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Gideon Parchomovsky

University of Pennsylvania Carey Law School

Endre Stavang

University of Oslo

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Parchomovsky, Gideon and Stavang, Endre, "The Green Option" (2015). *Faculty Scholarship at Penn Carey Law*. 449.

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Article

The Green Option

Gideon Parchomovsky & Endre Stavang[†]

INTRODUCTION

In this Article we advance a new policy tool designed to reinvigorate investment in green technologies. We propose that green companies be given an *option* to transfer a block of their shares to any corporation of their choice. Making established corporations shareholders in green companies will incentivize them to switch to environmentally friendly technologies and use their political clout to alleviate legal, regulatory, and political barriers to the adoption of such technologies. In short, giving established corporations a stake in green companies will give them a stake in the environment. Concretely, we propose enacting legislation that will empower green companies that meet certain conditions to transfer a call option to buy a block of its shares to an established company of their choice. The option will be given for free; the established company that receives the option will not have to pay anything for it initially. The exercise price will be the price of the green company's share at the time of the transfer and the receiving company will have a period of five years to exercise. We call this novel mech-

[†] Gideon Parchomovsky is the Robert G. Fuller Jr. Professor of Law, University of Pennsylvania Law School; Professor, Bar Ilan University Faculty of Law, Israel. Endre Stavang is a Professor, Faculty of Law, Oslo University, Norway. We are grateful to David Abrams, Matt Adler, Ian Ayres, Abraham Bell, Miriam Bitton, Bill Draper, Erling Eide, Lee Fennell, Mats Greker, Lital Helman, Adi Libson, Eleonore Maitre, participants at the American Law and Economics Association Annual Conference at Vanderbilt University and at workshops at the James E. Rogers School of Law at the University of Arizona, University of Minnesota Law School, Bar Ilan University Faculty of Law, and the Oslo University Faculty of Law for comments and criticisms on prior drafts. We are especially grateful to Peter Siegelman and Alex Stein for their invaluable contributions to this paper. For excellent research assistance we are grateful to Mariela Noles Cotito, Danby Kim, Levi Morris, James Park, and above all to Ananth Padmanabhan. Copyright © 2015 by Gideon Parchomovsky & Endre Stavang.

anism the “green option.” What distinguishes the green option from standard call options is that unlike regular call options that simply expire on their maturity date, in our case, the established company will be legally mandated to exercise the option at the end of the five-year period, even at a loss. Allowing the option to expire is *not* an option for the established firm.

A concrete example can help illustrate our proposal. Green NRG Co. is a startup company that develops a new technology for producing clean energy. Brown Inc. is a large corporation that operates power plants in several coastal states. Under our proposal, Green NRG would be able to transfer a free call option to buy 1,000,000 of its shares to Brown Inc. Assume that the call option was transferred in 2012 when a share of Green NRG was worth \$1. Brown Inc. will have until 2017 to exercise the option. Since Brown Inc. can't just let the option expire, it will make an effort to ensure that Green NRG's shares appreciate in value. For example, if the value of Green NRG's shares goes up to \$3 per share, Brown Inc. will have a \$2 million profit. If, on the other hand, Green NRG's technology fails and the share price falls to \$0.10 per share, Brown Inc. will lose \$900,000.

The proposed mechanism will give established firms an incentive to help the green technology in which they are invested to succeed in the marketplace. And if technological change and innovation are to truly help us bridge the gap between growing wants and resource-based constraints in the world, such new ideas as ours must be put on the table. Currently, the world is facing an idea crunch on the right kind of policy levers to enhance green technology investment. The incorrect setting of subsidies has forced European countries to withdraw or drastically reduce these incentives.¹ Extant market instruments such as tradable green certificates or renewable portfolio standards focus largely on energy efficiency and have had only marginal impact on technology changes. These market instruments have failed to drive up innovation—especially in the case of new energy-efficient technologies that are in their nascent stage,² and

1. FRANKFURT SCH.-UNEP COLLABORATING CTR. FOR CLIMATE & SUSTAINABLE ENERGY FIN., GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2013, at 38 (2013), available at <http://www.unep.org/pdf/GTR-UNEP-FS-BNEF2.pdf>.

2. Anna Bergek & Staffan Jacobsson, *Are Tradable Green Certificates a Cost-Efficient Policy Driving Technical Change or a Rent-Generating Machine? Lessons from Sweden 2003–2008*, 38 ENERGY POLY 1255, 1266–67 (2010).

green technologies that are better but involve higher cost³—or to enhance dynamic efficiency.⁴ When presented with an option, private actors tend to prefer cheaper and more conventional green technologies, resulting in lesser innovation in third generation green technologies.⁵ In contrast, we think our proposal is a way to increase corporate social responsibility without unnecessary tinkering with ordinary market processes. It increases the range of instruments to be analyzed by environmental law and economics scholars, and to be discussed in policy circles and ultimately in the legislature.⁶

From a legal standpoint, the mechanism we propose is not unprecedented. The use of forced transfers is not foreign to the law. For example, in *Hawaii Housing Authority v. Midkiff*, the Supreme Court upheld as constitutional legislation that empowered tenants to force an ownership transfer upon their landlord.⁷ The legislation was adopted to ameliorate land concentration problems. Furthermore, in the nineteenth century, railroad companies were given the power to take private property in exchange for the payment of compensation.⁸ The goal of the forced transactions in this case was to facilitate train transportation—the cutting edge technology of the time. Com-

3. Aviel Verbruggen & Volkmar Lauber, *Assessing the Performance of Renewable Electricity Support Instruments*, 45 ENERGY POL'Y 635, 640 (2012).

4. *Id.* at 641.

5. Nick Johnstone et al., *Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts*, 45 ENVTL. RESOURCE ECON. 133, 134, 147–48, 151 (2010).

6. For a fairly recent and reasonably comprehensive account, see ALFRED ENDRES, ENVIRONMENTAL ECONOMICS: THEORY AND POLICY 130–40, 187–201 (2011) (focusing on dynamic incentives and technological change as drivers of better environmental policies). This exposition, moreover, shows how much the distinct perspectives of (environmental) law and economics have converged in the best practices of mainstream environmental economics, thus further lowering the potential for controversy around this particular legal branch of interdisciplinary legal scholarship.

7. 467 U.S. 229, 239–43 (1984).

8. See Abraham Bell, *Private Takings*, 76 U. CHI. L. REV. 517, 517 (2009) (“[P]rivate takings—that is, takings carried out by nongovernmental actors—have a solid basis in our legal system.”); Barbara J. Evans, *Much Ado About Data Ownership*, 25 HARV. J.L. & TECH. 69, 84–85 (2011) (“There is a long history in the United States, dating back to colonial times, of delegating takings power to private parties—such as developers of milldams and railroads—so that they can take property directly for socially beneficial uses without having the government act as an intermediary.”). Even today, state and local governments routinely delegate their takings power to private development corporations for land assembly purposes. Bell, *supra*, at 549–50.

pared to these and other historical precedents, our proposed scheme is far less intrusive and controversial.

That said, we are cognizant of the fact that our proposal constitutes an economic imposition on established companies. One might argue that forcing established companies to accept a call option on the shares of green companies is tantamount to imposing a tax on them, or, more accurately, forcing them to subsidize green production. There is a kernel of truth to this argument, but it is largely overstated. It is critical to understand that unlike direct taxation, our proposal also creates a meaningful potential upside for established companies. The rub lies elsewhere: the real concern our proposal raises relates to the level of risk to which we expose established companies. Many producers of green technologies are startup companies that face a very uncertain business future. After all, most startups have a short commercial life expectancy and the likelihood of their failure far exceeds that of their success. This concern is real. However, it can be alleviated via the adoption of a simple constraint. The legislation we propose should be confined to green companies that (a) have a proven *working* technology that has been commercialized; and (b) have been in business for at least five years. The introduction of these twin conditions will significantly reduce the potential risk our proposal poses for established firms.

Furthermore, we believe that this risk is worth taking given the proposal's potential upside. A recent study reveals a steep fall of twenty-nine percent in the 2012 investment figures for green technologies in developed countries.⁹ Developed nations and conglomerates within, who have stronger leverage to resolve the problem, are balking from the solution.¹⁰ The recorded decline suggests that the time has come to think afresh about the interface between law, business, and the environment.

The adoption of our proposal will have several salutary effects. First, it will facilitate market adoption of green technologies. It bears emphasis that we are by no means arguing that green technology will never be adopted without our mechanism. Rather, we submit that implementing our proposal will accelerate the pace at which green technologies are adopted. It is important to understand that the introduction of any technolo-

9. See FRANKFURT SCH.-UNEP COLLABORATING CTR. FOR CLIMATE & SUSTAINABLE ENERGY FIN., *supra* note 1, at 20.

10. *Id.* at 13–14.

gy—green or not—is an uphill battle. Technological changes are costly for businesses. Even technologies that can clearly reduce operation costs or increase profits may not be adopted on account of short horizons and legal concerns. Specifically, the adoption of unproven technologies may expose companies to production glitches and enhanced liability. Technological changes invariably involve switching costs and uncertainty, and these two effects combine to create a certain status quo bias. When the technology at issue is only marginally better than the prevailing technology, profit-maximizing corporations will often decide to pass them up.

Insofar as green technologies are concerned, the barrier to entry is even greater. Green technologies often fall under the category of “disruptive technologies”¹¹—innovations that may compromise performance in the short term but yield considerable benefits in the long run.¹² As Clayton Christensen persuasively argued, established companies have all the incentives of marketplace incumbents: they are reluctant to adopt technologies that challenge existing production paradigms and prefer to hold steadfastly to the dominant technology they currently use.¹³ Moreover, green technologies often produce social benefits—both tangible and ideological—that cannot fully be captured by market prices. In that sense, they present the mirror-image problem of that analyzed by R.H. Coase in his seminal *The Problem of Social Cost*.¹⁴ Giving established business a share in the upside of green companies will make them more welcoming to green technologies, and if the upside is large enough, it may even convert them into champions of green technologies.

Second, and relatedly, having a stake in green technologies will induce the holding companies and their business partners to come up with complementary products and processes. This, in turn, will increase the demand for green technologies and reduce barriers to entry for other environmentally minded

11. See CLAYTON M. CHRISTENSEN, *THE INNOVATOR’S DILEMMA: WHEN NEW TECHNOLOGIES CAUSE GREAT COMPANIES TO FAIL*, at xv (1997).

12. *Id.* Electric cars provide a perfect example. At present, the performance of electric cars is inferior to that of cars operated by gas and it is more cumbersome to own an electric car. However, in the long term, the performance of electric cars is likely to equal, if not surpass, that of gas cars, and the costs associated with electric cars both to the owner and to society at large will be much lower.

13. *Id.* at 9–24, 29–56.

14. R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

businesses. Over time, this dynamic may result in a virtuous cycle that will transform the attitude of the business community toward environmentally friendly goods. From a broader social perspective, the gains will be even greater on account of the positive spillovers of green technologies.

Third, our proposal can go a long way toward leveling the political playing field. To get a handle on this effect, it is imperative to understand that legal and regulatory environments can dramatically affect the fate of new technologies. There is a rich theoretical and empirical economic literature showing that laws and regulations are adopted at the behest of influential business interests to create a barrier to entry for new entrants. The environmental domain is no exception. Established businesses with political clout can effectively bar entry of green innovation. One only needs to think about the obstacles to the introduction of electric cars to see the role of the political system in channeling innovation. The political environment would be very different, however, if incumbent firms had an interest in the success of green companies. The partial alignment of interest our proposal is intended to bring about will amplify the voice of green interests in the political world and will give them meaningful representation in the political process. This, in turn, may result in more environmentally-oriented policies and laws.

Fourth, and finally, our proposal is superior to various subsidization schemes as it relies almost exclusively on the market. Subsidization of green technologies is not only potentially wasteful of taxpayer money, but may also lead to serious market distortions. Subsidization introduces the risk of favoritism. Politicians may elect to funnel money to their potential supporters rather than to the most meritorious green firms. Furthermore, subsidization decisions are made early on in the technology-development process and under conditions of extreme uncertainty. As a result, even bracketing out concerns about favoritism, subsidization may result in the funding of the wrong companies. The relatively low success rate of venture capital funds and other private institutions in picking startups should serve as a warning sign to anyone who thinks that the government will do a better job. Our mechanism, by contrast, stimulates market competition and revelation of information. We leave it to the green companies themselves to decide *whether* and *to whom* to put their options. Our proposal fosters true market experimentation by lowering barriers to entry. It does

not risk public money. Consequently, it does not impose a cost on the public.

Structurally, this Article unfolds in three parts. In Part I, we discuss the legal and business obstacles faced by green technologies. We demonstrate that under the current legal regime, green technologies are unfairly disadvantaged relative to conventional technologies. We argue that this state of affairs is unwarranted and thus requires policymakers to level the playing field. In Part II, we introduce the green option mechanism, explain how it should be operationalized and assess its strengths and weaknesses. We then proceed to compare it to alternative state-sponsored mechanisms, such as subsidization, that are commonly used to support socially desirable activities and show that our mechanism is vastly superior. Finally, in Part III, we address potential objections to our proposal. A short Conclusion ensues.

I. IT AIN'T EASY BEING GREEN

Although some people erroneously assume a perfectly competitive marketplace is one in which new technologies instantaneously replace older ones, in reality, the road to commercial success is long and treacherous. As a matter of fact, “[m]ost technological innovations do not survive the transition from invention to marketplace success.”¹⁵ Innovative technologies, among them green ones, must traverse a host of regulatory and financial obstacles before they are adopted. In this Part, we will enumerate and discuss the legal and economic challenges faced by green technologies. We will demonstrate that green technologies are currently required to compete on a slanted playing field; the odds are stacked overwhelmingly against them. In light of this fact, and given the social desirability of green innovation, in Part II we will propose a way to facilitate the introduction of environmentally friendly technologies. But, first, we would like to elucidate the many obstacles green technologies encounter on their way to markets.

A. LEGAL BARRIERS

Technological competition is a desirable phenomenon, one we most certainly welcome. Technological competition is the

15. Marilyn A. Brown & Sharon (Jess) Chandler, *Governing Confusion: How Statutes, Fiscal Policy, and Regulations Impede Clean Energy Technologies*, 19 STAN. L. & POL'Y REV. 472, 473 (2008).

mechanism by which older technologies are replaced by newer, more effective ones. It is important to realize, however, that the process is far from perfect. Tempting though it might be to believe that superior new technologies will always drive inferior technologies out of the market, in reality the opposite might happen. To understand why, it is critical to explore the effect of legal rules and regulations on technological competition. Competition among technologies does not occur in a vacuum. Rather, it takes place in an institutional environment shaped by the law. Law, in turn, may be innovation welcoming or innovation impeding.¹⁶ For example, regulations that adopt progressively lower emission rates of greenhouse gases will have the effect of spurring cleaner manufacturing processes.¹⁷ Contrariwise, regulations that mandate treatment of toxic waste in a particular uniform way are liable to exert a chilling effect on the invention of new treatment technologies.¹⁸ Unfortunately, in the case of the environment, the law often creates barriers to the development and adoption of green technologies. This effect may be intended or unintended, but either way it hinders green innovation.

1. Grandfathering and Regulatory Lacunas

Over the past several decades, Congress has adopted various measures to protect the environment.¹⁹ Foremost among

16. In theory, it is possible to imagine a legal regime that adopts a completely neutral stance to innovation. In reality, this result is virtually impossible. As the discussion in the text illustrates, there are so many laws and regulations that affect the rate of technological substitution—both directly and indirectly—that it is hard to conceive of a state of affairs in which the opposing effects precisely cancel each other out.

17. See Michael E. Porter & Claas van der Linde, *Toward a New Conception of the Environment-Competitiveness Relationship*, 9 J. ECON. PERSP. 97, 100–04 (1995). For an economic analysis of how conventional government regulations can stimulate environmentally friendly innovations, see Joel F. Bruneau, *A Note on Permits, Standards, and Technological Innovation*, 48 J. ENVTL. ECON. & MGMT. 1192, 1198 (2004); Juan-Pablo Montero, *Permits, Standards, and Technology Innovation*, 44 J. ENVTL. ECON. & MGMT. 23, 31–39 (2002).

18. See, e.g., Martha L. Noble & J.W. Looney, *The Emerging Legal Framework for Animal Agricultural Waste Management in Arkansas*, 47 ARK. L. REV. 159 (1994) (discussing the legal regulations of animal and agricultural waste in Arkansas and how those regulations tailor the local efforts to deal with polluting waste, including an examination of common law remedies and corporate responsibility).

19. For general discussion, see RICHARD J. LAZARUS, *THE MAKING OF ENVIRONMENTAL LAW* 67–165 (2004).

those are the Clean Air Act,²⁰ the Clean Water Act,²¹ and the Comprehensive Environmental Response, Compensation, and Liability Act.²² These laws set various standards intended to safeguard important ecological amenities and promote environmental goals. At the same time, in response to the demand of powerful lobby groups, Congress introduced several exceptions and riders that undermined the pro-environmental goals.²³ The most famous and oft-cited example is the grandfathering of coal plants under the Clean Air Act, which exempted most old coal-producing plants from the new performance standards.²⁴ This exemption has proven especially detrimental to public health²⁵ and clean energy technologies. The high cost of compliance with standards set by the Act for new plants prompted plant owners to do whatever they could to prolong the operation of the old coal facilities.²⁶ The dual regulatory regime created by the Act had another undesirable effect: it disincentivized old plant operators from improving their facilities for fear that doing so would change the classification of their plants from old to new and subject them to the heightened standards that apply to the latter category.²⁷

20. 42 U.S.C. §§ 7401–671q (2012). The vast majority of the laws were enacted in the 1970s. For a comprehensive review, see Richard J. Lazarus, *Congressional Descent: The Demise of Deliberative Democracy in Environmental Law*, 94 GEO. L.J. 619, 623–29 (2006).

21. 33 U.S.C. §§ 1251–387 (2012).

22. 42 U.S.C. §§ 9601–675.

23. CURTIS MOORE & ALAN MILLER, GREEN GOLD: JAPAN, GERMANY, THE UNITED STATES, AND THE RACE FOR ENVIRONMENTAL TECHNOLOGY 82–84 (1994); Matthew J. Rizzo, *The Endangered Species Act and Federal Agency Inaction*, 13 ST. LOUIS U. PUB. L. REV. 855, 874 (1994).

24. See 42 U.S.C. §§ 7401–671q; Jonathan Remy Nash & Richard L. Revesz, *Grandfathering and Environmental Regulation: The Law and Economics of New Source Review*, 101 NW. U. L. REV. 1677, 1681–82 (2007) (discussing this example and suggesting that it was initially meant to be temporary).

25. According to a 2011 study by the American Lung Association, coal-fired plants are the most harmful source of industrial pollution in the United States. See AM. LUNG ASS'N, TOXIC AIR: THE CASE FOR CLEANING UP COAL-FIRED POWER PLANTS 1–5 (2011), available at <http://www.lung.org/assets/documents/healthy-air/toxic-air-report.pdf>.

26. This has come to be known as the “old plant effect.” See BRUCE A. ACKERMAN & WILLIAM T. HASSLER, CLEAN COAL/DIRTY AIR 67–68 (1981) (introducing and explaining this effect).

27. See Shi-Ling Hsu, *The Real Problem with New Source Review*, 36 ENVTL. L. REP. 10,095, 10,096–98 (2006).

Another disconcerting example is provided by the Toxic Substances Control Act (TSCA).²⁸ Enacted by Congress in 1976, this legislation was supposed to regulate the handling and disposal of potentially dangerous chemicals.²⁹ Unlike other environmental laws that have been amended over the years, the TSCA remained frozen in time for about three and half decades. As a result, the standards that apply to toxic substances in the United States are out of step with those existing in many European countries.³⁰ To make things worse, the legislation grandfathered in—without safety testing—over 60,000 industrial chemicals which were in use in 1976, and allowed chemicals that were developed subsequently to enter the market.³¹ According to one report, “in the 34 years since the TSCA was enacted, the EPA [Environmental Protection Agency] has required testing for only 200 chemicals out of the more than 80,000 available for use in the United States, and has regulated only five.”³²

Grandfathering is also ubiquitous in land use regulations. Zoning amendments usually exempt existing non-conforming uses.³³ As a result, land uses that hurt the environment can persist unimpeded for a long time. The regulation of residential and commercial structures also features extensive grandfathering. Local governments typically apply green building principles to new structures. Old ones are typically exempt from complying with heightened energy standards.³⁴ Although retrofitting of old buildings imposes a significant cost on the owner, in the long run the energy savings could more than offset it. Also, if owners of existing buildings were required to comply, it

28. 15 U.S.C. §§ 2601–697 (2012).

29. Cynthia Ruggerio, *Referral of Toxic Chemical Regulation Under the Toxic Substances Control Act: EPA's Administrative Dumping Ground*, 17 B.C. ENVTL. AFF. L. REV. 75, 85–89 (1989).

30. Dorit Kerret & Alon Tal, *Greenwash or Green Gain? Predicting the Success and Evaluating the Effectiveness of Environmental Voluntary Agreements*, 14 PENN ST. ENVTL. L. REV. 31, 38 (2005).

31. Bryan Walsh, *Regulation of Toxic Chemicals Faces Tightening*, TIME MAG. (Apr. 16, 2010), <http://content.time.com/time/health/article/0,8599,1982489,00.html>.

32. *Id.*

33. Christopher Serkin, *Existing Uses and the Limits of Land Use Regulations*, 84 N.Y.U. L. REV. 1222, 1224 (2009) (noting the existence of “a strong background rule running throughout the law of property that existing uses are entitled to protection from the government”).

34. Bruce R. Huber, *Transition Policy in Environmental Law*, 35 HARV. ENVTL. L. REV. 91, 99 (2011).

would create an incentive to come up with innovative and more cost-effective techniques to accomplish this result. Yet, local lawmakers prefer to protect homeowners from transitions. Indeed, building codes presented a serious obstacle to green construction, at least in the beginning: “The use of alternative methods, materials, and designs fell outside of the prescriptions in most building codes.”³⁵ As one commentator correctly observed, grandfathering and “[e]xcessive transition relief may also create new barriers to entry in a sector by favoring incumbents; these barriers, once erected, are difficult to remove.”³⁶

It is important to understand at this point that laws containing grandfathering provisions are not the worst possible outcome for the environment. Regulatory lacunas could lead to much worse results. Consider the case of coal ash dumping. Although scientists are of the opinion that the best way to dispose of coal ash is to bury it in dry landfills equipped with special facilities, the favored disposal method used by the industry is to store ash coal in wet ponds.³⁷ This method reached public awareness in 2009 when it resulted in a spill that effused “a billion gallons of toxic sludge across 300 acres of East Tennessee.”³⁸ According to one report, there exist over 1,300 ponds like the one in East Tennessee nationwide.³⁹ In the last thirty years, the EPA has been trying to come up with a regulatory framework to address the handling of ash coal, but so far all its efforts have fallen short.⁴⁰ In the absence of federal regulation, the matter was left for the states. However, there is consensus

35. Keith H. Hirokawa, *At Home with Nature: Early Reflections on Green Building Laws and the Transformation of the Built Environment*, 39 ENVTL. L. 507, 521 (2009); see also Alexandra Dapolito Dunn, *Siting Green Infrastructure: Legal and Policy Solutions To Alleviate Urban Poverty and Promote Healthy Communities*, 37 B.C. ENVTL. AFF. L. REV. 41, 63 (2010) (pointing out how downspout disconnection programs, effective in promoting the use of captured water for irrigation and green roofs, stood deterred by city regulations that required downspouts to be connected with storm sewer systems, and rain capture was rendered impermissible in certain states because of prior appropriation laws).

36. Huber, *supra* note 34, at 93–94; see also Serkin, *supra* note 33, at 1261–80, 1281 (stating and explaining how the intuition that existing uses demand categorical protection lacks sufficient social justification).

37. *Coal Ash: Hazardous to Human Health*, PHYSICIANS FOR SOC. RESP. (Aug. 5, 2013, 3:47 PM), <http://www.psr.org/assets/pdfs/coal-ash-hazardous-to-human-health.pdf>.

38. Shaila Dewan, *Hundreds of Coal Ash Dumps Lack Regulation*, N.Y. TIMES (Jan. 6, 2009), <http://www.nytimes.com/2009/01/07/us/07sludge.html>.

39. *Id.*

40. *Id.*

among experts that states are ill-equipped to deal with the issue.⁴¹ And so, in the absence of effective regulatory oversight, power plants naturally elect to handle the matter in the least costly way for them, even if it comes at a great cost to the environment. Effectively, the current practice of dumping ash coal is a typical example of an unaccounted for externality that creates a social cost. This much has been pointed out by law and economics scholars a long time ago.⁴² A less obvious cost is the chilling effect of this practice on environmentally friendly innovation. As long as the power industry can externalize harms onto the rest of our society at no cost to itself, it has no incentive to adopt greener disposal technologies. This, in turn, means that such technologies may never be developed.

Rigid environmental norms can also result in delayed adoption, or absolute curtailing, of transition to green technologies. For instance, in the baking industry, the EPA requires ethanol emission reductions between the range of eighty to ninety-five percent for any technology to qualify as a reasonably available control technology (RACT). The EPA has determined catalytic oxidation to be the only RACT that achieves this rigid reduction limit. The fallout of this is that more innovative and cheaper solutions that do not make use of toxic metals fail to receive EPA approval, despite their reduction efficacy being only slightly lower than the prescribed range. This also results in “close enough” cleaner technologies failing to obtain the commercial testing, demonstration, and refinement needed to improve their performance.⁴³ Similarly, the SO₂ emission rate limits prior to 1990 created a technology lock-in because many electrical utilities were compelled to use scrubbers, an “energy-intensive technology producing high levels of waste.”⁴⁴ When these rigid limits were replaced with an overall performance

41. *Id.*

42. See Gideon Parchomovsky & Peter Siegelman, *Cities, Property and Positive Externalities*, 54 WM. & MARY L. REV. 211, 220–28 (2012) (noting that “negative externalities were the key impetus for the development of the law and economics movement”). The classic articles on the subject can be found in ARTHUR C. PIGOU, *THE ECONOMICS OF WELFARE* 111–359 (1920) (suggesting that the problem of social cost be addressed by the imposition of tax on the private actors responsible for it) and Coase, *supra* note 14, at 8–15 (arguing that when transaction costs are sufficiently low private contracting can adequately address the social cost problem).

43. ENVTL. LAW INST., *BARRIERS TO ENVIRONMENTAL TECHNOLOGY INNOVATION AND USE* 43 (1998), available at <http://www.eli.org/sites/default/files/eli-pubs/d8.01.pdf>.

44. *Id.* at 4.

standard, cleaner process technologies could easily replace scrubbers and deliver the same result at almost half the earlier cost.⁴⁵ Cryptic barriers of this kind are “sticky” because a firm that invests in changing a standard would be opening the market for its competitors too. This acts as a disincentive, stopping them from working towards eliminating the barrier.⁴⁶

Another environmentally harmful activity that has evaded federal regulation so far is “fracking.” Fracking consists of the practice of forcefully injecting fluids into rock cracks in order to release gas out of the rock formation and allow it to be extracted.⁴⁷ By many accounts, the practice of fracking presents a real risk to our drinking water. In the past, the wastewater that contained a high degree of salt and other harmful minerals was dumped, untreated, into rivers.⁴⁸ The current industry practice is to store the water in artificial ponds.⁴⁹ However, due to leakage, some of the wastewater reached underground wells. The use of fracking has jeopardized the water supply of areas in Pennsylvania and New Mexico.⁵⁰ To make matters worse, some contend that the practice induces earthquakes and that the earthquakes in Ohio several years ago were caused by fracking.⁵¹ Yet, there is no federal regulation pertaining to the practice, and the states let the practice continue virtually unregulated for decades. Only recently, in response to public outcry, states’ environmental agencies turned their attention to

45. *Id.*

46. ALICE STOVER ET AL., AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., CRYPTIC BARRIERS TO ENERGY EFFICIENCY REPORT NUMBER A135, at 1, 14–15 (2013), *available at* <http://www.aceee.org/sites/default/files/publications/researchreports/a135.pdf>.

47. *See* REBECCA HAMMER & JEANNE VANBRIESEN, NATURAL RES. DEF. COUNCIL, IN FRACKING’S WAKE: NEW RULES ARE NEEDED TO PROTECT OUR HEALTH AND ENVIRONMENT FROM CONTAMINATED WASTEWATER REPORT NUMBER D:12-05-A, at 1 (2012), *available at* <http://www.nrdc.org/energy/files/fracking-wastewater-fullreport.pdf>.

48. Christopher Joyce, *With Gas Boom, Pennsylvania Fears New Toxic Legacy*, NPR (May 14, 2012, 12:10 PM), <http://www.npr.org/2012/05/14/149631363/when-fracking-comes-to-town-it-s-water-water-everywhere>.

49. ELIZABETH RIDLINGTON & JOHN RUMPLER, ENV’T AM. RESEARCH & POLICY CTR., FRACKING BY THE NUMBERS: KEY IMPACTS OF DIRTY DRILLING AT THE STATE AND NATIONAL LEVEL 10–11 (2013), *available at* http://www.environmentamerica.org/sites/environment/files/reports/EA_FrackingNumbers_scrn.pdf.

50. *Id.* at 9.

51. *Id.* at 18.

this problem.⁵² The case of fracking demonstrates once more that in the absence of comprehensive regulation, industry participants, as narrow self-interest maximizers, will adopt environmentally harmful practices as long as it is cost-effective from their own narrow perspective. This reality bars the development of environmentally friendly technologies.

2. Tax and Trade Law

Next consider the effect of fiscal laws and regulations. At first blush, tax law appears to be of little relevance to the present discussion, yet differential tax treatment can be a major factor in determining the outcome of technological competition. This can be best seen in the case of greenhouse gas reducing technologies. There exists broad consensus among scholars that reduction of greenhouse gas emissions is a laudable social goal.⁵³ One would expect, therefore, to see government policies that discourage greenhouse gas emissions. Yet, a careful examination reveals a host of policies that have had the opposite effect. For example, a tax break, popularly known as the “Hummer Loophole,” for businesses purchasing light trucks—a category that included, *inter alia*, sport utility vehicles (SUVs)—was limited after public furor, only to be replaced with an even more generous 100 percent bonus depreciation for vehicles weighing more than 14,000 pounds.⁵⁴ Light trucks and SUVs consume large amounts of conventional fuels that lead to greenhouse gas emissions. In light of this fact, one would have expected to see higher taxes levied on this category of vehicles. In reality, though, the opposite transpired. As a result, alternative energy sources that were friendlier to the environment were placed at a disadvantage. Moreover, government funding of research on the production of liquid fuels petroleum can erect “barriers to low-carbon alternative fuels.”⁵⁵

Another way in which tax law impedes adoption of green technologies has to do with the rules pertaining to the deprecia-

52. See Hannah Wiseman & Francis Gradijan, *Regulation of Shale Gas Development, Including Hydraulic Fracturing* 4–6 (Univ. of Tulsa Legal Studies, Research Paper No. 2011-11, 2012), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1953547.

53. See Brown & Chandler, *supra* note 15, at 472–73.

54. Janet Novack, *How To Take a 100% Tax Write-Off for a New Porsche, BMW or Cadillac*, FORBES (Apr. 8, 2011, 7:02 PM), <http://www.forbes.com/sites/janetnovack/2011/04/08/how-to-take-a-tax-write-off-for-a-new-porsche-bmw-or-cadillac>.

55. Brown & Chandler, *supra* note 15, at 476.

tion of capital investments and the expensing of energy-related costs. As Marilyn Brown and Sharon Chandler point out, “[i]n American industry, the current federal tax code discourages capital investments in general, as opposed to direct expensing of energy costs.”⁵⁶ Specifically, the code sets long depreciation periods, say fifteen years, for energy efficient products, while providing for much shorter periods of only a few years for expensing energy-related costs.⁵⁷ Consequently, businesses are disincentivized from investing in energy efficient plants and buildings that are not considered “direct” energy expenses under the tax code.⁵⁸ The divergent depreciation schedules for various investments “lock in” incumbent technologies⁵⁹ and, thus, retard the rate and distort the path of technological substitution.⁶⁰

Trade policies may also impact technological choice. The case of ethanol is an illuminating example. It is commonly believed that biofuels such as ethanol are environmentally friendlier than petroleum fuels.⁶¹ Yet, in the United States, ethanol is subject to an import tariff.⁶² Like all other trade barriers, the tariff on importation of ethanol makes it more expensive relative to domestic alternatives, which, in turn, favors domestic fuel producers while harming consumers. The tariff was adopted by Congress to ensure energy independence. But this commendable motivation does not change the effect of the tariff: it makes the purchase of ethanol from cheap foreign sources like Brazil less attractive for American industries. To make matters

56. *Id.*

57. 26 U.S.C. § 168 (2012).

58. For example, in one study that was conducted in 1996, Jenkins, Chapman, and Reilly concluded that on account of differential tax treatment, businesses would be better in terms of the tax implications investing in natural gas-operated plants than in plants using renewable energy sources. ALEC JENKINS, RICHARD CHAPMAN & HUGH REILLY, CAL. ENERGY COMM’N, TAX BARRIERS TO FOUR RENEWABLE ELECTRIC GENERATION TECHNOLOGIES (1996), available at <http://www.energy.ca.gov/papers/CEC-999-1996-003>. It should be noted that in light of legal amendments that have been passed after the study was conducted, it is not clear that its result remains valid.

59. See Gregory C. Unruh, *Escaping Carbon Lock-In*, 30 ENERGY POL’Y 317, 318 (2002) (discussing institutional sources of lock-in fossil fuel-based systems).

60. Robin Cowan, *Nuclear Power Reactors: A Study in Technological Lock-In*, 50 J. ECON. HIST. 541, 543–44 (1990) (explaining how markets can get locked into inferior technologies in early use).

61. *Ethanol Facts: Environment*, RENEWABLE FUELS ASS’N, <http://www.ethanolrfa.org/pages/ethanol-facts-environment> (last updated Mar. 2014).

62. See Brown & Chandler, *supra* note 15, at 481.

worse, the United States adopted a policy under which a larger subsidy is provided by the government to domestic gasoline blenders than to domestic ethanol manufacturers.⁶³ Together these policies have the effect of lowering the use of ethanol in the United States compared to what it could be in their absence.

3. Tort Liability

The design of our tort system presents yet another legal obstacle to innovative green technologies. As Alex Stein together with one of us pointed out, our tort law displays a strong bias in favor of customary technologies and, consequently, discourages innovation.⁶⁴ To see why, it is imperative to revisit the principles by which liability is assigned under our tort system. Not all activities that result in harm give rise to liability; liability attaches only in those cases in which it is determined that the harm-causing activity fails to meet the “socially acceptable” standard.⁶⁵ What is “socially acceptable,” in turn, is largely informed by custom. In other words, courts routinely appeal to custom in deciding whether a defendant was negligent.⁶⁶

The centrality of custom in our torts system can be best seen in the context of negligence determinations, where by and large courts tend to equate defendants’ non-compliance with relevant industry customs to negligence.⁶⁷ Specifically, courts generally presume that a defendant who failed to comply with safety-related customs prevalent in her industry acted negligently.⁶⁸ As the Restatement states: “In determining whether

63. *Id.*

64. Gideon Parchomovsky & Alex Stein, *Torts and Innovation*, 107 MICH. L. REV. 285, 286 (2008) (demonstrating the anti-innovation bias of tort law).

65. See DAN B. DOBBS, *THE LAW OF TORTS* § 8, at 12–13 (2000) (describing tort liability as premised on deviation from acceptable standards); PROSSER AND KEETON ON THE LAW OF TORTS § 2, at 6 (W. Page Keeton et al. eds., 5th ed. 1984) (same).

66. See PROSSER AND KEETON ON THE LAW OF TORTS, *supra* note 65, § 33, at 193; Clarence Morris, *Custom and Negligence*, 42 COLUM. L. REV. 1147, 1147–49 (1942) (underscoring the centrality and utility of courts’ reliance on custom in determining negligence). *But see* Richard A. Epstein, *The Path to The T.J. Hooper: The Theory and History of Custom in the Law of Tort*, 21 J. LEGAL STUD. 1, 2 (1992) (criticizing modern courts’ tendency to place cost-benefit analysis ahead of custom in ascribing liability in torts).

67. David G. Owen, *Proving Negligence in Modern Products Liability Litigation*, 36 ARIZ. ST. L.J. 1003, 1023–24 (2004).

68. See Barbara Kritchevsky, *Tort Law Is State Law: Why Courts Should Distinguish State and Federal Law in Negligence-Per-Se Litigation*, 60 AM. U. L. REV. 71, 88 n.99 (2010).

conduct is negligent, the customs of the community, or of others under like circumstances, are factors to be taken into account, but are not controlling where a reasonable man would not follow them.”⁶⁹ The defendant may, of course, attempt to rebut this presumption,⁷⁰ but in many cases, as a *practical* matter, non-compliance with custom often dooms defendants.⁷¹ This is so because in the absence of proof to the contrary, judges are empowered to give a directed verdict on the issue of negligence.⁷²

Similarly, custom plays a key role in product liability cases.⁷³ Here, too, courts use custom as a reference point in assessing whether the defendant’s product design was safe. A manufacturer’s compliance with the relevant industrial custom is admissible as evidence tending to prove that its product was safe.⁷⁴ Conversely, a manufacturer’s failure to conform to custom constitutes evidence suggesting the presence of a defect in its product.⁷⁵ Hence, any deviation from industry customs runs the risk of a finding that the product was defective. These factors are outcome determinative both under the “risk-utility”⁷⁶

69. RESTATEMENT (SECOND) OF TORTS § 295A, at 62 (1965); *see also* FED. R. EVID. 406 (noting that customs and routine practices are admissible as evidence to prove action was in conformity with those practices).

70. *See* RESTATEMENT (SECOND) OF TORTS § 295A cmts. b, c, at 62–63 (“If the actor does what others do under like circumstances, there is at least a possible inference that he is conforming to the community standard of reasonable conduct; and if he does not do what others do, there is a possible inference that he is not so conforming. . . . [W]here there is nothing in the situation or in common experience to lead to the contrary conclusion, this inference may be so strong as to call for a directed verdict, one way or the other, on the issue of negligence. . . . Any such custom is . . . not necessarily conclusive Customs which are entirely reasonable under the ordinary circumstances which give rise to them may become quite unreasonable in the light of a single fact in the particular case.”).

71. This practice has an obvious explanation: custom integrates the conventional wisdom—a decisional shortcut which is both easy and sensible to apply without generating much controversy over the court’s decision. *See* DOBBS, *supra* note 65, § 164, at 395–96; PROSSER AND KEETON ON THE LAW OF TORTS, *supra* note 65, § 33, at 193–94.

72. *See* RESTATEMENT (SECOND) OF TORTS § 295A cmt. b, at 62–63.

73. *See* David G. Owen, *Proof of Product Defect*, 93 KY. L.J. 1, 5–10 (2004) (documenting massive use of industry customs as a benchmark for determining design defects in product liability actions).

74. *Id.* at 8–9.

75. *Id.* at 7.

76. *See* DAVID G. OWEN, PRODUCTS LIABILITY LAW § 5.7, at 303–04 (2005).

and “consumer expectation”⁷⁷ tests that are used by the courts to decide product liability cases.

The combined effect of these tort rules is to subsidize conventional practices and technologies. At the same time, the custom rules expose innovators and adopters of new technologies to an increased risk of liability. The heavy reliance on custom and conventional technologies makes it more difficult for green innovation to succeed in the marketplace. The custom rules create a strong evidential association between any damage resulting from the firm’s activities and its adoption of new technologies that break away from the conventional wisdom. Naturally, innovators critically depend on the adoption of their novel products and processes by market actors. Failure in the marketplace means that considerable resources expended on research and development will be lost. The fact that innovative technologies expose adopters to a heightened risk of legal liability serves as a disincentive to choose green technologies over conventional ones. This means that when a green technology is not better than a conventional rival by a margin that is large enough to offset the heightened risk, it will not be adopted.⁷⁸ As a consequence, many green technologies will either be produced and fail in the marketplace or not be produced at all.⁷⁹

A case in point is green construction. Fear of liability delayed the adoption of green construction techniques.⁸⁰ Of particular concern was the implied warranty of quality that applies to construction of new units.⁸¹ Initially, there existed significant “uncertainty over whether the construction quality of newly constructed green homes will be measured on the same standards as conventionally constructed homes or (more likely) a much higher standard which incorporates the expecta-

77. *Id.* § 5.6, at 295.

78. We do not argue, of course, that green technologies will never be produced or adopted. Such an argument evidently fails. Our claim is different. We argue that in all those cases in which the green innovation does not offer potential adopters benefits or cost savings that are significant enough to offset the legal risk differential, it will not succeed in the real world, or, worse, not be produced at all.

79. See Parchomovsky & Stein, *supra* note 64, at 287–89; see also Porter & van der Linde, *supra* note 17 (discussing innovation offsets related to environmental regulations).

80. See Jeffrey D. Masters & John R. Musitano Jr., *Managing Liability Risks in Green Construction*, 30 L.A. LAW. 17, 17 (2007).

81. See Hirokawa, *supra* note 35, at 521 n.100, 523 (discussing the implied warranty of quality).

tions attendant to 'high performance' homes."⁸² Similar is the story with innovative water technologies that could completely do away with the use of the air pollutant perchloroethylene, the main solvent used by the dry cleaning industry. Adoption of cleaner technologies has faced setbacks due to "dry clean only" consumer labelling standards that pre-date current technologies and end up imposing a risk of liability on cleaners that use innovative water technologies.⁸³

In addition to impeding adoption of green technologies, the custom rules distort the direction of technological progress. The heightened risk of liability for tort damages induces innovators to confine their inventive endeavors to the conventional technological frameworks, instead of focusing upon inventions that can lead to genuine environmental breakthroughs. The dynamic efficiency loss occasioned by the custom rules may be far greater than it seems. By preventing certain inventions from ever being produced, the custom rules deprive society not only of those particular inventions but also of many subsequent innovations. This is especially true in cumulative innovation settings, in which new inventions rely on preexisting ones.⁸⁴

B. ECONOMIC BARRIERS

Legal barriers aside, green technologies may be passed up on account of pure economic, or business, considerations. Let it be clear that we do not suggest that firms shun green technologies on principle, out of pure animosity. On the contrary, we believe that, in principle, corporations are bottom-line oriented organizations. Accordingly, their tendency would be to adopt any innovation that can increase their profits. Yet, green innovation often displays certain characteristics that may repel conventional firms. Specifically, green innovation often imposes high switching costs on adopters, so it is perceived as riskier than conventional alternatives and it is considered "disruptive" of established business models.⁸⁵ In the proceeding paragraphs, we will elaborate on each of these effects.

82. *Id.* at 523.

83. ENVTL. LAW INST., *supra* note 43, at 2–4.

84. On cumulative innovation, see generally Howard F. Chang, *Patent Scope, Antitrust Policy, and Cumulative Innovation*, 26 THE RAND J. ECON. 34, 36 (1995) (providing an example of the cumulative innovation paradigm as applied to *Westinghouse v. Boyden Power Brake Co.*, 170 U.S. 537 (1898)).

85. We do not argue that these characteristics (or problems) are unique to green innovation. They may be displayed by non-green or conventional innovation as well. However, green innovation creates unique beneficial effects to our

1. Switching Costs, Decision Horizons, and Path Dependency

Recent studies in economics demonstrate that even relatively small switching costs may create strong lock-in effects.⁸⁶ For example, studies have shown that the need to incur a relatively minor cost of 150 to 240 dollars in order to switch from one cellular phone provider to another may cause users to stick with their current provider,⁸⁷ notwithstanding the fact that changing providers could have yielded them considerable long-term benefits.⁸⁸

In short, the presence of switching cost may doom efficient changes. In the case of green technologies the problem is exacerbated by the fact that the cost of switching from a conventional technology to a greener one may be quite substantial. As a result, even CEOs of companies who harbor an ideological preference for green technologies may elect not to use them.

To comprehend the potential magnitude of this problem, imagine a power plant that operates on coal or fossil fuels and considers switching to a cleaner source of energy, say, bio-fuels. Changing the underlying production technology would require the proprietor to overhaul its plant. The one-time investment necessary to affect the change may very well stop the initiative dead in its tracks, even though it may very well prove itself to be cost-justifiable in the long run. Indeed, this problem may well explain the persistence of coal-operated power plants in the real world.⁸⁹ Hence, in the absence of legal or financial in-

society and consequently society should be more concerned with barriers to the adoption of green innovation.

86. NAT'L ECON. RESEARCH ASSOCS., DEP'T OF TRADE & INDUS., SWITCHING COSTS: PART ONE: ECONOMIC MODELS AND POLICY IMPLICATIONS 10, 25, 31 (2003), http://webarchive.nationalarchives.gov.uk/20140402142426/http://www.oft.gov.uk/shared_oftr/reports/comp_policy/oft655.pdf.

87. Patrick Xavier & Dimitri Ypsilanti, *Switching Costs and Consumer Behaviour: Implications for Telecommunications Regulation*, 10 INFO 25 (2008) (discussing the extent to which telecommunication users switch and why); see also Juan Pablo Maicas et al., *Reducing the Level of Switching Costs in Mobile Communications: The Case of Mobile Number Portability*, 33 TELECOMM. POLY 544 (2009) (explaining the effect of regulation on switching costs for mobile phone users); NAT'L ECON. RESEARCH ASSOCS., *supra* note 86, at 10–11; Damon Darlin, *The High Cost of Loving Your Phone*, N.Y. TIMES (June 11, 2010), <http://www.nytimes.com/2010/06/13/technology/13every.html> (describing switching costs for mobile phone users).

88. NAT'L ECON. RESEARCH ASSOCS., *supra* note 86, at 10.

89. For a report on existing and planned coal-based power plants, see The Ctr. for Media & Democracy, *Existing U.S. Coal Plants*, SOURCEWATCH (June 1, 2012), http://www.sourcewatch.org/index.php?title=Existing_U.S._Coal_Plants. Also, for a report on new coal-based power plants under development,

centive to switch to greener production, companies will often prefer to stick with the status quo ante and live (and die) with the technology they have been using for years.

The switching cost effect is compounded by the decision horizons problem that inflicts corporate thinking. The private (and social) benefits of green technologies are often spread out over long periods of time. For example, the switch to a cleaner production technology may yield moderate cost savings every year. In the long haul, these amounts may dramatically increase the profits of the adopting corporation. But herein lies the rub. CEOs and corporate management typically do not have the same horizon as the shareholders—let alone the rest of our society. Corporations are run by agents seeking to maximize their own self-interest, not that of our society at large. This fact has two important implications for the present analysis. First, corporate decision making will not take into account environmental benefits that do not contribute to the firm's bottom-line. Second, corporate management will tend to favor short-term performance over long-term performance.

The former point is well known; the latter requires elaboration. In the era of performance-based remuneration,⁹⁰ the management of corporations will strive to maximize *short-term* profits.⁹¹ Under the prevailing compensation paradigm, the better the short-term performance, the higher the rewards for management. The long-term fate of the enterprise is of little interest to the presiding management. This means that the management would be very averse to sacrifice short-term profits for long-term success. Society's perspective is very different, of course. Society's planning horizon is much longer than that of the management and its interests are more varied. From a societal perspective, investments that yield long-term benefits should be made by corporations. But society does not get to decide. Hence, some form of intervention that more closely aligns

see ERIK SHUSTER, DEP'T OF ENERGY, TRACKING NEW COAL-FIRED POWER PLANTS (2011), <http://www.netl.doe.gov/coal/refshelf/nep.pdf>.

90. Sandeep Kapur & Allan Timmermann, *Relative Performance Evaluation Contracts and Asset Market Equilibrium*, 115 ECON. J. 1077, 1077 (2005).

91. See John M. Abowd, *Does Performance-Based Managerial Compensation Affect Corporate Performance?*, 43 INDUS. & LAB. REL. REV. 52 (1990) (analyzing corporate performance and compensation under a performance-based remuneration model); see also Rajiv D. Banker et al., *A Field-Study of the Impact of a Performance-Based Incentive Plan*, 21 J. ACCT. & ECON. 195 (1996) (describing a comprehensive management accounting field study of a performance-based compensation plan in the retail arena, and its positive corporate results).

the private interest of management with that of the rest of society is desirable in this context.

Finally, transition to a newer, greener technology is severely curtailed even when the switching costs or decision horizons effect is minimal, because of the “path-dependent, co-evolutionary” processes through which conventional energy solutions have found entrenchment.⁹² Large technological systems such as electricity generation, distribution, and end use have to be visualized as part of a techno-institutional complex (TIC), embedded in a social and institutional setting comprising of other public and private actors, rather than as “discrete technological artifacts.”⁹³ The initial adoption of a certain technology and its continued application are not so much the product of an optimization decision by rational economic actors as much as the outcome of “a path-dependent process in which timing, strategy and historic circumstance, as much as optimality, determine the winner.”⁹⁴ Once a dominant design survives in the market, firms focus on incremental innovation that locks them into this design and shy away from alternatives that render the design obsolete.⁹⁵

The more impactful lock-in, though, is at the institutional level, because of positive network externalities that make the technology more valuable to users. When there is higher inter-industry dependence on a technology, it is normally reinforced by private commercial institutions that finance the operationalization of such technology, and by educational institutions that disseminate knowledge pertaining to the same. Soon, institutional standards and conventions develop around the technology, in order to reduce or eliminate uncertainties that can hamper its further growth.⁹⁶ Unions and industry associations emerge to represent workers employed in its production.⁹⁷ Even media opinion and social behavior co-evolve with the technology.⁹⁸ Finally, all this momentum leads to formal recognition of the technology by governmental institutions. The last phase is particularly locking-in in its effects because it has the potential

92. Gregory C. Unruh, *Understanding Carbon Lock-In*, 28 ENERGY POLY 817, 818 (2000).

93. *Id.*

94. *Id.* at 820.

95. For detailed discussion, see *infra* Part I.B.3.

96. Unruh, *supra* note 92, at 822.

97. *Id.* at 823–24.

98. *Id.* at 824.

to “override market forces,” and survive in its initial form “for extended periods” due to the delays and uncertainties inherent in the political process.⁹⁹ In short, the technology, over time, pervades the larger economic, social, and political system, thus gradually but totally resulting in institutional lock-ins. Energy markets are especially prone to technology lock-in because of the perfect substitutability of the end product, electricity, from different technologies. This also prevents new, cleaner technologies from internalizing the value of future learning into the product price.¹⁰⁰

2. Risk Aversion and First Mover Disadvantage

Another significant obstacle to the adoption of green technologies is risk aversion. This factor especially pertains to green technologies that deviate from established patterns. The more path-breaking a technology is the higher the risk that may be associated with it. And, the higher the risk, the higher needs to be the expected reward for the technology to be adopted.¹⁰¹ Concern with risk is a paramount aspect of the business world.¹⁰² Yet, it puts new technologies (both green and brown) at an inherent disadvantage relative to technologies that have been used for extended periods of time and improvements on such technologies.¹⁰³ Simply put, firms possess much better information on the performance of conventional technology.

One should not underestimate the risk presented for corporations by new technologies. Technological changes run the risk of various malfunctions. The risk may be big or small, but in the absence of real world experience with the technology it may be very difficult to know. As a result, each firm would rather have another company adopt the technology first. However,

99. *Id.* at 824–25.

100. Matthias Kalkuhl et al., *Learning or Lock-In: Optimal Technology Policies To Support Mitigation*, 34 RESOURCE & ENERGY ECON. 1, 10 (2012).

101. George S. Day & Paul J.H. Schoemaker, *Innovating in Uncertain Markets: 10 Lessons for Green Technologies*, 52 MIT SLOAN MGMT. REV. 37 (2011), available at <http://sloanreview.mit.edu/article/innovating-in-uncertain-markets-10-lessons-for-green-technologies>.

102. PETER L. BERNSTEIN, AGAINST THE GODS: THE REMARKABLE STORY OF RISK 1–8, 192–93, 246 (1998); see also Charles A. Holt & Susan K. Laury, *Risk Aversion and Incentive Effects*, 92 AM. ECON. REV. 1644 (2002) (describing the risk aversion business paradigm and the incentives that make it shift).

103. Kenneth Gillingham & James Sweeney, *Market Failure and the Structure of Externalities*, in HARNESSING RENEWABLE ENERGY 69, 74–75 (A. Jorge Padilla & Richard Schmalensee eds., 2010), available at http://www.yale.edu/gillingham/GillinghamSweeney_MktFailureStructureExternalities_proof.pdf.

since all firms share the same preference vis-à-vis one another, the technology may not be adopted at all.¹⁰⁴

The problem may also be stated in a slightly different way: adoption of new technologies frequently creates a first mover disadvantage. The first adopter of a new technology absorbs the risk of failure for all other market participants. The first mover will have to deal with the cost of addressing the problems that arise over time, especially in the early stages, while its rivals can follow from afar and assess the new technology. The first mover disadvantage is very small when the technology at issue is an improvement of a preexisting technology. But it is very significant when the new technology at issue departs from the accepted paradigm, as many green technologies do.¹⁰⁵ The first mover disadvantage problem is especially acute when implementation of a green technology requires significant investment in infrastructure as is often the case in the transportation sector.¹⁰⁶

3. Disruption of Accepted Business Models

In his important book, *The Innovator's Dilemma*, Clayton Christensen explained how disruptive technologies can be the bane of successful, established corporations.¹⁰⁷ Disruptive technologies are cheaper than established technologies. In the beginning, they offer a lower performance alternative to the

104. ADAM B. JAFFE ET AL., RES. FOR THE FUTURE, A TALE OF TWO MARKET FAILURES: TECHNOLOGY AND ENVIRONMENTAL POLICY 6 (2004), available at <http://www.rff.org/documents/rff-dp-04-38.pdf>.

105. *Id.* at 7.

106. The shift to cleaner or smarter transportation necessitates massive investment in infrastructure, such as charging construction of advanced railroads or provision of new energy sources. In this case, the government must step in and provide the infrastructure as it does with other public goods. See CHARLES WHEELAN, NAKED ECONOMICS: UNDRRESSING THE DISMAL SCIENCE 54–103 (2002); Adam B. Jaffe et al., *A Tale of Two Market Failures: Technology and Environmental Policy*, 54 ECOLOGICAL ECON. 164, 169, 172–73 (2005); Alan Williams, *The Optimal Provision of Public Goods in a System of Local Government*, 74 J. POL. ECON. 18 (1966). Alternatively, a private company can step in and provide the necessary infrastructure. In fact, this is exactly what Google did in the case of smart cars. Google harnessed its “Street View” functionality to enable the operation of driverless cars that are supposed to reduce the pollution associated with private transportation. John Markoff, *Google Cars Drive Themselves, in Traffic*, N.Y. TIMES (Oct. 9, 2010), <http://www.nytimes.com/2010/10/10/science/10google.html>. For a broader discussion of the topic, see Theodore Bergstrom et al., *On the Private Provision of Public Goods*, 29 J. PUB. ECON. 25 (1986), and R. H. Coase, *The Lighthouse in Economics*, 17 J.L. & ECON. 357, 358–59, 375–76 (1974).

107. CHRISTENSEN, *supra* note 11, at xxiii, 117–38, 264.

dominant technology and thus do not appeal to high margin consumers.¹⁰⁸ Over time, though, disruptive technologies improve rapidly without a marked cost increase and ultimately they outperform and supersede established technologies.¹⁰⁹ Digital photography is perhaps the best example of a disruptive technology.¹¹⁰

Perversely, dominant firms are especially vulnerable to the emergence of disruptive technologies since they are deeply invested in the established technology and their entire business model is predicated on it. This happens in sequential stages. Scale economies result in significant ‘sunk costs’ in the dominant design, and this is soon followed by learning effects or “learning by doing” that leads to improvisation and innovation in the production process.¹¹¹ With increased adoption of the design, adaptive expectations arise because of reduced uncertainty in the design. Worse yet, initially the disruptive technology has little “market pull” and, hence, dominant firms are reluctant to switch for fear of losing their clientele.¹¹² Kodak-Easterman’s handling—or more accurately, mishandling—of digital photography provides a sad, yet powerful example of the approach of established corporations to disruptive innovation.¹¹³

While not all green technologies fall into the category of disruptive innovation, many of them do. Green innovation often challenges accepted production paradigms and long-standing profit models.¹¹⁴ After all, it is the very essence of green

108. *Id.* at xvii.

109. Erwin Danneels, *Disruptive Technology Reconsidered: A Critique and Research Agenda*, 21 J. PRODUCT INNOVATION MGMT. 246, 247 (2004).

110. David W. Cravens et al., *The Innovation Challenges of Proactive Cannibalisation and Discontinuous Technologies*, 14 EUR. BUS. REV. 257, 260 (2002).

111. STEVEN D. LEVITT ET AL., TOWARD AN UNDERSTANDING OF LEARNING BY DOING: EVIDENCE FROM AN AUTOMOBILE ASSEMBLY PLANT 1 (2013), available at <http://faculty.chicagobooth.edu/chad.syverson/research/learningbydoing.pdf>.

112. Timothy J. Foxon, *Technological Lock-In and the Role of Innovation*, in HANDBOOK OF SUSTAINABLE DEVELOPMENT 140, 142 (Giles Atkinson et al. eds., 2007).

113. Henry C. Lucas Jr. & Jie Mein Goh, *Disruptive Technology: How Kodak Missed the Digital Photography Revolution*, 18 J. STRATEGIC INFO. SYS. 46 (2009).

114. See Matt Rogers, *Energy = Innovation: 10 Disruptive Technologies*, MCKINSEY ON SUSTAINABILITY & RESOURCE PRODUCTIVITY (2012), http://www.mckinsey.com/~media/mckinsey/dotcom/client_service/

technologies to offer cleaner, environmentally friendlier products and processes that often represent a paradigm shift relative to the predominant technology.¹¹⁵ Consequently, established corporations may initially ignore green inventions and subsequently, as they gain a foothold in the market, even fight them. The attitude of the American automobile industry to electric cars is a case in point. The idea of an electric car has been floating around for years.¹¹⁶ Yet, it took car manufacturers several decades to warm up to it.¹¹⁷ Auto manufacturers whose profit model in the last decades heavily relied on powerful, albeit fuel-inefficient vehicles refused to buy into the concept of electricity-operated cars.¹¹⁸ The fact that electric cars were slower than fuel-operated cars did not help matters.¹¹⁹ It took a massive increase in gas prices and global economic crisis to cause the United States car industry to reconsider its approach to electric cars, and even so, it will probably take a few more decades until such cars become the standard.¹²⁰

sustainability/pdfs/mck%20on%20srp/srp_02_innovation.ashx (describing contemporary disruptive technologies in the environmental field).

115. THOMAS S. KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* 85 (3d ed. 1996).

116. Electric vehicles were actually the dominant form of motor vehicles in America during the mid to late nineteenth century. DAVID A. KIRSCH, *THE ELECTRIC VEHICLE AND THE BURDEN OF HISTORY* 37–41 (2000). After electric vehicles fell out of favor due to the development of the internal combustion engine, multiple oil crises and environmental concerns in the 1970s pushed alternative fuel vehicles into the public consciousness. This led to a revival in interest in electric cars during the second half of the twentieth century. *Id.* at 204.

117. *Id.* at 203–08.

118. *Id.*; see also Adam Hartung, *Why Tesla Is Beating GM, Ford and Toyota – Electric Cars*, *FORBES* (July 11, 2012), <http://www.forbes.com/sites/adamhartung/2012/07/11/why-tesla-is-beating-gm-ford-and-toyota-at-electric-cars> (detailing how auto manufacturers are reluctant even today to truly adopt the electric car).

119. For electric vehicles to sustain high speeds past twenty miles per hour, the battery must be able to meet the rapidly increasing electric power requirements. KIRSCH, *supra* note 116, at 106–07. Thus, it required the development of better batteries for electric cars to compete with the top speeds from gas powered vehicles. During the early 1970s, it was theorized that a mass-produced electric car would have a range of fifty miles at a speed of fifty miles per hour. John O'M. Bockris, *The Case for Electric and Fuel-Cell Powered Vehicles*, 3 *AMBIO* 15, 21 (1974).

120. See Brad Plumer, *As Battery Prices Drop, Will Electric Cars Finally Catch On?*, *WASH. POST WONKBLOG* (July 12, 2012), <http://www.washingtonpost.com/blogs/wonkblog/wp/2012/07/12/as-battery-prices-drop-will-electric-cars-finally-catch-on> (suggesting that because the price competitiveness of electric cars is tied to the cost of batteries, it will take some time

The challenge green technologies present for established corporations is compounded by the “not our idea” mentality.¹²¹ Research in behavioral psychology shows that individuals and corporations tend to over-evaluate their own ideas and underestimate the ideas of other people.¹²² Accordingly, corporations that developed the technology that currently holds sway on the market, or even licensed it, may be especially reluctant to give green technologies a try, especially if they were not developed in-house.¹²³ Thus, a chemical plant may steadfastly adhere to environmentally harmful manufacturing processes that it has used for a year, refusing to consider greener alternatives.

Having reviewed the various legal and business obstacles green companies face, in the next Part we proceed to introduce a new mechanism that may alleviate many of the roadblocks we discussed and give green technologies a better chance of making it in the marketplace.

II. WHAT CAN BROWN DO FOR YOU?

All else being equal, from a societal vantage point, environmentally friendly technology should be preferred to environmentally harmful, or even environmentally neutral, technologies.¹²⁴ And in a world with an omniscient beneficent social planner the correct technological choice would be made. In reality, however, technological choices are not made by a central planner. Rather, they are largely left to the market, or more accurately, to the firms operating in it.

The technology choices of private firms are likely to diverge from the socially optimal choice. The cost-benefit analysis performed by a firm is different from that of society at large. As profit-maximizing entities, firms will likely adopt production

before electric cars will be able to compete against regular internal combustion engine vehicles).

121. DAN ARIELY, *THE UPSIDE OF IRRATIONALITY: THE UNEXPECTED BENEFITS OF DEFYING LOGIC AT WORK AND AT HOME* 107–22 (2010) (discussing the phenomenon of actors overvaluing their own ideas and creations).

122. *Id.*

123. See Bryan Kent Bollinger, *Green Technology Adoption in Response To Environmental Policies* 1 (June 2011) (unpublished Ph.D. dissertation, Stanford University), available at <https://stacks.stanford.edu/file/druid:kw873vh9740/Green%20Technology%20Adoption-augmented.pdf>.

124. See Jonathan M.W.W. Chu, *Developing and Diffusing Green Technologies: The Impact of Intellectual Property Rights and Their Justification*, 4 WASH. & LEE J. ENERGY, CLIMATE & ENV'T 53, 60–62 (2013).

technology that guarantees them the highest possible expected net payoff, even when the choice is socially suboptimal. Moreover, firms will adopt profit-maximizing strategies even when those strategies impose costs on society at large.¹²⁵ Indeed, the indifference toward social costs gave birth to the law and economics movement. Left to their own devices, profit maximizing firms will not take account of environmental harms as long as those harms do not negatively affect their profits. This misalignment between the private calculus performed by firms and that of society at large is the standard justification for legal intervention in the marketplace.¹²⁶

Generally speaking, legal intervention can take the form of a stick or carrot.¹²⁷ The paradigmatic example of the former is regulation. Regulation tends to be negative in nature. It proscribes actors from taking certain action under the threat of legal punishment.¹²⁸ Private litigation is another form of a “stick.”¹²⁹ The norms of private law make certain deviations from socially desirable standards actionable and entrust private litigants and courts with the task of disciplining viola-

125. See James Halteman, *Externalities and the Coase Theorem: A Diagrammatic Presentation*, 36 J. ECON. EDUC. 385, 385 (2005); see also WILLIAM J. BAUMOL & WALLACE E. OATES, *ECONOMICS, ENVIRONMENTAL POLICY, AND THE QUALITY OF LIFE* 75–79 (1979) (noting that “the price system does not act as an efficient servant of the public’s preferences” when there are significant externalities).

126. See BAUMOL & OATES, *supra* note 125, at 230–32; PIGOU, *supra* note 42, at 134; cf. Coase, *supra* note 14, at 15 (arguing that if there are no transaction costs, legal interventions into the marketplace may not be necessary to fix this misalignment because the relevant parties would always bargain with one another to reach the socially optimal level of environmental harms).

127. See generally James Andreoni et al., *The Carrot or the Stick: Rewards, Punishments, and Cooperation*, 93 AM. ECON. REV. 893 (2003) (examining punishments and rewards in economic laboratory experiments).

128. See Dorothy Thornton et al., *General Deterrence and Corporate Environmental Behavior*, 27 LAW & POL’Y 262, 262 (2005) (explaining how regulatory programs depend on formal prosecutions and legal sanctions against violators to create a deterrence threat); see also Andrew Green, *You Can’t Pay Them Enough: Subsidies, Environmental Law, and Social Norms*, 30 HARV. ENVTL. L. REV. 407, 424 (2006) (describing government regulations as “sticks”).

129. See Stefanie Fleischer Seldin, *A Strategy for Advocacy on Behalf of Women Offenders*, 5 COLUM. J. GENDER & L. 1, 21 (1995) (“[L]itigation is a good ‘stick.’”); see also Ernst Fehr & Simon Gächter, *Cooperation and Punishment in Public Goods Experiments*, 90 AM. ECON. REV. 980 (2000) (providing evidence based on experimental data that there is a widespread willingness to punish those that free ride and abuse social norms).

tors.¹³⁰ Alternatively, society may use “carrots” to induce actors to behave in socially desirable ways. An oft-cited example of a “carrot” is a subsidy.¹³¹ A subsidy consists of a direct or indirect transfer of money from the public fisc to a private actor to reward a certain behavior. Tax breaks¹³² and prizes¹³³ may be used to the same effect.

In the paragraphs to come, we present a novel mechanism—the green option—that falls outside the conventional tools used by lawmakers to channel the behavior of market actors. Our mechanism is uniquely designed to harness the profit motivation of firms to facilitate the success of green companies. Moreover, the implementation of our mechanism requires a fairly minimal intervention in the operation of markets and no ongoing monitoring.

A. THE GREEN OPTION

The discussion in Part I demonstrated that green technologies face a myriad of legal and market barriers. Although we clearly do not suggest that established firms are directly responsible for erecting these barriers, it is clear that such firms can facilitate the introduction of green technologies and contribute to their success in the marketplace. Indeed, small companies that produce environmentally friendly inventions can dramatically benefit from partnering up with larger, more established firms.¹³⁴ The advantages that strategic business partners offer to small, startup firms are real and significant and can be the difference between success and failure.

130. See John C.P. Goldberg, *Introduction: Pragmatism and Private Law*, 125 HARV. L. REV. 1640, 1640 (2012).

131. See Harry Moren, Note, *The Difficulty of Fencing In Interstate Emissions: EPA's Clean Air Interstate Rule Fails To Make Good Neighbors*, 36 ECOLOGY L.Q. 525, 542 (2009) (“[A] government subsidy is a carrot.”); see also Green, *supra* note 128, at 424 (describing government subsidies as “carrots”).

132. 13B CHARLES ALAN WRIGHT ET AL., FEDERAL PRACTICE AND PROCEDURE § 3531.10.1, at 7 (Supp. 2014) (“A tax ‘break’ often is economically and functionally indistinguishable from a direct payment. Among the examples was this: a state that wishes to subsidize the ownership of crucifixes could buy and distribute them, or reimburse private purchases, or give a tax credit for the purchase price.”).

133. For discussion on the use of prizes to induce innovation, see Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525 (2001).

134. See, e.g., TERESA GORBETT ET AL., UNDERSTANDING THE BUSINESS RATIONALE BEHIND THE TREND TOWARDS ENVIRONMENTALLY FRIENDLY MANUFACTURING PRACTICES 16–17 (2005), available at <https://www.wm.edu/as/publicpolicy/documents/prs/green.pdf>.

Naturally, in light of the difference in market positions, there exists a large disparity in the bargaining power between established and startup firms. As a result, it is the large established corporations that get to decide whether to give a chance to green technologies, and if so, under what conditions. Under the extant regime, large corporations are under no obligation to endorse environmental innovations, and green companies can do little besides hope that their products offer cost savings sufficient enough to attract the attention of their larger peers. Society at large currently plays no part in this dynamic, despite its unequivocal interest in promoting environmentally friendly products and processes.¹³⁵

Yet society need not stay on the sidelines and hope that the market will yield socially desirable outcomes, especially when so much is at stake and the market is imperfect. A simple change in the law can go a long way toward transforming the current reality and give green innovation a much better chance at market success. Specifically, we propose that green companies will be granted the power to transfer a call option for five percent of their shares to an established company of their choice. For the purpose of our proposal, any publically traded company will be considered an established company. The option will be granted to the established company for free and its exercise price will be set to equal the value of the green company's share at the time of the transfer. It will be open for a period of five years. However, unlike the case with standard call options, the receiving company will not be able to simply allow the call option to expire at the end of the five-year period. Rather, it will be forced to exercise the option at that time. We call this policy tool "the green option."

A numerical example can illustrate how the green option would work. Assume that on August 1, 2012, ClearTech Inc. wishes to take advantage of the green option by transferring a call option for five percent of the company—or 1,000,000 shares—to BrownWater Co. At the time of the transfer, the value of each of ClearTech's shares was estimated at \$2. The transfer of the option will *not* expose BrownWater to an immediate financial liability. BrownWater receives the option for free. It will only have to pay the exercise price—in our case, \$2 per share—when it decides to exercise the option. For simplicity's sake, we will assume that BrownWater chooses to wait the

135. See Marilyn A. Brown, *Market Failures and Barriers As a Basis for Clean Energy Policies*, 29 ENERGY POL'Y 1197, 1201 (2001).

full five years and exercises the option on August 1, 2017. At this moment, it will have to pay \$2 million (\$2 x 1,000,000) to GreenTech. If the value of GreenTech quadrupled between 2012 and 2017, such that each share is now worth \$8, then BrownWater will have netted \$6 million.¹³⁶ If, by contrast, the value of each of GreenTech's shares dropped to \$1 by the exercise date, then BrownWater will lose \$1 million.¹³⁷

The proposed mechanism creates a partial alignment between the interests of established and green technology companies. Its point and purpose is to give established companies a financial stake in green technology and then harness their profit motive to promote the technologies in which they are invested. By empowering green companies to transfer an option on their stocks to established businesses, we will allow them to forge strategic partnerships with established corporations. Such strategic partnerships could be invaluable for green companies.¹³⁸ Indeed, they may well make the difference between success and failure in the marketplace.

Having a financial stake in a green company will prompt established businesses to promote the environmental technologies offered by the smaller startup firm. And although the profit (or loss) the established firm stands to gain (or lose) from the green venture may be small by comparison to other revenue streams it generates, we can make it significant enough so that it cannot be ignored even by successful large firms. It should be noted in this context that recent research in behavioral psychology demonstrated that even relatively small financial incentives may have a profound effect on behavior and decision making.¹³⁹ In line with this finding, we believe that by making established businesses stakeholders in green technologies,

136. It paid \$2 million for shares whose current worth is \$8 million.

137. In this case, it is paying \$2 million for shares that are worth only half of this amount, namely \$1 million.

138. For an in-depth analysis on how strategic partnerships can benefit small technology firms, see David B. Audretsch & Maryann P. Feldman, *Small-Firm Strategic Research Partnerships: The Case of Biotechnology*, 15 *TECH. ANALYSIS & STRATEGIC MGMT.* 273 (2003); Rachel Sheinbein, *Why Cleantech Startups Need To Partner with Big Companies*, *FORBES* (Sept. 26, 2011, 4:55 PM), <http://www.forbes.com/sites/ciocentral/2011/09/26/why-big-companies-need-to-partner-with-cleantech-startups>.

139. ARIELY, *supra* note 121, at 17–52 (discussing experiments that show that small incentives can lead to better performance than very large ones).

lawmakers can transform their attitude toward such technologies and turn them into agents of social change.¹⁴⁰

As far as green companies are concerned, our mechanism creates a win-win situation. Our proposal gives green companies complete discretion to decide whether to take advantage of the green option. From the vantage point of the green companies, the mechanism we propose is completely optional. Green companies can decide to use it or forego it, depending on their particular circumstances. A green company that prefers to “go it alone” or one that already has a strategic partner is at liberty not to use the mechanism. By contrast, a green company that can benefit from transferring a call option to an established business will have the unilateral power to do so. In effect, the green option adds another possibility to the menu of legal powers available to green companies,¹⁴¹ without taking anything away from that menu. Since there are significant differences among green firms in terms of their business models and financing potential, we expect that some of them will take advantage of the new power we bestow upon them while others will not. In other words, green companies will self-select whether to use the new legal option and a separating equilibrium will result.¹⁴²

The same cannot be said about established firms. From the vantage point of established firms, the green option constitutes an imposition. It forces them to take an interest in an environmental company or technology that they may not have invested in otherwise, or may have taken under more favorable terms. Hence, although our proposal creates a potential upside for the established firm, it is undeniable that the upside is accompanied by a risk. In defense of our proposal, it must be said that we have come a long way from the *laissez faire* ideology that dominated political thought at the end of the nineteenth and

140. It should be added that the financial interest of the established businesses in the green companies will not necessarily terminate at the end of the option's life. The established businesses will continue to have a stake in the green companies as long as they hold the stock. This interest will be terminated with the sale of the stock. This event, however, may take place many years into the future.

141. Ian Ayres, *Menus Matter*, 73 U. CHI. L. REV. 3, 3 (2006) (defining menu as, “a contractual offer that empowers the offeree to accept more than one type of contract”).

142. That is, in equilibrium, not all companies will act alike; or in economic parlance, they will not pool together.

beginning of the twentieth century.¹⁴³ Today, firms must comply with multiple laws and regulations that restrict their freedom of choice.¹⁴⁴

Nonetheless, in order to protect established firms from potential opportunism on the part of green entrepreneurs, we introduce two important limitations on the power of green companies to use the green option. First, in order to reduce the risk to receiving firms, we propose that the green option will only be available to startups that have been in existence for at least five years and have commercialized their core green technology. The point and purpose of this limitation is to filter out the startups that carry the highest risk of failure, those in the first few years of their existence.¹⁴⁵ In addition, we would make the green option available only to companies that produce the green technology they developed—or put differently, commercialized. The commercialization requirement is important for two reasons: it reduces the risk to the receiving company, and it enhances the likelihood of a future benefit to society at large.¹⁴⁶ The commercialization requirement is important for another reason: commercialization signals seriousness and that the green investors are really committed to their venture.

Second, we would exempt established firms that have already voluntarily partnered up with green companies or developed a similar green technology “in house” from taking the green option. These companies will, of course, be at liberty to make an *additional* investment in green companies should they

143. For a history of *laissez faire*, see HAROLD U. FAULKNER, *THE DECLINE OF LAISSEZ FAIRE, 1897–1917* (1951); JACOB VINER, *ESSAYS ON THE INTELLECTUAL HISTORY OF ECONOMICS* (Douglas A. Irwin ed., 1991).

144. For a discussion of the many ways that firms are regulated, see Colin Scott, *Regulation in the Age of Governance: The Rise of the Post-Regulatory State*, in *THE POLITICS OF REGULATION: INSTITUTIONS AND REGULATORY REFORMS FOR THE AGE OF GOVERNANCE* 145, 160–66 (Jacint Jordana & David Levi-Faur eds., 2004).

145. For a discussion on the correlation between “years of existence” or “age” and the “likelihood of success” for startup companies, see Sue Birley, *The Role of New Firms: Births, Deaths and Job Generation*, 7 *STRATEGIC MGMT. J.* 361, 363–64, 368–69 (1986); Josef Brüderl & Rudolf Schüssler, *Organizational Mortality: The Liabilities of Newness and Adolescence*, 35 *ADMIN. SCI. Q.* 530 (1990).

146. Ted Sichelman explains in his article, *Commercializing Patents*, how commercializing an invention into a viable product is a costly and risky development process. Ted Sichelman, *Commercializing Patents*, 62 *STAN. L. REV.* 341, 343 (2010). Thus, it is logical to assume that once an invention has been transformed into a commercial product, the overall risk associated with that invention is reduced because it was able to overcome a significant hurdle.

choose to do so. But they will be under no legal obligation to accept the green option if it is offered to them. The point of our proposal is to get as many established companies as possible involved in the promotion of green technologies. Companies that chose to invest in green technologies on their own accord already bear their fair share of the burden. In addition, the proposed exemption has the salutary effect of incentivizing firms to actively search for the most promising green technologies and invest in them, rather than sit passively and wait until an environmental startup forces them, under the terms of our scheme, to take a financial interest in it.

B. TAKING STOCK

The implementation of our proposal will yield several important benefits for green companies, as well as for society at large. We will conduct our analysis of these benefits from three different perspectives: a business perspective, a political perspective, and a societal perspective.

1. The Business Perspective

Forming a strategic allegiance with an established business may dramatically increase the odds of success for green companies. Once a green company transfers an option on its shares to an established business in accordance with our proposal, the receiving company will have an incentive to see the green company succeed. Moreover, since our scheme correlates the payoff to the established company to the success rate of the green company, it incentivizes established businesses that receive a green option to use their market position to promote the green technology in which they are invested.

Established businesses can help green companies in several important ways. On the most basic level, they can provide economic advice and guidance. Drawing on their own experience, connections, and business acumen, large corporations can help startups avoid critical mistakes. They can also instruct as to how to allocate existing resources more efficiently and how to raise new funds. Receiving free advice will generate another benefit for green companies: it will enable them to save funds that they might have otherwise spent on buying consulting services.

Sharing information and knowledge is not the only means by which established businesses can help green companies. They can adopt the green technology at issue and use it in their

own operations. Doing so will obviously create revenues for the green company. Equally important, it will give the green company an invaluable opportunity to test the technology and to show that it works in the real world. Moreover, such a move will send a signal to the market about the quality of the green technology.¹⁴⁷ The signaling aspect is especially important in this case since the established company is presumed to have superior information relative to the rest of the market owing to its special relationship with the green company and because the signal in this case is very costly for the established business.¹⁴⁸

Finally, large corporations can help green startups gain foothold in the market by introducing them to their clients, financiers, and other business partners. Establishing a new business relationship will be particularly easy if the established corporation chose to adopt the green technology in its operations. But even if the established corporation decided not to use the green technology, it should be able to open new doors for the green company for two principal reasons. First, under the terms of our proposal, the established company could turn down the offer of the green company and invest in an alternative green technology. The fact that it chose not to do so means that it sees real potential in the green company whose option it has taken. Second, after the option has been taken, the fates of the two corporations become intertwined. Failure by the green company may have adverse consequences for the established firm, as well as for its suppliers, clients, and business partners. As a result, all the businesses that work with the established firm have an indirect interest in the success of the green company.

The benefit flow is not a one-way street, as even established firms can immensely gain from collaboration with green companies and technologies.

2. The Political Perspective

Established businesses can also affect the legal and regulatory regimes that govern the different businesses. Public choice

147. See Amna Kirmani & Akshay R. Rao, *No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality*, 64 J. MARKETING 66, 66 (2000).

148. The incorporation of a new technology into a business requires a considerable investment of resources. At times, it requires a complete overhaul of the business model.

theorists have long analogized the political arena to a market environment in which goods and services are bought and sold. The pioneering work of public choice theorists, such as Gordon Tullock,¹⁴⁹ James Buchanan,¹⁵⁰ Sam Peltzman,¹⁵¹ Gary Becker,¹⁵² and Anne Krueger,¹⁵³ famously suggested that government services are sold by politicians to private bidders.¹⁵⁴ Subsequent empirical studies validated the main predictions of the theory.¹⁵⁵ Large industry participants can use their wealth to secure favorable legislation and regulation, or, conversely, to pass legislation that adversely impacts their competitors.¹⁵⁶ Successful firms, in other words, must establish a presence in the political arena.¹⁵⁷

Small startup firms do not share a similar ability to affect the political process for two main reasons. First, they don't have the financial wherewithal to secure legislative and regulatory changes.¹⁵⁸ Put in stark terms, small companies simply

149. See Gordon Tullock, *The Welfare Costs of Tariffs, Monopolies, and Theft*, 5 W. ECON. J. 224, 228 (1967).

150. See, e.g., James M. Buchanan, *Rent Seeking and Profit Seeking*, in TOWARD A THEORY OF THE RENT-SEEKING SOCIETY 3, 8–11 (James M. Buchanan et al. eds., 1980).

151. See, e.g., Sam Peltzman, *Toward a More General Theory of Regulation*, 19 J.L. & ECON. 211, 211–13 (1976).

152. E.g., Gary S. Becker, *A Theory of Competition Among Pressure Groups for Political Influence*, 98 Q.J. ECON. 371, 392 (1983).

153. See, e.g., Anne O. Krueger, *The Political Economy of the Rent-Seeking Society*, 64 AM. ECON. REV. 291, 302 (1974).

154. For discussion of the implications of public choice for environmental law and economics, see MICHAEL FAURE & GÖRAN SKOGH, *THE ECONOMIC ANALYSIS OF ENVIRONMENTAL POLICY AND LAW* 171–77, 203–05 (2003).

155. See, e.g., Thomas Stratmann, *What Do Campaign Contributions Buy? Deciphering Causal Effects of Money and Votes*, 57 S. ECON. J. 606, 615 (1991) (discussing how members and lobbyists of the sugar industry were able to extract legislative favors in exchange for donations).

156. See Steven C. Salop & David T. Scheffman, *Raising Rivals' Costs*, 73 AM. ECON. REV. 267, 267–68 (1983) (stating that government regulations are prone to rent-seeking behavior as it would be in the best interests of the firms with lobbying power to raise competitors' relative compliance costs).

157. See Jill E. Fisch, *How Do Corporations Play Politics?: The FedEx Story*, 58 VAND. L. REV. 1495, 1558 (2005) (observing that “firm competition takes place both in the marketplace and in the political arena; the dynamics of one environment affect the other”).

158. Just to get a sense of the amounts involved, the entertainment industry spent \$123 million on lobbying efforts in 2011. Ctr. for Responsive Politics, *TV/Movies/Music: Industry Profile 2011*, OPENSECRETS, <http://www.opensecrets.org/lobby/indusclint.php?id=B02&year=2011> (last visited Dec. 12, 2014). The Internet industry topped that amount with \$127 million in spending. Ctr. for Responsive Politics, *Computers/Internet: Industry Profile*

cannot afford the “price” politicians require for their services. Accordingly, many environmental startup firms have no voice in the political process. They must live and die by the laws and regulations designed by their larger, more established peers without any meaningful ability to stop them from being enacted or affecting their content.

Second, as Jill Fisch demonstrated, a one-time political donation cannot get a firm a say in the political process.¹⁵⁹ Rather, firms gain political clout through multiple interactions with politicians that occur over an extended period of time.¹⁶⁰ Corporations must establish bonding and trust with political actors before they can turn to them for help. This requirement puts new corporations at a serious disadvantage relative to more established ones. Even if a new corporation decides to make a campaign contribution in an attempt to amend the prevailing regulatory regime it is unlikely to find a political actor who will be willing to play along.

The political fortunes of a small corporation can dramatically change if it can find a larger corporation to take it under its wing. In this case, the more established business could use its political and financial capital to watch out for the interests of the small firm and ensure that it gets adequate representation in the political arena. By effecting a partial financial alignment between the interests of green corporations and established businesses, the implementation of our proposal will provide the latter a meaningful incentive to support environmentally friendly regulation or, at the very least, not to oppose it.¹⁶¹

One may wonder whether our proposal gives the established business a sufficient monetary incentive to mobilize its political allies in favor of the relevant environmental cause. We can think of three responses to this concern. First, as we explained, in many cases all that is required from the established corporation is *not to block* (or effectively veto) pro-

2011, OPENSECRETS, <http://www.opensecrets.org/lobby/indusclient.php?id=B12&year=2011> (last visited Dec. 12, 2014). Google Inc. alone spent \$9.7 million toward this end. Ctr. for Responsive Politics, *Annual Lobbying by Google Inc.*, OPENSECRETS, <http://www.opensecrets.org/lobby/clientsum.php?id=D000022008&year=2011> (last visited Dec. 12, 2014).

159. See Fisch, *supra* note 157, at 1559 (describing how established corporations foster relationships with politicians over extended periods of time in order to secure favorable (de)regulatory treatment).

160. *Id.* at 1559–60.

161. The same is suggested in ENDRES, *supra* note 6, at 200–02.

environmental regulation, and even a modest financial interest should suffice to achieve this result. Second, under the current political environment, there exists significant political goodwill to promote environmental causes. Consequently, the cost of mobilizing pro-environmental initiatives may be much lower than the cost of opposing them. Third, and most importantly, often the relevant level for intervention is the local level of government. Many of the regulatory standards that apply to construction, transportation, and energy are set at the local level,¹⁶² and affecting political decision making on the local level is far less costly than attempting to influence lawmakers on the state or nationwide level.

3. The Social Perspective

As we explained, society has a clear interest in protecting the environment by avoiding unnecessary environmental harm. This social goal implies, at the very least, that legal policies that impede green innovation should be repealed in order to give green innovation a chance to compete on a level playing field. For the reasons we discussed, however, removing the legal obstacles will fall short of achieving this objective on account of the business barriers to green products and technologies.¹⁶³

One could suggest at this point that the best way to level the playing field is to subsidize green technologies. After all, green technologies confer a benefit to the public and hence it makes sense for the public to fund them. We would caution against this superficially alluring solution. In fact, we contend that our proposal is clearly superior to subsidization. There are several problems with the subsidization solution. First, any subsidization scheme gives rise to a herculean information challenge. Even if all politicians were benign and well-meaning, which is clearly not the case in the real world, they would still need to overcome two dual informational problems prior to adopting a subsidization plan: they would need to decide which green technology to subsidize and by what amount. Failure to make both decisions correctly will distort competition among green technology companies by channeling excessive amounts

162. Kirsten Engel, *State and Local Climate Change Initiatives: What Is Motivating State and Local Governments To Address a Global Problem and What Does This Say About Federalism and Environmental Law*, 38 URB. LAW. 1015, 1016–20 (2006).

163. See *supra* Part I.B.

of public funds into the wrong hands. However, given the early stage at which subsidization decisions ought to be made and in the absence of market feedback, the government cannot possibly make the correct decisions.

Second, once we move from the ideal world of Pigouvian government that only acts in the best interest of the public to the real world in which at least some politicians seek to maximize their narrow self-interest over that of the public, the shortcomings of subsidization rush to the fore. There is a voluminous literature documenting how politicians use subsidies to benefit their supporters, rather than the public at large.¹⁶⁴ In light of our past experience with subsidization, it is highly unlikely that the resources will be allocated optimally, and, worse yet, a considerable amount of money will be squandered in the process as private corporations will engage in fierce, albeit unproductive, competition for the subsidies doled out by the government.¹⁶⁵

Third, and finally, subsidies come from the public fisc. They use up money that could have been used to advance other important public goals. Alternatively, the government could raise the funds necessary to subsidize a certain economic activity by raising taxes. However, politicians are highly disinclined to levy new taxes on the public or even to raise existing ones. Furthermore, it bears emphasis that taxation creates its own economic costs, including a considerable deadweight loss.¹⁶⁶

Our solution, by comparison, sidesteps the main problems that attend subsidization. Our solution relies on the market rather than on the political system. Although markets are far from perfect, they have several critical advantages in the present context. Markets do not only allocate goods and services to their highest value users; they produce valuable information in the process.¹⁶⁷ Furthermore, market competition is the best way

164. BRUCE E. CAIN ET AL., THE PERSONAL VOTE: CONSTITUENCY SERVICE AND ELECTORAL INDEPENDENCE 197–98 (1987); Avinash Dixit & John Londregan, *The Determinants of Success of Special Interests in Redistributive Politics*, 58 J. POL. 1132, 1133 (1996); Herbert Kitschelt, *Linkages Between Citizens and Politicians in Democratic Polities*, 33 COMP. POL. STUD. 845, 849 (2000); Rigoberto A. Lopez, *Campaign Contributions and Agricultural Subsidies*, 13 ECON. & POL. 257, 271–72 (2001).

165. Green, *supra* note 128, at 426.

166. Ian W.H. Parry & Wallace E. Oates, *Policy Analysis in the Presence of Distorting Taxes*, 19 J. POL'Y ANALYSIS & MGMT. 603, 604 (2000).

167. F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 526 (1945).

we have of ensuring the success of the best technologies.¹⁶⁸ Over time, competition tends to select the more efficient technologies and channel resources in their direction. Our proposal provides a helpful illustration of the advantages of competition. Under our proposal, established businesses can turn down a green option as long as they have invested in rival green technology. The opt-out mechanism that is built into our proposal enhances competition in two related ways. First, it gives established businesses an incentive to educate themselves about the green technologies that are available on the market and actively search for the best ones. Second, it gives green companies an extra motivation to improve their processes and products. Under our proposal, green companies cannot get complacent and rely on the green option to bail them out because if their technology is not good enough, established businesses will turn down the option and invest instead in the superior technology of another company.

A final advantage of our proposal is that it does not require public spending. Consequently, it does not give rise to the familiar political economy objections that attend subsidization. First and foremost, it does not raise the specter of corruption. By preserving open market competition, we make sure that all investment decisions will be made strictly on the merits. An established business that invests based on favoritism will quickly lose its investment and be disciplined by the market. Second, our proposal frees up public money for other important purposes. It will bestow a benefit on the public without exposing it to any significant cost.¹⁶⁹ Thus, from a societal perspective, there are weighty reasons to favor our proposal over subsidization.

168. See, e.g., Lital Helman & Gideon Parchomovsky, *The Best Available Technology Standard*, 111 COLUM. L. REV. 1194, 1212–29 (2011); Philip J. Weiser, *The Internet, Innovation, and Intellectual Property Policy*, 103 COLUM. L. REV. 534, 583–600 (2003).

169. One could argue that by forcing public corporations to invest in green technologies we may bring about the downfall of many established businesses, which will lead to an economic crisis. We find this scenario is unfounded. For this result to happen, all, or at least most, established businesses should lose considerable amounts of money because of their investment in green technologies. It is virtually impossible to imagine a world in which this risk will materialize. Green technologies do not present such a risk. In fact, most green technologies represent an opportunity for the recipient firms to improve their operations and become more profitable.

III. ADDRESSING POTENTIAL OBJECTIONS: SHOULD OUR PROPOSAL GET THE GREEN LIGHT?

In this Part, we would like to address several potential objections to our proposal. We believe that in addition to the more specific objections that we explored in Part II as we were laying out our proposal, one can come up with three more general objections. First, one could argue that the concept of “green technology” that lies at the core of our proposal is too vague and as a consequence our proposal may be subject to manipulation. Second, one might contend that the government has no business intervening in the operations of private corporations and should certainly stay out of their investment decisions. Third, and finally, one may wonder why focus on the environment when there are other worthy social goals that may be equally important. We take on these objections in order.

A. WHAT’S GREEN?

The first objection to our proposal centers on the concept of “green technology.” Adopting a cynical perspective, one could argue that under a very lax definition any technology can be defined as “green.”¹⁷⁰ After all, green technologies are not self-identifying and what is environmentally friendly is open to debate.¹⁷¹ If this is the case, established businesses can easily manipulate our system by investing in any technology.

While the concept of green technology is central to our proposal, we do not consider the problem insurmountable. In fact, we posit that there is a simple fix. The task of defining what technologies are green is not nearly as daunting as one might think. In our opinion, the task of defining what constitutes a green technology should not be performed by the government. Rather, it should be left to the market, or more specifically, to

170. Here we could not help but be reminded of Oscar Wilde’s famous definition of a cynic. Wilde famously defined a cynic as “[a] man who knows the price of everything and the value of nothing.” OSCAR WILDE, *Lady Windermere’s Fan*, in *THE IMPORTANCE OF BEING EARNEST AND OTHER PLAYS* 45 (Peter Raby ed., Clarendon Press 1995) (1892). Wilde’s definition is very fitting in our case.

171. See Elizabeth K. Coppolecchia, Note, *The Greenwashing Deluge: Who Will Rise Above the Waters of Deceptive Advertising?*, 64 U. MIAMI L. REV. 1353, 1401–02 (2010) (arguing that courts and laypeople have trouble determining the validity of “environmentally friendly” claims because of a lack of any objective criteria).

private certification organizations.¹⁷² Such certification organizations need not be invented or created; they are already in existence. At present, there are several certification organizations that award green certification marks to businesses that meet certain predetermined criteria.¹⁷³ Those certification organizations can also be relied upon for the purpose of implementing our proposal. Only companies who receive a green certification mark from a reputed certification organization would be entitled to use the green option.

At this point, one may wonder what would stop corporations that seek to evade our scheme from establishing a new certification organization that would award bogus green certification marks to businesses that do not deserve to receive them.¹⁷⁴ Once again, we are unfazed by this possibility. There are two simple ways to stem concern with strategic abuse. The first way is to adopt a rule that only certification organizations that have been in existence for ten years or more prior to the *adoption* of our proposal would have the power to award green certification marks. The imposition of this limitation would preemptively bar attempts to rig our system by establishing fraudulent certification bodies.

While we are mindful of the fact that there will be a certain time lag between the adoption of our proposal into law and its use in practice, the lag should be much shorter than ten years. As a result, even established businesses that are ideologically opposed to our plan will have to act in accordance with it and invest in green technologies. After that point, they will no longer be motivated to try to manipulate the system.

172. The certification is typically given via certification marks. For discussion of certification marks, see BARTON BEEBE ET AL., TRADEMARKS, UNFAIR COMPETITION, AND BUSINESS TORTS 40 (2011) (“Certification marks serve to certify conformity with centralized standards. . . . [They] are meant to bear the ‘seal of approval’ of a central organization . . .”).

173. Examples include Green Mark certification (GREEN MARK, <http://www.greenmark.co.uk/index.php> (last visited Dec. 12, 2014)), Green Business Bureau certification (GREEN BUSINESS BUREAU, <http://www.gbb.org> (last visited Dec. 12, 2014)), Green Seal certification (GREEN SEAL, <http://www.greenseal.org/GreenBusiness/Certification.aspx> (last visited Dec. 12, 2014)), and Green Business certification (INSTITUTE FOR GREEN BUSINESS CERTIFICATION, <http://www.gbcertified.com/11-Home.asp> (last visited Dec. 12, 2014)).

174. Jorgen Wouters, *‘Tested Green’ Certification Scam Busted by FTC*, DAILYFINANCE (Jan. 12, 2011), <http://www.dailyfinance.com/2011/01/12/tested-green-certification-scam-busted-by-ftc>.

A second possible response to the possibility of manipulation is to get the government involved in an overseer capacity. Specifically, the government can be given the power to decide which certification organizations can be trusted with the task of awarding green certification marks. It bears emphasis that the government will not be required to select a single certification organization for the purpose of implementing our scheme. On the contrary, under our vision, there will be multiple certification organizations that will compete among themselves. This way, no single certification organization will be able to charge monopolistic prices to green technology companies. The role of the government should therefore be limited to that of a gatekeeper: it should ensure that fraudulent certification organizations do not take advantage of the system.

Of course, the two aforementioned mechanisms could be combined. The government, in performing its role, can prescribe that only certification organizations with an adequate past record and a sufficiently long history of operation will be eligible to award the green technology certification mark. Together, these steps should suffice to assuage the risk of abuse, especially if these measures will be backed by criminal penalties and civil sanctions on manipulators.

B. WHOSE GREEN?

Another possible objection to our proposal is that the government should not intervene in the decision making processes of private corporations. Corporations, so the argument goes, should not be burdened with the task of furthering social goals.¹⁷⁵ The goal of corporations is to maximize profits for stockholders and not worry about the public at large. Of course, corporations could be regulated in order to prevent harm to third parties, but they should not be required to affirmatively promote social goals that include the environment. In sum, the argument can be summarized as follows: corporations should worry about the “green” in their shareholders’ bank accounts and not about the green in nature.¹⁷⁶

We find this objection somewhat anachronistic. This is not the place to rehearse the entire normative debate on corporate responsibility. Nor is it necessary to do so here. We live in the

175. See, e.g., Henry Hansmann & Reinier Kraakman, *The End of History for Corporate Law*, 89 GEO. L.J. 439, 441–42 (2001).

176. MILTON FRIEDMAN, CAPITALISM AND FREEDOM 133 (40th anniversary ed. 2002).

age of regulation.¹⁷⁷ No economic activity is completely immune from the government's regulatory powers.¹⁷⁸ Nor should it be. In a society where most resources are in private hands and actors have extensive discretion to use them as they please, it is necessary to impose certain constraints on market transactions in order to ensure that they do not lead all of us astray.

Nor is it true as a factual matter that the government can only regulate to prevent harm, but cannot use its regulatory powers in order to secure a benefit. Moreover, the distinction between harm prevention and benefit conferral is not very useful in the environmental context.¹⁷⁹ For example, when the government regulates the use of environmentally sensitive amenities in order to prevent their destruction, is it employing its regulatory powers to prevent harm or to secure a benefit? There is no obvious answer to this question. But there is an even greater problem with the harm/benefit distinction. One may wonder why we should wait until the environment is actually harmed—possibly irreparably—in order to impose regulations, instead of preempting the problem. After all, if protecting the environment is a worthy goal, what is the point of waiting until harm occurs? Indeed, in the eminent domain context, courts have abandoned the distinction between harm prevention and benefit conferral and have allowed the government to impose far-reaching restrictions on the use of environmental resources without requiring it to pay compensation to the owners.¹⁸⁰

One may nonetheless argue that our proposal “goes too far” in that it forces established businesses to take a stake in green

177. JAMES A. LOWE & MARK L. WAKEFIELD, *AMERICAN LAW OF PRODUCTS LIABILITY* § 67:37 (3d ed. 2000) (“We live in an age of regulation”); Kimberly Koscielniak, *Litigation Searching*, 83 MICH. B.J., May 2004, at 45 (“[I]n this age of regulation. . . .”); David Levi-Faur & Jacint Jordana, *Preface: The Making of a New Regulatory Order*, 598 ANNALS AM. ACAD. POL. & SOC. SCI. 6, 6 (2005) (quoting Scott Jacobs, the head of the program on regulatory reform of the Organisation for Economic Co-operation and Development, as stating, “we live in the golden age of regulation”).

178. See Douglass C. North, *The Growth of Government in the United States: An Economic Historian's Perspective*, 28 J. PUB. ECON. 383, 384–87 (1985).

179. *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1026 (1992).

180. *Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency*, 535 U.S. 302, 343 (2002); *Palazzolo v. Rhode Island*, 533 U.S. 606, 632 (2001); Joseph L. Sax, *Takings, Private Property and Public Rights*, 81 YALE L.J. 149, 151–61 (1971).

companies.¹⁸¹ We disagree. We do not view our proposal as particularly extreme or invasive. The law constrains corporate behavior in a myriad of ways. The law controls information disclosure by corporations,¹⁸² prescribes compensation methods,¹⁸³ and mandates certain governance structures.¹⁸⁴ In certain cases, the law goes further and limits the investment choices of certain financial establishments, forcing them to avoid investment opportunities that involve excessive risk.¹⁸⁵ It is noteworthy that in response to the 2008 economic crisis a growing number of theorists proposed that such limitations be used more extensively.¹⁸⁶ True, our proposal differs from existing restrictions in that it imposes an affirmative investment obligation on established businesses. However, it would not be the first time that the law imposes an affirmative duty on corporations. Many of the legal rules that pertain to information disclosure, compensation methods, and corporate governance impose affirmative duties on corporations.¹⁸⁷

Moreover, we do not think that much should turn on the distinction between affirmative regulation that requires performance of certain acts and negative regulation that requires

181. Jim Nelson, *US Government Should Trust the Free Market for Green Energy Investment*, RENEWABLEENERGYWORLD (May 29, 2012), <http://www.renewableenergyworld.com/rea/news/article/2012/05/us-government-should-trust-the-free-market-for-green-energy-investment>.

182. Zohar Goshen & Gideon Parchomovsky, *The Essential Role of Securities Regulation*, 55 DUKE L.J. 711, 737–40 (2006).

183. See, e.g., 12 U.S.C. § 5567 (2012); 15 U.S.C. § 7243 (2012); Stephanie L. Soondar & Allen Major, *Litigation and Recoupment of Executive Compensation*, 6 HASTINGS BUS. L.J. 397, 398 (2010).

184. 15 U.S.C. § 78j-1; Sanjai Bhagat et al., *The Promise and Peril of Corporate Governance Indices*, 108 COLUM. L. REV. 1803, 1806 (2008).

185. Franklin A. Gevurtz, *The Role of Corporate Law in Preventing a Financial Crisis: Reflections on In re Citigroup Inc. Shareholder Derivative Litigation*, 23 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 113, 120 (2010).

186. RICHARD A. POSNER, *THE CRISIS OF CAPITALIST DEMOCRACY* 335–62 (2010); John C. Coffee, Jr. & Hillary A. Sale, *Redesigning the SEC: Does the Treasury Have a Better Idea?*, 95 VA. L. REV. 707, 774–81 (2009); Richard Squire, *Shareholder Opportunism in a World of Risky Debt*, 123 HARV. L. REV. 1151, 1203–05 (2010); Squam Lake Working Grp. on Fin. Regulation, *An Expedited Resolution Mechanism for Distressed Financial Firms: Regulatory Hybrid Securities* 3–5 (Council on Foreign Relations, Working Paper, 2009).

187. Jeffrey D. Bauman, *Rule 10b-5 and the Corporation's Affirmative Duty To Disclose*, 67 GEO. L.J. 935 (1979); Dennis J. Block et al., *Affirmative Duty To Disclose Material Information Concerning Issuer's Financial Condition and Business Plans*, 40 BUS. LAW. 1243, 1244–57 (1985); Sean M. Donahue, *Executive Compensation: The New Executive Compensation Disclosure Rules Do Not Result in Complete Disclosure*, 13 FORDHAM J. CORP. & FIN. L. 59, 65 (2008).

abstaining from certain activities. Rather, it is the nature and the extent of the interference that should matter. Our proposal represents a relatively modest encroachment on the autonomy of established corporations. Obviously, it requires large corporations to take a stake in smaller green companies. But it leaves large corporations extensive freedom in deciding which green companies to choose. Furthermore, it does not entail a considerable interference in the business activities of the receiving firm. Nor does it expose the receiving firm to a high level of risk.

Finally, we would like to note that there are many examples of legal mechanisms that incorporate call (and even put) options. The most famous example is the government power of eminent domain.¹⁸⁸ The government essentially holds a call option on all private property.¹⁸⁹ It can exercise this option as long as it meets the “public use” requirements and it pays the owner “just compensation.”¹⁹⁰ Interestingly, the government exercised its takings power to further distributional goals¹⁹¹ and spark economic growth,¹⁹² and the Supreme Court approved these exercises of the takings power even when the title to the taken properties was transferred by the government into private hands. More importantly, perhaps, there exist multiple examples of legal rules that grant call and put options to private actors. In the eighteenth and nineteenth centuries, many states adopted “mill acts” that empowered private actors to condemn land suitable for the operation of mills.¹⁹³ Also, in the nine-

188. 6A WILLIAM MEADE FLETCHER, FLETCHER CYCLOPEDIA OF THE LAW OF CORPORATIONS § 2901 (2013).

189. Abraham Bell & Gideon Parchomovsky, *Taking Compensation Private*, 59 STAN. L. REV. 871, 892 (2007).

190. U.S. CONST. amend. V; *Kelo v. City of New London*, 545 U.S. 469, 482–83 (2005); *Hawaii Hous. Auth. v. Midkiff*, 467 U.S. 229, 243 (1984); *Berman v. Parker*, 348 U.S. 26, 29 (1954); D. Benjamin Barros, *The Police Power and the Takings Clause*, 58 U. MIAMI L. REV. 471, 498–524 (2004); Abraham Bell & Gideon Parchomovsky, *The Uselessness of Public Use*, 106 COLUM. L. REV. 1412, 1426–48 (2006); William A. Fischel, *The Political Economy of Public Use in Poletown: How Federal Grants Encourage Excessive Use of Eminent Domain*, 2004 MICH. ST. L. REV. 929, 932–35 (2004).

191. See *Midkiff*, 467 U.S. at 243.

192. See *Kelo*, 545 U.S. at 484; *Whittaker v. Cnty. of Lawrence*, 437 F. App'x 105, 108 (3d Cir. 2011); *Goldstein v. Pataki*, 516 F.3d 50, 60 (2d Cir. 2008).

193. See generally *Head v. Amoskeag Mfg. Co.*, 113 U.S. 9, 16–21 (1885). For a historic review, see Charles E. Cohen, *Eminent Domain After Kelo v. City of New London: An Argument for Banning Economic Development Takings*, 29 HARV. J.L. & PUB. POL'Y 491, 500–08 (2006).

teenth century, railroad companies were empowered to take private property in order to facilitate the construction of tracks.¹⁹⁴ But the use of options is not merely a thing of the past. At present, the laws of many states resolve encroachment disputes by granting the encroached upon party a call option on the projecting structure, or a put option that enables her to force a sale of the encroached upon land to the encroacher.¹⁹⁵ In sum, our mechanism will be breaking no new ground as far as the use of options in the law is concerned.

C. WHY GREEN?

A final objection to our proposal centers on our focus on environmental goals. After all, there are many other worthy social goals that policymakers should strive to advance. Why then should the environment take precedence over other important social goals?¹⁹⁶ For example, why shouldn't we force corporations to invest in health-related innovation or education institutions, rather than in green technologies?

Actually, we do not disagree. We do not presume to provide a cardinal or even ordinal ranking of social values. Such an undertaking is clearly beyond the scope of this Article. This does not mean, however, that our proposal should be rejected. Quite the contrary. First, the fact that there may be difficulties in ranking social goals must not create governmental impasse. Those difficulties do not allow the government to sit idly and refrain from promoting any social goals.

Second, and most important, although our discussion focuses on the environment, the mechanism we developed in this Article may be used to further other socially important goals. Indeed, it can easily be extended to other contexts. Specifically, lawmakers can agree on a list of goals they wish to further—without ranking them—and empower small enterprises that promote those goals to harness the help of large businesses by giving them call options. Of course, in this scenario, large corporations will only be required to engage in the advancement of

194. Harry N. Scheiber, *Property Law, Expropriation, and Resource Allocation by Government: The United States, 1789–1910*, 33 J. ECON. HIST. 232, 237–48 (1973).

195. WIS. STAT. § 843.10 (2012). See generally Ian Ayres, *Protecting Property with Puts*, 32 VAL. U. L. REV. 793, 800 (1998) (“[P]ut options are a traditional part of the common law and . . . they should remain so.”).

196. *Majority Say Environment, Global Warming Not a Top Priority*, ENVIRONMENTAL LEADER (Jan. 26, 2009), <http://www.environmentalleader.com/2009/01/26/majority-say-environment-global-warming-not-a-top-priority>.

one social interest. Hence, large establishments will have to choose which social goals they prefer to promote, with their choice being motivated by profit.

Viewed in this light, our proposal may hold the key not only to the advancement of environmental goals, but also for other important values. Clearly, one should proceed with caution. Our mechanism will *not* work in all settings. For example, the education sector is populated by many non-profit organizations. Clearly, our mechanism is not suitable for non-profits. Furthermore, it is necessary to examine carefully the costs and benefits of involving large businesses in the furtherance of every social goal. Also, alternative methods should be weighed in every case. In the education context for example, taxation and public funding may yield better results than our mechanism. More generally, we do not argue that our mechanism will always work. Nor do we argue that it will always outperform the alternatives. We do claim, however, that our mechanism should be added to the list of options available to policymakers and should be implemented in appropriate circumstances.

CONCLUSION

In this Article, we introduced an innovative market-based mechanism intended to advance environmental goals. Our contribution can be seen as an answer to a call from environmental economics to supplement the use of a familiar environmental policy instrument with a targeted ecologically-oriented technology policy. Our mechanism employs option theory to give established businesses a financial stake in the success of green technologies.

Going against the conventional wisdom among corporate law scholars, our analysis demonstrated that markets may be harnessed to advance broader social goals. Furthermore, we showed that market-oriented mechanisms can be superior to government based incentive schemes. Markets have several obvious advantages over subsidization or conventional modes of regulation. Markets produce valuable information about the quality of products and services as well as about prices. Moreover, the market process aggregates social preferences better than regulators can ever do. Finally, the market process sidesteps the political economy problems that plague political decision making. Despite the obvious advantages of markets, they are rarely used to advance social goals. In our opinion, this is an anomaly.

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An important lesson from our analysis is that the profit motive of corporations can be put at the service of broader social goals. The challenge for policymakers is to adopt the right incentive scheme that best aligns the narrow self-interest of firms with the broader societal interest. In this Article, we explained how it can be done. All it takes is a change in the way we think about our institutions and the goals they are supposed to achieve.