact the economics of decarbonization, though they may be defensible in terms of broader societal goals.[107] These provisions raise the cost of clean energy, requiring the use of more expensive domestic sources at the expense of cheaper foreign ones, and raising labor costs. The result could be to delay deployment of clean technology.

Even from the narrow perspective of decarbonization, however, these design choices may be justified despite their drag on clean energy deployment. Building an onshore manufacturing sector with well-paying jobs may help climate advocates assemble broader coalitions, including progressives and labor interests. Moreover, the growth of domestic industries will make rollbacks of the climate policy less likely and increase the chances of adopting even stronger future policies. Arguably, these political benefits are worth the decarbonization delays. We return to those issues of political dynamics at the end of Part III.

III. THE ECONOMIC AND POLITICAL DYNAMICS OF GREEN INDUSTRIAL POLICY

As we have seen, green industrial policy in the form of IIJA, CHIPS, and the IRA seems likely to cause substantial declines in carbon emissions in the United States. Those declines represent the direct effect of these laws in supplanting the use of fossil fuels. However, besides its direct effect on emissions, green industrial policy can also spark a cycle of innovation and declining cost, further accelerating the energy transition. In addition, green industrial policy may have political

105. For details on these requirements, *see Frequently Asked Questions about the Prevailing Wage and Apprenticeship under the Inflation Reduction Act*, INTERNAL REVENUE SERVICE, https://www.irs.gov/credits-deductions/frequently-asked-questions-about-the-prevailing-wage-and-apprenticeship-under-the-inflation-reduction-act [https://perma.cc/GQS9-Y5NA] (last updated July 3, 2024); *Analysis and Observations About Prevailing Wage and Apprenticeship Requirements*, KPMG (Nov. 2, 2022), https://kpmg.com/us/en/home/insights/2022/12/tnf-kpmg-report-analysis-and-observations-about-prevailing-wage-and-apprenticeship-requirements.html [https://perma.cc/AP5Q-7RUP].

106. For a discussion of the risk of protectionism in this setting, *see* Donnelly, *supra* note 103.

107. For an analysis of disputes about the place of climate policy in broader visions of social justice, *see* Jonas J. Monast, *The Ends and Means of Decarbonization: The Green New Deal in Context*, 50 ENV. L. 21 (2020).

effects[108] that help entrench climate policy, providing a more secure basis for investors. These indirect, dynamic effects will be the subject of Part III.

The analysis begins with a review of the extraordinary plunge in the costs of renewable energy and storage within the past two decades, which has transformed the policy landscape. The remainder of Part III shows how green industrial policy enhances the economic and political feasibility of the energy transition. To succeed, climate strategies will need to stimulate energy innovation, both to accelerate cost declines and to address sectors where emission reductions remain difficult, such as heavy industry and transport. Thus, climate policy must also be an innovation policy. However, creating new technologies is not enough; those technologies must also be deployed at scale. As it turns out, however, there is a beneficial feedback effect in which increased deployment drives innovation and cost decreases, which, in turn, drives further increases in deployment. The mechanisms include what economists call economies of scale and learning by doing. Both the longevity of climate policy and private sector responses depend on politics as much as economics. Part III closes with a discussion of the ways that industrial policy can strengthen the political bases for climate action.

A. The Startling Trajectory of Clean Energy Costs

Since 2010, renewable energy has become far more competitive with fossil fuels. In 2010, the levelized cost of onshore wind was almost double that of the lowest cost fossil fuel generation, but by 2022, the positions were reversed: the cheapest fossil fuel was double the cost of power from onshore wind. Similarly, offshore wind went from being two-and-a-half times more expensive than fossil fuels, to only 17% more expensive.[109]

Solar photovoltaic costs fell even more steeply. In 2010, photovoltaic energy was seven times more expensive than fossil-fuel generation. But by 2022, photovoltaics were almost a third *less* expensive than new fossil fuel generation on a cost per kilowatt hour basis.[110] This was possible because the cost of new solar power generation had

108. *See generally* Daniel E. Walters, *Tomorrow's Climate Law, Today*, U.C. DAVIS L. R. (forthcoming 2025), https://ssrn.com/abstract=4750208 [https://perma.cc/NA3S-RH8Y].

109. INTERNATIONAL RENEWABLE ENERGY AGENCY [IRENA], RENEWABLE POWER GENERATION COSTS IN 2022 17 (2023), https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022 [https://perma.cc/NNT6-DF32].

110. *Id*.

dropped by nearly 90% during that period.[111] In comparison, if its costs had dropped equally quickly since 2010, a new iPhone would cost under thirty dollars today.

In short, as the International Renewable Energy Agency (IRENA) puts it, "[t]he rate at which the cost of electricity from solar and wind power has fallen is quite remarkable."[112] By 2021, renewables were not only competitive with fossil fuels but significantly cheaper—often less expensive than the operating expenses of existing fossil fuel plants, never mind the capital costs.[113]

The cost of electricity storage has also fallen dramatically.[114] Like solar power, battery storage costs have dropped around 90% since 2010.[115] In the short span from 2015 to 2018—about long enough for a student to finish college—the cost of storage dropped by almost 70%.[116] The cost per kilowatt hour of four-hour, utility scale lithium storage is expected to fall by about an additional third or more by 2030.[117] According to the International Energy Agency, the combination of solar with battery storage is already competitive with new coal plants in India, and within two years, will also be competitive with new coal in China and new natural gas in the United States.[118] In China, the cheapest EVs cost less than comparable gas vehicles, and

111. *Id.* Besides these decreases in capital costs, it appears that operation and maintenance costs for solar and wind have also been declining. *See* Sarah Kurtz, *Are We Still Overestimating Costs for Wind and Solar?,* 4 JOULE 292 (2020).

112. IRENA, *supra* note 109, at 16.

113. *Id.* at 35.

114. According to the *Economist*:

> In the early 1990s the storage capacity needed to power a house for a day would have cost about $75,000. The cells themselves would have weighed 113kg (250lbs) and taken up as much space as a beer keg. Today the same amount of power can be delivered at a cost of less than $2,000, from a 40kg package roughly the size of a small backpack.

Lithium Battery Costs Have Fallen by 98% in Three Decades, THE ECONOMIST (Mar. 31, 2021), https://www.economist.com/graphic-detail/2021/03/31/lithium-battery-costs-have-fallen-by-98-in-three-decades [On File with the Columbia Journal of Environmental Law].

115. John Weaver, *Battery Prices Collapsing, Grid-Tied Energy Storage Expanding*, PV MAGAZINE (Mar. 6, 2024), https://pv-magazine-usa.com/2024/03/06/battery-prices-collapsing-grid-tied-energy-storage-expanding/ [https://perma.cc/WS5L-NUY3].

116. *Utility-Scale Battery Storage Costs Decreased Nearly 70% Between 2015 and 2018*, ENERGY INFORMATION ADMINISTRATION (Oct. 23, 2020), https://www.eia.gov/todayinenergy/detail.php?id=45596 [https://perma.cc/YAZ6-P8L5].

117. WESLEY COLE & AKASH KARMAKAR, COST PROJECTIONS FOR UTILITY-SCALE BATTERY STORAGE: 2023 UPDATE 4, NATIONAL RENEWABLE ENERGY LABORATORY (2023), https://www.nrel.gov/docs/fy23osti/85332.pdf [https://perma.cc/8EXV-3SDH]. INTERNATIONAL ENERGY AGENCY, BATTERIES AND SECURE ENERGY TRANSITIONS 13 (Apr. 2024), https://iea.blob.core.windows.net/assets/cb39c1bf-d2b3-446d-8c35-aae6b1f3a4a0/BatteriesandSecureEnergyTransitions.pdf [https://perma.cc/RG63-TANF].

118. INTERNATIONAL ENERGY AGENCY, *supra* note 117, at 13.

the upfront price gap in developed countries is expected to close rapidly.[119]

Decreasing costs have translated into increasing volume. Global renewable capacity quadrupled globally from 2010 to 2019, with solar capacity rising by a factor of twenty-six.[120] In little over a decade, U.S. wind generation tripled and solar capacity increased by a factor of seventy-three.[121] By late 2023, combined U.S. sales of new battery vehicles (hybrids, plug-in hybrids, and EVs) had reached 17% of sales, and automakers had invested more than $210 billion in EV-related manufacturing.[122]

In policy terms, it is not an overstatement to say that "this changes everything." The plunging cost of clean energy is the single most positive development for climate policy. Back in 2010, the year the Waxman-Markey bill failed to pass, emissions reduction was expected to be expensive. It was possible to argue that substantially reducing the use of fossil fuels would be a heavy burden even on developed countries and would risk miring developing countries in poverty. This is not to say that the argument was correct, even then, but it was not ridiculous.

However, a decade later, it was obvious that large expansions in clean energy were possible at manageable costs both in developed countries like the United States and in developing countries. The period since 2010, when the Waxman-Markey bill died in the Senate, "represents a seismic shift in the balance of competitiveness between renewables and incumbent fossil fuel and nuclear options."[123] Consequently, "the challenge today in most parts of the world is identifying how to integrate the maximum amount of solar and wind power possible into current electricity systems."[124] Policies that might have been considered absurdly burdensome in 2010 now impose much

119. *Id.* at 14. Even in developed countries today, EVs have higher sticker prices but compensate with lower operating and maintenance costs. *Id.*

120. Press Release, U.N. Environment Programme, A Decade of Renewable Energy Investment, Led by Solar, Tops USD 2.5 Trillion (Sept. 5, 2019), https://www.unep.org/news-and-stories/press-release/decade-renewable-energy-investment-led-solar-tops-usd-25-trillion [https://perma.cc/686U-MKR5].

121. *Global Electric Car Sales by Key Markets, 2010-2020*, INTERNATIONAL ENERGY AGENCY (May 18, 2020), https://www.iea.org/data-and-statistics/charts/global-electric-car-sales-by-key-markets-2015-2020 [https://perma.cc/MWY9-RKZM].

122. Robert Walton, *EV Sales Climb and are on Track to be 9% of US New Car Purchases in 2023*, UTILITY DIVE (Nov. 28, 2023), https://www.utilitydive.com/news/electric-vehicles-EVs-new-car-sales-2023/700799/ [https://perma.cc/UWR8-4A2Q].

123. MICHAEL TAYLOR ET AL., RENEWABLE POWER GENERATION COSTS IN 2022, INTERNATIONAL RENEWABLE ENERGY AGENCY 34 (2022).

124. *Id.*

smaller burdens or even offer cost savings.[125] On the other hand, policies that favor fossil fuels are now more difficult to justify economically and must overcome contrary market forces. Thus, efforts by the new Trump Administration toward fossil fuel dominance will have to contend with economic headwinds.

B. Climate Policy as Innovation Policy

Although solar panels and wind turbines are no longer novel technologies, there is still room for further innovation. As for other technologies—apart from ongoing development in battery technology—current technological development projects include the design of direct air capture, algae-based fuels, and zero-carbon aircraft designs; low-carbon technologies for producing cement and steel; and hydrogen production and use.[126] A push toward green innovation may also be needed to overcome the incumbent advantages of legacy fossil fuel technologies.[127]

Innovation policy has long relied on the patent system as its primary tool. This strategy seems to have run out of steam in terms of clean technology. Although research and development spending has remained robust,[128] apart from batteries and hydrogen,[129] there has been a slowdown in patenting for clean technologies at the very time we most need innovation.[130] Efforts to improve the patenting situation by fast-tracking patents for green technologies have not been successful.[131]

125. Even eight years ago, the competitive landscape for renewable energy and storage versus fossil fuels was much less encouraging than it is today. *See* Thomas Covert et al., *Will We Ever Stop Using Fossil Fuels?*, 30 J. ECON. PERSP. 117 (2016) (doubting the cost-competitiveness of clean energy and calling for extremely aggressive policies to limit fossil fuels).

126. Reinhilde Veugelers, *Powering the Clean Energy Innovation System* 4–6 (Peterson Inst. for Int'l Econ., Working Paper No. 24-5, 2024).

127. *Id.* at 7.

128. According to Vergeulers:

> Together the R&D expenditures of these dedicated clean energy companies represented 0.2 percent of all R&D spent in 2021 by the 2500 companies. This might seem small, but it represents about one quarter of all scoreboard R&D spent by *oil and gas* companies and 44 percent of all R&D spent by *utilities* companies. Furthermore, R&D expenditures by dedicated clean energy companies are fast growing.

Id. at 12.

129. *Id.* at 10. The slowdown in patenting may partly be due to tight credit, which impacts the ability of newer firms to invest in innovation. *See* Philippe Aghion, et al., *Lost in Transition: Financial Barriers to Green Growth* (INSEAD, Working Paper No. 2024/16/EPS, 2024).

130. *See* Jauyne Piana*, Diffusion of Green Technology: Patents, Licenses, and Incentives*, 52 TEX. ENV. L. REV. 37, 38 (2022).

131. *Id.* at 38–39.

Even under ideal circumstances, there are inherent limits to the patent system's ability to provide sufficient incentives for clean technologies.[132] Technology users will generally pay extra only for the benefits of the invention to themselves.[133] Thus, the patent incentive system does not reflect clean technology's environmental benefits.[134] However, public support for innovation can correct the underinvestment in innovation produced by the patent system.

The patent system also has the built-in drawback of inhibiting the actual use of new technologies. The patent system relies on the prospect of high profits from the patent monopoly to incentivize invention, but this mechanism raises prices for users and thereby disincentivizes actual use of the invention.[135] Public financial support for innovation and deployment can help counter this effect.

Researchers have surfaced another benefit of public support for innovation: a spillover effect on other innovations.[136] This key finding emerges from the study of a major Department of Energy research program. The program has provided a total of $40 billion to support early-stage innovation by small businesses over twenty years, or about $200 million per year.[137] Researchers found that every new patent incentivized by the program resulted in three additional patents in related fields by other inventors.[138] Because of the spillover effect, the grant recipients were only able to capture one-quarter to one-half of the patent-based benefits of innovation.[139] These large spillovers indicate that the patent system would not produce enough innovation, at least in energy technology, because the patentee can only recover a portion of the value of the social invention.[140]

132. *See* A. Paul Lehmann & Patrik Söderholm, *Can Technology-Specific Deployment Policies Be Cost-Effective?*, 71 ENV. & RES. ECON. 475, 482 (2018); Adam B. Jaffe et al., *Env't Pol'y and Technological Change*, 22 ENV. & RES. ECON. 41 (2002); DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW 95 (2003).

133. *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Innovation Policy Pluralism*, 128 YALE L.J. 544, 575 (2019).

134. *See id.* For a more recent discussion of the need to subsidize clean technology innovation, *see* Daron Acemoglu et al., *Green Innovation and the Transition toward a Clean Economy* (Peterson Inst. for Int'l Econ., Working Paper No. 23-14, 2023).

135. *See* Joseph E. Stiglitz, *Economic Foundations of Intellectual Property Rights*, 57 DUKE L.J. 1693, 1696, 1704, 1713 (2008).

136. Kyle R. Myers & Lauren Lanahan, *Estimating Spillovers from Publicly Funded R&D: Evidence from the US Department of Energy*, 112 AM. ECON. REV. 2393, 2394–96 (2022).

137. *Id.* at 2397.

138. *Id.* at 2394.

139. *Id.* at 2396.

140. *Id.* at 2419.

The economic evidence, then, suggests supplementing the patent system with grants for research and development of new technologies that produce public benefits.[141] As noted in the introduction, the 2021–2022 funding bills (particularly the CHIPS Act) provide billions of dollars in such funding, which will accelerate much-needed innovation in the energy sector. Besides encouraging innovation directly, the government can do so indirectly by expanding the market for clean energy. This is most obvious when the government intervention spurs greater uptake of existing technologies that were previously deployed only slowly.[142] Because deployment subsidies make clean technologies more profitable, they also make related research and development (R&D) more profitable by providing a larger market for innovations. The upshot is that those subsidies can shift financial resources and research talent from the fossil fuel industry to clean technology innovation.[143] There is a substantial body of empirical work showing that subsidies for the deployment of various clean

141. Stiglitz, *supra* note 135, at 1713, 1721–22; Hemel & Ouellette, *supra* note 133, at 551–52 (direct government funding and the national law system account for a quarter of all U.S. R&D); *but see generally* Charles J. Delmotte, *The Case Against Tax Subsidies in Innovation Policy*, 48 FLA. ST. U. L. REV. 285, 287 (2021) (arguing innovation tax subsidies are subject to overwhelming information problems and significant rent-seeking issues).

142. David E. Adelman & Kirsten H. Engel, *Reorienting State Climate Change Policies to Induce Technological Change*, 50 ARIZ. L. REV. 835, 840–41 (2008).

143. Zachary Liscow & Quentin Karpilow, *Innovation Snowballing and Climate Law*, 95 WASH. U. L. REV. 387, 444 (2017). Other models provide similar results:

> [T]he dependence of technological progress on market size creates positive returns to scale. If innovation today increases the size of the market, the partially fixed expenses for research become more profitable, setting off a virtuous cycle. The path dependencies in research can strengthen the case for R&D subsidies as a complement to an optimal carbon tax to promote an early switching to cleaner energy sources.

Johannes Eugster, *The Impact of Environmental Policy on Innovation in Clean Energy* (Int'l Monetary Fund, Working Paper No. 2021/213, 2021). In this IMF paper, Eugster concludes that tightening environmental policies across a range of countries had approximately the same effect on clean innovation as a $70 per barrel increase in the cost of oil. Notably, estimating a model of innovation production, Eugster found that:

> [B]oth market policies (including trading schemes and feed-in tariffs) as well as non-market policies (including emission limits (e.g. on power plants) and R&D subsidies) made positive, statistically significant and roughly comparable contributions to clean innovation. This remains true if all others policy tools are controlled for. Such a result is encouraging in two ways. It first confirms that market mechanisms are effective at stimulating innovation, consistent with models of endogenous technological change, where the expected future demand for a product can incentivize research into producing it more efficiently. Results however also suggest a degree of substitutability among policy tools, at least as far as innovation is concerned, and that multiple policy tools – or a combination thereof – can promote clean innovation in a comparable way.

Id. at 3.

technologies significantly increase innovation, with variations depending on the technology in question and the type of subsidy.[144]

The dynamic among subsidies, innovation, and clean energy technologies is an example of what Zachary Liscow and Quentin Karpilow have called "innovation snowballing."[145] Based on a review of recent research, they conclude that innovation policy deserves a central role in environmental law and is particularly important for the energy transition.[146] Government regulations, such as renewable portfolio standards and deployment incentives like those in the IRA, can lower prices and spark further growth. The growth of the sector means that innovators have a greater market for their inventions; lower costs and better products due to increased innovation further accelerates the sector's growth. In other words, there is a multiplier effect for government clean energy stimulus.

The upshot is that we can expect the IRA and the CHIPS Act to spark a round of greater investment in research and development. The result will be declining costs for the production, storage, and use of clean energy. These feedback effects promise to augment the IRA's direct impact on clean energy use. Disincentives to use fossil fuels, such as a carbon tax or regulation of carbon emissions, can act as additional spurs to innovation.[147]

C. Expanding Scale, Learning Curve Effects, and Green Industrial Policy

The feedback between deployment and innovation is related to a broader phenomenon in which increasing scale drives cost reductions. As we have seen, major federal actions—in particular the IRA—have aimed to expand the clean technology sector, and green industrial policy has become a key part of the climate agenda.[148] Industrial policy—the deliberate effort to grow sectors of the economy identified as important for economic or other reasons—has had a bad name

144. *See* Liscow & Karpilow, *supra* note 143.

145. *Id.* at 404.

146. *Id.* at 393.

147. *See generally* Derek Lemoine, *Innovation-Led Transitions in Energy Supply*, 16 AM. J. ECON. MACROECON. 29 (2024); Alkis T. Pitelis, *Industrial Policy for Renewable Energy: The Innovation Impact of European Policy Instruments and Their Interactions*, 22 COMPETITION AND CHANGE 227 (2018).

148. A working definition of green industrial policy is "'government intervention to hasten the restructuring of the economy towards environmental sustainability,' including 'shifting economic trajectories away from traditional industries towards new, "greener" technological industrial futures.'" Ahmad et al., *supra* note 9, at 1101.

among economists, who tend to be dubious about government efforts to "pick winners."[149] However, recent economics research has tended to be more favorable to industrial policy. A recent survey of the literature found that the weight of recent research supports the conclusion that the effects of industrial policies can be large and durable.[150] Quasi-experiments where local industrial policies have happened "by accident" demonstrate "the potential for long-lasting, transformational local effects, showing the scale of the market failures that industrial policy is designed to overcome."[151]

Using industrial policy to grow clean energy has a special justification since we need this technology to avert potentially catastrophic global impacts. As with the use of industrial policy to support national security, this overriding goal provides a justification for government action even if, as a general matter, we doubt the government's capacity to identify "economic winners."[152]

Another argument for green industrial policy is the need to coordinate the growth of multiple types of infrastructure. For instance, expanding the use of electric vehicles means providing charging stations, additional renewable energy to power the vehicles, and grid upgrades to handle the added power demand—all of which must be developed in tandem to be effective. In economic terms, then, the

149. For a survey of the literature, *see* Reka Jahasz et al., *The New Economics of Industrial Policy* (NBER, Working Paper No. 31538, 2023). The authors identify two major critiques of industrial policy:

> One of these objections is about information shortcomings, the other about political capture. The informational critique asserts that even if the market failures on which governments could act are widespread, real-world governments are unlikely to know enough about the location and magnitude of these failures to make the correct decisions. The political critique asserts that even if governments have (or could acquire) the relevant information, industrial policy opens the door to self-interested lobbying and political influence activities, diverting the government into activities that enrich private interests without enlarging the social pie.

Id. at 6.

150. *Id.* at 26. The authors view ARPA-E as "[o]ne of the most successful cases of industrial policy in advanced countries." *Id.* at 32.

151. *Id.* at 26.

152. As Nobel laureate economist Paul Krugman has observed, industrial policy has had its critics; however, the "reason we're able to make major progress on climate using carrots rather than sticks—subsidies rather than taxes or quotas—is that green technology has been advancing at an incredible rate, consistently outpacing official projections." Paul Krugman, *How to Think About Green Industrial Policy*, N.Y. TIMES (May 9, 2023), https://www.nytimes.com/2023/05/09/opinion/climate-inflation-reduction-act-biden.html [On File with the Columbia Journal of Environmental Law]. And because there are "good reasons to believe that clean energy is subject to steep learning curves . . . subsidizing a green transition will cause the technological progress making such a transition possible to advance even faster." *Id.*

energy transition involves a lumpy social good, one that "only delivers value when irreducibly complementary parts are assembled."[153] As with a jigsaw puzzle or bridge, "unless and until all the necessary pieces come together, the project as a whole and the individual pieces themselves are of substantially less value."[154]

Government intervention may be needed to break the logjam. For example, Texas—historically the paradigm "free market" state—was the home of one of the most successful industrial policy measures. The state first identified the opportunity for expanded wind power and new transmission, and then coordinated construction of the new infrastructure by bringing "stakeholders and policy analysts together to hash out a plan to spend $6.7 billion building transmission lines capable of delivering large amounts of power from West Texas to population centers, all to be recovered from ratepayers throughout the state."[155]

Expanding the renewable energy sector can lead to positive feedback that lowers prices and thereby fuels further expansion.[156] Some of this may simply be due to economies of scale in production. Greater deployment also creates the opportunity for manufacturers to engage in "learning by doing," as they find ways to improve quality control, cut costs, and make product improvements.

153. Walters, *supra* note 14, at 548.

154. *Id.*

155. *Id.* at 559–60. In a reversal of Texas's free market traditions, the passage of Proposition 7 in late 2023 creates a $10 billion fund for low-interest loans for new dispatchable power generation, intended to make natural gas plants viable despite economic headwinds. Robert Walton, *Texas Voters Approve $10B Energy Fund, with Most Going to Build Gas-Fired Power Plants*, UTILITY DIVE (Nov. 8, 2023), https://www.utilitydive.com/news/texas-voters-approve-energy-fund-gas-power-plants-proposition-7/699110/ [https://perma.cc/54GE-RY6Q]. The impact of the funding will depend on the availability of creditworthy projects and the extent to which any resulting new facilities end up being run, but these developments do illustrate the risk of ideologically driven pushback against the energy transition.

156. A recent paper by Oxford researchers explores the relationship between growth of renewables and their production cost using Wright's Law to estimate future energy costs. Rupert Way et al., *Empirically Grounded Technology Forecasts and the Energy Transition*, 6 JOULE 2057 (2022). As the authors explain, "Under Wright's law, costs depend on experience. Although experience does not directly cause costs to drop, it is correlated with other factors that do, such as level of effort and R&D, and has the essential advantage of being relatively easy to measure." *Id.* Way et al. predict dramatic decreases in the costs of renewables, storage, and related technologies, resulting in large savings to consumers: "We want to emphasize that our results indicate that a rapid green energy transition is likely to be beneficial, even if climate change were not a problem. When climate change is taken into account, the benefits of the Fast Transition become over-whelming." *Id.* at 2074. These findings indicate that a large bump in deployment, such as that produced by the IRA, could substantially accelerate movement down the cost curve. *See id.* at 2069–70.

Recent empirical evidence confirms the dramatic effect of learning by doing in the clean energy sector,[157] which has resulted in billions of dollars in reduced costs across the economy annually.[158] As early adopters work out the kinks in producing and marketing new technologies, others benefit from the improvements and are quicker to adopt them.[159] Through this "learning by doing" channel, regulatory requirements and subsidies can lead to improvements that augment the spread of new technologies.[160]

Recent research confirms the significance of learning-by-doing in the clean energy sector.[161] A 2021 study found variations in the learning rates for various technologies, with the slowest rate of learning for production of onshore wind turbines and the fastest for solar panels, which had about twice the learning rate of typical technologies.[162] The study found even faster learning rates when the unit of comparison is the levelized cost of energy, rather than equipment costs,[163] because of increases in the power that can be produced from the equipment (for instance, by using tracking rather than stationary solar panels).[164] Battery storage has had an 80% learning curve, far higher than earlier clean technologies.[165]

157. *See* Mathias Mier et al., *Endogenous Technological Change in Power Markets* 1 (Ifo Inst., Working Paper No. 373, 2022) (finding that learning-by-doing in power markets generally leads to lower costs and earlier deployment of technological improvements, though with regional differences).

158. Adelman & Engel, *supra* note 142, at 848. For instance, "[f]or both transmission and storage policy, regulators and experts have identified the persistence of so-called 'chicken-or-egg problems,' by which they mean that either the existence of more renewable resources could induce greater infrastructure development, or greater infrastructure development could induce greater development of renewables, but neither occurs because developers in either space would rather wait for the other to act first." Walters, *supra* note 14, at 570. As Walters explains, the "strong complementarities between renewable generation and storage . . . render the production function for grid-scale, long-duration storage non-linear: after the grid reaches a certain threshold of renewable generation, the value of this kind of storage increases at a faster rate than it did before, and vice versa for renewable generation itself." *Id.* at 583. The coordination problem arises because "a high penetration of renewables on the grid is also more valuable when there is sufficient long-duration grid-scale storage to facilitate low levels of curtailment of available renewable capacity." *Id.*

159. Adelman & Engel, supra note 142, at 849.

160. *Id.* at 850.

161. *See* Gunther Glenk et al., *Cost Dynamics of Clean Energy Technology*, 73 SCHMALENBACH J. BUS. RES. 179 (2021).

162. *Id.* at 182.

163. *Id.* at 187–194. For a discussion of the utility and limitations of the levelized-cost metric, *see* IRENA, *supra* note 112, at 57.

164. Glenk, *supra* note 161, at 195.

165. *Id.* at 191.

D. The Political Dynamics of Green Industrial Policy

Green industrial policy is both an economic and political strategy. Climate policies can create their own constituencies of businesses and workers, locking in support for clean energy.[166] As an example, consider the effort to roll back California's climate policy through a 2010 popular initiative.[167] The initiative was soundly defeated.[168] One notable objection to the measure was that a rollback would threaten jobs in the renewable energy industry, which had become important to California's economy.[169] A third of the funding to oppose the measure came from the renewable energy industry.[170]

Indeed, renewable industries can generate political support from unexpected quarters. The desire to support local businesses can sometimes overshadow ideological opposition to climate action. Texas is the leading producer of electricity from wind. Not coincidentally, Texas Senator Ted Cruz, a climate change denier,[171] won an award for supporting wind power in Congress.[172] Driven by similar motivations, Iowa Senator Chuck Grassley, a conservative Republican, received an award for "[h]is vision and decades of tireless support for America's wind workers."[173]

The IRA seems to have already impacted the politics of clean energy. For instance, House Republicans recently joined with Democrats to defeat a provision that would undermine the IRA.[174] A 2023 study found that at least thirty-seven congressional Republicans

166. This has long been understood, *see, e.g.*, Michaël Aklin & Johannes Urpelainen, *The Strategy of Sustainable Energy Transitions: Political Competition and Path Dependence*, 57 AMER. J. POL. SCI. 643 (2011).

167. *See* Eric Biber, *Cultivating a Green Political Landscape: Lessons for Climate Change Policy from the Defeat of California's Proposition 23*, 66 VAND. L. REV. 399, 403–11 (2013).

168. *Id.* at 400.

169. *Id.* at 417.

170. *Id.* at 412 n.57.

171. Diane Nguyen, *What Do Ted Cruz and Beto O'Rourke Say About Climate Change on the Campaign Trail?,* TEX. PUB. RADIO (Oct. 24, 2018, 12:56 PM), https://www.tpr.org/2018-10-24/what-do-ted-cruz-and-beto-orourke-say-about-climate-change-on-the-campaign-trail [https://perma.cc/A9E6-GPXA].

172. TRI GLOB. ENERGY, *U.S. Senator Ted Cruz Receives Tri Global Energy's 2019 Wind Leadership Award*, PR NEWSWIRE (Dec. 23, 2019), https://www.prnewswire.com/news-releases/us-senator-ted-cruz-receives-tri-global-energys-2019-wind-leadership-award-300978981.html [https://perma.cc/F4PK-CU37].

173. Evan Vaughan, *Sen. Grassley Receives "U.S. Wind Champion Award,"* CHUCK GRASSLEY (Aug. 6, 2018), https://www.grassley.senate.gov/news/news-releases/sen-grassley-receives-us-wind-champion-award [https://perma.cc/9357-NU4B]

174. Kelsey Brugger, *Why House Republicans Voted in the Climate Law's Favor,* E&E NEWS (Apr. 12, 2024), https://www.eenews.net/articles/why-house-republicans-voted-in-the-climate-laws-favor/ [https://perma.cc/LFK3-UMZ7].

represented districts with new or expanded clean energy production fostered by the IRA, IIJA, or the CHIPS and Science Act.[175] Other observers have reached similar conclusions about the economic impact of these laws in Republican districts.[176] One analysis "found that Republican districts were home to about two-thirds of the major renewable energy, battery, and electric vehicle projects that companies had announced since President Biden signed the IRA in August."[177] Another report found that "Republican-headed states have claimed the lion's share of new renewable energy and electric vehicle activity since the legislation, with Republican-held congressional districts hosting more than 80% of all utility-scale wind or solar farms and battery projects currently in advanced development."[178] This constellation of interests led a group of House Republicans to urge retention of IRA provisions benefitting their districts, resulting in a declaration by the Republican Speaker of the House that IRA reform would have to use a scalpel, much to the consternation of the party's conservative wing.[179]

Moreover, because the IRA is agnostic about individual low-carbon technologies rather than being limited to solar and wind, it also funds emission reduction activities by fossil fuel companies in communities

175. Emma Dumain & Timothy Cama, *One Reason the Debt Fight is Getting Awkward for Republicans*, POLITICO (Apr. 22, 2023), https://www.politico.com/news/2023/04/22/gop-attacks-energy-spending-00093204 [PDF on file with the Columbia Journal of Environmental Law].

176. This was certainly the hope of the Biden Administration. *See* Benjamin Storrow, *Podesta on Trump Undoing IRA: 'Very, very difficult*,' CLIMATEWIRE (Apr. 17, 2024), https://www.eenews.net/publication/climatewire/ [https://perma.cc/F8LP-ERJ5].

177. *Id.* For example, archconservative Rep. Marjorie Taylor Greene's district benefited from a new solar factory, something President Biden took special pains to publicize. *See* Robin Bravender, *How Marjorie Taylor Green's District Became Biden's Climate Poster Child*, POLITICO (July 12, 2023), https://www.politico.com/news/2023/07/11/marjorie-taylor-greene-district-climate-biden-00104848 [On File with the Columbia Journal of Environmental Law]. Similarly, Volkswagen was able to obtain extensive subsidies from the state of South Carolina for a $2 billion electric vehicle factory. The Republican Governor, "who had signed an executive order weeks earlier declaring South Carolina's intent to support the electric vehicle industry, pushed to get a $1.3 billion incentives package for [Volkswagen] through the Legislature—despite opposition from some members of his own party, belonging to the ultra-conservative Freedom Caucus." Marianne Lavelle, *South Carolina Welcomes Multibillion Dollar Electric Vehicle Projects, Even Though Many Echo Trump's Harsh EV Critiques*, INSIDE CLIMATE NEWS (Feb. 24, 2024), https://insideclimatenews.org/news/24022024/south-carolina-electric-vehicle-projects-many-echo-trumps-harsh-critiques/ [https://perma.cc/88TM-E9AU].

178. Oliver Milman, *Republicans in the US 'Battery Belt' Embrace Biden's Climate Spending*, THE GUARDIAN (Feb. 22, 2023), https://www.theguardian.com/environment/2023/feb/22/climate-spending-republican-states-clean-energy-funding [https://perma.cc/G6CL-D8A9].

179. Kelsey Brugger & Emma Dumain, *Johnson Talk On Green Tax Credits Splits House Republicans: Conservatives Rebuked the House Speaker Wednesday, Saying the Tax Incentives "Need to Go Away*," E&E DAILY (Sept. 19, 2024), https://www.eenews.net/articles/johnson-talk-on-green-tax-credits-splits-house-republicans/ [https://perma.cc/LFK3-UMZ7].

with connections to the fossil fuel industry. That funding may help entrench the IRA in ways that might not be easy with a regulatory statute. For instance, according to one press report, some oil executives—including the CEO of Exxon—praise the IRA for its support for CCS and clean hydrogen, dulling the oil industry's interest in IRA repeal.[180] In addition, IRA funding for communities that depend on fossil fuel production or use[181] could help mollify political resistance to the transition.[182] From the point of view of climate advocates, this odd alliance with the fossil fuel industry might be seen as a case of "holding your friends close and your enemies closer." Public utilities have also found much to attract them in the IRA, and the leading utility organization—led by a former Trump cabinet member, no less[183]—has pledged to defend the law.[184]

180. Maxine Joselow, *The Surprising Reasons Why Big Oil May Not Want a Second Trump Term*, WASH. POST (Mar. 26, 2024), https://www.washingtonpost.com/climate-environment/2024/03/26/big-oil-trump-2024/ [On File with the Columbia Journal of Environmental Law]. Exxon's CEO explained, "I was very supportive of the IRA — I am very supportive of the IRA — because as legislated the IRA focuses on carbon intensity and in theory is technology-agnostic . . . . They're not trying to pick a particular technology." *Id.* Exxon has several IRA-funded projects in the works:

> Vijay Swarup, Exxon's senior director of climate strategy and technology, added that the IRA is "getting projects to advance." Exxon has signed contracts to store the carbon captured from an ammonia plant and a steel plant in Louisiana, as well as a yet-to-be-built hydrogen plant in Texas, Swarup said in an interview.

Id.

181. According to MIT researchers, "[a] disproportionate amount of the money is also flowing into low-income areas and 'energy communities,' or regions that previously produced fossil fuels." James Temple, *Trump Wants to Unravel Biden's Landmark Climate Law. Here is What's Most at Risk*, MIT TECH. REV. (Feb. 26,2024), https://www.technologyreview.com/2024/02/26/1088921/trump-wants-to-unravel-bidens-landmark-climate-law-here-is-whats-most-at-risk/ [https://perma.cc/H6E8-SC3G]. Despite the title, the author argues that "some sizeable share of Republicans will likely push back on more sweeping changes to the IRA" if the changes would be detrimental to businesses or stymie new projects. *Id.* On the other hand, he views subsidies for EV buyers as particularly unpopular with Republicans and therefore vulnerable. *Id.*

182. *See* Tara Righetti, et al., *Adapting to Coal Plant Closures: A Framework for Understanding State Resistance to the Energy Transition*, 51 ENV. L. 957 (2021). This impact may be especially significant in rural communities where other economic opportunities are scarce. *Id.* at 963.

183. The individual in question, Dan Brouillette, served both as Secretary of Energy and Deputy Secretary of Energy under President Trump. *See Dan Brouillette: President and CEO*, EDISON INSTITUTE https://www.eei.org/-/media/Project/EEI/Documents/About/Leadership/Brouillette.pdf [https://perma.cc/W7TL-S77F].

184. Jason Plautz, *EEI Chief Vows to Defend Climate Law from Republican Attacks*, ENERGYWIRE (Feb. 21, 2024), https://subscriber.politicopro.com/article/eenews/2024/02/21/eei-chief-vows-to-defend-climate-law-from-republican-attack-00142256 [On File with the Columbia Journal of Environmental Law]. The EEI's support signals the view of an important economic sector. EEI stands for the Edison Electricity Institute, which describes itself as:

Unstable climate policies have been a problem elsewhere in the world where policy has flipped after political shifts.[185] Rollbacks are not an insignificant concern in the United States, given the reversals of policy that have occurred under successive Presidents.[186] Making policy durable is especially important in situations involving major infrastructure investments since investors will be less likely to participate when the future profitability of the infrastructure is exposed to policy instability. Yet, as the IRA illustrates, in today's polarized and closely divided polity, climate legislation is likely to pass by very narrow margins, which increases the risk that a small political shift could result in repeal.[187]

If the IRA survives shifting political winds, one reason for its survival will be that it has changed the political landscape. As discussed above, an important dimension of the shift is the creation of powerful economic interests in the expansion of clean energy, giving investors, workers, and communities a stake in the continuation of the statute's subsidies and tax credits. Another dimension may be psychological. As wind and solar expand as part of the power mix and more and more cars are electric, they will be assimilated into the baseline that people take for granted as part of the status quo. Both factors will become

> The Edison Electric Institute (EEI) is the association that represents all U.S. investor-owned electric companies. Our members provide electricity for nearly 250 million Americans and operate in all 50 states and the District of Columbia . . . . In addition to our U.S. members, EEI has more than 70 international electric companies as International Members, and hundreds of industry suppliers and related organizations as Associate Members . . . . Organized in 1933, EEI provides public policy leadership, strategic business intelligence, and essential conferences and forums.

Our Mission, EDISON ELECTRIC INSTITUTE, https://www.eei.org/about-eei/About#mission [https://perma.cc/D8D5-WRER].

185. Hari M. Osofsky & Jacqueline Peel, *The Grass is Not Always Greener: Congressional Dysfunction, Executive Action, and Climate Change in Comparative Perspective*, 91 CHI.-KENT L. REV. 139, at 141, 154–68 (2016).

186. *Id.* at 146–54; LAZARUS, *supra* note 40, at 195, 291–294; Martin Lockman, *Climate Entrenchment in Unstable Legal Regimes*, 118 NW. U.L. REV. ONLINE 98, 104–106 (Aug. 11, 2023). As Jonathan Masur has observed, policy instability is a particular concern in the context of climate change because rollbacks result in long-term additions to atmospheric CO_2, undermine the ability of the U.S. to reach international agreements, and foster uncertainty for investors, "whose decisions about whether to invest in cleaner technologies will be driven by guesses about which way the political winds will blow." Jonathan S. Masur, *Regulatory Oscillation*, 39 YALE J. ON REG. 744, 748 (2022).

187. Before the IRA was passed, David Spence predicted more generally that "if climate legislation comes at all, it will come not as a republican moment with massive support in Congress, but rather by very thin legislative margins with little or no Republican support. That does not bode well for the prospect of strong, durable change in climate policy." David B. Spence, *Naïve Administrative Law: Complexity, Delegation, and Policy*, 39 YALE J. ON REG. 964, 997 (2022).

stronger the longer the IRA is on the books, and the more infrastructure and manufacturing take place.

The 2024 election left the federal government under unified control, with a zealous opponent of climate policy in the White House. Both ideology and fealty to the President favor repeal of the IRA. We cannot rule out the possibility that Republican members of Congress will be more influenced by those forces than by the concrete economic interests of their constituents.[188] But we can at least be confident in making a comparative judgment: As we enter into a tumultuous period for federal policies of all kinds, the chances that much or all of the IRA will survive are clearly greater than the chances of Biden-era EPA climate regulations surviving a second Trump presidency. Further, it seems almost incontestable that, all things being equal, a bill that creates financial benefits for significant parts of the population will be harder to repeal than one that directly creates only financial costs.

Beyond the political economy of green innovation in the United States, international dynamics are also at play. Subsidies in one country may trigger subsidies in others who wish their industries to remain competitive. This appears to have happened in the European Union due to the IRA.[189] Although matching American subsidies is an expense the EU might prefer to avoid, they would further expand the production of solar panels, wind turbines, batteries, and electric vehicles—a global benefit.

A broader question is whether funding laws like the IRA diminish the likelihood of enacting stricter controls on carbon emissions or putting a price on carbon with a carbon tax or trading system. International experience does not seem to support this theory. Recent research found that "[o]ne of the most important ways to shift interest group perspectives on energy law and policy is through shaping the investments made by those interest groups."[190] International experiences indicate that green industrial policies spark capital investments, which in turn "nurture the growth of new interest groups friendly to decarbonization and encourage existing interest groups to shift their relationship to decarbonization, as those interest groups

188. Timothy Cama, *House Republicans Target Climate Law*, E&E NEWS (Mar. 8, 2024), https://www.eenews.net/articles/house-republicans-target-climate-law-in-new-budget-plan/ [On File with the Columbia Journal of Environmental Law].

189. Lamar Johnson, *EU Passes Domestic Clean Energy Act, Trailing US Supply Chain and Climate Bills*, ESG DIVE (Feb. 12, 2024), https://www.esgdive.com/news/eu-passes-net-zero-industry-act-domestic-supply-climate-chain-ira-iija-chips/707018/ [https://perma.cc/9BGX-KSDC].

190. Eric Biber et al., *The Political Economy of Decarbonization: A Research Agenda*, 82 BROOK. L. REV. 605, 617 (2017).

accumulate capital in regulation-adapted investments."[191] Based on this analysis, researchers have concluded that incentivizing the growth of clean technologies fosters, rather than crowds out,[192] further advances in climate policy: "Green industries are political allies in the development of more stringent climate policy . . . . Carrots buy sticks."[193] In other words, a green industrial policy can pave the political path to stricter regulations.[194]

While this may be true in general, it is still possible that overinflated expectations for the IRA could deflate pressure for stricter controls.[195] More generally, passage of the IRA could create the impression that the climate problem has been successfully addressed, reducing its salience, and thus, pushing the issue off (or at least pushing it further down) the political agenda.[196] Moreover, funding measures such as the IRA could create constituents who benefit only from funding

191. *Id.* at 617–18.

192. *See* Jonas Meckling et al., *Winning Coalitions for Climate Policy: Green Industrial Policy Builds Support for Carbon Regulation*, 349 SCI. 1170, 1170 (2015). On the positive impacts of the IRA on the economy, *see* John Bistline et al., *The Inflation Reduction Act Could Energize the Economy*, BROOKINGS (May 1, 2023), https://www.brookings.edu/opinions/the-inflation-reduction-act-could-energize-the-economy/ [https://perma.cc/LY96-2YTS].

193. Meckling et al., *supra* note 192, at 1170.

194. Murray and Monast explain some of the dynamics involved:

> For instance, whatever the positive merits of prescriptive regulation and carbon pricing might be for controlling GHG emissions, they are salient instruments in which the costs are highly visible and the benefits are diffuse. These features can engender political opposition from the parties bearing the costs (often regulated companies and their customers) and thereby impede passage into law. In contrast, policies that provide direct payments from the government to parties for the adoption of climate-friendly technologies (like the IRA) have salience features that work in the other direction—well-defined beneficiaries (firms and individuals receiving tax credits and grants) and diffuse bearers of the costs (taxpayers).

Murray & Monast, *supra* note 27, at 447. A new working paper by Eric Biber explores in much greater depth how an approach to climate policy built on interest group mobilization would work, including risks such as creating "dead ends" in which groups have a vested interest in technologies that have turned out not to be useful. *See* Eric G. Biber, Toward Effective Climate Policy (July 22, 2024) (unpublished manuscript) [On File with the Columbia Journal of Environmental Law].

195. Adam Orford argues that:

> [T]he flawed narrative of BIL and IRA's effectiveness is, in turn, making it less likely that the United States will enact further, necessary climate legislation. Although this is difficult to prove with certainty, theory suggests that BIL and IRA will drain away support for alternative climate policies, and what evidence is available today tends to support the conclusion that this is happening.

Orford, *supra* note 15, at 3.

196. *Id.* at 40.

approaches and resist replacing them with regulatory measures.[197] As noted earlier, however, the evidence suggests that "carrots" like the IRA lead to regulatory "sticks" rather than crowding them out.[198]

IV. SYNERGIES BETWEEN FINANCIAL AND REGULATORY TOOLS

While a forward-looking climate policy does not anoint regulation as *the* answer to emissions reduction, regulations remain important as "push" policies that complement the "pull" policies of technology incentives. Part IV focuses on the ways that industrial policy efforts like the IRA can support more aggressive EPA emission regulation. After a quick survey of the regulatory terrain, we will examine how green industrial policy can promote stronger regulations by reducing compliance costs and then consider how the IRA might help agencies stave off judicial reversals.

A. Brief Overview of State and Federal Emissions Regulation

Federal regulation of carbon emissions is centered on EPA.[199] The agency's authority to regulate carbon emissions stems from *Massachusetts v. EPA*,[200] which held that greenhouse gases are air pollutants for purposes of the Clean Air Act. EPA's path since then has been a saga in frustration due to changes in administrations and pushback from the Supreme Court.[201]

After the Supreme Court's ruling, EPA was faced with the question of how to go about regulating greenhouse gases using a statute

197. *Id.* Orford worries that "[i]f BIL and IRA have reduced the salience of climate change as a problem, spent up whatever political capital existed for climate action for the foreseeable future, and entrenched spending policies to the detriment of mandates, then it could be a very long time before it is possible to do anything else at the national level." *Id.*

198. Although I do not find Orford's crowding-out argument persuasive, we do agree on a more fundamental point:

> A healthier policy ecosystem would include a wider variety of approaches arranged as a mutually reinforcing mix of incentives and mandates. Where market forces temporarily stymie the demand-pull of tax incentives, renewable portfolio standards and zero-emission vehicle mandates could stand in to maintain policy progress. Where voluntary programs fail to achieve results, backstop mandates might loom, not only as alternatives, but as incentives to make the voluntary programs work.

Id. at 39. I also agree with his call for the climate policy community to redouble its efforts to obtain stronger climate policies. *Id.*

199. For a comprehensive history of EPA's climate efforts, *see* Freeman, *supra* note 20.

200. Massachusetts v. E.P.A., 549 U.S. 497 (2007).

201. For fuller accounts of EPA's greenhouse gas regulations, *see* FARBER & CARLARNE, *supra* note 21, at 163–75; Freeman, *supra* note 20.

enacted when urban air pollution was a predominant concern.[202] This was a relatively straightforward issue in terms of vehicle emissions.[203] Section 202 of the Clean Air Act requires EPA to impose standards for emissions from new motor vehicles once it has found they endanger human health.[204] The Obama Administration issued rules restricting tailpipe emissions,[205] which were upheld by the D.C. Circuit.[206] Illustrating the cross-cutting political winds, the first Trump Administration froze the Obama standards, which otherwise would have become stricter, an action the Biden Administration rolled back as a prelude to even stricter rules.[207]

To regulate emissions from existing power plants—especially existing coal-fired plants—EPA turned to Section 111(d) of the Clean Air Act.[208] Under Section 111(d), EPA can require states to submit plans to control emissions from existing plants once it has issued a standard for new sources in the same category under Section 111(b). If a state fails to submit a valid plan, EPA must submit its own enforceable plan for that state. The plans are supposed to be based on the standard of performance for the industry—that is, the best "system of continuous emission reduction" for existing plants that has been "adequately

202. EPA's deliberations on this issue are recounted in Freeman, *supra* note 20, at 45–48 (Bush Administration), *Id.* at 53–63 (Obama Administration).

203. The word "relatively" deserves emphasis here. Although EPA's legal authority was clear and the car industry ultimately acquiesced in the standard, the process itself was fraught. The story is told from the perspective of a participant in Freeman, *supra* note 20, at 52–55.

204. Section 202(1) of the Clean Air Act provides:

> The Administrator shall by regulation prescribe (and from time to time revise) in accordance with the provisions of this section, standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.

42 U.S.C. § 7521.

205. For an insider's view of the rulemaking, *see* Jody Freeman, *The Obama Administration's National Auto Policy: Lessons from the "Car Deal,"* 35 HARV. ENV'T L. REV. 343 (2011).

206. Coal. for Responsible Regul., Inc. v. EPA, 684 F.3d 102 (2012) (per curiam). A different portion of the court of appeals opinion dealing with stationary sources was partially reversed in Util. Air Regul. Grp. v. EPA, 573 U.S. 302 (2014). For a fuller description of policies to reduce transportation emissions, see FARBER & CARLARNE, *supra* note 21, at 148–55.

207. For background on these developments, *see* RICHARD K. LATTANZIO ET AL., CONG. RSCH. SERV., R445204, VEHICLE FUEL ECONOMY AND GREENHOUSE GAS STANDARDS: FREQUENTLY ASKED QUESTIONS (2021).

208. 42 U.S.C. § 7411(d). Once EPA has issued a new source standard for a pollutant other than certain non-greenhouse gas pollutants, § 111(d) requires EPA to "prescribe regulations which shall establish a procedure . . . under which each State shall submit to the Administrator a plan which (A) establishes standards of performance for any existing source for any air pollutant . . . to which a standard of performance under this section would apply if such existing source were a new source." *Id.*

demonstrated."[209] A crucial issue involved the scope of the term "system"—does it include only plant-specific emission limitations measures, or could a system be defined more broadly to include changes in a state's energy mix?

The Obama Administration adopted a broad definition of the term "system." Its Section 111(d) regulation was known as the Clean Power Plan.[210] EPA's choice for the best system of emission reduction for existing power plants consisted of three building blocks: (1) efficiency improvements in coal-fired plants, (2) substitution of natural gas generation for coal-fired generation when feasible, and (3) increased use of renewables.[211] The Trump EPA contended that the statute unambiguously barred any regulation beyond efficiency improvements at individual coal-fired power plants. In President Trump's first year in office in his first term, EPA proposed repealing the Clean Power Plan, and a year later proposed a replacement, the Affordable Clean Energy (ACE) rule.[212] The final regulation repealing and replacing the Clean Power Plan was issued in 2019.[213]

209. Section 111(a)(1) defines a standard of performance as "a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated." 42 U.S.C. § 7411(a)(1).

210. Carbon Pollution Emission Guidelines for Existing Sources: Electric Utility Generation Units, 80 Fed. Reg. 64662 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60). For contemporaneous commentary on the Clean Power Plan, *see e.g.*, William S. Scherman & Jason J. Fleischer, *The Environmental Protection Agency and the Clean Power Plan: A Paradigm Shift in Energy Regulation Away from Energy Regulators*, 36 ENERGY L.J. 355, 357 (2015); Jessica M. Wilkins, *The Validity of the Clean Power Plan's Emissions Trading Provisions*, 91 NYU. L. REV. 1386, 1389 (2016); Jody Freeman & David B. Spence, *Old Statutes, New Problems*, 163 U. PA. L. REV. 1 (2014).

211. *Fact Sheet: Overview of the Clean Power Plan: Cutting Carbon Pollution from Power Plants*, ENV'T PROT. AGENCY, https://19january2017snapshot.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan_.html [https://perma.cc/B2FC-R88K] (last visited Dec. 29, 2024).

212. Repeal of the Clean Power Plan; Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guidelines Implementing Regulations, 84 Fed. Reg. 32520 (July 8, 2019) (to be codified at 40 C.F.R. pt. 60). For explanation of the Trump rule, *see EPA Proposes Affordable Clean Energy (ACE) Rule*, ENV'T PROT. AGENCY (Aug. 21, 2018), https://www.epa.gov/archive/epa/newsreleases/epa-proposes-affordable-clean-energy-ace-rule.html [https://perma.cc/YAB6-CVDB]; *Fact Sheet: The Affordable Clean Energy Rule*, ENV'T PROT. AGENCY, https://www.epa.gov/sites/default/files/2019-06/documents/bser_and_eg_fact_sheet_6.18.19_final.pdf [https://perma.cc/B889-9L7H] (last updated June 20, 2024). For a fuller discussion of the differences between the Trump and Obama rules, *see* Katherine McCormick, *How Clean Is Clean?: An Analysis on the Difference Between the Affordable Clean Energy Rule and the Clean Power Plan and Why States Should Adhere to Stricter Emissions Standards*, 37 PACE ENV'T. L. REV. 103, 105 (2019).

213. *EPA Finalizes Affordable Clean Energy Rule, Ensuring Reliable, Diversified Energy Resources While Protecting Our Environment*, ENV'T PROT. AGENCY (June 19, 2019), https://www.

Legal challenges to the Clean Power Plan reached the Supreme Court in *West Virginia v. EPA.*[214] In a 6-3 decision, the Court upheld the Trump Administration's repeal of the Clean Power Plan. The Court's rationale was that EPA's claim of authority to issue the Plan raised a "major question." Under what it called the major questions doctrine, an agency must demonstrate a clear delegation of authority from Congress when a regulation involves a major question, and the Court found no such statutory clarity. We will return to the major questions doctrine and its implications for climate regulations later, but first, we need to complete the story.

The Biden Administration issued its own replacement for the Trump and Obama-era rules, which focuses heavily on the use of carbon capture and sequestration as a method of curtailing emissions from coal-fired power plants. The Biden rule was immediately engulfed in litigation.[215] The issue of how to interpret Section 111(d) seems certain to return to the Supreme Court at some point, but the advent of the second Trump Administration makes it likely that more regulatory upheaval will occur before the issue is ultimately decided.

This saga reveals one important virtue of using financial tools: they seem to be much less prone to litigation and therefore much less at risk of reversal by anti-regulatory judges. In addition, because they are less litigation prone than conventional regulations, they are also able to take effect more quickly, without waiting for lengthy lawsuits to be resolved.

While federal climate policy has encountered speed bumps, many states have moved forward on their own.[216] We can expect these state activities to intensify in response to President Trump's anti-environmental agenda. Many states have adopted renewable portfolio

epa.gov/newsreleases/epa-finalizes-affordable-clean-energy-rule-ensuring-reliable-diversified-energy [https://perma.cc/GJJ6-NTG6] (suggesting that the ACE would reduce CO_2 emissions by 11 million short tons—less than 1% of current U.S. emissions). The process that led to the issuance of the Clean Power Plan is described in Freeman, *supra* note 20, at 60–63. Freeman describes the Trump rule as "a far more modest proposal based on a narrower reading of 'best system' that required only marginal onsite efficiency upgrades." Freeman, *supra* note 20, at 66. Even modest reductions in emissions were not guaranteed because the Trump rule delegated considerable discretion over implementation to the states. *Id.*

214. West Virginia v. Env't Prot. Agency, 597 U.S. 697 (2022).

215. *EPA rule to cut power sector GHG emissions faces legal and political challenges*, DAVIS POLK (May 29, 2024), https://www.davispolk.com/insights/client-update/epa-rule-cut-power-sector-ghg-emissions-faces-legal-and-political-challenges [https://perma.cc/ZK59-A7E4].

216. *See* Freeman, *supra* note 20, at 48 ("By the time Barack Obama clinched the Democratic nomination for president in 2008, the states had become the driving force of U.S. climate policy."). A fuller description of state climate policies can be found in FARBER & CARLARNE, *supra* note 21, at 197–201, 143–55.

standards (RPS), which require that utilities obtain a certain percentage of electricity from renewable sources. By forcing utilities to buy specified amounts of renewable energy, an RPS promotes the development of more solar and wind energy.[217] These standards vary from state to state in terms of the targets, deadlines, and types of generation classified as renewable.[218] For instance, California has a 2030 target of 60% renewables,[219] while Illinois mandates 40% renewables by 2030 and 50% by 2040.[220] By 2019, nearly half the states had adopted climate-related targets of some kind, half had some type of energy efficiency program, and over half were engaged in some form of adaptation planning.[221]

California's leading role in addressing climate change[222] dates back to a 1988 law mandating an inventory of California's greenhouse gas emissions.[223] In 2002, the state took advantage of an exception to federal preemption of emissions standards for new cars by enacting the Pavley Act, which mandated reduction of vehicle CO_2 emissions.[224] In 2006, Governor Arnold Schwarzenegger signed the California Global Warming Solutions Act (AB 32), which required California to reduce emissions to the 1990 level by 2020.[225] Elsewhere in the United States, the Regional Greenhouse Gas Initiative created a multistate

217. *Renewable Portfolio Standards,* NAT'L RENEWABLE ENERGY LAB'Y, https://www.nrel.gov/state-local-tribal/basics-portfolio-standards.html [https://perma.cc/AUX5-8R3C] (last visited Nov. 15, 2024). The description in the text is a bit of an oversimplification because it neglects the use of renewable energy credits as a tradeable mechanism for satisfying the requirements. This complication is not relevant for current purposes.

218. *See, e.g.*, CAL. HEALTH & SAFETY CODE § 44258.5 (West 2017); Sharmila L. Murthy, *States and Cities as "Norm Sustainers": A Role for Subnational Actors in the Paris Agreement on Climate Change*, 37 VA. ENV'T. L.J. 1, 19, 21, 23 (2019).

219. *Renewable Portfolio Standard (RPS) Program*, CAL. PUB. UTIL. COMM'N, https://www.cpuc.ca.gov/rps/ [https://perma.cc/773Y-6CBZ] (last visited Dec. 29, 2024). The program's targets have escalated rapidly from a 2015 target of 50% by 2030 to 60% by 2030 and 100% by 2045. *Id.*

220. *The Renewable Portfolio Standard*, ILL. POWER ASSOC., https://ipa.illinois.gov/content/dam/soi/en/web/ipa/ipa-factsheet-renewable-portfolio-standard-92722.pdf [https://perma.cc/PFZ2-ESSZ].

221. Sam Ricketts et al., *States Are Laying a Road Map for Climate Leadership*, CTR. FOR AM. PROGRESS (Apr. 30, 2020), https://www.americanprogress.org/article/states-laying-road-map-climate-leadership/ [https://perma.cc/3SQG-MV75].

222. *See* Daniel A. Mazmanian et al., *State Leadership in U.S. Climate Change and Energy Policy: The California Experience*, 29 J. ENV'T & DEV. 51, 69 (2020), (calling California "a first mover among U.S. states in seeking to comprehensively control GHG emissions"). The authors provide a helpful listing of major California climate initiatives through 2019. *See id.* at 62 tbl.1.

223. Env'l Planning—Global Warming Trends—Study, 1988 Cal. Legis. Serv. 1506 (West).

224. *See* MICHAEL R. PEEVEY & DIANNE O. WITTENBERG, CALIFORNIA GOES GREEN: A ROADMAP TO CLIMATE LEADERSHIP 100–101 (2017).

225. CAL. HEALTH & SAFETY CODE § 38500, 38530 (West 2007).

trading system for power plant emissions with the goal of achieving a 10% reduction by 2019,[226] later revised to a goal of reducing emissions 30% below 2020 levels by 2030.[227]

While California's efforts have been particularly prominent, it is far from being alone.[228] For instance, in 2022, Massachusetts passed a new law with major funding for offshore wind, a 2035 cut-off date for sales of new gas and diesel vehicles,[229] and permission for some municipalities to ban new natural gas hookups.[230] Currently, twenty-four states have adopted economywide or grid-specific deadlines for eliminating carbon emissions.[231]

Many of the states emphasizing renewable energy are politically liberal, but the expansion of renewable energy in some conservative states has also been noteworthy.[232] Texas is a prime example. While Texas is the state with the highest oil production, it has also consistently been number one in wind energy, producing a quarter of the country's total wind power.[233] Even prior to the passage of the IRA, the Texas grid operator projected large additions of solar and wind power to the grid.[234] Texas now has the second highest solar

226. CONG. RSCH. SERV., R41836, THE REGIONAL GREENHOUSE GAS INITIATIVE: LESSONS LEARNED AND ISSUES FOR CONGRESS (2017)

227. REG'L GREENHOUSE GAS INITIATIVE, *supra* note 25.

228. Vicki Arroyo, *From Paris to Pittsburgh: U.S. State and Local Leadership in an Era of Trump*, 31 GEO. J. ENV. L. 433, 438–48 (2019) (surveying state efforts).

229. Act of Aug. 11, 2022, ch. 179, §§ 9A, 81(a), 2022 Mass. Acts (driving advancement in clean energy and offshore wind).

230. Allyson Chiu, *Massachusetts Just Passed a Massive Climate and Clean Energy Bill*, WASH. POST (Aug. 11, 2022, 5:45 PM), https://www.washingtonpost.com/climate-solutions/2022/08/11/massachusetts-climate-clean-energy-bill-charlie-baker [On File with the Columbia Journal of Environmental Law].

231. *Table of 100% Clean Energy States*, CLEAN ENERGY STS. ALL., https://www.cesa.org/projects/100-clean-energy-collaborative/guide/table-of-100-clean-energy-states/ [https://perma.cc/6PA9-9T4X] (last visited Dec. 29, 2024). These jurisdictions contain over half of the U.S. population. *Id.*

232. Historically, attitudes toward climate change have diverged from those toward renewable energy. For instance, partisan affiliation is not a major factor in determining rates of installation of rooftop solar. *See generally* Matto Mildenberger et al., *Households with Solar Installations Are Ideologically Diverse and More Politically Active than Their Neighbours,* 4 NATURE ENERGY 1033 (2019).

233. *Texas: State Profile and Energy Estimates*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/?sid=TX [https://perma.cc/WX4G-WQNW] (last visited Dec. 29, 2024).

234. ELEC. RELIABILITY COUNCIL OF TEX., ERCOT SYSTEM PLANNING: 2020 LONG-TERM SYSTEM ASSESSMENT FOR THE ERCOT REGION ii (2020), https://www.ercot.com/files/docs/2020/12/23/2020_LTSA_Report.zip [On File with the Columbia Journal of Environmental Law] ("Wind generation additions represented the largest resource capacity change on the system throughout the five scenarios. . . . [T]otal wind generation capacity additions ranged from 35,000 MW to 44,800 MW in the five scenarios. Solar generation capacity additions were also

electricity production in the nation, and leads the country in adding new solar capacity.[235] Texas's prominence in renewable energy is a testament to the economic tailwinds that now favor clean technology.

Given the concern that climate change might lose political salience due to the passage of IRA, it is instructive to examine state policy changes since its passage in 2022. One expert called 2023 "a banner year" for climate policy, as states adopted policies that "climate hawks could once only dream of."[236] A partial list of the 2023 state laws conveys a sense of their tenor: a new clean energy standard in Minnesota, a half-dozen states adopting California's clean car standard, a state ban on fossil fuel infrastructure in new buildings, and a variety of state subsidy programs for clean energy.[237] Most notably, California enacted two pathbreaking corporate disclosure laws. Senate Bill 253[238] requires major public businesses operating in California to report all emissions relating to their businesses, including those of suppliers and customers. A partner bill, the Climate-Related Financial Risk Act (SB 261), requires disclosure of the financial threats businesses face from climate change itself and the transition to a net-zero economy.[239]

With President Trump's reelection, it is unlikely that climate advocates will feel any sense of complacency, with or without the IRA. It will forever remain unknown whether, if Vice President Kamala Harris had won rather than President Trump, the IRA would have encouraged the expansion of federal climate policy or led to complacent reliance on existing strategies. The evidence from 2023–2024 does not, however, support the complacency hypothesis.

significant, ranging from 22,200 MW to 35,300 MW across all scenarios. Conversely, more than 21,000 MW of existing coal and natural gas generation capacity was retired by 2035 in all scenarios."). The same forecast indicated that additional natural gas plants will be added to the system, but under none of the scenarios did this amount to more than about a fifth of the total new capacity, with the remainder being renewable. *Id.* By 2023, wind and solar generated 37% of the state's electricity. *See* John Bleasby, *Texas Bets Big on Renewable Energy for the Future*, DAILY COM. NEWS (Jan. 24. 2023), https://canada.constructconnect.com/dcn/news/usa/2023/01/texas-bets-big-on-renewable-energy-for-the-future [https://perma.cc/TXH4-2BJP].

235. Geraldene Orentas & Samantha Allen, *Texas Solar Statistics in 2024,* FORBES (July 31, 2024), https://www.forbes.com/home-improvement/solar/texas-solar-statistics/ [On File with the Columbia Journal of Environmental Law].

236. Adam Aton, *How 2023 Changed the Way States Do Climate Policy*, E&E NEWS (Dec. 21, 2023), https://www.eenews.net/articles/how-2023-changed-the-way-states-do-climate-policy [https://perma.cc/8XRS-987Y].

237. *Id.*

238. Climate Corporate Data Accountability Act, 2023 Cal. Legis. Serv. Ch. 382 (S.B. 253) (codified as amended at CAL. HEALTH & SAFETY CODE § 38532) (West).

239. Greenhouse Gases: Climate-Related Financial Risk, 2023 Cal. Legis. Serv. Ch. 383 (S.B. 261) (codified as amended at CAL. HEALTH & SAFETY CODE § 38533) (West).

B. Financial Support for Clean Technology and Regulatory Stringency

While regulatory mandates can indirectly spark cost reductions for clean technology by incentivizing the creation and deployment of those technologies, the reverse is also true: falling costs can lead to tighter regulations. Compliance cost is generally a factor in setting standards.[240] At the federal level, except when prohibited by law, regulations must pass a cost-benefit analysis. Many environmental statutes themselves require regulators to set standards based on the best available technology with cost as an important factor in determining whether a regulation is feasible. Thus, by making emission reductions more economically feasible, the IRA can strengthen the hand of regulators.

The Biden Administration provided signs of this effect. In its proposed regulations for light-duty vehicle emissions beginning in 2027, the Biden Administration relied on the IIJA and IRA as evidence of the economic viability of its proposed standards.[241] In EPA's view, "Congressional passage of the [IIJA] and IRA represent pivotal milestones in the creation of a broad-based infrastructure instrumental to the expansion of clean transportation, including light- and medium-duty zero-emission vehicles, and we have taken these developments into account in our assessment of the feasibility of the proposed standards."[242] A rule governing greenhouse gas emissions from heavy trucks gives even more attention to the IIJA and IRA, arguing that they make more rigorous regulations feasible.[243] The IRA and IIJA also

240. *See, e.g.,* Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 88 Fed. Reg. 29184, 29232 (May 5, 2023) (to be codified at 40 C.F.R. pts. 85, 86, 600, 1036, 1037, 1066).

241. The proposal devotes careful attention to IIJA and IRA. *See id.* at 29195.

242. *Id*. at 29196.

243. *See* Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3, 88 Fed. Reg. 25926, 25943–48 (Apr. 27, 2023) (to be codified at 40 C.F.R. pts. 1036, 1037, 1054, 1065, 1074):

> While there are challenges facing greater adoption of heavy-duty ZEV technologies, the IRA provides many financial incentives to overcome these challenges and thus would also support our proposed rulemaking. We expect IRA sections 13502 and 13403 to support the adoption of HD ZEV technologies in the market, as detailed in our assessment of the appropriate GHG standards we are proposing. Additionally, we expect IRA sections 13404, 60101–60104, 70002, 13501, 50142–50145, 50151–50153, and 13204 to further accelerate ZEV adoption, but we are not including them quantitatively in our analyses.

figure prominently in EPA's discussion of the economic feasibility of hydrogen as a fuel for power plants.[244]

The declining costs and expanded renewable use stemming from the IRA have also begun to influence state climate policy. For example, New York's scoping plan (its strategy for reducing emissions) noted that the state intends to leverage new federal resources to expand state investments.[245] Specifically, it emphasized that the IRA, IIJA, and CHIPS and Science Act will provide unprecedented levels of federal funding to support state job growth and economic expansion. There were similar indications in other states of a recognition that the boost in federal funding would allow an accelerated energy transition.[246]

EPA also relied heavily on the IRA in new regulations of power plant emissions that rely on carbon capture and sequestration (CCS) and the use of hydrogen as a fuel.[247] For instance, EPA explained that "provisions in the IIJA and IRA are expected to significantly increase the CO_2 pipeline infrastructure and development of sequestration sites,

244. *See* Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units, 88 Fed. Reg. 33240, 33312 (May 23, 2023) (to be codified at 40 C.F.R. pt. 60):

> [I]ncentives in recent Federal legislation are anticipated to significantly increase the availability of low-GHG hydrogen by 2032, including for the utility power sector. . . . As of August 2022, 374 new projects had been announced that would produce 2.2 megatons (Mt) of low-GHG hydrogen annually, which represents a 21 percent increase over current output.

245. N.Y. STATE CLIMATE ACTION COUNCIL, SCOPING PLAN, 56–57, 71–72 (2022), https://climate.ny.gov/resources/scoping-plan/ [On File with the Columbia Journal of Environmental Law].

246. For example, in releasing a comprehensive zero-emission vehicles plan for North Carolina, the governor announced that plan involved "a comprehensive strategy . . . identified through development of the North Carolina Clean Transportation Plan and supported by unprecedented federal funding through Infrastructure Investment and Jobs Act and the Inflation Reduction Act of 2022." Press Release, NC Governor Roy Cooper, Governor Cooper Signs Executive Order to Grow North Carolina's Clean Energy Economy by Supporting the Market-Driven Transition to Zero-Emission Trucks and Buses (Oct. 25, 2022), https://governor.nc.gov/news/press-releases/2022/10/25/governor-cooper-signs-executive-order-grow-north-carolinas-clean-energy-economy-supporting-market [https://perma.cc/7D59-3CNH]. Similarly, in explaining a rule setting deadlines for zero-emission trucks, the California Air Resources Board pointed to IIJA and IRA as sources of funding for the transition. *Advanced Clean Fleets Regulation Summary*, CAL. AIR RES. BD. (May 17, 2023), https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-regulation-summary [On File with the Columbia Journal of Environmental Law].

247. New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule, 88 Fed. Reg. 33240 (proposed May 23, 2023) (to be codified at 40 C.F.R. pt. 60). See *id.* at 33260–62 for discussion of the impact of the IRA and IIJA on technology availability and cost.

which, in turn, are expected to result in further cost reductions for the application of CCS at new combined cycle EGUs [Electric Generating Units]."[248] In addition, EPA said that "[i]n determining the cost of CCS, EPA is taking into account the tax credit provided under IRC section 45Q, as revised by the IRA."[249] Indeed, EPA pointed out, "[t]he legislative history of the IRA makes clear that Congress was well aware that EPA may promulgate rulemaking under CAA section 111 based on CCS and explicitly stated that EPA should consider the tax credit to reduce the costs of CCUS [carbon capture, use, and storage]."[250]

When it came time to issue the final rule,[251] EPA chose not to make hydrogen cofiring a benchmark technology. But EPA again relied on the IRA in determining that CCS was feasible for the industry. It pointed to a CCS project that will come online in 2028, noting that the project was made possible by an IRA tax credit.[252] EPA found it "particularly relevant" that the "incentives in the IRA . . . support expansion of technologies, such as CCS" that reduce greenhouse gas emissions from gas and coal-fired power plants.[253]

The Trump Administration will undoubtedly seek to repeal these EPA regulations. Indeed, that process has already begun. However, actors seeking rollbacks will have to account for the lower compliance costs identified by the Biden EPA in their cost-benefit analyses. Those cost savings via the IRA may make rollbacks more vulnerable to judicial review.

248. *Id.* at 33300.

249. *Id.*

250. *Id.*

251. New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule, 89 Fed. Reg. 39798 (May 9, 2024) (to be codified at 40 C.F.R. pt. 60).

252. EPA quoted the firm's CEO to that effect: "Government Inflation Reduction Act (IRA) funding through 45Q tax credits makes the project financially viable. With these government tax credits, the company does not expect a rate increase as a result of this project." *Id.* at 39851.

253. More specifically, EPA explained that:

> [T]he Inflation Reduction Act (IRA), enacted in 2022, extended and significantly increased the tax credit for carbon dioxide (CO2) sequestration under Internal Revenue Code (IRC) section 45Q. The provision of tax credits in the IRA, combined with the funding included in the Infrastructure Investment and Jobs Act (IIJA), enacted in 2021, incentivize and facilitate the deployment of CCS and other GHG emission control technologies. . . . Some companies have already made plans to install CCS on their units independent of the EPA's regulations.

Id. at 39800.

C. IRA and EPA Regulatory Authority

Although primarily aimed at creating subsidies, the IRA also contains several amendments to the Clean Air Act that provide a firmer basis for EPA's regulatory authority in limiting emissions.[254] One notable example involves EPA regulations limiting emissions of methane, a potent greenhouse gas, by the oil and gas industry. Section 136 adds an emission charge for methane to the statute,[255] which is tied into EPA's regulations of methane emissions.[256] It thus removes any basis for arguing that EPA lacks the power to regulate methane.

Another IRA provision reinforces EPA's authority over emissions from power plants by providing funding "to ensure that reductions in greenhouse gas emissions are achieved through the use of the existing authorities of this Act."[257] The preceding IRA subsection calls on EPA to model expected reductions in greenhouse gas emissions from the energy sector, a vote of confidence in EPA's expertise in the area.[258] Other provisions support EPA's power to authorize California's zero-emission vehicle rules and EPA's own authority to limit emissions of greenhouse gases from new vehicles.[259] In addition, to reduce the risk that conservative Justices would cancel EPA jurisdiction over greenhouse gases, several new provisions explicitly define those gases as pollutants, at least for the purposes of those sections.[260]

EPA invoked those provisions to defend its regulatory authority during the Biden Administration. In a regulation applying to light

254. *See* Greg Dotson & Dustin J. Maghamfa, *The Clean Air Act Amendment of 2022: Clean Air, Climate Change, And the Inflation Reduction Act*, 53 ENV. L. REP. 10017, 10018 (2023); Nicholas S. Bryner, *The Once and Future Clean Air Act: Impacts of the Inflation Reduction Act on EPA's Regulatory Authority*, 65 B.C. L. REV. 1 (2024). Bryner observes that:

> Despite the limitations of spending policy, the IRA, if it works as intended, can and will operate to strengthen and reinforce EPA's regulatory authority, bringing about the generation shifting envisioned in the Clean Power Plan. The IRA will allow the EPA to adopt more effective rules over the next decade to consolidate the technological advances that the statute will usher in.

Id. at 5.

255. Section 136(f)(6) provides an exemption for activities in compliance with EPA methane regulations. 42 U.S.C. § 7436.

256. In another non-subsidy provision, the IRA provides a standard for imposing royalties on flared or vented methane in operations on federal land, which the Bureau of Land Management relied on in narrowing a previous exemption. *See* Waste Prevention, Production Subject to Royalties, and Resource Conservation, 89 Fed. Reg. 25378, 25387 (Apr. 10, 2024) (to be codified at 43 C.F.R. pts. 3160, 3170).

257. Clean Air Act § 135(a)(6), 42 U.S.C. § 7435(a)(6).

258. Clean Air Act § 134(a)(5), 42 U.S.C. § 7435(a)(5).

259. Greg Dotson & Dustin J. Maghamfa, *supra* note 254, at 10030–32.

260. David D. Doniger, *West Virginia, the Inflation Reduction Act. and the Future of Climate Policy*, 53 ENV'T L. REP. 10553, 10566 (2023); Dotson & Maghamfar, *supra* note 254.

vehicles (cars, pickup trucks, and SUVs), EPA observed that Congress included provisions in the IRA specifically designed to strengthen EPA authority:

> The recently enacted Inflation Reduction Act "reinforces the longstanding authority and responsibility of [EPA] to regulate GHGs as air pollutants under the Clean Air Act," and "the IRA clearly and deliberately instructs EPA to use" this authority by "combin[ing] economic incentives to reduce climate pollution with regulatory drivers to spur greater reductions under EPA's CAA authorities." The IRA specifically affirms Congress's previously articulated statements that non-ICE [non-Internal Combustion Engine] technologies will be a key component of achieving emissions reductions from the mobile source sector, and Congress provided a number of significant financial incentives for PEVs [plug-in vehicles] and the infrastructure necessary to support them.[261]

Like the rule governing cars and light-duty trucks, EPA's regulation of heavy-duty vehicles also relies on the IRA as reinforcement for its statutory authority.[262]

Thus, besides supporting a move toward stricter regulation by lowering costs, Congress also took specific action to rebut any charges that EPA was exceeding its regulatory authority. The apparent intent was to ensure that an EPA push toward expanded use of electric vehicles could not be overturned as a usurpation of regulatory authority under the major questions doctrine.

The IRA also contains several provisions designed to strengthen state climate regulation. It provides EPA with $5 billion to assist states, air pollution control agencies, tribes, and local governments in developing ($250 million) and implementing ($4.75 billion) local climate pollution reduction strategies. Newly-added Section 135(a) of the Clean Air Act also provides funding for EPA outreach, partnerships, and technical assistance relating to state and tribal efforts to reduce emissions from the electricity sector.[263] Finally, newly-added

261. Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 88 Fed. Reg. 29184, 29233 (May 5, 2023) (to be codified at 40 C.F.R. pts. 85, 86, 600, 1036, 1037, 1066). The EPA also cited relevant legislative history: "The Congressional Record reflects that 'Congress recognizes EPA's longstanding authority under CAA section 202 to adopt standards that rely on zero emission technologies, and Congress expects that future EPA regulations will increasingly rely on and incentivize zero-emission vehicles as appropriate.'" *Id.* (citation omitted).

262. EPA stated that the IRA "reinforces the longstanding authority and responsibility of [EPA] to regulate GHGs as air pollutants under the Clean Air Act," and "clearly and deliberately instructs EPA to use" a combination of "economic incentives to reduce climate pollution" and "regulatory drivers to spur greater reductions under EPA's CAA authorities." *Id.* at 25950.

263. 42 U.S.C. § 7435(a)(4).

Section 137 of the Clean Air Act provides $250 million to fund greenhouse gas air pollution reduction plans in every state.[264]

The IRA also provides states with funding "to adopt and implement greenhouse gas and zero-emission standards for mobile sources pursuant to Section 177 of the Clean Air Act."[265] Some background is needed to understand this provision. The Clean Air Act generally preempts state regulation of emissions from new vehicles, but it contains an exception for California.[266] Section 177 allows other states to piggyback on California's regulations by adopting them as their own.[267] The new IRA provision necessarily assumes that California has authority to regulate greenhouse gases and to mandate zero-emission vehicles. It thus strengthens the case for California's regulatory authority as against legal arguments used by the Trump Administration to rescind the state's preemption waiver.[268]

The IRA's support for state climate programs is particularly important at present because those programs will be operating against the backdrop of presidential hostility to federal action. By signaling congressional support for state efforts—and particularly for California's regulations of tailpipe emissions of carbon dioxide—these IRA provisions make it harder for opponents to argue that state regulations are preempted by federal law.

Apart from the direct effects of its provisions, the IRA may also undermine arguments that Biden-era regulations run afoul of the major questions doctrine. As the Court articulated the doctrine in *West Virginia v. EPA*,[269] in certain "extraordinary cases," "separation of powers principles and a practical understanding of legislative intent" create a presumption against agency authority that can only be rebutted by "clear congressional authorization."[270] As to what constitutes a major question, the Court has referred to "the 'history and the breadth of the authority that [the agency] has asserted,' and the 'economic and

264. 42 U.S.C. § 7437.

265. Inflation Reduction Act of 2022, Pub. L. No. 117-169, § 60105(g), 136 Stat. 2068 (2022).

266. 42 U.S.C. § 7543(e)(2).

267. 42 U.S.C. § 7507.

268. An attempt was made by the previous Trump administration to withdraw California's waiver. The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program, 84 Fed. Reg. 51310, 51313–50 (Sept. 27, 2019) (to be codified at 40 C.F.R. pts. 85, 86).

269. West Virginia v. Env't Prot. Agency, 597 U.S. 697 (2022).

270. *Id.* at 2609.

political significance' of that assertion."[271] Those terms are hardly self-explanatory.[272]

There is considerable uncertainty about the parameters of the major questions doctrine as shown by the confusion in the lower courts on the subject.[273] There is an obvious risk that its application will turn on the degree to which a regulation cuts against a judge's policy orientation. That would not be good news for environmental regulators given the conservative supermajority on the Supreme Court. Lower courts have adopted a variety of approaches but have found difficulty in applying them—and, unfortunately, the political party of the appointing president is a strong predictor of a judge's rulings.[274]

Until the Court provides more clarification,[275] it is hard to speak with great confidence about how the doctrine will ultimately be

271. *Id*. at 2608 (citations omitted).

272. The decision and its articulation of the major questions doctrine have received some strong criticism. The major questions doctrine is controversial among scholars. *See, e.g.*, Louis J. Capozzi III, *The Past and Future of the Major Questions Doctrine*, 84 OHIO ST. L.J. 191, 194 (2023); Daniel T. Deacon & Leah Litman, *The New Major Questions Doctrine*, 109 VA. L. REV. 1009 (2023); Jody Freeman & Matthew C. Stephenson, *The Anti-Democratic Major Questions Doctrine*, 2022 SUP. CT. REV. 1 (2022); Mila Sohoni, *The Major Questions Quartet*, 136 HARV. L. REV. 262 (2022). Sohoni points out the doctrine's vagueness, quoting Brett Kavanaugh as a circuit judge saying that "determining whether a rule constitutes a major rule sometimes has a bit of a 'know it when you see it' quality." *Id.* at 287–88. Justice Gorsuch's concurrence provides a list of factors to consider, but Sohoni concludes that "[t]aken together, these clusters of 'triggers' and 'telling clues' invite courts to perform exactly the kind of all-things considered, open-ended inquiry that textualism was meant to teach courts to avoid like the plague." *Id.* at 288.

273. *See* Natasha Brunstein, *Major Questions in Lower Courts*, *75* ADMIN. L. REV. 661, 663 (2023) ("There is no one major questions doctrine in the lower courts. Judges have taken vastly different approaches to defining and applying the doctrine both within and across circuits.").

274. After canvassing the lower court opinions, Brunstein concludes that:

> [M]any judges may view the doctrine as a little more than a grab bag of factors, which they seem to be choosing from at their discretion. Lower court judges do not appear to be constrained in how they apply the doctrine. In a majority of cases concerning Biden Administration agency actions and executive orders, judges applied the doctrine to reach outcomes that aligned with the political party of their appointing President.

Id. Brunstein found that judges differed in what factors they considered to be triggers for the doctrine, how to define those factors, what metrics to apply in assessing the strength of those factors, and even whether they relied on the majority opinion in *West Virginia* or a concurring opinion. *Id.* at 663–65.

275. Deacon and Litman argue that the trend at the Supreme Court level is to emphasize three factors:

> First, the Court has indicated that politically significant or controversial policies are more likely to be major and thus require clear authorization. Second, the Court has signaled that the novelty of a policy . . . is a reason to think that the policy is a major one. Finally, the Court has considered the majorness of other, theoretically possible agency policies not actually before the Court but that might be supported by the agency's broader rationale.

applied. In the *West Virginia* case, the Court did point to several salient features of the regulation: First, EPA was relying on a "newfound power" it claimed derived from "the vague language of an 'ancillary provision[]' of the statute", one that "had rarely been used in the preceding decades."[276] Second, EPA had adopted a "regulatory program that Congress had conspicuously repeatedly declined to enact itself."[277] Third, EPA lacked expertise in the functioning of the electric power system, which was not generally part of its regulatory domain.[278]

The IRA may be helpful along several dimensions in defending against the argument that Biden-era regulations must be repealed because they violate the major questions doctrine. First, of course, the subsidies and tax credits provided in the IRA lessen the potential economic impact of EPA climate regulations, speaking to a regulation's economic significance. It is unclear how much importance the Supreme Court attaches to a regulation's price tag, but it may be relevant if the goal is to assess whether the decision is one that Congress would have thought too important to delegate.

Second, the IRA shows that Congress did contemplate major shifts in the energy sources powering the grid and specifically intended to substantially expand the role of renewable energy while also supporting emission reduction technologies such as hydrogen, CCS, and electric vehicles. The IRA does not explicitly amend the statutory authority of agencies to authorize specific regulations like requiring CCS for coal plants, but the major questions doctrine calls for courts to move beyond the statute itself to gauge whether an agency has tried to make major decisions of national policy without congressional guidance. Congress's enthusiasm for the energy transition should make a difference in making that assessment.[279]

Deacon & Litman, *supra* note 272, at 1013. Deacon and Litman argue that the "politically significant" factor threatens to give parties and political movements veto power over otherwise lawful agency actions. *Id.* at 1015. Notably, they contend that in recent cases "the Supreme Court mostly seemed to care about whether members of the public *today* would view the agency's policy as a major one." *Id.* at 1041. The argument would be that given the *big* push toward clean energy Congress embraced in the IRA, the public would not regard the *smaller* incremental push in EPA regulation as "major."

276. West Virginia v. Env't Prot. Agency, 597 U.S. 697, 723–724.

277. *Id*. The Court repeated this point later in the opinion. *See id.* at 2614.

278. *Id*. at 2612–13.

279. This is not to say that a sufficiently motivated judge could not ignore this argument or even draw the inference that Congress's approval of fiscal incentives implicitly rejected other measures—but this would fly in the face of the obvious intent of the IRA.

Third, the provisions in the Clean Air Act on which the Biden EPA relied for its regulatory power are referenced in the IRA—meaning that Congress was at least aware of them and to some extent signaled approval of their use. If, as the *West Virginia* Court said, congressional refusal to adopt a policy counts against an agency regulation, congressional acknowledgment of that policy should count in its favor. It cuts against the idea that the agency has gone where Congress refused to tread.[280]

A leading conservative administrative law scholar has suggested that a key factor in applying the major questions doctrine is "whether the agency action is a big deal."[281] The IRA supports the argument that, while an EPA rule may seem like a big deal considered on its own, the agency is merely surfing atop a wave created by Congress itself.

Indeed, in its 2024 emissions regulations for power plants, EPA also invoked the IRA as part of its defense against application of the major questions doctrine:

> Congress's enactment of the IRA and IIJA further shows its view that reducing air pollution – specifically, in those laws, GHG emissions to address climate change – is a high priority. . . . [T]hat law provided funds for DOE grant and loan programs to support CCS, and extended and increased the IRC section 45Q tax credit for carbon capture. It also adopted the Low Emission Electricity Program (LEEP), which allocates funds to EPA for the express purpose of using CAA regulatory authority to reduce GHG emissions from domestic electricity generation through use of its existing CAA authorities. CAA section 135, added by IRA section 60107. EPA is promulgating the present rulemaking with those funds.[282]

When EPA returns to the task of issuing climate regulations, the same parts of the IRA could be relevant in any setting involving the reasonableness of the agency's interpretation of a statute. That would have been true under the traditional *Chevron* doctrine, where courts

280. In addition, EPA's role in dispensing IRA grants indicates that Congress was comfortable with its expertise in some of the relevant policy domains.

281. Thomas W. Merrill, *The Major Question Doctrine: Right Diagnosis, Wrong Remedy* 6 (Columbia Pub. L. Rsch. Paper 1, 2023). Merrill is quite critical of the major questions doctrine. *Id.* at 24–29. In Merrill's view: "The major questions doctrine portends a world in which the most consequential questions—the most controversial and those implicating the most significant conflicting interests—will be made by courts having neither accountability nor expertise. This is a deeply misguided division of authority over regulatory policy." *Id.* at 26. He also criticizes the doctrine's "extreme indeterminacy." *Id.*

282. *See* New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule, 89 Fed. Reg. 39798, 39901 (May 9, 2024) (to be codified at 40 C.F.R. pt. 60).

were instructed to defer to reasonable statutory interpretations of ambiguous statutes.[283] The factors are also relevant today under *Skidmore* deference.[284] There, deference to an agency interpretation is based upon "all those factors which give it power to persuade, if lacking power to control."[285] *Skidmore* is based partly on factors unrelated to the content of the agency's interpretation, such as the degree of consideration by the agency, but the economic impact of an action and the degree to which it harmonizes with other expressions of congressional policy could be seen as relevant to the persuasiveness of the agency's explanation.

In overruling *Chevron*, the Supreme Court continued to cite *Skidmore* with approval.[286] The Court also made it clear that when a statute like the Clean Air Act delegates power to an agency, a court's role involves "recognizing constitutional delegations, 'fix[ing] the boundaries of [the] delegated authority,' and ensuring the agency has engaged in 'reasoned decisionmaking' within those boundaries."[287] Unless the Supreme Court means to find that longstanding provisions of the Clean Air Act are unconstitutional delegations, a court's role would be limited to determining two things. The first is whether an EPA regulation is outside the bounds of a reasonable application of the statute (and therefore beyond its delegated authority). As we have seen, the IRA is relevant to determining whether EPA's application of the statute is so clearly unreasonable as to be outside its delegated authority. The second determination is whether the agency has engaged in reasoned decision-making. Again, the IRA is relevant. It not only seems reasonable for EPA to take IRA funding into account in

283. Chevron U.S.A., Inc. v. Nat. Res. Def. Council, 467 U.S. 837 (1984).

284. Skidmore v. Swift & Co., 323 U.S. 134 (1944). Under United States v. Mead Corp., 533 U.S. 218 (2001), *Skidmore* deference applied when the agency lacked the power to take actions with the force of law; otherwise, *Chevron* applied.

285. *Skidmore*, 323 U.S. at 139. *Meade* used somewhat different language:

> The fair measure of deference to an agency administering its own statute has been understood to vary with circumstances, and courts have looked to the degree of the agency's care, its consistency, formality, and relative expertness, and to the persuasiveness of the agency's position. The approach has produced a spectrum of judicial responses, from great respect at one end, to near indifference at the other.

Meade, 533 U.S. at 228.

286. Loper Bright Enterprises v. Raimondo, 144 S. Ct. 2244, 2247 (2024).

287. *Id*. at 2263 (citations omitted). The Court cited Michigan v. EPA, 576 U.S. 743 (2015), as precedent for determining the scope of a delegation. The Court determined that, in completely ignoring cost as a factor in making a regulatory decision, EPA had behaved in a way that was "not rational, let alone 'appropriate.'" *Id.* at 750 (taking the word "appropriate" from the applicable statute).

determining what is feasible for the industry, but it would be unreasonable for EPA to fail to do so.

For the same reasons that the IRA could support judicial deference to regulations of carbon emissions, it might also present an obstacle to rollbacks of those regulations. The IRA makes it harder to argue that carbon regulations are outside an agency's delegated authority, given indications that Congress meant to support regulatory efforts. And it will also be harder to argue that rollbacks represent reasoned decision-making.

V. CONCLUSION

When your only tool is a hammer, everything looks like a nail. By the same token, when your only policy tool is regulation, every problem looks like harmful conduct in need of government control. The harm from emitting greenhouse gases is real, but the problem requires more than simple caps on emissions: it requires a massive transformation of the energy sector. As the IRA illustrates, the government has policy tools other than regulation that will help not only reduce emissions but build a much better energy system. Given the instability of federal climate regulations, relying predominantly on emission regulations is all the more questionable as a climate policy strategy. Emissions regulation will remain an important part of the policy portfolio, but as a steppingstone to a new energy system rather than an end.

The travails of President Obama's Clean Power Plan illustrate the need for a new paradigm. EPA recognized that, unlike conventional pollution problems, the solution was to revamp the entire electricity system rather than simply to force polluters to reduce their emissions. The conservative majority on the Supreme Court caught the scent of this paradigm shift and was unwilling to give EPA the flexibility it needed to set off on this new path. The passage of the IRA just two months later signaled a recognition by Congress that the goal must be the energy transition, not simply phasing down emissions by firms using fossil fuels.

A future-facing climate policy must look beyond emission regulation if it is to create the replacement for today's energy system. We need instead to plan our move to a much better energy system—one that is more efficient, non-polluting, carbon neutral, and immune from geopolitical and market turmoil. Regulation of fossil fuel users can help with the initial push away from the existing system, but building a new system will require a much broader policy portfolio.

This Article has emphasized the promise of strategies that conceptualize the problem in terms of the energy transition rather than emission reduction. Implementation of those strategies will be far from straightforward given the inevitable barriers to a massive change in energy technologies. But by keeping our eyes on the prize—the net-zero society we are trying to engineer—we can better plot the course for getting there.