THE LAW AND ECONOMICS OF SUBSIDIES

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INTRODUCTION

In 2022, Congress passed the most ambitious climate legislation in its history—the Inflation Reduction Act of 2022 (IRA).[1] The

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[1] *See* Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818 (2022) (codified as amended mostly in scattered sections of 26 U.S.C.A.)

IRA, however, did not follow the pattern that the global climate regime and the practice of many governments around the world suggests.[2] It did not impose a "price on carbon" either through an emissions trading scheme or a carbon tax.[3] Instead, it provided massive subsidies—originally estimated at approximately $370 billion—to encourage the deployment of clean technology.[4]

This shift of regulatory tools—from carbon pricing sticks to the carrots of significant subsidies—requires a major change in thinking

[hereinafter IRA]. For a review of IRA programs administered by the EPA, see Greg Dotson & Dustin J. Maghamfar, *The Clean Air Act Amendments of 2022: Clean Air, Climate Change, and the Inflation Reduction Act*, 53 ENV'T L. REP. (ENV'T LAW INST.) 10017 (2023). A few months earlier Congress had passed the Infrastructure Investment and Jobs Act (Infrastructure Bill), Pub. L. No. 117-58, 135 Stat. 429 (2021) (codified as amended in scattered section of U.S.C.A.), which funded climate-related infrastructure such as electric utility grids and charging stations. *See Summary H.R. 3684—Infrastructure Investment and Jobs Act*, CONG. RSCH. SERV., https://www.congress.gov/bill/117th-congress/house-bill/3684#:~:text= (last visited Feb. 9, 2025); Kayla M. Bright, "*In Nature Nothing Exists Alone": The Collaborative Fight Against Climate Change,* 55 INT'L LAW. 551, 572 (2022) (detailing some of the infrastructure bill's measures funding adaptation); *see also* L.E. Goldenhersh et al., *Infrastructure Investment and Jobs Act Oversight Summary and Recommendations*, 63 WAYNE L. REV. 145, 146–47 (2022) (providing a detailed treatment of the programs encouraging electric vehicle charging).

[2] *See* David M. Driesen & Michael A. Mehling, *Pricing, Decarbonization, and Green New Deals,* 48 WM. & MARY ENV'T. L. & POL'Y REV. 211, 221–226 (2024) (providing a detailed account of the role of carbon pricing in the global climate regime).

[3] *See* David M. Driesen, *Putting a Price on Carbon: The Metaphor,* 44 ENV'T L. 695, 705–06 (2014) [hereinafter Driesen, *Pricing Carbon*] (discussing the idea of putting a price on carbon); David M. Driesen, *Free Lunch or Cheap Fix?: The Emissions Trading Idea and the Climate Change Convention*, 26 B.C. ENV'T AFF. L. REV. 1, 3–4 (1998) [hereinafter Driesen, *Climate Trading*] (discussing emissions trading under the Kyoto Protocol). There is one exception to this. The bill establishes a "waste emissions charge" for high emissions of methane from petroleum and natural gas systems unless emitted in compliance with promulgated standards. *See* IRA, 42 U.S.C. § 7436(c)–(h).

[4] *See* THE WHITE HOUSE, BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION 5 (2023), https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf (citing $370 billion of investments in "clean energy solutions"). Because the tax incentives are not capped, the total cost might be larger. *See* Jim Tankersley & Brad Plumer, *Companies Flock to Biden's Climate Tax Breaks, Driving Up Cost,* N.Y. TIMES (May 3, 2023), https://www.nytimes.com/2023/05/03/business/ira-climate-tax-breaks-biden.html.

about how environmental law operates.[5] It raises the possibility that the main action in environmental protection, particularly at the federal level, will come not from pricing carbon or from traditional government regulations, but from government subsidies. Just before Congress enacted the IRA, the Supreme Court handed down a decision disapproving an emissions trading program created by President Obama to limit emissions from power plants, the second most important source of U.S. greenhouse emissions after transportation.[6] That decision—*West Virginia v. EPA*—decreases the likelihood that carbon pricing (or traditional regulation) will drive the massive economic transformation that the climate crisis demands.[7] The subsidies in these new bills just might, especially if they create a path forward for additional policy support for green technology.[8]

Economists identify several drawbacks to subsidies as the primary tool for addressing greenhouse gas emissions. Their targeted nature makes them generally less efficient than broader carbon pricing initiatives. Unlike carbon pricing, subsidies cost governments

[5] *See generally* Brian Galle, *The Tragedy of the Carrots: Economics and Politics in Choice of Policy Instruments,* 64 STAN. L. REV. 797, 801 (2012) (contrasting carrots and sticks).

[6] *See* David D. Doniger, *West Virginia, The Inflation Reduction Act, and the Future of Climate Policy,* 53 ENV'T L. REP. (Env't Law. Inst.) 10553, 10553, 10562–63 (2023) (noting that power plants constitute the "second-largest source of climate-changing pollution" and describing the emissions trading scheme in the rule).

[7] *See* West Virginia v. EPA, 597 U.S. 697, 719–21, 735 (2022) (holding that EPA violated the Clean Air Act by forcing a "transition away from fossil fuels").

[8] *Cf.* Eric Laschever, *Comment*: *Clean Air Act Regulation After West Virginia and the Inflation Reduction Act*, 52 ENV'T L. REP. (Env't Law. Inst.) 10876, 10881–82 (2022) (pointing out that some IRA provisions support regulation); Doniger, *supra* note 6, at 10569 (explaining that the IRA's tax incentives and grants should lower the cost of regulating and therefore justify increasing stringency). Subsidies are mainly administered through tax returns and administration of grants and loans. While the Treasury Department will likely issue rules clarifying some issues under the IRA, they are less likely to attract intense judicial skepticism than government regulation demanding changes in conduct. Furthermore, litigation is unlikely to wholly defeat a subsidies program as it might a regulatory program. *Cf.* Pamela King, *How a Diminished Chevron Doctrine Could Weaken Biden's Climate Law*, E&E NEWS (Jan. 25, 2024, 1:25 PM), https://www.eenews.net/articles/how-a-diminished-chevron-doctrine-could-weaken-bidens-climate-law/ (pointing out that eliminating *Chevron* deference might help litigants challenge government interpretations of the IRA); *see also* Loper Bright Enters. v. Raimondo, 144 S. Ct. 2244, 2249 (2024) (affirming that *Skidmore* deference, the practice of taking agency judgment and expertise into account in adjudicating challenges to agency decisions, still applies).

money, and some of the benefits go to consumers who would have made the same purchases without a subsidy.

Policy analysts will likely be at least equally concerned with the question of whether subsidies have the potential to make climate policy much more ambitious than it has been in the past. There is widespread agreement among experts that climate policy has not been sufficiently ambitious given the seriousness of the climate crisis, partly because governments have proven unwilling to impose high broad-based carbon prices on their economies.[9] One might ask whether subsidies provide a more promising avenue to increase the ambition of climate policy and drive us toward net zero emissions—the goal that both the science and economics of climate disruption point to.[10]

This article seeks to come to grips with this massive shift in how we address one of the greatest challenges the world has ever faced—the global climate crisis. It does this by examining the law and economics of subsidies in the context suggested by the new legislation. While we carefully consider economic efficiency, we also pay attention to political economy questions relevant to understanding the likely effectiveness of massive subsidies as a strategy for addressing global climate disruption.

We highlight one of the article's conclusions at the outset, because it suggests that our analysis will prove important not just in the United States, but globally: the U.S. subsidies regime now in place will likely catalyze an increase in the use of subsidies in many other countries, because of the economic dynamics of national subsidies policies.

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[9] *See, e.g.*, Jeffrey Ball, *Hot Air Won't Fly: The New Climate Consensus That Carbon Pricing Isn't Cutting It*, 2 JOULE 2491 (2018)*;* Jeffrey Ball, *Why Carbon Pricing Isn't Working*, 97 FOREIGN AFF. 134 (2018); Eric Haites et al, *Experience with Carbon Taxes and Greenhouse Gas Emissions Trading Systems*, 29 DUKE ENV'T L. & POL'Y FORUM 109 (2018); Daniel Rosenbloom et al., *Why Carbon Pricing is not Sufficient to Mitigate Climate Change—and How "Sustainability Transition Policy" Can Help*, 117 PROC. NAT'L ACAD. SCI. U.S.A. 8664 (2020); *but see* Jeroen van den Bergh & Wouter Botzen, *Low-Carbon Transition Is Improbable without Carbon Pricing*, 117 PROC. NAT'L ACAD. SCI. U.S.A. 23219 (2020).

[10] *See* William Boyd, *The Poverty of Theory: Public Problems, Instrument Choice, and the Climate Emergency*, 46 COLUM. J. ENV'T L. 399, 417 n.54 (2021) (explaining that the IPCC projects that limiting warming to a 1.5°C increase requires net-zero emissions of carbon dioxide by 2050 and net zero for all gases by the 2060s).

This article proceeds as follows. The first part provides the background. It discusses the role of carbon pricing, traditional regulation, and subsidies before 2022. It then proceeds to summarize the law on subsidies created by the IRA. We emphasize a distinction important to our subsequent analysis of political economy and economic efficiency—the distinction between consumer subsidies, such as tax credits for the purchase of electric vehicles, and production subsidies, such as subsidies for the production of renewable energy.

The second part of the article examines the advantages and disadvantages of subsidies, drawing on the economic literature on the subject. We explain why subsidies will tend to be less cost-effective than carbon pricing and point out that they require use of public revenue. On the other hand, we suggest that subsidies may enhance the allocative efficiency of an economy relative to a baseline without carbon pricing (the current federal baseline) and may help bring costly innovations to market.

The third part highlights questions of political economy. We suggest that concerns about competitiveness create a dynamic where ambitious subsidies adopted in one country incentivize creation of ambitious subsidies in other countries. By contrast, a pricing policy may tempt countries to gain a competitiveness advantage by free-riding. This competitiveness dynamic and public choice theory suggest that a subsidies regime may prove more successful at catalyzing ambitious climate policy around the globe than a pricing strategy has. On the other hand, the U.S. legislation shows that countries can make subsidies into agents of protectionism. Such protectionism is not only economically inefficient but can also impede markets' ability to deliver technological change needed to address the climate crisis.

I. MOVING FROM CARBON PRICING TO SUBSIDIES

This part first discusses the role of carbon pricing and other tools in the effort to ameliorate global climate disruption prior to 1990. It then provides a summary of the switch to subsidies associated with the IRA.

A. *Carbon Pricing*

Economists have long advocated carbon pricing as the appropriate tool to address global climate disruption, largely because of

its economic efficiency.[11] The literature generally uses the term carbon pricing to refer to both carbon taxes and emissions trading—sometimes called cap and trade.[12] A carbon tax requires regulated entities to pay a tax on each ton of greenhouse gases emitted into the atmosphere. The government establishes a tax rate, which provides an incentive to reduce emissions.[13] Under an emissions trading approach, the government establishes a cap on the carbon emissions of regulated entities but allows trades among regulated entities to reallocate emission reductions.[14] So, for example, a power plant limited to 100 tons of carbon dioxide emissions might emit 120 tons of carbon if its owner buys 20 tons of carbon reduction credits from a plant that reduced emissions 20 tons below its emissions limit. The purchase of credits covering excess emissions establishes a transparent market price for carbon.[15]

[11] *See id.* at 402 (noting the general enthusiasm for trading among experts and policymakers and the dominance of carbon pricing schemes in debates over climate policy).

[12] *See, e.g.*, William Nordhaus, *Climate Change: The Ultimate Challenge for Economics*, 109 AM. ECON. REV. 1991, 2003 (2019) (explaining that the price of carbon can be raised through cap-and-trade or a carbon tax). While most analysts use the terms emissions trading and cap-and-trade interchangeably, a cap-and-trade program constitutes a subset of emissions trading programs and probably constitutes a null set in the climate space. In a pure cap-and-trade program, the government imposes a mass-based cap on a set of carbon emitters and permits trading only among capped sources. This design helps account for the success of the United States acid rain program, put in place in 1990. By contrast, some emissions trading programs only impose rate-based limits on emissions, for example, by limiting the tons of carbon per British Thermal Energy unit produced from power plants while allowing trading of credits calculated from emission rates. These trading programs are less effective and are not cap-and-trade programs. Generally speaking, trading programs addressing carbon emissions have been hybrid programs rather than pure cap-and-trade programs. Most of them impose a mass-based cap on targeted sources but permit capped sources to escape local obligations by purchasing credits from sources without emission caps. This structure is more vulnerable to lost emission reductions than a pure cap-and-trade program.

[13] *See* Driesen, *Pricing Carbon, supra* note 3, at 705–06.

[14] *See* David M. Driesen, *Capping Carbon,* 40 ENV'T L. 1, 3 (2010) (explaining that "cap-and-trade programs establish caps on regulated polluters' emissions, but allow these polluters to forego meeting their caps if they pay other regulated polluters to go below their assigned cap").

[15] *See* Driesen, *Pricing Carbon, supra* note 3, at 705 (explaining that under trading market transactions generate a price in response to government limits on the quantity of emissions allowed).

Governments have used carbon pricing as a major tool to address greenhouse gas emissions.[16] Prior to the adoption of the first international agreement limiting greenhouse gas emissions—the Kyoto Protocol to the United Nations Framework Convention on Climate Change (hereinafter Kyoto Protocol)—a few countries had introduced a carbon tax in some sectors.[17] The Kyoto Protocol, however, encouraged international emissions trading—a novel variant on emissions trading.[18] The Kyoto Protocol authorized the purchase of credits realized through non-required emission reductions in one country in lieu of meeting otherwise applicable emission limits in another.[19] The European Union pioneered international emissions trading by enacting an emissions trading scheme focused on the European Union and authorizing regulated entities in Europe to purchase credits generated by projects outside the EU.[20] Other

[16] *See* IBRD, PUBLICATION: STATE AND TRENDS OF CARBON PRICING 2023 7 (May 2023), https://openknowledge.worldbank.org/handle/10986/39796 (providing current data on the extent of carbon markets); THE EVOLUTION OF CARBON MARKETS: DESIGN AND DIFFUSION 4 (Jørgen Wettestad & Lars H. Gulbrandsen eds., 2018) (discussing design features found in various countries' trading programs).

[17] *See* GREEN TAXES: ECONOMIC THEORY AND EMPIRICAL EVIDENCE FROM SCANDINAVIA 27 (Runar Brännlund & Ing-Marie Gren, eds., 1999); Claudia Kettner & Daniela Kletzan-Slamanig, *Carbon Taxation in EU Member States: Evidence from the Transport Sector, in* THE GREEN MARKET TRANSITION: CARBON TAXES, ENERGY SUBSIDIES, AND SMART INSTRUMENT MIXES 17, 22 (Stefan E. Weishaar et al. eds. 2017) (noting that Finland and Sweden established carbon taxes in 1990 and 1991 respectively).

[18] *See* David M. Driesen, *Sustainable Development and Market Liberalism's Shotgun Wedding: Emissions Trading Under the Kyoto Protocol,* 83 INDIANA L. J. 21, 33–39 (2008) (discussing how the Kyoto Protocol encouraged emissions trading and some responses to it).

[19] *See* Driesen, *Climate Trading, supra* note 3, at 27–46 (analyzing the Kyoto Protocol and Framework Convention's treatment of trading in detail).

[20] *See* Harro van Asselt, *Emissions Trading: The Enthusiastic Adoption of an 'Alien' Instrument?*, *in* CLIMATE CHANGE POLICY IN THE EUROPEAN UNION: CONFRONTING THE DILEMMAS OF MITIGATION AND ADAPTATION? 125, 125–29 (Andrew Jordan et al. eds., 2010); Brettny Hardy, *How Positive Environmental Policies Affected Europe's Decision to Oppose and then Adopt Emissions Trading*, 17 DUKE ENV'T L. & POL'Y F. 297, 300–06 (2006) (tracing the shift from skepticism about market-based approaches in the EU to adoption of the EU ETS as a central pillar of EU decarbonization); Jørgen Wettestad, *The Making of the 2003 EU Emissions Trading Directive: An Ultra-Quick Process due to Entrepreneurial Proficiency?*, 5 GLOB. ENV'T POL. 1, 1–7 (2005).

governments followed suit—including California and a coalition of states in the northeastern United States.[21]

While these programs reduced emissions, recently scholars have pointed out that the amount of reductions realized through these programs has proven modest relative to the goals of the global climate regime—moving to net zero emissions by 2050.[22] And many of these critics doubt that governments will impose a high enough carbon price to meet ambitious climate goals.[23] They argue that a high and visible carbon price tends to excite opposition to ambitious climate policy.[24] They also point out that existing infrastructure locks in patterns of fossil fuel consumption and that a

[21] For a very detailed and useful review of the design of carbon pricing regimes around the world, *see* EVOLUTION OF CARBON MARKETS, *supra* note 16. For up-to-date basic information about the spread of carbon pricing around the world *see State and Trends of Carbon Pricing Dashboard,* WORLD BANK, https://carbonpricingdashboard.worldbank.org/ (last visited September 9, 2024).

[22] The net zero goal stems from a combination of legal commitments and scientific information. The Conference of the Parties adopting the United Nations Framework Convention on Climate Change in 1992 agreed on a goal of avoiding dangerous climate change. *See* U.N. Conference on Environment and Development: Framework Convention on Climate Change, *Report of Intergovernmental Negotiating Committee for a Framework Convention on Climate Change on the Work of the Second Part of its Fifth Session,* U.N. Doc. A/AC.237/18 (Part II)/Add. 1, art. 2, Annex I (May 9, 1992). Subsequent scientific work suggested that temperature increases of 1.5° to 2° Celsius would prove dangerous. *See* AVOIDING DANGEROUS CLIMATE CHANGE 256 (Hans Joachim Schnellnhuber ed. 2006) (pointing that a large number of studies have identified dangerous impacts occurring above 2°C but that dangerous impacts occur in "some sectors and regions" below that threshold). Accordingly, the Conference of the Parties established avoiding temperature increases of that magnitude as goals in adoption the Paris Agreement in 2015. *See* U.N. Framework Convention on Climate Change, *Report of the Conference of the parties on its Twenty-First Session*, U.N. Doc. FCCC/CP/2015/10/Add.1, Annex, (Jan. 29, 2016) [hereinafter *Paris Agreement*]. Modeling suggests that achieving these goals requires reducing emissions to net zero in developed countries.

[23] *See*, *e.g.*, Matto Mildenberger & Leah Stokes, *The Trouble with Carbon Pricing*, 16 BOS. REV. 128 (2020).

[24] *See* BARRY RABE, CAN WE PRICE CARBON? 17, 24 (2018) (finding alternatives to carbon pricing more politically attractive because they make costs "less explicit or transparent"); Stefano Carattini, Maria Carvalho, & Sam Fankhauser, *Overcoming Public Resistance to Carbon Taxes,* 9 WILEY INTERDISC. REV.: CLIMATE CHANGE 1, 3 (2018), https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wcc.531 (noting the public perception that the personal costs of a carbon tax are too high).

carbon price alone will not overcome that.[25] Proponents of environmental justice, who played a large role in creating the IRA, have always been skeptical of emissions trading in particular. They fear that such programs can trade away sorely needed ancillary emission reductions in disadvantaged communities and harm the purchasing power of low-income households.[26]

In the United States, the Supreme Court has put up barriers to using emissions trading as a tool to move toward net zero emissions. The EPA under President Obama promulgated power plant standards that could be met through emissions trading.[27] The EPA based these standards, in part, on the ability of electric utilities in an emissions trading scheme to achieve emission reductions by shifting generation from coal-fired power plants to zero emission renewables or lower emission natural gas-fired power plants.[28] The Supreme Court struck down these rules in *West Virginia v. EPA*.[29] It crystallized and relied on the major questions doctrine, which now prohibits agencies from taking novel actions on matters of great social and economic significance based on general language in legislation.[30] While this doctrine is unpredictable, *West Virginia v. EPA* creates opportunities for special interests to argue that ambitious rules authorized by a statute are illegal precisely because they are ambitious.[31]

The Supreme Court's recent decision in *Loper Bright v. Raimondo* and its general hostility toward regulation will also hinder less novel and ambitious efforts to address global climate disruption

[25] *See* Karen C. Seto et al., *Carbon Lock-In: Types, Causes, and Policy Implications*, 41 ANN. REV. ENV'T & RES. 425, 429–32 (2016).

[26] *See* James Boyce, Michael Ash, & Brent Ranlli, *Environmental Justice and Carbon Pricing: Can They be Reconciled,* 7 GLOB. CHALLENGES 1, 1 (2023).

[27] *See* West Virginia v. EPA, 597 U.S. 697, 713 (2022) (explaining that EPA's Clean Power Plan for electric utilities allowed states to employ emissions trading as a means of reducing greenhouse gas emissions).

[28] *See id*. at 713.

[29] *See id.* at 734–735 (finding that section 111(d) of the Clean Air Act does not authorize the system of emission reductions that EPA authorized in the Clean Power Plan).

[30] *See id.* at 724–735 (relying primarily on the major questions doctrine to strike down the Clean Power Plan).

[31] *See* Lisa Heinzerling, *The Power Canons,* 58 WM & MARY L. REV. 1933, 1987–88 (2017) (suggesting that the cases forming the basis for the major questions doctrine favor special interests).

through the regulatory process.[32] *Loper Bright* authorized federal judges to limit applications of ambiguous statutes by overturning the *Chevron* doctrine, which had required deference to reasonable agency interpretations of unclear statutes.[33]

B. *Traditional Regulation and Subsidies Prior to the IRA*

Although scholars and analysts usually focus much of their writing on carbon pricing, governments have never relied upon pricing schemes as exclusive vehicles for achieving carbon reductions.[34] Traditional standards—either performance standards imposing emission limits for particular pollution sources or "work practice requirements" to make specific technological changes—have played a large role.[35] And even prior to the recent passage of the IRA, subsidies have played a role as well.[36]

Ambitious traditional standards and subsidies played a role in catalyzing electric vehicles, which now offer the potential to reach zero carbon in the transportation sector—the largest source of greenhouse gas emissions in the United States.[37] California

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[32] *See* Loper Bright Enters. v. Raimondo, 144 S. Ct. 2244 (2024) (reversing the holding in *Chevron v. Natural Resources Defense Council* that judges should defer to reasonable agency interpretations of the statutes they administer); *see, also* Ohio v. EPA, 601 U.S. 279, 300 (2024) (granting a formerly extraordinary emergency stay of a long overdue rule requiring abatement of interstate air pollution).

[33] *See Loper Bright*, 144 S. Ct. at 2273 (stating that "*Chevron* is overruled").

[34] *See* Erik Haites, *A Dual-Track Transition to Global Carbon Pricing: Nice Idea, But Doomed to Fail*, 20 CLIMATE POL'Y 1344, 1344 (2020) (noting that every jurisdiction "with a pricing policy also has multiple regulatory policies"); *see* David M. Driesen, *Emissions Trading Versus Pollution Taxes: Playing Nice With Other Instruments*, 48 ENV'T L. 29, 51–55 (2018) (reviewing the types of non-pricing policies governments use and their functions).

[35] *See, e.g.*, Nathan Lemphers et al., *Rooted in Place: Regional Innovation, Assets, and the Politics of Electric Vehicle Leadership in California, Norway, and Quebec,* 87 ENERGY RES. & SOC. SCI. 102462, 8–9 (2022) (discussing California's zero emission vehicle requirements)*; see generally* David M. Driesen, *Alternatives to Regulation? Market Mechanisms and the Environment, in* THE OXFORD HANDBOOK OF REGULATION 203, 204–05 (Robert Baldwin et al. eds. 2012) (defining traditional regulation).

[36] *See* MOLLY F. SHERLOCK ET AL., CONG. RSCH. SERV., R47202, TAX PROVISIONS IN THE INFLATION REDUCTION ACT OF 2022 (H.R. 5376) 5–13 (2022) (describing various federal subsidies that pre-dated the IRA and explaining how the IRA changed them).

[37] *See* Jonas Meckling & Jonas Nahm, *The Politics of Technology Bans: Industrial Policy Competition and Green Goals for the Auto Industry*, 126 ENERGY POL'Y 470, 475 (2019) (noting that California's requirement to sell EVs and

established requirements that a small percentage of vehicles sold in that state emit no greenhouse gases at all.[38] California, and governments following its lead, complemented standards that demand zero emission vehicles with subsidies, both to encourage purchases and to support building charging stations for electric vehicles.[39] China helped the burgeoning global effort to bring electric vehicles to market by offering massive subsidies as part of an effort to encourage production of electric vehicles in China.[40] As the prices dropped and production increased, many countries not only adopted standards predicated on a growing market share for zero emission vehicles, but also announced phaseout dates for selling gasoline-based engines.[41] Thus, both traditional standards and subsidies have spurred the proliferation of zero carbon electric vehicles.

China's subsidies for them "had a global market-making effect"); EPA, EPA 430-R-23-002, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2021 ES 22 (2023). We define a subsidy to include any payment to a producer made or required by the government, other than a purchase at market price. This definition includes feed-in tariffs, even though they are not always considered subsidies under European Union Law. *Compare* 2019 E.C.R. C-405/16 P, ¶¶ 69–71, 73, 80 (holding that Germany's feed-in tariff did not constitute illegal state aid because Germany did not pay the costs of the feed-in tariff and only authorized but did not require utilities that paid the tariff to pass costs on to consumers) *with* 2013 E.C.R. C-262/12, ¶¶ 26, 37 (treating feed-in tariff as an illegal subsidy where French government is obligated to pay portion of feed-in tariff if funds collected from consumers did not suffice); 2023 E.C.R C-702/20 and C-17/21, ¶¶ 37, 43 (stating that requiring payers of feed-in tariff to pass costs on to consumers creates a violation of ban on state aid); 2008 E.C.R C-206/06 ¶ 66 (holding that where legislation required the charge to be passed to the consumer, public control existed in the form of a levy creating an illegal state subsidy).

[38] *See* Am. Auto. Mfrs. Ass'n v. Cahill, 152 F.3d 196, 199 (2d Cir. 1998) (describing California's ZEV mandate and its modification).

[39] *See* Nora Naughton & Christina Rogers, *How Tax Credits and Government Subsidies Have Aided the Electric-Vehicle Market*, WALL ST. J. (Nov. 26, 2021), https://www.wsj.com/articles/how-tax-credits-and-government-subsidies-have-aided-the-electric-vehicle-market-11637583826 (reviewing federal subsidies and other governments' support for electric vehicles).

[40] *See* Meckling & Nahm, *supra* note 37, at 476 (describing the Chinese support for ZEVs).

[41] *See id.* at 470, 473; *cf.* Stephen Castle, *Sunak Poised to Weaken U.K. Climate Targets as Election Approaches,* N.Y. TIMES, (Sept. 21, 2023), https://www.nytimes.com/2023/09/20/world/europe/uk-sunak-climate-change.html (stating that the British Prime Minister now plans to postpone UK ban on the sale of gasoline and diesel-powered vehicles to 2035 in light of electoral concerns).

An especially important example of pre-IRA carrots comes primarily from Europe. Several European governments encouraged renewable energy by employing a feed-in tariff, which pays producers above-market rates for renewable energy fed into the electricity grid.[42] Scholars widely credit the German feed-in tariff, in particular, with creating demand for solar energy that led to cost declines, making solar energy competitive with fossil fuels.[43] The United States provided subsidies for renewable energy primarily through tax credits, although they were often small and subject to policy disruption.[44] The IRA consists, in part, of amendments to laws creating these subsidies, which extend the subsidies' duration and increase their potential size.[45] At the same time, many governments, including the United States, continued to subsidize fossil fuels, thereby contributing to increased greenhouse gas emissions.[46] In 2023, President Biden suggested reducing fossil fuel subsidies in the debt ceiling debate, but Congress did not support the idea.[47]

Subsidies have long played a role in reducing greenhouse gas emissions in the building sector. Both here and abroad, governments subsidize low-income weatherization projects which make homes

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[42] *See* Felix Mormann, Dan Reicher, & Victor Hanna, *A Tale of Three Markets: Comparing Renewable Energy Experiences of California, Texas, and Germany,* 35 STAN. ENV'T L. J. 55, 81–82 (2016) (explaining that Germany's feed-in tariff began to generate significant deployment of renewables when the tariff was set to provide a profit above estimated generation costs); *see also* Marc Ringel, *Fostering the Use of Renewable Energies in the European Union: The Race Between Feed-in Tariffs and Green Certificates*, 31 RENEWABLE ENERGY 1, 6–8 (2006) (listing the countries adopting feed-in-tariffs prior to 2006).

[43] *See* Wolfgang Buchholz, Lisa Dippl & Michael Eichenseer, *Subsidizing Renewables as Part of Taking Leadership in International Climate Policy: The German Case*, 129 ENERGY POL'Y 765 (2019); *see* Todd D. Gerarden, *Demanding Innovation: The Impact of Consumer Subsidies on Solar Panel Production Costs*, 69 MGMT. SCI. 7799, 7801 (2023); *see also* Ping Huang et al., *How China Became a Leader in Solar PV: An Innovation System Analysis*, 64 RENEWABLE & SUSTAINABLE ENERGY REV. 777, 783 (2016).

[44] *See* SHERLOCK, *supra* note 36, at 5–6 (mentioning that law prior to the IRA's passage provided an energy production tax credit and a temporary investment tax credit for new renewable energy).

[45] *See id.* (describing the modifications of renewable energy tax credits).

[46] *See Biden Budget to Target U.S. Fossil Fuel Subsidies*, REUTERS (Mar. 9, 2023, 11:22 AM), https://www.reuters.com/business/energy/biden-budget-target-us-fossil-fuel-subsidies-2023-03-09/ (estimating the value of the subsidies at $10 to $50 billion a year).

[47] *See id.* (explaining that President Biden's budget targets fossil fuel subsidies).

habitable by financing energy efficiency improvements that occupants cannot afford.[48] Electric utilities in many U.S. states (and abroad) also more broadly subsidize energy efficiency improvements in buildings, usually charging the costs to ratepayers.[49] These "demand-side management" programs help align supply and demand by reducing demand for electricity as a substitute for the often more expensive and dirtier approach of building more power plants to increase energy supply.[50]

It should be noted that pricing and subsidies are not always separate. The Operating Authority of the Regional Greenhouse Gas Initiative (RGGI)—the emissions trading scheme implemented by a consortium of northeastern states in the US—auctions off allowances to emit carbon instead of giving them away for free.[51] The auction revenue subsidizes renewable energy and energy efficiency improvements in the RGGI states.[52] Carbon taxes also generate revenue, which governments can use to subsidize the transition to net zero emissions.

But the federal government of the United States has never implemented a carbon pricing policy for greenhouse gas emissions. The subsidies offered in the IRA now constitute the heart of the legislative effort to reduce greenhouse gas emissions in the United States.

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[48] *See, e.g. Weatherization Assistance Program*, U.S. DEP'T OF ENERGY, https://www.energy.gov/scep/wap/weatherization-assistance-program (last visited Nov. 17, 2024).

[49] *See* Driesen, *supra* note 34, at 52 (stating that many countries fund energy efficiency in buildings); Judson Boomhower & Lucas W. Davis, *A Credible Approach for Measuring Inframarginal Participation in Energy Efficiency Programs*, 113 J. PUB. ECON. 67, 67 (2014) (noting that "United States electric utilities spent $34 billion on energy efficiency programs between 1994 and 2012"); Steven Stoft & Richard J. Gilbert, *A Review and Analysis of Electric Utility Conservation Incentives,* 11 YALE J. REG. 1, 5–6 (1994) (discussing the use of demand-side management programs to subsidize insulation and purchase of energy efficient appliances).

[50] *See* Stoft & Gilbert, *supra* note 49, at 5 (explaining that "Conservation proponents have argued that energy can be saved more cheaply than it can be produced").

[51] *See* Brian C. Murray & Peter T. Maniloff, *Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors*, 51 ENERGY ECON. 581, 581–82 (2015).

[52] *See id.* at 588 (referencing the use of auction revenue to fund "energy efficiency and other low-carbon investments").

C. *The IRA*

In this subsection, we first describe the IRA's scope and ambition. Then we describe the types of subsidies available. A distinction between production and consumption subsidies will prove important to our subsequent analysis. We then discuss some of the protectionist elements in the IRA.[53] Finally, we discuss the taxation generating the funding for the subsidies.

1. Scope and Ambition

In some respects, the IRA seems quite ambitious. As noted previously, it provides at least $370 billion in funding for clean energy and other climate action. It touches more sectors than almost all carbon pricing schemes. It addresses all manner of clean energy technologies.[54] The subsidies go beyond supporting clean transportation and electricity generation to offer some promise of cleaning up hard-to-decarbonize sectors like steel and aluminum, partly by subsidizing carbon capture and storage and partly by supporting new advanced technology, providing some room for unexpected developments.[55] IRA subsidies also apply to agricultural and land use emissions of methane, which are often left out of carbon pricing obligations because of the difficulty of measuring methane emissions.[56]

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[53] *See generally* Thomas J. Shoenbaum*, The Biden Administration's Trade Policy: Promise and Reality*, 24 GERMAN L. J. 102, 107 (2023) (claiming that the IRA and other laws advance a protectionist "buy American" policy).

[54] *See* THE WHITE HOUSE, *supra* note 4, at 9–77.

[55] *See id.* at 67–73.

[56] *See id.* at 101, 133; Steve Buckley, *Detecting Methane Emissions: How Spectroscopy is Contributing to Sustainability Efforts*, 37 SPECTROSCOPY 22, 22 (2022) ("[. . .Methane] is relatively difficult to measure"); *see, e,g., Scope of the EU ETS*, EUR. COMM'N, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/scope-eu-ets_en (last visited Oct. 24, 2024) (explaining that the EU Trading Scheme focuses only on carbon dioxide, nitrous oxide, and perfluorocarbons because these gases "can be measured . . . with a high level of accuracy"); *Getting Started with the B.C. Output-Based Pricing System*, GOV'T OF B.C., https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/carbon-tax/obps-technical
-backgrounder.pdf (last visited Oct. 23, 2024) (British Columbia's carbon tax specifically excludes sectors with significant methane emissions, like agriculture and natural gas production); *About the Regional Greenhouse Gas Initiative*, Reg'l Greenhouse Gas Initiative, https://www.rggi.org/program-overview-and-design/elements (last visited Oct. 23, 2024) (showing that RGGI applies only to carbon dioxide); *cf. FAQ Cap-and-Trade Program*, CAL. AIR RES. BD.,

The IRA subsidizes energy efficiency improvements, which reduce carbon dioxide emissions by diminishing electricity consumption.[57] While pricing schemes can incentivize energy efficiency improvements, some critics maintain that problems of imperfect information, asymmetric information, and bounded rationality greatly limit their effectiveness in doing so.[58] The IRA also supports carbon sequestration (mostly land uses that sequester carbon already emitted) and adaptation (programs to ameliorate the impacts of the ongoing climate crisis).[59] The IRA resists easy summary, and this does not constitute a complete review, but merely supports the claim that it provides rather comprehensive support for climate action.

Still, this legislation does not by itself prove that a subsidy strategy suffices to overcome the failures of carbon pricing to put us on a path to net zero emissions. Most studies claim that the IRA positions the United States to achieve approximately a 40% reduction in carbon emissions by 2030 below a 2005 baseline.[60] This falls short of the 50% reduction the United States has pledged to make under the Paris Agreement—an international agreement to pledge

https://ww2.arb.ca.gov/resources/documents/faq-cap-and-trade-program (last visited Oct. 23,
2024) (while CARB's "cap-and-trade" program does not include agriculture, but that projects reducing methane are allowed to be counted as offsets against other reduction obligations).

[57] THE WHITE HOUSE, *supra* note 4, at 105–130.

[58] *See* Christian Stoll & Michael A. Mehling, *Climate Change and Carbon Pricing: Overcoming Three Dimensions of Failure*, 77 ENERGY RES. & SOC. SCI. 102062, 3 (2021) (discussing how these problems pose particular problems for certain types of energy efficiency investments).

[59] *See* THE WHITE HOUSE, *supra* note 4, at 138, 145–146.

[60] *See* U.S. EPA, EPA 430-R-23-004, ELEC. SECTOR EMISSIONS IMPACTS OF THE INFLATION REDUCTION ACT: ASSESSMENT OF PROJECTED CO2 EMISSION REDUCTIONS FROM CHANGES IN ELECTRICITY GENERATION AND USE 11 (2023) (predicting 35–43% economy-wide emission reductions below 2005 levels by 2030); JOHN LARSEN ET AL., A TURNING POINT FOR US CLIMATE PROGRESS: ASSESSING THE CLIMATE AND CLEAN ENERGY PROVISIONS IN THE INFLATION REDUCTION ACT 3 (Aug. 12, 2022), https://rhg.com/wp-content/uploads/2024/02/A-Turning-Point-for-US-Climate-Progress_Inflation-Reduction-Act-1.pdf (estimating that with the IRA, U.S. emissions will decline to 32% to 42% below 2005 levels by 2030). This may underestimate the emission reductions, as many of the tax credits are not limited and increased uptake could mean greater emission reductions than predicted. *See generally,* EPA, *supra* at 13 (explaining some of the reasons for differences in economic modeling results).

reductions with the goal of avoiding dangerous climate disruption.[61] The IRA does not promise net-zero emissions by 2050—the goal usually identified with avoiding dangerous climate disruption by limiting warming to a 2 degree or 1.5 degree Celsius increase in global mean surface temperature.[62] Furthermore, the 40% reduction estimate includes not just the IRA, but also previously enacted state or federal policies.[63] The IRA alone may provide for a 10% reduction below levels achieved without it.[64]

So, the question of whether subsidies have better potential to propel us to net zero emissions than pricing requires some prediction about the strategy's future potential worldwide. We will address that in part III.

2. Form of the Subsidies

The majority of the subsidies in the IRA take the form of tax credits.[65] Tax analysts sometimes refer to tax credits as tax expenditures, because their impact on the federal budget is the same as a grant or other outlay.[66] This is especially true in the IRA context, because many of the tax subsidies for production include direct pay provisions, which allow entities to claim a credit even if the credit

[61] *See Paris Agreement*, *supra* note 22; UNITED STATES OF AMERICA NATIONALLY DETERMINED CONTRIBUTION: REDUCING GREENHOUSE GAS EMSSION GASES IN THE UNITED STATES: A 2030 EMISSIONS TARGET, U.S. 1 (2021), https://unfccc.int/sites/default/files/NDC/2022-06/United%20States%20NDC%20April%2021%202021%20Final.pdf (committing to reduce emissions by 50–52 percent below 2005 levels by 2030); Daniel Bodansky, *The Paris Climate Change Agreement: A New Hope?*, 110 AM. J. INT'L L. 288 (2016).

[62] *See* Boyd, *supra* note 10, at 417 n.54 (explaining that the IPCC projected that limiting warming to a 1.5°C increase requires net-zero emissions by 2050 and net zero for all gases by 2060s).

[63] LARSEN ET AL., *supra* note 60, at 3 (finding that *net US greenhouse gas emissions* will decline 32–42% with the IRA in place).

[64] *See id.* (estimating that the IRA generates "up to 10% more reductions than under current policy without the IRA").

[65] *See* Justin Badlam et al., *The Inflation Reduction Act: Here's What's in It*, MCKINSEY & CO. (Oct. 24, 2022), https://www.mckinsey.com/~media/mckinsey/industries/public%20and%20social%20sector/our%20insights/the%20inflation%20reduction%20act%20heres%whats%20in%20it/the-inflation-reduction-act-heres-whats-in-it_final.pdf.

[66] *See* Felix Mormann, *Beyond Tax Credits: Smarter Tax Policy for a Cleaner, More Democratic Energy Future*, 31 YALE J. REG. 303, 337 (2014).

exceeds their tax liability.[67] Yet, absent a cap, tax subsidies can provide more robust financial support than a fixed subsidy, because the amount of the subsidy is open-ended. It can increase if the activity it supports increases. Some of the subsidies, however, take the form of direct grants.[68] The IRA also includes loan and rebate programs.[69]

Most of the subsidies support production, either directly or by subsidizing investment.[70] The IRA provides an estimated $30 billion in production tax credits for U.S. manufacture of solar panels, wind turbines, batteries, and minerals critical to the clean energy transition.[71] The legislation provides investment tax credits for those investing in the manufacture of electric vehicles, wind turbines, solar panels, and other clean technologies.[72] The IRA subsidizes the auto industry by providing $3 billion in loans to build new vehicle manufacturing facilities and $2 billion in grants to retool existing facilities to manufacture clean vehicles and their components.[73]

The subsidies for consumers generally build upon, expand, and extend existing consumer subsidies.[74] The IRA funds a variety of programs to help homeowners increase the energy efficiency of their houses through installation of heat pumps, rooftop solar, improved insultation, and efficient electric heating, air conditioning, and water heating.[75] The IRA also increases, extends and

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[67] *See* Badlam et al., *supra* note 65; *cf.* Mormann, *supra* note 66, at 308–09 (pointing out that tax credits without this feature do not work very well for renewable energy).

[68] *See* THE WHITE HOUSE, *supra* note 4, at 2 (stating that the IRA "provides billions in grant and loan programs and other investments for clean energy and climate action").

[69] *See id.*

[70] *See* Badlam et al, *supra* note 65 (estimating that corporations' tax incentives make up $216 billion of the $394 billion of the climate change funding in the IRA).

[71] *See* CONG. BUDGET OFF., ESTIMATED BUDGETARY EFFECTS OF H.R. 5376, THE INFLATION REDUCTION ACT OF 2022 12 (August 5, 2022); IRA § 13502, 26 U.S.C. § 45X.

[72] *See* IRA §§ 13702; 13401–02.

[73] THE WHITE HOUSE, BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION 47 (version 2, January 2023).

[74] *See* SHERLOCK ET AL., *supra* note 36, at 11–13 (discussing how the IRA modifies existing law providing subsidies for consumers' investments in energy efficiency); *cf.* Mormann, *supra* note 66, at 308–09 (explaining that in the past tax credits have supporting renewable energy have proven rather inefficient and ineffective, because they only benefit producers when they have a tax liability).

[75] *See* IRA, §§ 13301–04.

restructures existing tax credits for electric vehicle purchases.[76] Because electric vehicles have been very expensive, subsidies for electric vehicles have largely benefitted rather wealthy people. The IRA makes up to $7,500 of tax credits available to support purchase of new electric vehicles but caps the income of recipients.[77] It also creates a new $4,000 subsidy to purchase *used* electric vehicles, which should benefit lower and middle-income consumers who usually purchase used rather than new cars.[78]

3. Labor Protections

Congress designed the IRA to enhance its benefits to American workers. In a number of instances, firms wishing to maximize their tax credits must pay the "prevailing wage" or use registered apprentices.[79]

The IRA also ties many of its tax credits to domestic or North American content requirements.[80] These provisions make some of the available subsidies for products (such as electric vehicles or solar power plants) dependent on the use of materials or products manufactured or produced domestically or by U.S. trading partners.[81] Local content requirements may well create problems under international trade law. In particular, international trade law generally prohibits countries from discriminating against foreign goods, and

[76] *See* IRA, § 13401.

[77] *See* Tom Krishner, *The Easiest Way to Get a $7,500 Tax Credit for an Electric Vehicle? Consider Leasing*, ASSOCIATED PRESS (May 30, 2023), https://apnews.com/article/electric-vehicle-lease-buy-cheaper-tax-credit-6cfe4101ad04bd993c634d860ec5598b (describing the income caps for getting the full credit); IRA § 13401(f)(10).

[78] *See* IRA § 13402.

[79] *See* THE WHITE HOUSE, *supra* note 4, at 7 (describing these provisions as offering "bonus credits").

[80] *See* Kimberly A. Clausing & Catherine Wolfram, *Carbon Border Adjustments, Climate Clubs, and Subsidy Races When Climate Policies Vary*, 37 J. ECON. PERSP. 137, 146 (2023) (mentioning domestic content requirements for wind energy, solar energy, and electric vehicle subsidies); Keith Martin, *Bonus Tax Credits and the Inflation Reduction Act* (2022), https://www.projectfinance.law/publications/2022/october/bonus-tax-credits-and-the-inflation-reduction-act/.

[81] *See, e.g.*, Abigail Pelton, *Protecting Protectionism in the WTO: A Reinterpretation of the General Exceptions to Protect the IRA's Local Content Requirements*, 49 COLUM. J. ENV'T L. 100, 117–18 (2024) (providing examples of domestic content requirements in the IRA).

domestic content requirements violate that principle.[82] They also pose problems associated with protectionism, which we discuss in Part III.

4. Taxation

The IRA funds all these subsidies through tax increases on the wealthy and corporations. In particular, it imposes a 1% excise tax on corporate stock buybacks, which tend to inflate stock prices.[83] It also imposes a minimum tax of 15% on corporations that earn more than $1 billion a year in profits, some of which had avoided paying corporate taxes altogether in the past.[84] It includes $80 billion in additional IRS funding, including an estimated $45 billion to improve enforcement against wealthy taxpayers.[85] It also extends limits on deduction of pass-through business losses enacted in the 2017 Tax Cuts and JOBS Act through 2028.[86] And it levies a 95% excise tax penalty on drug manufacturers to incentivize lower drug prices.[87] Because of these taxes, the Tax Foundation initially estimated that the IRA would decrease the federal deficit by $324 billion.[88] But more recent evidence indicates that the IRA may yet create a budget

[82] *See id.* at 119–126 (explaining national treatment rules in various trade agreements). The General Agreement on Tariffs and Trade contains some general exceptions to the National Treatment principle. For an argument that these exceptions should apply to several trade law treaties, *see id.* at 134–143.

[83] *See* IRA § 10201.

[84] *See id*. § 10101; *see also* Jeff Stein, Maxine Joselow, & Rachel Roubein, *How the Inflation Reduction Act Might Affect You and Change the U.S.*, WASH. POST (Aug. 29, 2023), https://www.washingtonpost.com/us-policy/2022/07/28/manchin-schumer-climate-deal/ (stating that "dozens of Fortune 500 companies pay no federal income tax at all").

[85] *See* CONG. RSCH. SERV., IRS-RELATED FUNDING IN THE INFLATION REDUCTION ACT (October 20, 2022), https://crsreports.congress.gov/ product/pdf/IN/IN11977. Congress subsequently curtailed $20 billion of the spending on IRS enforcement as part of the deal made to lift the federal debt ceiling. *See* Stein, *supra* note 84.

[86] *See* Kasey Pittman & Michael Wronsky, *Excess Business Loss Limitation Developments: 2022 Year-End Tax Letter*, BAKERTILLEY (Oct. 26, 2022), https://www.bakertilly.com/insights/excess-business-loss-limitation-developments.

[87] *See* IRA § 11003.

[88] *See* Alex Durante et al., *Details and Analysis of the Inflation Reduction Act Tax Provisions*, TAX FOUND. (Aug. 10, 2022), https://taxfoundation.org/research/all/federal/inflation-reduction-act/.

deficit, as uptake of tax credits has exceeded expectations (implying potentially greater environmental benefits than predicted).[89]

II. THE ECONOMICS OF SUBSIDIES

In principle, subsidies could achieve the same carbon reduction goals as a carbon tax or cap-and-trade program of the same level of ambition.[90] And, like a carbon tax, they can improve the efficiency of an economy.[91] Economic theory supports putting a price on carbon, because markets do not by themselves take into account the social cost of carbon—the costs of continuing to warm the planet.[92] Economists consider carbon's social cost an "externality" because market prices do not incorporate such costs. As a result, unregulated markets tend to encourage more activities producing greenhouse gas emissions than an optimal economy would. A price for carbon helps correct this problem.

Subsidies can be thought of as the converse of a price on carbon. Just as we can say that the costs of goods and services involving carbon emissions are too low (as they fail to account for external costs), we can say that the costs of clean (carbon-free) goods and services are too high.[93] That is, clean goods and services have an advantage not priced by markets—the absence of harmful carbon emissions.

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89 *See* William McBride et al., *Inflation Reduction Act One Year After Enactment 22*, TAX FOUND. (Aug. 16, 2023), https://taxfoundation.org/wp-content/uploads/2023/08/Inflation-Reduction-Act-One-Year-Later-2023-fv.pdf.

90 *See generally* Galle, *supra* note 5, at 801 (finding no "marginal difference" between a tax and an equivalent subsidy).

91 *See* Severin Borenstein & Ryan Kellogg, *Carbon Pricing, Clean Electricity Standards, and Clean Electricity Subsidies on the Path to Zero Emissions*, 4 ENV'T & ENERGY POL'Y & ECON. 125, 127 (2023) (finding that subsidies in a program to obtain zero emissions may be "efficiency enhancing"); Hongli Feng et al., *Subsidies! The Other Incentive-Based Instrument: The Case of the Conservation Reserve Program, in* MOVING TO MARKETS IN ENVIRONMENTAL REGULATION: LESSONS FROM TWENTY YEARS OF EXPERIENCE 230, 232 (Jody Freeman & Charles D. Kolstad eds., 2007) (stating that "per unit subsidies have the same short-run efficiency properties as a corresponding tax").

92 *See* Nordhaus, *supra* note 12, at 2003–2004.

93 *See generally* Galle, *supra* note 5, at 807–08 (pointing out that "externalities can be either positive or negative" and can addressed through either a price or a subsidy).

A. *Disadvantages of Subsidies*

But for subsidies to reduce carbon emissions efficiently and effectively, they need to be targeted correctly, which is unlikely in practice.[94] A particular problem is that subsidies are implemented on a product-by-product basis. Thus, even if they promote more efficient use of green technologies, they do not promote efficient levels of carbon emissions across different sectors.[95]

Moreover, subsidies rarely target the externality directly. That is, rather than directly rewarding emissions reductions, they reward investments associated with lower emissions. Such subsidies often have unintended effects. One example is the rebound effect, which is often observed when subsidizing energy efficiency investments.[96] Consider, for example, Davis et al.'s (2014) study of Mexico's Cash for Coolers program.[97] From 2009–2012, this program gave households subsidies to replace old refrigerators and air conditioners with newer models.[98] Eligible households that turned in an air conditioner or refrigerator that was at least 10 years old received subsidies to replace it with a new model that met minimum energy efficiency standards.[99] Using household billing data for over 25 million Mexican homes, the authors found that replacing refrigerators reduced electricity consumption by about 8%.[100] However, replacing air conditioners led to increased electricity use.[101] Lower operating costs for new, more efficient units led to households running them more frequently during hot summer months.[102] Similarly, subsidies for electric vehicles do not consider how much the vehicles will be

94 *But see* Borenstein, *supra* note 91, at 127, 139 (acknowledging subsidies' targeting problem but stating that subsidies may be at least as efficient as pricing carbon in a push to zero emissions).

95 *See* Joseph E. Aldy et al., *How is the US Pricing Carbon? How Could We Price Carbon?*, 13 J. BENEFIT-COST ANALYSIS 310, 314–21 (2022) (explaining why product-by-product subsidies are unlikely to be efficient).

96 *See* Galle, *supra* note 5, at 811 (noting that subsidies for clean energy can produce output increases).

97 *See* Lucas W. Davis et al., *Cash for Coolers: Evaluating a Large-Scale Appliance Replacement Program in Mexico*, 6 AM. ECON. REV.: ECON. POL'Y 207 (2014).

98 *See id.* at 208.

99 *See id.*

100 *See id.* at 208–209.

101 *See id.* at 208.

102 *See id.*

driven. An electric vehicle purchased as a household's second car will offset fewer emissions than if it is a household's primary vehicle.[103] Burlig et al. find that electric vehicles in California are driven less than vehicles with internal combustion engines.[104]

Another disadvantage of subsidies is that they require government revenue.[105] In contrast, emission fees and auctioned cap-and-trade permits raise revenues that can be used to reduce other taxes or to make fees more politically palatable.[106] Because subsidies require tax revenues from other sources to finance them, any inefficiencies caused by these taxes must be part of the analysis of any subsidy. Even if subsidies are not explicitly funded by additional taxes, the opportunity costs of tax revenue not raised, known as *tax expenditures*, should be considered.

A third disadvantage of subsidies is that some beneficiaries are likely non-additional, meaning that they would have made the same decisions even without a subsidy in place.[107] For example, recipients can receive a subsidy for a new energy-efficient appliance even if they would have purchased the same energy-efficient appliance without the subsidy. Such users add to the cost of implementing the subsidy without providing additional environmental benefits. The extent to which participants are non-additional depends on how sensitive consumers are to prices. The less they react to price changes, the more likely that they would have made the same purchase even without the subsidy. In the case of the aforementioned Cash for Coolers program, Boomhower and Davis estimate that half of all

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[103] *See* John E.T. Bistline, Neil R. Mehrotra, & Catherine Wolfram*, Economic Implications of the Climate Provisions of the Inflation Reduction Act*, 2023(1) BROOKINGS PAPERS ON ECON. ACTIVITY 77, 130 (Spring 2023).

[104] *See* Fiona Burlig et al., *Low Energy: Estimating Electric Vehicle Electricity Use*, 111 AEA PAPERS & PROC. 430 (2021).

[105] *See* Galle, *supra* note 5, at 814.

[106] *See* David Klenert et al., *Making Carbon Prices Work for Citizens*, 8 NATURE CLIMATE CHANGE 669, 670–71 (2018) (pointing out that "carbon revenues" can "go towards the general government budget" but that citizens support carbon pricing gains more public acceptance if revenues are earmarked for "green investments" or transfers to disadvantaged groups).

[107] *See* Boomhower & Davis, *supra* note 49, at 68, 78 (stating that "economists have long argued" that many participants in energy efficiency programs "would have adopted these technologies with a lower subsidy or with no subsidy at all" but empirical proof has been lacking).

participants would have adopted energy efficient models even without a subsidy.[108]

Additionality has also been a concern in many emissions trading programs, although not in carbon taxation programs.[109] Many of them allow for offset credits—which allow polluters subject to a cap to avoid making local reductions if they purchase credits reflecting emission reductions achieved at sources not subject to a cap or even from carbon sequestration projects (such as reforestation).[110] The rules in these contexts require that the credits come from "additional" projects—projects that would not have happened but for the financing of those purchasing carbon credits.[111] But it has been difficult in practice to enforce these rules.[112] Non-additionality, however, is not an important impediment to all carbon pricing, but rather a problem in designs that allow offset credits. When credits are non-additional, planned emission reductions are lost, but money is saved.[113] Conversely, in the subsidies context, no environmental benefit is lost, but money is wasted when government subsidizes non-additional activities.[114]

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[108] *See id.* (finding that under "reasonable assumptions . . . about half of all participants would have replaced their appliances with no subsidy").

[109] *See* David M. Driesen, *Decisions About Emissions Trading Design, in* II ENCYCLOPEDIA OF ENVIRONMENTAL LAW 187, 192–93 (Leroy C. Paddock, Robert L. Glicksman, & Nicholas S. Bryner eds., 2016) (describing the difficulties involved in determining additionality); Michael Dutschke & Axel Michaelowa, *Development Assistance and the CDM: How to Interpret "Financial Additionality,"* 11 ENV'T & DEV. ECON. 235, 235 (2006) (characterizing additionality as an important need for a trading program).

[110] *See* Driesen, *supra* note 109, at 192–94 (describing offsets as the generation of emission reduction credits from uncapped sources); Driesen, *Climate Trading*, *supra* note 3, at 32–34 (describing the origins of offsets, including for carbon sequestration, in the Kyoto Protocol).

[111] *See* Dutschke & Michaelowa, *supra* note 109, at 235 (explaining that the additionality requirement has its roots in Article 12(5c) of the Kyoto Protocol).

[112] *See* Driesen, *supra* note 109, at 192–93 (characterizing determination of offset credits' validity as "information intensive and problematic"); Dutschke & Michaelowa, *supra* note 109, at 237–245 (describing in detail the difficulties in determining "financial additionality" under the Kyoto Protocol).

[113] *See* James Salzman & David Weisbach, *The Additionality Double Standard*, 48 HARV. ENV'T L. REV. 117, 133–138 (2024).

[114] *See id.*

B. *Advantages of Subsidies*

That said, the relevant economics suggests that subsidies have some advantages in encouraging expensive but necessary innovation. As we accelerate the decarbonization transition, new technologies will be needed to complement existing clean energy technologies such as wind or solar energy. Energy policy now operates in a world where policy both promotes expanded use of market-ready renewables while still needing to incentivize development of technologies further from the market that will be necessary for full decarbonization, such as batteries capable of storing intermittent energy.[115] It is widely recognized that markets, even markets that include a carbon price, do not necessarily provide optimal incentives for innovation. Would-be innovators may underinvest in innovation because of the certainty of high costs and uncertainty about ultimate results.[116] Furthermore, innovators will bear all the costs (and risks) associated with pursuing innovation, but may not capture all of the returns if their innovation proves successful.[117] Patent law is designed to ameliorate this problem by granting those who develop and deploy innovations a monopoly on the use of the invention for a limited period of time.[118] In exchange, the innovator must publish the patent, which allows competitors to build on the innovation and make further improvements.[119] But even for a patentable innovation, the incentives for innovation may be suboptimal.[120] In

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115 *See* Jay Blake, *Utility-Scale Battery Storage: Solving the Intermittency Issues of Wind & Solar Power Generation,* XXII HOUS. BUS. & TAX L. J. 301 (2022) (discussing the role battery storage might play in enabling renewable energy to power a grid consistently and policy measures aimed at facilitating battery development).

116 *See* Adam B. Jaffe, Richard G. Newell, & Robert N. Stavins, *Environmental Policy and Technological Change*, 22 ENV'T & RES. ECON. 41, 44 (2002) (stating that the "combination of great uncertainty and intangible outcomes" makes finance of innovation difficult).

117 *See* DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW 94–95 (2003).

118 *See* J. Jonas Anderson, *Secret Inventions*, 26 BERKELEY TECH. L. J. 917, 928–9 (2011) (explaining that the patent system seeks to promote innovation by providing inventors with "exclusive rights" to their discoveries).

119 *See* Note, *The Disclosure Function Of The Patent System (Or Lack Thereof)*, 118 HARV. L. REV. 2007, 2008–10 (2005) (explaining that many economists believe that patent disclosure requirements generate "R & D spillovers").

120 *See* Paul Lehmann & Patrik Söderholm, *Can Technology-Specific Deployment Policies Be Cost-Effective?*, 71 ENV'T & RES. ECON. 475, 482 (2018) (suggesting ways in which patents may impede innovation); David Popp et al., *The*

such a setting, no one low-carbon energy technology policy is a silver bullet. Instead, a complex mix of policy tools will be needed.[121]

Subsidies can be part of this mix. For example, the potential for learning-by-doing from emerging technologies is often used to justify subsidies, particularly when the resulting cost-reductions benefit not only early adopters, but also those who wait to adopt until costs fall.[122] However, the existing literature on learning-by-doing generally suggests that the benefits of learning-by-doing alone are not sufficient to justify the current mix of subsidies and other policy tools historically used in U.S. policy.[123] That is, the literature suggests that less reliance on subsidies and more reliance on pricing and R & D incentives would be more cost-effective.

Nonetheless, other potential links between early adoption and innovation are important. Because subsidies target specific technologies, they are more effective than technology-neutral policies at directing innovation towards currently high-cost technological solutions.[124] High German feed-in tariffs encouraged innovation in what were then expensive solar PV technologies.[125] These solar energy subsidies increased demand for solar power by seventy-eight percent between 2010 and 2015, with over half of that increase due to lower costs from innovation induced by the subsidies.[126] Chinese manufacturers ramped up production of photovoltaic cells to sell

Next Wave of Energy Innovation: Which Technologies? Which Skills? 8 (Nat'l Bureau Econ. Rsch., Working Paper No. 30343, 2022) (describing market failures that may limit innovation).

[121] *See* Popp et al., *supra* note 120, at 28 (stating that developing complementary technologies needed for a zero-carbon transition "requires a portfolio of policies").

[122] *See, e.g.*, Lehmann & Söderholm, *supra* note 120.

[123] *See* Carolyn Fischer et al., *Environmental and Technology Policy Options in the Electricity Sector: Are We Deploying Too Many?*, 4 J. ASS'N ENV'T & RES. ECON. 959, 962 (2017); Gregory F. Nemet, *Subsidies for New Technology: Knowledge Spillovers from Learning by Doing*, 31 J. POL'Y ANALYSIS & MGMT. 601, 602 (2012).

[124] *See, e.g.,* Driesen, *supra* note 18 (showing that the Kyoto Protocol's project-based trading mechanisms produced mostly end-of-the-pipe controls, while more targeted programs have produced more fundamental changes).

[125] *See* Nick Johnstone et al., *Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts*, 45 ENV'T & RES. ECON. 133, 148 (2010) (stating that Germany's feed-in tariff positively affects "solar energy patenting").

[126] *See* Todd D. Gerarden, *Demanding Innovation: The Impact of Consumer Subsidies on Solar Panel Production Costs*, 69 MGMT SCI. 7799, 7800 (2023).

into the German market created by the feed-in tariff, perhaps contrary to the intentions of the politicians who created the program.[127] The Chinese manufacturing, however, helped lower the cost of solar energy.[128] Politicians probably did not anticipate the benefits to Chinese manufacturers, so it had no effect on the extension of the feed-in tariff to solar energy.

Subsidies may also help in cases where capital investments are long-lived, such as new factories or power plants. If the long-term goal is to decarbonize all sectors eventually, early abatement efforts in high-cost sectors transfer abatement capital into the future. Because these sectors will require more investment to be fully decarbonized, early investments are particularly valuable when capital in the sector is long-lived, as the investments made today will be in place for decades. Similarly, retrofitting these plants in the future with cleaner technology will be even more expensive than simply choosing clean technology today.[129] However, more work is needed to identify the optimal mix of R&D investment and direct subsidies that bring emerging technologies to market faster, as well as understand the tradeoffs inherent in different policy options. For example, while early investments help bring technologies to market faster, they could potentially also lock in inferior early versions of technology.

C. *Implementing Subsidies Effectively*

If subsidies are used, how can they be implemented effectively? First, carefully considering the incentives provided by subsidies matters. For example, both output and investment subsidies have been used to promote wind energy in the United States.[130] Investment subsidies reduce the cost of building a turbine. Output subsidies provide tax credits per megawatt-hour of electricity produced. As part of the American Recovery and Reinvestment Act of

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[127] *See* Mormann, Reicher, & Hanna, *supra* note 42, at 94 (Germany's FIT drove global demand of solar equipment which supported expansion of Chinese manufacturing).

[128] *See id.* at 84–85 (Chinese manufacturing "helped drive down solar PV prices").

[129] *See* Adrien Vogt-Schilb et al., *When Starting with the Most Expensive Options Make Sense: Optimal Timing, Cost and Sectoral Allocation of Abatement Investment*, 88 J. ENV'T ECON. & MGMT. 210 (2018).

[130] *See* Mormann, *supra* note 66, at 313–15.

2009, between 2009 and 2012 wind farm developers could choose between investment or output subsidies.[131] Operators choosing investment subsidies produced ten percent less power than those choosing output subsidies.[132] While the investment subsidy rewards the building of a wind turbine, relative to the output subsidy it provides less incentive to consider optimal locations for turbine placement.

The distributional effects of subsidies also raise concerns. Historically, the biggest beneficiaries from tax credits such as electric vehicles and solar panels have been high income households.[133] Owning a home or affording a new vehicle are a necessary pre-condition to take advantage of such policies. Recent subsidies partially address this through caps on income or on the price of goods eligible for a subsidy. The IRA also addresses equity by making electric vehicle tax credits available for the purchase of used electric vehicles. Such initiatives reduce inequities in who benefits from these subsidies. But measures improving equity may have costs. To take an example: Unless one assumes that these used electric vehicles would have been scrapped if not purchased with a subsidy, a subsidy on used electric vehicles does not lead to more electric vehicles on the road, and thus has little to no effect on emissions.

III. THE POLITICAL ECONOMY OF SUBSIDIES

This section applies the economic dynamic theory of law and economics to the question of the potential for subsidies to help solve the climate crisis.[134] This theory endorses analysis of the economic incentives that law creates, a common practice in law and economics.[135] But actors do not always know about or respond to all potentially relevant economic incentives.[136] Accordingly, economic

131 *See* Joseph E. Aldy, et al., *Investment Versus Output Subsidies: Implications of Alternative Incentives for Wind Energy*, 10 J. ASS'N ENV'T & RES. ECONOMISTS 981, 982 (2023).

132 *See id.* at 1016.

133 *See* Severin Borenstein & Lucas W. Davis, *The Distributional Effects of U.S. Clean Energy Tax Credits*, 30 TAX POL'Y & ECON. 191 (2016).

134 *See* DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF LAW 216 (2012); *see also* DRIESEN, *supra* note 117, at 133.

135 *See* DRIESEN, ECONOMIC DYNAMICS, *supra* note 134, at 8 (embracing neoclassical law and economics' emphasis on economic incentives' importance).

136 *See id*. at 9 (explaining that actors ignore incentives not made relevant by their "habits, routines, and identity").

dynamic theory takes the bounded rationality of those who an incentive might influence into account.[137] And it supports doing this by looking at the habits and routines influencing the particular form of bounded rationality to expect from those policymakers hope to incentivize.[138]

In this section, we examine the economic incentives that a program of massive subsidies in one country may create for other countries. This is an important topic, as climate disruption is a global problem that requires global action. Unfortunately, the international law regime addressing global climate disruption has never created a sufficiently robust set of common obligations to steer the world to net zero emissions. Given this, transnational law—the law that emerges when countries react to each other's initiatives—has become an important mechanism for addressing the climate crisis.[139]

A. *The Economic Dynamics of Carbon Pricing*

The literature criticizing pricing mechanisms as insufficiently ambitious notes that almost all countries that have employed a carbon price have employed it fairly narrowly. RGGI covers only electric utilities, and Sweden's carbon tax—the highest in the world—focuses primarily on transportation fuels.[140] Only California's emissions trading program and British Columbia's carbon tax approximate the comprehensive coverage envisioned by pricing

[137] *See id*. at 64.

[138] *See id.* at 8–9 (explaining that economic dynamic analysis requires attention to the bounded rationality of the individuals or institutions subject to an incentive).

[139] *See* Frédéric Gilles Sourgens, *The Paris Paradigm*, 2019 U. ILL. L. REV. 1637, 1653–56 (describing actions under the Paris Agreement as participation in a transnational network); *see generally* Harold Hongju Koh, *Transnational Legal Process,* 75 NEB. L. REV. 181 (1996); *cf.* Sharmilla 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, 2 (2019) (arguing that "subnational actors," such as states and cities, act as transnational norm sustainers when they "pledge to uphold a global treaty").

[140] *See* Julius J. Anderson, *Carbon Taxes and CO2 Emissions: Sweden as a Case Study*, 11 AM. ECON. J. ECON. POL'Y 1, 2 (2019) (explaining that Sweden's carbon tax focuses primarily on transport fuels); Murray & Maniloff, *supra* note 51, at 581 (describing RGGI as limiting carbon dioxide emissions "from electric power generation").

proponents, although the EU has broadened its trading scheme over time.[141]

Competitiveness concerns explain some of the gaps in coverage in existing pricing schemes.[142] The EU and its member states, for example, have been concerned that applying carbon pricing to industries facing stiff international competition would cause European firms to relocate or lose market share to competitors abroad.[143] It has therefore enacted a "carbon border adjustment mechanism"—a price on carbon-intensive imported goods with deductions available for carbon prices paid by the exporter—to level the playing field and make broader carbon pricing more palatable. Absent such a measure, the European Commission has explained, EU carbon reduction efforts can trigger "leakage"—increased dirtier production abroad—thereby undermining the effectiveness of the pricing scheme.[144] But a border adjustment mechanism raises issues under international trade law.[145] While international trade law generally authorizes non-discriminatory taxes, the border tax adjustment could face problems from the WTO if its trade panels construe the

[141] *See* Kerstine Appunn & Julian Wettengel, *Understanding the European Union's Emissions Trading Systems*, CLEAN ENERGY WIRE (Jan. 26, 2023), https://www.cleanenergywire.org/factsheets/understanding-european-unions-emissions-trading-system (explaining the scope of the EU ETS, which is still not a comprehensive system, but is slated to almost become one more than two decades after its initiation); *British Columbia's Carbon Tax*, B.C., https://www2.gov.bc.ca/gov/content/environment/climate-change/clean-economy/carbon-tax (last visited October 27, 2024) (stating the B.C.'s carbon tax covers 80% of provincial greenhouse gas emissions).

[142] *See* Klenert et al., *supra* note 106, at 669 (explaining that "many countries" have granted "trade exposed sectors" exemptions from carbon taxes or free allowances in a trading scheme); *see, e.g.*, *Proposal for a Regulation of the European Parliament and Council Establishing a Carbon Border Adjustment Mechanism*, at 2–3 COM (2021) 564 final (Jul. 14, 2021) (hereinafter Border Adjustment Proposal) (explaining that the current ETS addresses "the risk of carbon leakage" by weakening price signals by subsidizing electricity and allocating emission allowances for free).

[143] *See* Border Adjustment Proposal, *supra* note 142 at 2, 8 (explaining that a border adjustment mechanism would avoid having EU "emissions reduction efforts" lead to "relocation of production or increased imports").

[144] *See id.* at 2.

[145] *See id.* at 10; Wendell Roelf & Kate Abnett, *S. Africa Considers Complaining to WTO Against EU Carbon Border Tax,* REUTERS (May 22, 2024, 8:53 PM), https://www.reuters.com/world/africa/safrica-considers-complaining-wto-against-eu-carbon-border-tax-2024-05-22/ (describing the EU measure).

General Agreement on Tariffs and Trade ("GATT") obligations broadly.[146]

In the United States, such competitiveness concerns have proven even more detrimental to efforts to use carbon pricing effectively. These concerns played a role in the failure of the federal government to enact any carbon pricing program at all.[147] Because some countries have not adopted carbon pricing and all countries limit pricing's scope, carbon pricing covers only 23.17% of global emissions.[148] This represents an increase in coverage over time, but it also indicates that in spite of a concerted, decades-long international effort to promote carbon pricing, it has enjoyed limited success.[149]

This leads to a more general point. Carbon pricing creates incentives for countries to free-ride. When one country implements carbon pricing, another country can seize a competitiveness advantage by not doing so.[150] Economists recognize this problem and recommend international agreements as a way of solving collective action problems.[151] But efforts to forge strong binding international agreements mandating ambitious emission reductions world-wide

146 *See* Michael A. Mehling & Robert A. Ritz, *From Theory to Practice: Determining Emissions in Traded Goods under a Border Carbon Adjustment,* 39 OXFORD REV. ECON. POL'Y 123, 128–29 (2023) (explaining that trade panels have held that measures treating products differently based on how they are produced are discriminatory, so that such measures would have to be justified under defenses for measures protecting human health and natural resources); Michael A. Mehling et al., *Designing Border Carbon Adjustments for Enhanced Climate Action*, 113 AM. J. INT'L L. 433, 456–71 (2019) (providing a more general analysis of the trade law issues facing border tax adjustments).

147 *Cf.* West Virginia v. EPA, 597 U.S. 697, 713 (2022) (explaining that EPA's rule governing electric utility emissions from existing plants authorized states to use a cap-and-trade regime as a compliance mechanism, before invalidating that plan).

148 *See State and Trends of Carbon Pricing Dashboard,* WORLD BANK, https://carbonpricingdashboard.worldbank.org/compliance/coverage (last visited September 9, 2024).

149 *See* Driesen & Mehling, *supra* note 2, at 228–29 (explaining that the coverage limitations support pricing critics' claims that carbon pricing has proved insufficiently ambitious).

150 *See* Mormann, *supra* note 66, at 307 (explaining that "political and economic pressures to keep . . . domestic industries globally competitive" have impeded "the widespread adoption of [adequate] emissions pricing").

151 *See, e.g.*, Nordhaus, *supra* note 12, at 1993 (stating "that nations can ensure effective climate . . . policies" only by "implementing . . . *cooperative multinational policies*").

have failed. Instead, we have a regime of varying pledges by countries concerned about the climate crisis.[152]

Public choice theory supports the observation that carbon pricing will tend to provoke resistance.[153] It posits that countries tend to adopt legislation to please special interests, which are more capable of organizing effectively than the general public.[154] Fossil fuel interests tend to resist high carbon prices, producing schemes with cheap loopholes, limited coverage, and low prices, where they exist at all.[155]

Furthermore, consider the bounded rationality of politicians shaping climate policy. As public choice theorists point out, politicians often respond to pressure from organized groups because they have the capacity to influence electoral results.[156] Special interests, however, like to make public interest arguments to convince politicians that what they want is plausibly in the public interest.[157] Credible claims that carbon pricing will put taxed firms at a disadvantage with other countries creates both popular and special interest pressure to limit the scope of carbon pricing. While a high carbon price proves efficient because it generates benefits in the form of avoided climate damage far in excess of costs, political leaders will feel constrained by the prospect of quickly apparent loss of production to

152 *See* Bodansky, *supra* note 61, at 289 (describing the Paris agreement as embodying a "bottom-up approach, in which the Agreement reflects rather than drives national policy") (internal quotations omitted).

153 *See* Mormann, *supra* note 66, at 337 (noting that subsidies have more political appeal than pricing).

154 *See* JAMES BUCHANAN & GORDON TULLOCK, THE CALCULUS OF CONSENT 283–95 (1962); *see also* Robert D. Tollison, *Public Choice and Legislation*, 74 VA. L. REV. 339, 342–43 (1988) (explaining why special interests have advantages in organizing to "demand" legislation).

155 *See*, *e.g.*, Mildenberger & Stokes, *supra* note 23, at 122–23 (explaining how the fossil fuel industry kept California's carbon price low).

156 *See* William Landes & Richard Posner, *The Judiciary in an Interest Group Perspective*, 18 J. L. & ECON. 875, 877 (1975) (summarizing the economic theory of legislation as one that maintains groups buy legislation through campaign contributions and delivery of votes); *see also* Daniel A. Farber & Philip P. Frickey, *The Jurisprudence of Public Choice*, 65 TEX. L. REV. 873, 892 (1987) (discussing some public choice models' emphasis on special interest groups' provision of financial backing, publicity, and endorsements).

157 *See* Michael E. DeBow & Dwight R. Lee, *Understanding (and Misunderstanding) Public Choice: A Response to Farber and Frickey*, 66 TEX. L. REV. 993, 1004 (1988) (stating that private interests "cloak" their appeals to politicians in "public interest rhetoric").

foreign rivals. Targeted policies such as subsidies can also help create constituencies that benefit from more stringent climate policy.[158] In most jurisdictions with broader decarbonization policies, "carrots" such as feed-in tariffs preceded the use of "sticks" such as cap-and-trade and helped create winning coalitions in support of broader decarbonization. As Meckling et al. (2015) write, "(c)arrots buy sticks."[159]

B. *The Economic Dynamics of Subsidies*

1. The Potential for a Race to the Top

The economic dynamics of subsidies work very differently. Subsidies can induce a "race to the top" by encouraging other countries to adopt stronger climate policy. As noted in section II, subsidies targeting high-cost technologies induce innovation that lowers costs. The aforementioned German solar subsidies exemplify this effect. As prices declined, Germany was able to lower the cost of the feed-in tariff and still seize the benefits of solar energy, both for those building solar installations and for the local (and global) environment.[160]

While the effects of subsidies on innovation are well-documented, we highlight a second potential mechanism through which subsidies encourage a race to the top that has received less attention. Subsidies can create a competitive advantage for the firms receiving them, which politicians may regard as proof that they are providing

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158 *See generally* Galle, *supra* note 5, at 802 (suggesting that politics tends to favor subsidies because they transfer wealth to special interests).

159 Jonas Meckling, J. et al., *Winning Coalitions for Climate Policy*, 349 SCI. 1170, 1170 (2015). They note that, as of 2013, 35 of the 54 jurisdictions with carbon pricing first had a "green industrial policy" such as a feed-in tariff or renewable energy mandate. *Id.*

160 *See* TOBY D. COUTURE ET AL., A POLICYMAKER'S GUIDE TO FEED-IN TARIFF POLICY DESIGN 37 (2010) (explaining that Germany uses a 10% per year tariff "degression" for solar energy because the technology evolves rapidly); Buchholz et al., *supra* note 43, at 768 (discussing the high share of German solar installations); *see also* Manuel Frondel et al., *Economic Impacts from the Promotion of Renewable Energy Technologies: The German Experience,* 38 ENERGY POL'Y 4048, 4053 (2010) (stating that solar employment in Germany increased "nearly twofold" between 2004 and 2008); Ulrike Lehr et al., *Green Jobs?: Economic Impacts of Renewable Energy in Germany*, 47 ENERGY POL'Y 358, 359 (2012) (explaining that employment in renewable energy, including solar installations "increased . . . over the last years").

a competitiveness advantage for the country. Politicians' tendency to pay attention to national competitiveness concerns may induce them to favor climate policy based on subsidies when a trading partner puts their country at a competitive disadvantage by subsidizing production at home. Concerns for a "level playing field" can motivate countries to counter competitors' carbon reducing subsidies with efforts of their own to subsidize greenhouse gas abatement.

Recent experience provides evidence of this second mechanism. Once the United States adopted the IRA, other countries became concerned about losing out competitively. In response to the IRA, Canada's finance minister announced a package of subsidies in the Fall of 2022 designed to level the playing field and promised more measures in the 2023 budget.[161] The European Union responded to the IRA by facilitating subsidies from member states.[162] Even before the IRA's passage, the EU had announced $600 billion in financial support partly in response to the Green New Deal proposal that led to the IRA.[163] Thus, we see evidence that a subsidy in one country can encourage other countries to follow suit.

The vigor of this dynamic effect may vary with the institutional setting.[164] The European Green Deal is not as generous as the IRA,

[161] *See* GOV'T OF CAN., FALL ECONOMIC STATEMENT 27–33 (2022), https://www.budget.canada.ca/fes-eea/2022/report-rapport/FES-EEA-2022-en.pdf 27.

[162] *See* CHRISTIAN SCHEINERT, EU'S RESPONSE TO THE US INFLATION REDUCTION ACT (IRA) 3–5 (2023), https://www.europarl.europa.eu/RegData/etudes/IDAN/2023/740087/IPOL_IDA(2023)740087_EN.pdf.

[163] *See The European Green Deal*, THE EUR. COMM'N, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en (last visited Jun. 19, 2023); Recognizing the Duty of the Federal Government to Create a Green New Deal, H.R. 109, 116th Cong. (2019), https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf; BIDEN-SANDERS UNITY TASK FORCE, BIDEN-SANDERS UNITY TASK FORCE RECOMMENDATIONS: COMBATING THE CLIMATE CRISIS AND PURSUIING ENVIRONMENTAL JUSTICE (2020), https://joebiden.com/wp-content/uploads/2020/08/UNITY-TASK-FORCE-RECOMMENDATIONS.pdf (presenting recommendations adopted by a task force created to reconcile the electoral campaign platform of then-candidate Biden with demands from supporters of the Green New Deal); Press Release, The White House, President Biden Announces the Build Back Better Framework (Oct. 21, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/28/president-biden-announces-the-build-back-better-framework (providing the presidential proposal that led to the IRA).

[164] *See, e.g.,* Clausing & Wolfram, *supra* note 80, at 146 (pointing out that low and middle income countries may not be able to subsidize carbon abatement partly due to inefficient tax collection).

partly because the EU's lack of taxation authority limits its ability to subsidize clean-up.[165] State aid rules restricting member states' ability to subsidize their firms may discourage member states from competing with the United States by increasing their subsidies.[166] The EU, however, has waived its state aid rules in response to the IRA, allowing member states to match subsidies in other countries.[167] This waiver may cause EU member states to participate in the race to the top by matching IRA's subsidies. But it does not allow member states to race ahead of the United States, by providing greater subsidies than the IRA currently provides. Such increased subsidies could put pressure on the United States to increase its subsidies beyond what the IRA contemplates, spurring a true race. That distinction between matching and surpassing a competitor's subsidy, however, may matter less than it appears to, because the subsidies offered in the form of tax credits are not capped and could increase in unpredictable ways to the extent firms wish to take advantage of them by moving to cleaner technology.[168]

A country's fiscal capabilities may also limit their ability to compete by subsidizing cleaner production. Some developing countries, most notably China, have successfully subsidized clean technologies in the past. But smaller and more impoverished nations may have difficulty affording the costs of subsidizing clean production. The international climate regime seeks to address this problem through creation of international funding to help with clean-up (and adaptation). But developed countries have not fully funded these commitments.[169]

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165 *See Taxation*, EUR. UNION, https://european-union.europa.eu/priorities-and-actions/actions-topic/taxation_en#:~:text=The%20EU%20does%20not%20have,the%20collected%20taxes%20are%20spent (last visited on Jul. 5, 2024) (stating that "the EU does not have a direct role in . . . setting tax rates").

166 *Cf.* 2019 E.C.R. C-405/16 P (holding that European Union restrictions on "state aid" to firms does not preclude the German feed-in tariff).

167 *See* David Kamin & Rebecca Kysar, *The Perils of the New Industrial Policy: How to Stop a Global Race to the Bottom*, 102 FOREIGN AFF. 92, 99 (2023).

168 *Cf.* Kamin & Kysar, *supra* note 167, at 96 (noting that approximately ¾ of the IRA's subsidies come from tax credits).

169 *See generally* David M. Driesen & Cinnamon Carlarne, *Climate Finance After Paris, in* RESEARCH HANDBOOK ON CLIMATE CHANGE MITIGATION LAW 263, 264 (Leonie Reins & Jonathan Verschuuren eds., 2022).

It should be mentioned that this problem of developing country capacity is not unique to the subsidies mechanism. While the use of carbon pricing has increased in developing countries over time, citizens of an impoverished country may not have the financial means to pay a price on carbon. And commentators have doubted their capacity to implement a complex scheme like emissions trading.

2. When Will Subsidies Create A Race to the Top?

Production subsides will prove more likely to trigger a response from countries concerned about subsidies putting them at a competitive disadvantage than consumer subsidies not limiting the sources of goods purchased. Production subsidies lower manufacturing costs faced by domestic firms, allowing domestic firms to offer a lower price for their product than rival firms in other countries. When a country adopts production subsidies, other countries fear that this effort will undermine the competitiveness of their industries.

Consumer subsidies, absent constraints, will not excite the same level of competitiveness concern. Consumers can use straightforward consumer subsidies to purchase products made domestically or abroad. Consumer subsidies, like investment and research subsidies, lower the out-of-pocket cost of adopting a technology. But consumer subsidies have that effect regardless of whether consumers purchase domestically manufactured or foreign products.

Finally, production subsidies tend to become politically entrenched, because those receiving the subsidies want to keep getting them, and countries may fear that removing subsidies can put the nation at a competitive disadvantage. For that reason, they may prove more stable than carbon prices, some of which have been cut back or eliminated during changes of government.[170]

3. Potential of Protectionism to Snarl Supply Chains and Hinder Cooperation

The IRA includes "content requirements" for some of the subsidies encouraging purchase and production of electric vehicles. These subsidies, for example, require that an increasing percentage of electric vehicle components come from the United States or from

[170] *See* BARRY G. RABE, CAN WE PRICE CARBON? 57–67 (2018) (discussing the problem of losing carbon pricing with changes in government, with many examples).

countries with whom we have free-trade agreement.[171] These provisions, including the consumer subsidies, likely enhance incentives for other countries to match the subsidies, but pose some risks.

Local content requirements can impair the effectiveness of a domestic subsidy program by making it too difficult or expensive to access the subsidies. For example, manufacturers are struggling to figure out how to make electric vehicles with only local components. Fortunately, most of IRA's clean energy and production tax credits do not have domestic content requirements.[172]

Even if companies can comply with local content requirements, doing so can increase the cost of clean technology. This may cause consumers to refrain from purchasing cleaner technology, such as electric vehicles, or to bear higher costs than they should have to for harder to avoid costs, like those associated with electricity consumption.

National security concerns may have motivated some of these domestic content requirements.[173] A lot of clean technology relies on Chinese components. Accordingly, analysts fear that becoming too dependent on China may make us vulnerable to economic disruption or blackmail if tensions increase. But IRA subsidies do not only impact China, the primary source of possibly legitimate national security concern. They also impact U.S. allies in Europe and Canada and have caused great consternation in those quarters.[174]

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171 *See* IRA § 13401(e)(1).

172 Kysar & Kamin, *supra* note 167, at 97.

173 *See, e.g.,* NICHOLAS E. BUFFIE, FOREIGN ENTITY OF CONCERN REQUIREMENTS IN THE SECTION 30D CLEAN VEHICLE CREDIT (2024), https://crsreports.congress.gov/product/pdf/IN/IN12322 (explaining that a vehicle must not use battery components from "foreign entities of concern" to be eligible for tax credits partly because of national security concerns); Andy Home, *China Ups Critical Minerals Heat With Graphite Controls*, REUTERS (Oct. 24, 2023, 3:41 AM), https://www.reuters.com/markets/commodities/china-ups-critical-minerals-heat-with-graphite-controls-2023-10-24/#:~:text=The%20new%20measures%2C%20which%20prohibit,lubricants%20sectors%20have%20been%20rescinded (explaining that China has restricted graphite to target electric vehicle production in response to U.S. restrictions of high techn exports to China).

174 *See* Kysar & Kamin, *supra* note 167, at 99 (noting that Emanuel Macron told Senator Manchin that he is "hurting my country"); Naimul Karim, *One Year on, How America's Inflation Reduction Act has Changed Canada: A Look Back at the Impact of a Bill that Sent Shock Waves Through the World's Supply Chains,* FIN. POST (August 15, 2023) (quoting the senior vice-president of the Canadian Chamber of Commerce as saying that capital is heading south in response to IRA

U.S. domestic content requirements could also lead other countries, concerned about being placed at a competitiveness advantage, to follow suit by adding their own domestic content requirements.[175] Such a "race to the bottom" could impede global climate progress, by raising the cost and complexity of taking effective climate action. The protectionist impulse reflected in the IRA has led President Biden to impose a 100% tariff on Chinese electric vehicles.[176] President Biden cited no national security justification for this action.[177] Such a measure will reduce the competitiveness pressures that have helped spur increased domestic investment in the production of zero emission vehicles. This perverse pricing policy also runs counter to the philosophy behind the IRA's subsidies—to stimulate climate action by making clean technology cheaper.

CONCLUSION

A proper understanding of the international economic dynamics of subsidies suggests that they have the potential to greatly advance global climate action, setting off a race to the top. They represent an efficiency improvement relative to a baseline of inaction, even though they are not perfectly efficient. But they will work best if countries resist the temptation to add protectionist domestic content requirements to subsidy bills, which may impede worldwide progress on this enormous global challenge by raising costs and snarling supply chains.[178]

and that "Canadian talent, research and innovation will follow as the U.S. builds momentum"); *see also* Jack Colman, *U.S. Eying Ways to Include Europe in Electric Car Tax Breaks,* POLITICO (Mar. 24, 2023, 1:30 PM), https://www.politico.com/news/2023/03/24/biden-electric-vehicle-subsidies-eu-00088757.

[175] *See* Kysar & Kamin, *supra* note 167 at 93 (complaining that the "new industrial policy" of IRA and the Chips Act may "set off a counterproductive subsidies race against friends").

[176] *See* Sophia Busch & Josh Lipsky, *Biden's Electric Vehicle Tariff Strategy Needs a United Front,* ECONOGRAPHICS (May 23, 2024), https://www.atlanticcouncil.org/blogs/econographics/bidens-electric-vehicle-tariff-strategy-needs-a-united-front/.

[177] *See id.* (noting that the stated motivations are to "stimulate US clean energy industries and supply chains" and to "counter a flood of Chinese goods").

[178] *See* Nordhaus, *supra* note 12, at 2006 (stating that "policies that seek to maximize the interests of a single country at the expense of other countries . . . are a poor way to resolve global problems.").