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Sustainable Development and Market Liberalism's Shotgun Wedding: Emissions Trading Under the Kyoto Protocol

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SUSTAINABLE DEVELOPMENT AND MARKET LIBERALISM'S SHOTGUN WEDDING: EMISSIONS TRADING UNDER THE KYOTO PROTOCOL

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Abstract

This article analyzes the international emissions trading regime at the heart of the world's effort to address global warming as a means of exploring broader international governance issues. The trading regime seeks to marry two models of global governance, market liberalism, which embraces markets as the model of global governance, and sustainable development, which seeks to change development patterns to protect future generations.

This article explores a previously unacknowledged tension between market liberalism's goal of maximizing short term cost effectiveness and sustainable development's goal of catalyzing technological change for the benefit of future generations. This article presents new data and theory unsettling the traditional view that market mechanisms encourage innovations vital to sustainable development. Market actors fail to take positive spillovers, *e.g.* benefits accruing to competitors and thence to future generations, into account in making technological choices. Because of this failure to take long-term economic development into account, the international trading markets have contributed far less to sustainable energy development than more targeted programs.

Consideration of these spillovers yields fresh insights. Market liberalism's ideal of comprehensive evaluation of costs and benefits conflicts with its preference for free markets. Conversely, sustainable development advocates' tendency to rely on collective decision-making to make difficult technological choices may prove unrealistic. This article unsettles prevailing notions of governance and seeks to stimulate a richer more subtle discourse about the roles of government and markets in addressing global problems.

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I. INTRODUCTION

An entrepreneur in India wishes to implement a project reducing emissions of greenhouse gases, which trap heat and thereby contribute to global warming.[1] She plans to sell credits representing her project's emission reductions to owners of coal-fired power plants in Germany, who face emission reduction obligations under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol or Kyoto).[2] Under the Kyoto Protocol's emission trading programs, these plant owners can purchase credits reflecting the emission reductions generated by foreign environmental projects in lieu of making all of the required greenhouse gas reductions at their own facilities.[3] So, if our entrepreneur develops a suitable project, a European company may pay her for the credits her emission reduction project generates, enabling her to make a profit.

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[1] *See* ANDREW E. DESSLER & EDWARD A. PARSON, SCIENCE AND POLITICS OF GLOBAL CLIMATE CHANGE: A GUIDE TO THE DEBATE 8 (2006) (explaining that greenhouse gases warm the earth by absorbing infrared radiation that would otherwise escape into space).

[2] December 11, 1997, *Report to the Conference of the Parties on its Third Session,* 3rd Sess. Pt. 2, Annex I, U.N. Doc. FCCC/CP/1997/7/add.1, 37 I.L.M. 22 [hereinafter Kyoto Protocol]. *See generally* FARHANA YAMIN & JOANNA DEPLEDGE, THE INTERNATIONAL CLIMATE CHANGE REGIME: A GUIDE TO RULES, INSTITUTIONS, AND PROCEDURES (2004); MICHAEL GRUBB ET AL., THE KYOTO PROTOCOL: A GUIDE AND ASSESSMENT (1999).

[3] *See* Kyoto Protocol, *supra* note 2, art. 12; Kevin A. Baumert, Note, *Participation of Developing Countries in the International Climate Change Regime: Lessons for the Future*, 38 GEO. WASH. INT'L L. REV. 365, 383 (2006) (explaining that the Kyoto Protocol's "Clean Development Mechanism" allows "companies from industrialized countries to . . . receive emission reduction credits from projects based in developing countries."). *See generally* David M. Driesen, *Free Lunch or Cheap Fix?: The Emissions Trading Idea and the Climate Change Convention*, 26 B. C. ENVTL. AFF. L. REV. 1, 27-35 (1998) (analyzing the key language in the Kyoto Protocol authorizing trading). In all likelihood, the producer can only substitute credits for "some" of her reductions, because the Kyoto Protocol requires that trading function as a supplement to domestic reductions. *See* Kyoto Protocol, *supra* note 2, arts. 6(1)(d), 12(3)(b), 17. For any particular producer, the extent of permissible reliance on foreign credits will depend upon domestic trading rules implementing the Kyoto Protocol's "supplementarity" requirement.

Let us assume that she faces a choice between two emission reduction projects. One project involves using an end-of-the-pipe technology to control HFC 23, a potent greenhouse gas.[4] The other involves installing a new type solar energy technology, a form of renewable energy, thereby avoiding emissions of carbon dioxide, the most ubiquitous greenhouse gas.[5] In this situation, our entrepreneur would likely choose the option that produces the cheapest emission reductions.[6] Since HFC 23 control usually costs less than solar power installation, she would likely choose the end-of-the-pipe option.[7] Is this society's best choice?

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[4] *See* PricewaterhouseCoopers (P) Ltd., CDM Project Design Document: Project for GHG Emission Reduction by Thermal Oxidation of HFC 23 at HCFC 22 Plant of Gujarat Fluorochemicals Limited at 8 (2003), http://cdm.unfccc.int/Projects/registered.html [hereinafter HFC PDD] (describing installation and operation of a thermal oxidation system to control HFC 23 emissions).

[5] *See* Inho Choi, *Global Climate Change and the Use of Economic Approaches: The Ideal Design Features of Domestic Greenhouse Gas Emissions Trading and an Analysis of the European Union's CO_2 Emissions Trading Directive and the Climate Stewardship Act,* 45 NAT. RESOURCES J. 865, 936 (2005) (explaining that renewable energy reduces emissions by avoiding fossil fuel combustion); WORKING GROUP III TO THE SECOND ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995 - ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 241 (James P. Bruce et al. eds., 1996) (noting that renewable energy sources emit little carbon and that switching to them reduces emissions); Kirsten Engel, *The Dormant Commerce Clause Threat to Market-Based Environmental Regulation: The Case of Electricity Deregulation,* 26 ECOLOGY L. Q. 243, 270 n. 73 (1999). *See generally* Simone Espey, *Renewable Portfolio Standard: A Means for Trade With Electricity from Renewable Energy Sources,* 29 ENERGY POL'Y 557, 558 (2001) (explaining that renewable resources are "inexhaustible").

[6] These technological options involve choosing between reductions of two different greenhouse gases. The climate change regime employs scientific assessment of different greenhouse gases' relative contributions to global warming to create trading ratios, measuring the value of all relevant emission reductions in carbon dioxide equivalents. *See* Richard B. Stewart & Jonathan B. Wiener, *The Comprehensive Approach to Global Climate Policy: Issues of Design and Practicability,* 9 ARIZ. J. INT'L & COMP. L. 83, 86 (1992); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), WORKING GROUP I, IPCC THIRD ASSESSMENT REPORT: THE SCIENTIFIC BASIS, ch. 6, pt. 12, subpt. 2 (2001), *available at* http://www.grida.no/climate/ipcc_tar/wg1/248.htm. *See generally* James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law,* 53 STAN. L. REV. 607 (2000) (explaining that choosing a common currency for environmental benefits trades can prove problematic). For a potent greenhouse gas like HFC 23, a relatively small amount of reduction can generate a "carbon benefit" (i.e. reduced warming) equal to a relatively large carbon dioxide reduction. For purposes of understanding the text's hypothetical problem, the reader should assume that both technological options deliver the same amount of carbon dioxide equivalents. Also, this Article uses the term "carbon" in isolation to refer to carbon dioxide equivalents.

[7] *See* Karan Capoor & Philippe Ambrosi, State of the Carbon Market 2006 i (2006), http://carbonfinance.org/docs/StateoftheCarbonMarket2006 (characterizing HFC projects as the "lowest-cost options" and therefore becoming the "first asset class to be systematically tapped globally."); Xingshu Zhao & Axel Michaelowa, *CDM Potential for Rural Transition in China Case Study: Options in Yinzhou*

Two overarching concepts tend to shape observers' answers to this question. One concept, that of market liberalism, tends to favor free global markets and the use of economic principles developed to describe ideal markets.[8] Another concept, that of sustainable development, emphasizes adequately meeting the current generation's basic needs while protecting future generations.[9]

If we view emissions trading as a mechanism that happily marries sustainable development and market liberalism we would assume that society should prefer HFC 23 control, the least cost option. This happy marriage view suggests that selection of a cost effective solution is always a good outcome that provides for sustainable development and allows the free market to work its magic.[10]

If we reject the happy marriage view, however, the choice of the HFC control option appears problematic. We may believe that free markets tend to favor the current generation's interests over those of future generations, and that emissions trading markets conform to this tendency. This HFC 23 comes from production of HCFC 22, an ozone-depleting substance used in refrigeration.[11] The international community, including India, has agreed to phase out HCFC 22 under the Montreal Protocol on Substances that Deplete the Ozone Layer.[12] This HFC project promises a perfectly good greenhouse gas

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District, Zhejiang Province, 34 ENERGY POL'Y 1867, 1876 (2006) (finding the initial cost of solar installation high, even though over the long term it is cost competitive).

[8] *See* Douglas A. Kysar, *Sustainable Development and Private Global Governance*, 83 TEX. L. REV. 2109, 2116 (2005).

[9] *See* WORLD COMMISSION ON ENVIRONMENT & DEVELOPMENT (WCED), OUR COMMON FUTURE 8 (1987) (defining sustainable development as development meeting the current generation's needs without compromising future generations' ability to meet their own needs).

[10] *See* Baumert *supra* note 3, at 384 (explaining that the CDM encourages private sector project development to seek out the least cost reductions); *cf.* David M. Driesen, *Markets are Not Magic*, 20 ENVTL FORUM 19 (Nov. - Dec. 2003) (discussing the "tendency to view the free market as a magical solution environmental problems").

[11] *See* HFC PDD, *supra* note 4, at 8.

[12] Sept. 16, 1987, S. TREATY DOC. NO. 100-10 (1987), 1522 UNTS 3; *see* Menoj Mehrota, Possible Alternative Approaches to Assessing the Baseline Scenario for Destruction of HFC 23 in

emission reduction, which would help ameliorate future climate change. But it provides a technological benefit that will only help the current generation, not future generations.[13] This facility should shut down anyway at some point and HFC 23 control would lose all value to society.[14]

The solar technology also reduces greenhouse gas emissions, but this reduction could continue indefinitely[15] (unlike the reduction in HFC 23, which only provides a real additional benefit during the HCFC 22 plant's short remaining life). Moreover, deployment of an experimental solar option might contribute to solving the most important long-term technological problem at the heart of climate change, how to run advanced industrial economies without ever increasing fossil fuel use.[16] For burning fossil fuels creates carbon dioxide, the most important greenhouse gas contributing to global warming.[17] Also, fossil fuel is a non-renewable resource, meaning that it will

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the HCFC 22 Industry at 2, http://cdm.unfccc.int/methodologies/inputam0001/ Comment_AM0001_ SRF_071004.pdf (noting that India has ratified the Montreal Protocol with its London and Beijing Amendments and has passed implementing regulations addressing HCFC 22); *see also* Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, Country Program Update, India at 3, UNEP/OzL.Pro/ExCom/49/37 (2006), http://www.multilateralfund.org/files/49/4937.pdf (stating that HCFC 22 production has gone up in India even while India has phased out other ozone depleters).

13 *See* Gerard Winn, *U.N. Kyoto Chief Judges Climate Change Options*, Reuters, May 30, 2006, http://www.alertnet.org/thenews/newsdesk/L30295511.htm (criticizing the HFC 23 reduction project and stating that "the environmental benefits must be clear for future generations.")

14 *Cf.* Othmar Schwank, Concerns About CDM Projects Based on Decomposition of HFC-23 Emissions from HFC-23 Emissions from 22 HCFC Production Sites at 4 (2004), http://cdm.unfccc.int/ methodologies/inputam0001/Comment_AM0001_Schwank_081004.pdf (expressing a concern that approval of CDM credits for emissions associated with HCFC 22 production may create an incentive to delay phasing out this ozone depleting chemical). If one assumes that the carbon credits will create sufficient incentives to keep the HCFC 22 plant open, then the decision to use this option creates a continuing carbon benefit, but creates an ozone depletion cost. Either way, the net societal value of the project may be less than a project that does not involve an ozone depleting production process.

15 *See* Winn, *supra* note 13 (recognizing renewable energy as creating "a stable structure" for not emitting CO_2).

16 *See* RICHARD A. POSNER, CATASTROPHE: RISK AND RESPONSE 15 (2004) (explaining that breakthroughs in solar technology could help enable a substitution of solar energy for fossil fuels at reasonable cost).

17 *See* ID. (describing global warming as largely a product of fossil fuel combustion); Richard B. Stewart, *Economic Incentives for Environmental Protection: Opportunities and Obstacles, in* ENVIRONMENTAL LAW, THE ECONOMY, AND SUSTAINABLE DEVELOPMENT 228 (RICHARD L. REVESZ ET AL.

eventually run out.[18] If this solar experiment leads to technological developments significantly reducing our reliance on fossil fuels, it may help improve the welfare of the future generations that will need alternatives to finite fossil fuel resources. Thus, the cost effective choice that the market favors may not coincide with the choice that sustainable development considerations favor.

This Article examines the question of whether emissions trading marries market liberalism and sustainable development. Douglas A. Kysar has correctly identified this question of market liberalism's compatibility with sustainable development as a key question for global environmental governance.[19] Indeed, responses to this question color perceptions of most environmental and economic issues.[20] Therefore, it is not surprising that the relationship between free market and sustainable development ideals has commanded scholars' attention.[21]

Emissions trading helps shape perceptions of this relationship. Very few neoliberals (market liberalism advocates) condemn government regulation altogether.[22] Instead, most neoliberals support regulatory reforms that employ market concepts to

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EDS. 2000) [hereinafter ENVIRONMENTAL LAW] (characterizing carbon dioxide as "the most important" greenhouse gas).

[18] *Cf.* POSNER, *supra* note 16, at 59 (recognizing that fossil fuel resources are finite, but arguing that they may not be finite relative to human demand because prices will rise when they become scarce).

[19] *See* Kysar, *supra* note 8, at 2114-18 (discussing the rise of market liberalism and international interest in sustainable development).

[20] *See generally* Barbara Ann White, *Economic Efficiency and the Parameters of Fairness: A Marriage of Marketplace Morals and the Ethic of Care*, 15 CORNELL J. L. & PUB. POL'Y 1, 2 (2005) (discussing "the great divide" between scholars "using theories of welfare maximization derived from the study of market[s]" and those more concerned about equity).

[21] *See, e.g.*, Kysar, *supra* note 8, at 2118-2147 (describing tensions between market liberalism and sustainable development); WILLFRED BECKERMAN, A POVERTY OF REASON: SUSTAINABLE DEVELOPMENT AND ECONOMIC GROWTH xii (2003) (an economist arguing that the sustainable development ideal is not ethically superior to the "economist's goal of maximizing the sum of human welfare over future generations"); GEOFFREY HEAL, VALUING THE FUTURE: ECONOMIC THEORY AND SUSTAINABILITY (1998); HERMAN E. DALY, BEYOND GROWTH: THE ECONOMICS OF SUSTAINABILITY (1996).

[22] *See* Kysar, *supra* note 8, at 2120 (noting that neoclassical economics does support some regulation).

shape environmental regulations.[23] These reforms include wider use of cost-benefit analysis (CBA) to determine environmental regulation's goals and of emissions trading to meet these goals.[24] The international embrace of emissions trading under the Kyoto Protocol suggests that emissions trading may qualify as the most widely accepted neoliberal environmental reform.[25] Hence, if a marriage exists anywhere, it should exist in the realm of emissions trading under the Kyoto Protocol.

This article claims that markets neglect positive "spillovers" associated with technological choices, *i.e.* benefits that do not lead to increased rents for the firm making the choice, which are crucial to sustainable development. If introduction of a new solar technology inspires technological advances by competitors, for example, this creates a positive spillover. This article aim to show that positive spillovers are vital to addressing global climate change and shine new light on our understanding of market liberalism, sustainable development, and environmental law.

Part one of this Article provides needed background, introducing the concepts of market liberalism and sustainable development, explaining emissions trading, and providing a primer on the climate change regime. It emphasizes emissions trading's role in seeking to cement a union between sustainable development and market liberalism ideals. The second part presents data on technological choices under the Kyoto Protocol, like the choices our entrepreneur faces. The data raise questions about whether global

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23 *See* Thomas O. McGarity, *The Expanded Debate over the Future of the Regulatory State*, 63 U. CHI. L. REV. 1463, 1492 (1996) (describing "economic efficiency" as the "guiding light" for "free marketers").

24 *See* id. at 1491-97 (explaining that "free marketeers" favor CBA and market-based mechanisms); *see, e.g.,* Robert W. Hahn & Robert E. Litan, 8 J. INT'L ECON. L. 473 (2005) (arguments by the American Enterprise Institute's co-founders for CBA).

25 The term neoliberal describes a world view embracing broad reliance on global markets and supporting economic concepts, i.e. the view embracing market liberalism. *See* Kysar, *supra* note 8, at 2116.

emissions trading spurs technological innovation that aids sustainable development. The third part uses the concept of positive spillovers to explore this data's implications for environmental law and for the relationship between sustainable development and market liberalism.

II. EMISSIONS TRADING UNDER THE KYOTO PROTOCOL: A PRIMER

A. Market Liberalism and Sustainable Development

Market liberalism embraces free markets and a set of economic concepts that provides ideological support for neoliberal reforms.[26] The economic concepts generally stem from efforts to describe, not justify, markets. But many of those employing these concepts, especially in the law and economics movement, use them to justify market-based solutions to problems.[27] In general, economists tend to evaluate all policies and decisions in terms of efficiency, and leading law and economics scholars, most prominently, Richard Posner, have argued that efficiency constitutes an important goal for government policy.[28]

While true devotees of free markets may prefer no regulation at all, most of those employing economic concepts to justify markets recognize the need for some regulation.[29] Economists generally presume that markets are efficient only when they generate no "externalities," costs or benefits not reflected in prices.[30] They characterize the harms pollution causes as "negative externalities," *e.g.* as costs not reflected in market

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[26] *See* id. at 2116 (identifying market liberalism with a "neoliberal political philosophy" and "cultural exaltation of the market").

[27] *See, e.g.*, POSNER, *supra* note 16, at 201 (claiming that economics is both normative and positive).

[28] *See* RICHARD A. POSNER, THE ECONOMICS OF JUSTICE (1983); *see also* Louis Kaplow v. Steven M. Shavell, *Fairness v. Welfare*, 114 HARV. L. REV. 961 (2001).

[29] *See* McGarity, *supra* note 23, at 1484-1513 (contrasting "radical anti-interventionists" opposing nearly all government regulation with other neoliberal groups that support reformed regulation).

[30] *See* David M. Driesen, *The Societal Cost of Environmental Regulation: Beyond Administrative Cost-Benefit Analysis*, 24 ECOLOGY L. Q. 545, 552-53(1997).

prices.[31] They state that regulation and pollution taxes "internalize" costs associated with environmental harms, by raising the market price of goods and services to reflect their true environmental costs.[32] Thus, economists regard regulation and pollution taxes raising electricity prices, for example, to reflect their true environmental costs (i.e. a cost associated with the harms they create) as efficient.[33]

This focus on efficiency tends to produce recommendations for two sets of regulatory reforms. First, economists and their supporters tend to favor CBA's use in establishing environmental regulation's goals.[34] Such an approach requires policy-makers to attempt to quantify environmental policies' costs and benefits before implementation.[35] The costs of environmental policies come from expenditures to make technological improvements, like those our entrepreneur contemplated.[36] The benefits include prevention of human deaths and illness and preservation of ecosystems.[37] Economists define efficient regulations as those equating costs and benefits at the margin.[38] CBA proponents tend to favor quite comprehensive consideration of costs and benefits in defining policy goals, including consideration of future costs and benefits.[39]

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[31] Id. at 553 (discussing economists' characterization of harms from pollution as a cost external to the market).

[32] Id. (explaining that economists support regulating and or taxing pollution to internalize pollution's cost).

[33] Id. at 577-78 (explaining the concept of an optimal, i.e. efficient, level of pollution as that where the marginal benefits of control equal the marginal costs).

[34] *See* DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW 1 (2003) (describing the "economics-based regulatory reform agenda" as including increased use of CBA).

[35] *See* Driesen, *supra* note 30, at 558 (explaining that CBA requires the comparison of pollution control costs with "costs" consisting of environmental and health effects).

[36] *See* David M. Driesen, *Getting Our Priorities Straight: One Strand of the Regulatory Reform Debate*, 31 ENVT'L L. REP. (Envt'l L. Inst.) 10003, 10019 n. 204 (2001)

[37] *See* Driesen, *supra* note 30, at 558-59 (noting the difficulty of quantifying these benefits).

[38] Id. at 582-83; *see* WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 23 (1975).

[39] *See* THOMAS O. MCGARITY, REINVENTING RATIONALITY: THE ROLE OF REGULATORY ANALYSIS IN THE FEDERAL BUREAUCRACY 5 (1996) (characterizing CBA as supporting "comprehensive analytical rationality").

Whether or not policymakers employ CBA in setting environmental goals, moderate neoliberals tend to favor using "market-based mechanisms," principally emissions trading and environmental taxation, to achieve these goals.[40] These mechanisms encourage efficiency in a different sense, the selection of least cost technological options for achieving any given environmental goal.[41] This framework implies that private actors, like our Indian entrepreneur, will make their own choices about how to achieve a defined government goal, such as a target for carbon dioxide reduction, free of government influence. Thus, market liberalism tends to leave technological choice to quite narrow private decision-making focusing on cost effective achievement of a government specified environmental goal.

Market liberalism also embraces free trade, the original efficiency enhancing reform.[42] This free trade emphasis tends to lead market liberals to favor not just emissions trading, but free global trading markets, where credits may be traded across industries and between countries. Global trading markets enhance opportunities for cheap emission reductions; thereby lowering environmental protection's cost.[43]

Sustainable development, by contrast, generally focuses on adequately meeting the current generation's basic needs without impairing future generations' ability to meet

[40] *See* DRIESEN, *supra* note 34, at 1 (discussing use of "economic incentive" measures to meet environmental goals as part of the "economics-based regulatory reform agenda").

[41] *See* Driesen, *supra* note 30, at 564-65 (explaining the difference between allocatively efficient goal selection and selection of cost effective means of meeting chosen goals).

[42] *See* David M. Driesen, *What is Free Trade: The Real Issue Lurking Behind the Trade and Environment Debate,* 41 VA. J. INT'L L. 279, 287-291 (2001) (describing free trade's classical origins and explaining that modern economists "employ an allocative efficiency test" in thinking about free trade).

[43] *See* Jonathan Baert Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context,* 108 YALE L. J. 677, 748 (1999) (explaining that widening participation in emissions trading to include developing countries reduces abatement costs).

their own needs.[44] It reflects some skepticism of the idea that free market actors choose developmental paths that adequately address either poverty or future generations' needs. The concept originated in efforts to bridge differences between developing and developed countries on international law and numerous international agreements embrace sustainable development as a goal.[45] Definitions of the concept vary and many scholars lament its lack of precision.[46] Scholars studying sustainable development refer to the consideration of future generations' needs under the rubric of intergenerational equity.[47]

Sustainable development involves an emphasis on integrated planning and public participation.[48] This emphasis arises from a distinctive view of the relationship between economic development and environmental protection. The report often credited with creating the sustainable development concept, the Brundtland Report, claims that environmental degradation often impedes economic development and, conversely, that

[44] WCED, *supra* note 9, at 8. I have not attempted to provide a comprehensive account of sustainable development's elements here, but instead focus on the components most relevant to this Article's thesis. *Cf.* John Martin Gillroy, *Adjudication Norms, Dispute Settlement Regimes and International Tribunals: The Status of "Environmental Sustainability" in International Jurisprudence*, 42 STAN. J. INT'L L. 1, 12 (2006) (identifying eight sustainable development "sub-principles").

[45] MARIE-CLAIRE CORDONIER SEGGER & ASHFAQ KHALFAN, SUSTAINABLE DEVELOPMENT LAW: PRINCIPLES, PRACTICES, AND PROSPECTS 15 (2004) (discussing sustainable development's origins as a "compromise" term); PHILIPPE SANDS, GENERAL PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 252 (2003) (stating that the term sustainable development now appears regularly in international environmental instruments).

[46] *See, e.g.*, BECKERMAN, *supra* note 21, at xi ; SEGGER & KHALFAN, *supra* note 45, at 4 (explaining that the vagueness of the sustainable development concept helped it gain universal acceptance, but creates "difficulties").

[47] *See, e.g.*, Kysar, *supra* note 8, at 2118.

[48] *See* John C. Dernbach, *Sustainable Development: Now More than Ever*, *in* STUMBLING TOWARD SUSTAINABILITY 51-53, 56 (John C. Dernbach ed. 2002) [hereinafter STUMBLING]; SEGGER & KHALFAN, *supra* note 45, at 3 (explaining that sustainable development seeks to encourage integrated solutions to our most important problems by requiring "accommodation of between economic development, social justice, and environmental protection through a process requiring public participation); SANDS, *supra* note 45, at 263 (discussing integration of environment and development as an "element" of sustainable development); United Nations Conference on Environment and Development, June 3-14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/6/Rev. 1, princ. 4 (June 16, 1992), 31 I.L.M. 874 (stating that achievement of sustainable development requires the integration of environmental and developmental concerns).

poverty frequently causes environmental degradation.[49] This view suggests that proper economic development choices will simultaneously protect the environment and aid poverty elimination and leads to support for governance reforms integrating economic development and environmental decision-making.[50] This view of environmental policy and economic development as complimentary contrasts with market liberalism's perspective, which tends to view environmental protection as in conflict with economic development, leading to a desire to carefully consider tradeoffs between them and reduce environmental protection's cost. Sustainable development implies a significant role for collective decision-making, presumably including government.[51]

B. Understanding Emissions Trading

Environmental law has traditionally relied heavily upon uniform performance standards as a means of meeting environmental goals.[52] Such standards generally require all parts of an industry to achieve a numerically specified emission reduction target.[53]

Economists have criticized this uniform standards approach as inconsistent with the free market ideal of economic efficiency.[54] Facilities have widely varying control

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49 WCED, *supra* note 9, at 3.

50 ID. at 8-11 (affirming that it is possible to make development sustainable and then explaining how this requires broadening the mandates of economic development and environmental ministries to allow for integrated consideration of the environment and economic development).

51 *See* Kysar, *supra* note 8, at 2147 (discussing sustainable development proponents' argument for collective decision-making).

52 *See* Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333, 1335 (1985) (explaining that environmental law relies heavily upon uniform standards for industrial categories); *cf.* David M. Driesen, *Is Emissions Trading an Economic Incentive Program?: Beyond the Command and Control/Economic Incentive Dichotomy*, 55 WASH. & LEE L. REV. 289, 308 n. 93 (1998) (arguing that commentators have exaggerated the extent of the uniform standard approach's use); Driesen, *supra* note 3, at 36-37 (noting that the Kyoto Protocol does not impose uniform standards upon countries, but explaining why emissions trading increases cost effectiveness anyway); *see, e.g.*, 33 U.S.C. § 1312 (2000); 42 U.S.C. §§ 7411(a), 7412(d), 7521 (2000).

53 *See* Jason Johnston, *Tradable Pollution Permits and the Regulatory Game*, *in* MOVING TO MARKETS IN ENVIRONMENTAL PROTECTION: LESSONS FROM 20 YEARS OF EXPERIENCE 358 (Jody Freeman and Charles Kolstad eds., 2007) [hereinafter MOVING TO MARKETS] (federal environmental regulations require uniform emission reductions for facilities of the same approximate age in an industry category).

costs. Accordingly, facilities can achieve any aggregate target more cheaply than a uniform standard allows, if facilities with relatively cheap control costs make more of the aggregate reductions than facilities with high control costs.[55] Emissions trading ingeniously corrects traditional government regulation's failure to generate the cost-effective outcomes hypothesized for an ideal free market.[56] The regulator can set the same limits as would undergird a traditional regulation, but allow facility owners to buy emission reduction credits from over-complying facilities in lieu of local reductions. This opportunity will encourage facility owners with cheap pollution control options to provide extra emission reductions, because they can sell credits representing the excess reductions to facility owners facing relatively expensive control options.[57] Conversely, owners of facilities generating high control costs will avoid making reductions at their own facilities, and purchase credits from operators of facilities with low cost reduction options instead.[58] Thus, emissions trading encourages a cost effective shift of reductions from high to low cost facilities.[59]

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[54] *See* id. at __ ("command and control" regulation has been "widely decried as inefficient").

[55] Unfortunately, regulators rarely have sufficient marginal cost information to tailor regulation to each facility's marginal control cost. *Cf.* EMISSIONS TRADING FOR CLIMATE POLICY: U.S. AND EUROPEAN PERSPECTIVES at 3 (Bernd Hansjürgens, ed. 2005) [hereinafter EMISSIONS TRADING] (explaining that regulators could tailor standards to each firm's marginal abatement cost).

[56] I use the term "traditional regulation" to refer to performance standards, which require a particular pollution source to meet a quantitative limit for pollution outputs, and work practice standards, which dictate use of a particular technology or practice. Some writers use the term "command and control" regulation in the same way. *See* Driesen, *supra* note 52, at 297, n.44. I eschew use of this term, because it is misleadingly suggests that performance standards dictate technological choices or that work practice standards dominate environmental law. Id. at 296-302.

[57] *See* Geoffrey Bertram, *Tradable Emissions Permits and Control of Greenhouse Gases*, 28 J. DEV. STUD. 423, 425 (1992).

[58] Id.

[59] Stewart, *supra* note 17, at 190 (describing trading as "automatically transferring" resources from high cost to low cost sources); *see* Driesen, *supra* note 3, at 36 (illustrating trading's encouragement of cost effective reduction shifts with a numerical example).

The United States enjoyed its first major success with this "market-based approach" in the acid rain program enacted as part of the 1990 Clean Air Act Amendments.[60] Congress assigned emission limits to each electric utility unit generating sulfur dioxide, a major contributor to acid rain.[61] But Congress allowed electric utility operators to purchase extra emission reductions realized at other capped generating units in lieu of local compliance.[62] The program produced significant aggregate sulfur dioxide reductions at much lower cost than regulators had anticipated, precisely what the market liberalism model predicts.[63] Since then, environmental benefit trading has taken off, becoming the most ubiquitous approach to meeting environmental standards in the United States.[64]

C. Emissions Trading in the Climate Change Regime

Meanwhile, scientific evidence mounted that greenhouse gases, especially carbon dioxide, a byproduct of fossil fuel combustion, had warmed the earth's average mean surface temperature and would likely increase warming in the future.[65] Recent scientific

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[60] 42 U.S.C. §§ 7651-7651o (2000). *See* Jacob Kreutzer, *Cap and Trade: A Behavioral Analysis of the Sulfur Dioxide Emissions Market*, 62 NYU ANN. SURV. AM. L. 125, 129 (2006) (calling the acid rain program "a success by any measure"); Byron Swift, *Command Without Control: Why Cap-and-Trade Should Replace Rate Standards for Regional Pollutants*, 31 ENVTL. L. REP. (Envtl. L. Inst.) 10330, 10331-32 (2001) (explaining that the acid rain program produced early reductions and cheaper than expected costs); Driesen, *supra* note 52, at 314-17 & n. 131 (reviewing the history of trading prior to 1990).

[61] *See* 42 U.S.C. §§ 7651c(e); 7651d (2000).

[62] 42 U.S.C. § 7651b(b) (2000).

[63] *See* Choi, *supra* note 5, at 890 (conceding, in the context of a fairly critical appraisal, that the acid rain program has achieved its goals); Swift, *supra* note 61, at 10331-32 (discussing the reductions and cost savings).

[64] *See* Choi, *supra* note 5, at 892-94 (claiming that trading has been used frequently in the U.S. and providing examples). While other emissions trading programs have failed because of monitoring and tracking difficulties, this Article will assume, perhaps unwisely, that the Kyoto trading programs will produce real emission reductions as planned. *See* id. at 932-933 (explaining that the European Emissions Trading scheme does not require continuous emissions monitors in all cases). This assumption, whether realistic or not, makes it easier to address the Article's chief theoretical concern, the relationship between market liberalism and sustainable development.

[65] *See* Zachary Tyler, *Massachusetts v. EPA: The D.C. Circuit's Failure to Extend the Clean Air Act to Greenhouse Gas Emissions,* 36 ENVTL. L. REP. (Envtl. L. Inst.) 10456, 10457 (2006) (explaining the link between fossil fuel combustion and carbon dioxide); DESSLER & PARSON, *supra* note 1,

papers show that global warming has already begun melting glaciers,[66] raising sea levels,[67] and intensifying hurricanes[68]. But the scientific literature raises even more concerns about what future generations might face, if the current generation does not safeguard their welfare. The literature predicts that rising sea levels will inundate coastal areas and small island states.[69] It predicts more violent future weather events, droughts in areas where many people already suffer from malnutrition, and the proliferation of tropical diseases in areas where they have hitherto afflicted nobody.[70] Global warming may also lead to rapid ecological changes accelerating many species' extinction.[71]

The international community responded to the mounting scientific evidence that human activities seriously disrupt the global climate by enacting the United Nations

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at 8-10 (explaining that carbon dioxide and water vapor are the principal greenhouse gases and that by the 1980s evidence had mounted that temperatures were warming).

[66] GERMAN ADVISORY COUNCIL ON GLOBAL CLIMATE CHANGE (WGBU), THE FUTURE OCEANS – WARMING UP, RISING HIGH, TURNING SOURCE: SUMMARY FOR POLICY-MAKERS 2 (2006) (citing "indications that the continental ice sheets on Greenland and in the Antarctic are beginning to disintegrate.").

[67] ID. at 1 (that that "the sea level is rising ever faster"); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) WORKING GROUP I, *supra* note 6, at 4 (finding that sea levels have risen by four to eight inches over the last 100 years).

[68] Kerri Emanuel, *Increasing Destructiveness of Tropical Cyclones over the Past 30 Years,* 436 NATURE 686 (2005) (showing a correlation between the increased destructiveness of tropical cyclones and average mean surface temperature); WGBU, *supra* note 43, at 2 (stating that both "observed data" and mathematical models show that global warming boosts hurricanes' "destructive energy."). *See generally* DESSLER & PARSON, supra note 1, at 83 (explaining that because the strength of tropical cyclones depends on sea surface temperatures, "there is a good basis" to expect more intense hurricanes and typhoons).

[69] IPCC WORKING GROUP II, CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY, at sec. 19.3.4.1 (2001) (discussing the vulnerability of Antigua, the Cook Islands, the Federated States of Micronesia, Kiribati, the Maldives, the Marshall Islands, Nevis, Tonga, and Tuvalu); WGBU, *supra* note 43, at 2 ("Sea-level rise will lead to inundation of coasts and small island states. . .").

[70] ID. at 5-6, 12, 489.

[71] ELIZABETH KOLBERT, FIELD NOTES FROM A CATASTROPHE 84-85 (2006) (reporting biologists' preliminary estimate of species extinction as between 15% and 37%); Note, *Ratification of Kyoto Aside: How International Law and Market Uncertainty Obviate the Current U.S. Approach to Climate Change Emissions*, 47 WM. & MARY L. REV. 2089, 2093 (2006) [hereinafter *Ratification Aside*] (discussing studies predicting "devastating consequences" for polar bears and certain seals); IPCC WORKING GROUP II, *supra* note 46, at 19.2.2.2.

Framework Convention on Climate Change (Framework Convention) in 1992.[72] The Framework Convention reflects both international support for the sustainable development ideal and market liberalism's ascendancy.

The Framework Convention proclaims that "the Parties . . . should . . . promote sustainable development"[73] and "protect the climate system for the benefit of future generations. . ."[74] This proclamation is consistent with the intergenerational concerns at the heart of sustainable development.[75] The Framework Convention's general goal more concretely expresses sustainable development's possible meaning in this context by declaring an "ultimate objective" of stabilizing "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. . ."[76]

The Framework Convention simultaneously embraces market liberalism by stating that "policies and measures should be cost-effective so as to ensure global benefits at the lowest possible cost."[77] Employing the language of neoliberal CBA proponents this clause refers to measures reducing greenhouse gas emissions not as avoiding harm, but as ensuring "benefits."[78] At the same time, this language suggests the need for emissions trading by establishing cost-effectiveness as a major objective of the climate

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72 May 29, 1992, U.N. Doc. A/AC.237/18 (1992), 31 I.L.M. 849 [hereinafter FCCC]. *See generally* Daniel Bodansky, *The United Nations Framework Convention on Climate Change: A Commentary*, 18 YALE J. INT'L L. 451 (1993).

73 FCCC, *supra* note 72, art. 3(4).

74 Id., art. 3(1).

75 *See generally* EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERNATIONAL EQUITY (1989).

76 FCCC, *supra* note 72, art. 2.

77 Id.

78 *Cf.* Driesen, *supra* note 30, at 560-61 & n. 67 (pointing out that cost-benefit proponents' use the word "benefits" to describe averted harms).

change regime.[79] This language did not enter the agreement by accident. The United States, a leading bastion of market liberalism, resisted mandatory emission reduction targets, partially because it considered their achievement too costly.[80] United States negotiators also argued that liberal international emissions trading should become part of the agreement.[81] This position created a tension between the United States and countries more interested in binding limits and skeptical of emissions trading.[82] This tension led to a clause establishing an "aim of returning *individually or jointly* to . . . 1990" developed country greenhouse gas emission levels.[83] This language established an emission reduction goal in lieu of an emission reduction requirement.[84] And the reference to joint achievement of the stabilization "aim" suggests using international emissions trading to achieve this goal.[85]

The United States continued its emissions trading advocacy and its opposition to binding emission reduction targets during the meetings that produced the Kyoto

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79 *See* SANDS, *supra* note 45, at 365-66 (linking the joint implementation provision to the Framework Convention's language on cost effectiveness); Driesen, *supra* note 3, at 15-18 (explaining that the language surrounding the cost effectiveness principle seems to qualify it, but that "cost effectiveness concerns have tended to dominate debates about implementation of the Climate Change Convention.").

80 SANDS, *supra* note 45, at 360 (stating that the United States publicly opposed specific targets and timetables for greenhouse gas emission reductions); James A. Beard, *An Application of the Principles of Sustainability to the Problem of Global Climate Change: An Argument for Integrated Energy Services*, 11 J. ENVTL. L. & LIT. 191, 203 (1996) (discussing the U.S. effort to defeat a proposal for a 20% emissions cut).

81 *See Ratification Aside*, *supra* note 71, at 2101 (attributing the inclusion of some trading provisions to "U.S. pressure").

82 *See* SANDS, *supra* note 45, at 365 (pointing out that the European Union and other countries supported a clear commitment to stabilizing greenhouse gas emissions at 1990 levels).

83 FCCC, *supra* note 72, art. 4(2)(b); *see* PRUE TAYLOR, AN ECOLOGICAL APPROACH TO INTERNATIONAL LAW 332 (1998) (describing this compromise as a "watering down of obligations" achieved through a U.S. threat to boycott the talks).

84 *See* Bodansky, *supra* note 72, at 515-17 (describing this clause as establishing a "quasi-target").

85 *See* Driesen, *supra* note 3, at 28 (explaining that the "joint implementation" language suggests authorization of trading, but could also be interpreted as contemplating one country helping another achieve reductions without credit sales).

Protocol.[86] This placed the United States in tension with the EU, which supported strict targets and less use of trading.[87] Then Vice-President Al Gore helped break an impasse that threatened to scuttle a Kyoto agreement, by signaling the United States' willingness to accept modest binding emission reduction targets in exchange for a liberal international emissions trading regime.[88] The resulting Kyoto Protocol generally obligates advanced industrialized countries to deliver emission reductions representing a 5% cut below their joint 1990 emission levels, but allowed them to substitute carbon credits generated abroad for some of these cuts. [89]

The Kyoto Protocol provides for no less than three international emission trading programs, usually referred to as the Kyoto "flexibility mechanisms," as a means of achieving the reduction targets for individual countries.[90] Article 17 authorizes trades of national allowances among the developed countries that assumed reduction obligations

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86 *See* DESSLER & PARSON, *supra* note 1, at 14 (discussing the Clinton Administration's initial reluctance to accept mandatory emission reductions).

87 *See* ID. at 15 (describing the tension between the U.S. and EU on the liberality of trading); Axel Michaelowa & Sonja Butzengeiger, *EU Emissions Trading: Navigating Between Scylla and Charybdis*, 5 CLIMATE POL'Y 1, 2 (2005) (noting that the EU opposed international trading in the "run-up" to the Kyoto conference).

88 *See* Joby Warrick, *Gore Urges Resolution at Climate Talks; With Summit in Disarray, Vice-President Prods U.S. Negotiators to Bridge Gaps*, WASH. POST, Dec. 8, 1998, at A1 (describing the U.S. compromise accepting a 7% reduction target); James H. Searles, *Analysis of the Kyoto Protocol to the U.N. Framework Convention on Climate Change*, 21 INT'L ENV'T REP. (BNA) 131, 133 (Feb. 4, 1998) (U.S. demanded emissions trading in exchange for legally binding emissions reductions).

89 *See* Kyoto Protocol, *supra* note 2, art. 3(1) (requiring industrialized countries to reduce their emissions by the amounts assigned in annex B "with a view to reducing their overall emissions by at least 5 per cent below 1990 levels."); Kyoto Parties End Meetings With Consensus for Avoiding Gap in Post-2012 Reductions, 37 ENVTL. REP. (BNA) 1154 (2006) (explaining that "The Kyoto Protocol . . . requires 36 industrialized countries . . . to collectively reduce carbon dioxide emissions about 5 percent below 1990 levels. . .").

90 *See* LEGAL ASPECTS OF IMPLEMENTING THE KYOTO PROTOCOL MECHANISMS 175 (David Freestone & Charlotte Streck eds. 2005) [hereinafter, KYOTO MECHANISMS] (introducing Joint Implementation, Emissions Trading, and the Clean Development Mechanism as the three "market-oriented mechanisms" provided for in the Kyoto Protocol); SANDS, *supra* note 45, at 372 (listing the flexibility mechanisms as "emissions trading, joint implementation, and the Clean Development Mechanism"); *cf.* Stewart, *supra* note 17, at 238 (interpreting the Kyoto Protocol as providing four different economic incentive systems).

under the Kyoto Protocol.[91] Article 6, the joint implementation provision, authorizes project-based trades among developed countries or among private parties within developed countries.[92] Article 12 establishes a Clean Development Mechanism (CDM) that authorizes developed countries, or private companies within developed countries, to purchase credits from projects in developing countries, even though developing countries have assumed no emission reduction obligations under the Kyoto Protocol.[93] The CDM's "purpose is to assist" developing countries in "achieving sustainable development."[94]

In order to meet CDM's sustainable development goals, the parties to the Kyoto Protocol established a process for public participation and collective decision-making in choosing CDM projects.[95] This process requires "designated operational authorities" (often a private consulting firm paid for by project developers) to provide for public comment on proposed projects, estimate emission reductions, and validate the subsequent emissions. [96] A designated national authority within the country hosting the project reviews the project for compatibility with sustainable development goals.[97] An international executive board reviews credit estimation techniques and exercises oversight.[98]

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91 Kyoto Protocol, *supra* note 2, art. 17.

92 Id. art. 6.

93 Id. art. 12.

94 Id. art. 12(2). The CDM also aims to contribute to achieving the Framework Convention's objective of avoiding dangerous climate change and assisting developed countries in complying with their emission reduction obligations. Id.

95 *See* KYOTO MECHANISMS, *supra* note 90, at 71-104.

96 *See* ID. at 198-202 (describing the role of designated operational authorities).

97 *See* ID. at 213-219 (explaining that the role of the designated national authority includes review for sustainability).

98 ID. at 202 (stating that the executive board reviews projects for environmental integrity).

D. Implementation

President George W. Bush renounced the Kyoto Protocol shortly after coming into office, thereby depriving the climate change regime of support from the world's largest greenhouse gas emitter.[99] In spite of this setback, the Kyoto Protocol entered into force in 2005, and most of world's developed countries have begun to implement it.[100]

Thanks to the United States federal government's absence,[101] the EU and its member states have become the most important actors in shaping Kyoto implementation[102]. The EU has used a variety of approaches to meeting its Kyoto targets.

1. The European Union's Emissions Trading Scheme

As we saw, the EU reluctantly accepted a global trading regime in the hopes of obtaining reductions from the United States in return. Even though the effort to combine market liberalism and sustainable development under the Kyoto canopy attempts

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99 *See* ID. at 370 (stating that Bush's repudiation of the Kyoto Protocol in early 2001 threw the Protocol into doubt, because the U.S. emits about a quarter of the world's greenhouse gases); Transcript, Bush Press Conference at the White House, March 29, 2001, http://www.whitehouse.gov/news/releases/2001/03/20010329.html (explaining President Bush's concerns about cost and the ineffectiveness of the agreement); *see also* S. Res. 98, 105th Cong. (1997) (enacted) (disapproving of climate change agreements that do not mandate developing country emission reductions and expressing cost concerns).

100 *See* DESSLER & PARSON, *supra* note 1, at 26 (noting that the Kyoto Protocol entered into force on February 16, 2005).

101 *See* Kirsten H. Engel, *Mitigating Global Climate Change in the United States A Regional Approach*, 14 N.Y.U. ENVTL. L. J. 54, 55 (2005) (noting "the absence of the federal government's participation in the Kyoto Protocol"); Kirsten H. Engel and Scott R. Saleska, *The Subglobal Regulation of the Global Commons: The Case of Climate Change*, 32 ECOLOGY L. Q. 183, 186 (2005) (pointing out that the United States federal government has "eschewed substantive regulation"); *cf.* Deborah Keeth, *The California Climate Law: A State's Cutting Edge Efforts to Achieve Clean Air*, 30 ECOLOGY L. Q. 715 (2003) (discussing California climate change law); Gary C. Bryner, *Carbon Markets: Reducing Greenhouse Gas Emissions Through Emissions Trading*, 17 TUL. ENVTL. L. J. 267, 273 (2004) (describing the Bush Administration's plan to address climate change without meeting Kyoto targets).

102 *See* Choi, *supra* note 5, at 952 (stating that the European Emissions Trading Scheme "will provide important lessons to the rest of the world," including the U.S.).

something of a shotgun marriage,[103] the EU moved rapidly to adopt a trading scheme after it signed the Kyoto accord[104].

The European Parliament adopted a two-phased trading program requiring individual countries to establish limits for the carbon dioxide emissions of listed major industrial sources, such as power plants.[105] This trading program, however, does not confine itself to trades between capped sources in Europe. It allows regulated European polluters to purchase credits generated by projects approved under the Kyoto Protocol's CDM and Joint Implementation provisions to satisfy part of their compliance obligations.[106] The European Parliament adopted this global liberalization of the trading regime specifically to advance the sustainable development goal by facilitating resource transfers to developing countries and to further the cost effectiveness goal by increasing the availability of cheap credits.[107] Thus, the EU embraced, to a remarkable degree, the marriage of sustainable development and market liberalism, even though the country seeking the marriage, the United States, had absconded.[108]

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103 Michael A. Mehling, *Emissions trading and National Allocation in the Member States-An Achilles' Heel of European Climate Policy,* 5 Y.B. EUR. ENVTL. L. 113, 118-19 (2005) (describing emissions trading as something "largely adopted in response" to U.S. "pressure").

104 Id. at 123, 127 (describing EU decision to adopt trading after "notoriously" opposing it as a "remarkable shift" and noting that it moved from proposal to adoption in "less than four years.").

105 *See* Council Directive 2003/87, 2003 O.J. (L 275); Rie Watanabe & Guy Robinson, *The European Union Emissions Trading Scheme,* 5 CLIMATE CHANGE 10 (2005) (explaining the particulars of the scheme); B. Mortensen, *The EU Emissions Trading Directive,* 14 EUR. ENVTL. L. REV. 275 (2004).

106 *See* Council Directive 2004/101/, preamble, 2004 O.J. (L 338), 18, 18 [hereinafter Linking Directive]; Watanabe & Robinson, *supra* note 106, at 13.

107 *See* Linking Directive, *supra* note 106 (preamble).

108 *Accord* Reimund Schwarze, *Incentives to Adopt New Abatement Technology and US-European Regulatory Cultures, in,* EMISSIONS TRADING, *supra* note 55, at 58 (likening the EU to a hesitant bride expecting a baby after the father has left).

2. Alternatives to Global Trading

The EU, however, has not relied upon global trading as the sole means of meeting its Kyoto goals.[109] The EU has established targets for increased use of renewable energy.[110] Member countries have sought to achieve these targets primarily through two energy regulatory mechanisms, often coupled with some form of tax incentive. Many countries (and many states in the United States) employ renewable energy portfolio standards that usually require electric utilities to obtain a fixed percentage of their energy from renewable sources.[111] Typically, a renewable portfolio standard allows an electricity retailer to comply by using renewable energy from a facility it owns, purchasing power from somebody else's renewable energy facility, or by buying a

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109 Mehling, *supra* note 103, at 121-22 (describing legislation on energy efficiency, renewable energy, energy taxation, funding and promotion schemes, voluntary agreements with industry, and monitoring of greenhouse gas emissions as following in the wake of a Europe Commission decision to make climate change a priority in 1992).

110 Commission of the European Communities, Commission Staff Working Document: The Share of Renewable Energy in the EU: Country Profiles Overview of Renewable Energy Sources in the Enlarged European Union, SEC (2004) 547 (discussing EU target of a 12% share of renewable energy consumption by 2010); Commission of the European Communities, The Share of Renewable Energy in the EU: Commission Report in Accordance with Article 3 of Directive 2001/77/EC, Evaluation of the Effect of Legislative Instruments and Other Community Policies on the Development of the Contribution of Renewable Energy Resources in the EU and Proposals for Concrete Actions, SEC(2004) 547, at 11 [hereinafter 2004 Commission Energy Evaluation] (discussing an "indicative target" of 22% renewable electricity generation by 2010 for the EU 15).

111 Kevin S. Golden, *Senate Bill 1078: The Renewable Portfolio Standard: California Asserts its Renewable Energy Leadership,* 30 ECOLOGY L. Q. 693, 699 (2003) (describing renewable energy portfolio standards as requirements that "retail electricity sellers" include "a determined percentage of renewable energy sources" in their "resource portfolios."); Barry G. Rabe, Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards 3-4 (2006) (listing states and countries that have adopted renewable portfolio standards); Andrew Ford et al., *Stimulating Price Patterns for Tradable Green Certificates to Promote Electricity Generation from Wind,* 35 ENERGY POL'Y 91, 92-94 (2007) (describing state programs and mentioning the European countries employing similar programs); Commission of the European Communities, Communication from the Commission: The Support of Electricity from Renewable Energy Sources, COM(2005) 627, at 4-5 [hereinafter Renewables Support] (listing countries employing green certificate systems, which can be a form of renewable portfolio standards); *see also* Espey, *supra* note 5, at 560 (explaining that the term renewable portfolio standard comes from U.S. practice, but that other countries employ different names to describe similar programs). *See generally* Nancy Rader & Scott Hempling, The Renewables Portfolio Standard: A Practical Guide (2001).

renewable energy credit.[112] In Europe, even more countries have used feed-in tariffs, which require electricity providers to pay renewable energy providers a fixed above-market price for their energy.[113] This approach relies on an economic incentive as a means of meeting a goal for technological change. But it relies on a "distortion" of the "natural market" - basically government price fixing - to achieve sustainable development goals.[114] Thus, Europe has employed both feed-in tariffs (a price mechanism) and production quotas (a quantity mechanism) to encourage renewable energy.[115]

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112 Golden, *supra* note 111, at 699-700. *Cf.* Engel, *supra* note 5, at 268 n. 72 (only one state, Arizona, currently uses tradable renewable power credits); Ford et al., *supra* note 111, at 94 (characterizing green certificates as quite new); Espey, *supra* note 5, at 557 (describing "certificates" as a means of proving compliance with a renewable portfolio standard). Espey further explains that the certificate system allows a utility to participate in financing renewable energy without acquiring a production facility or obtaining the renewable power, for a utility can acquire a certificate without acquiring the underlying power. Id. at 560. This separation can both simplify enforcement and provide flexibility for those complying with a renewables portfolio obligation. *See* Rader & Hempling, *supra* note 111, at 55-71 (discussing trading's potential uses). While the green certificates have a number of advantages, the evidence suggests that the quotas themselves, not the trading, have spurred the technological development. *See, e.g.,* M.H. van der Linden et. al., Review of International Experience With Renewable Energy Obligations Support Mechanisms (LBNL-57666) at 49 (2005) (suppliers usually purchase tradable renewable energy credits from suppliers of renewable energy in order to meet their own compliance obligations); Ryan Wiser & Ole Langniss, The Renewables Portfolio standard in Texas: An Early Assessment (2001), http://eetd.lbl.gov/EA/EMP 15 (stating that certificate trades "may not be essential" to effective design of a renewable portfolio standard).

113 Renewables Support, *supra* note 111, at 4 (most EU member states employ feed-in tariffs); Karen Palmer & Dallas Burtraw, *Electricity, Renewables, and Climate Change: Searching for a Cost-Effective Policy*, 8-9 (2004), http://www.rff.org (discussing feed-in tariffs' use in several European countries). Feed-in tariffs constitute a subsidy and as such bear some similarity to the "Federal Production Tax" credit. *See* Ford et al., *supra* note 111, at 94 n. 12.

114 *See* Renewable Energy Certificates System International, The Use of Guarantees of Origin 24 (2005), http://www.recs.org/doctree/RECS%20International/05%20Evaluation%20Report.pdf (explaining that a fixed feed-in tariff introduces a "market distortion.")

115 *See* Lene Nielsen & Tim Jeppesen, *Tradable Green Certificates in Selected European Countries_ Overview and Assessment,* 31 ENERGY POL'Y 3, 5 (2003) (all countries planning green certificate program except the Netherlands "envisage . . . politically determined demand"); van der Linden et. al., *supra* note 112, at 11-12 (discussing feed-in tariffs, a tendering system where the government contracts for renewable power, financial incentives, and tax incentives); Palmer & Burtraw, *supra* note 113, at 3 (discussing state subsidies and funded by a surcharge on electricity purchases and federal renewable energy production tax credits). *See generally* Wiener, *supra* note 43, at 706-713 (developing the distinction between price and quantity instruments with examples).

The European Commission has also proposed shifting transport taxation to focus on carbon.[116] While the European Parliament has not yet adopted this reform, several member states have employed relevant green taxes.[117]

3. *The Emerging U.S. Program*

While the United States has not yet agreed to Kyoto targets, several states have moved forward with programs addressing greenhouse gas emissions.[118] These programs, like their European counterparts, involve a mixture of emissions trading and other approaches.[119] And pending federal legislation relies heavily on emissions trading.

This Article cannot catalogue all developed country efforts to meet Kyoto targets. But this brief description of a few key programs illustrates an important predicate for subsequent discussion, that most countries have combined global emissions trading with other more targeted approaches.

III. TECHNOLOGICAL CHOICES UNDER THE KYOTO PROTOCOL

Our Indian entrepreneur is not alone in making technological choices. Other credit generators must decide between projects generating renewable energy (like the solar project), projects employing end-of-the-pipe approaches (like the HFC 23 project), and projects enhancing energy efficiency (which indirectly reduce carbon dioxide

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[116] Commission of the European Communities, Proposal for a Council Directive on Passenger Related Taxes, COM(2005)261 Final, at 7-8, *available at* http://ec.europa.eu/environment/co2/pdf/taxation_com_2005_261.pdf.

[117] *See* David M. Driesen, *Economic Instruments for Sustainable Development, in* ENVIRONMENTAL LAW FOR SUSTAINABILITY: A CRITICAL READER 295 (Stepan Wood, Benjamin J. Richardson eds. 2006) (discussing taxes touted as carbon taxes in several European countries); Choi, *supra* note 5, at 896-97 (discussing "green taxes" in the European energy sector).

[118] *See generally,* Engel, *supra* note 101, at 54 (describing state and local government as "taking the lead in addressing global climate change."); Engel & Saleska, *supra* note 101, at 185 (stating that "at least half the states" have passed legislation addressing global warming); BARRY RABE, STATEHOUSE AND GREENHOUSE: THE EMERGING POLITICS OF AMERICAN CLIMATE CHANGE POLICY (2004).

[119] *See* Engel, *supra* note 101, at 65-68 (discussing various regional initiatives); Engel & Saleska, *supra* note 101, at 212-13 (discussing vehicle emission standards and renewable energy programs).

emissions). Also, private actors make technological changes in responding to renewable portfolio standards and other measures aimed at stimulating greenhouse gas emission reductions. What sorts of choices have people made under the Kyoto Protocol?

A. Technological Choices Generated by Global Emissions Trading

A survey of technological responses to the Kyoto Protocol's project-based mechanisms suggests that those in our Indian entrepreneur's position have made a variety of choices. A quick glance at the projects list might suggest that renewable energy projects have dominated, since they constitute the majority of projects.[120]

But a more careful analysis suggests much more emphasis on end-of-the-pipe approaches than on renewable energy or energy efficiency. End-of-the-pipe approaches have generated the lion's share of credits available in the market.[121] End-of-the-pipe technologies received most of the funding available for credit generating projects, with HFC control projects alone, like the project our entrepreneur contemplated, garnering 58% of the $2.5 billion invested in CDM projects in 2005.[122]

The chart below reflects the distribution of credits sold in 2005 and early 2006 under the Kyoto Protocol's project-based trading mechanisms (CDM and Joint Implementation).[123] It shows end-of-the-pipe controls' predominance and relatively little production of renewable energy

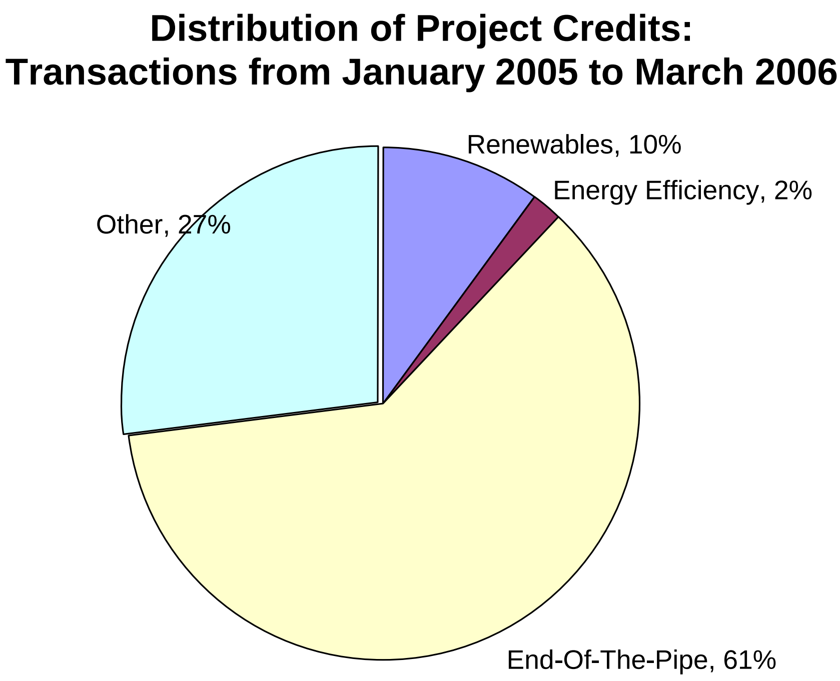
[120] Capoor & Ambrosi, *supra* note 7, at 33 (stating that 51% of the projects generating transactions have involved energy efficiency or renewable energy).

[121] *See* Baumert, *supra* note 3, at 386 (noting that gas capture/destruction projects account for 66 percent of expected emission reduction credits); Michael Wara, *Is the Global Carbon Market Working?*, 445 NATURE 595, 596 (2007) (showing that waste gas projects account for the majority of credits claimed for projects "in the pipeline").

[122] *See* Robin Lancaster, *Beyond All Expectation,* 3 CARBON FIN. 15 (May 2006) (stating that HFC23 reductions accounted for 58% of the market volume between January 2005 and March 2006).

[123] *See* Capoor & Ambrosi, *supra* note 7, at 9, 32-33 (explaining that the data comes from signed contracts and presenting figures from January of 2005 through March of 2006).

credits.[124]



If one examines somewhat less reliable numbers for projects "in the pipeline" (i.e. not yet fully-approved) for CDM only, renewable energy credits rise to about 17%.[125] The

124 I have derived this chart from the chart at the top of page 32 of the Capoor & Ambrosi report. *See* Capoor & Ambrosi, *supra* note 7, at 32 (presenting more disaggregated data, including percentages of credits for different types of renewable energy sources). On the next page of text, the Capoor & Ambrosi estimate that renewables and energy efficiency constitute 10% of the total by credits generated. Id. at 33. This suggests that some of the energy efficiency projects may be combined with renewable energy projects, since the chart shows 10% renewables and 2% efficiency projects, suggesting an aggregated total of 12%. The "other" category in my chart denotes technologies that are not known to involve end-of-the-pipe, renewable efficiency, or energy efficiency technologies. The "other" category includes some projects that might be properly viewed as "end-of-the-pipe" projects, so that the percentage of end-of-the-pipe credits may be understated. The finding that renewables projects generate a small percentage of the total credits is broadly consistent with other analysts' conclusions. *See, e.g.*, Ben Pearson, *CDM is Failing*, 56 TIEMPO 12, 12 (2005), *available at* http://www.tiempocyberclimate.org/portal/archive/pdf/tiempo56high.pdf (stating that renewables projects have generated just 11% of the total credits); CDM Watch, The World Bank and the Carbon Market: Rhetoric and Reality, http://www.cdmwatch.org/files/World%20Bank%20paper%20final.pdf, at 16 (noting that renewables projects generated about 11% of CDM credits through April of 2005).

125 *See* Jane Ellis & Katia Karousakis, The Developing CDM Market: May 2006 Update 6-7 (2006), http://www.oecd.org/document/60/0,2340,en_2649_34361_1943164_1_1_1_1,00.html (discussing projects "in the pipeline" and then concluding that renewables are expected to generate 17% of the CDM credits). This number represents a decline in the amount of renewable energy in the pipeline. Id. at 7. Furthermore, renewables project developers may face greater risks than developers of cheaper projects of

Kyoto mechanisms have stimulated even less energy efficiency credits than renewable energy credits, since energy efficiency projects have generated just 2% of the total credits.

Sustainable development advocates have used the public participation provisions in project approval processes to oppose projects promising no additional carbon benefit and to address broader concerns about some projects' collateral consequences for poor people in host countries. For example, they have expressed concerns about ecological destruction and chemical contamination associated with a eucalyptus plantation generating carbon displacing biofuel and providing incentives to keep a landfill slated for closure open in order to allow methane capture for credit.[126] The CDM Executive Board has sometimes revised or rejected emission estimates on the grounds that they exaggerate the carbon benefits or involve no additional carbon benefit from baseline conditions.[127] But public participation aimed at furthering sustainable development has not reversed the market trend favoring end-of-the-pipe control.[128]

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having their projects emission credits disapproved or reduced. *See* Lucy Mortimer, *An Uncertain Path*, 3 CARBON FIN. 14 (April, 2006), *available at* http://www.carbon-financeonline.com (noting that many projects may not make it through the registration process because of financial problems, methodological problems, and uncertainty about the post-2012 carbon market); CDM Watch, *supra* note 124, at 16 (noting that many renewables projects may not meet the Kyoto Protocol's "additionality" criterion).

[126] *See, e.g.,* Jim Vallette et al., A Wrong Turn from Rio: The World Bank's Road to Climate Change Catastrophe 9-10 (2004), http://www.seen.org (describing these projects and their effects); CDM Watch, *supra* note 124, at 11 (discussing a methane project in South Africa that might discourage the government from fulfilling its promise to close a landfill sited in a poor community under apartheid). I am reporting here the sustainable development group's characterization of the effects, which I have not independently evaluated. *Cf.* The World Bank Carbon Finance Unit, Brazil: Plantar Sequestration and Biomass Use (2006), http://carbonfinance.org/Router.cfm?Page=Projport&ProjID=9600#DocsList (suggesting that the Plantar project will lessen ecological destruction). The point here is not to determine who is right about project disputes, but simply to characterize the types of concerns that come up in public comment processes on CDM projects.

[127] *See, e.g.,* CDM Watch, *supra* note 124, at 23-25 (describing the reasons for rejection of some CDM projects).

[128] *Cf.* U.N. Conference on Environment and Development, Agenda 21, U.N. Doc. A/CONF.151.26 ¶ 9.9 (1992) (calling for renewable energy in a document providing a blueprint for sustainable development); David M. Driesen, *Air Pollution*, in STUMBLING, *supra* note 48, at 257-261.

B. Technological Choices Under More Targeted Programs

By contrast with global trading's emphasis on end-of-the-pipe strategies, more targeted regulatory programs have increased the use of renewable energy and energy efficiency.[129] On the renewables front, they have catalyzed an enormous increase in wind power.[130] The technological development that these programs have encouraged has caused a drop in price, which has made wind power a cost effective energy source.[131] Photovoltaic module production for solar energy has also increased markedly in Europe.[132] And the prices for solar and biomass technologies have dropped over time, although usually not to levels that make them cost competitive with heavily subsidized fossil fuels.[133]

(discussing Agenda 21's provisions favoring renewable energy and energy efficiency as part of sustainable development).

[129] *See, e.g.,* Van der Linden et al., *supra* note 112, at 38 (suggesting that a number of policy instruments have contributed to increased renewable energy production in Sweden); James W. Moeller, *Of Credits and Quotas: Federal Tax Incentives for Renewable Resources, State Renewable Portfolio Standards, and the Evolution of Proposals for a Federal Renewable Portfolio Standard*, 15 FORDHAM ENVTL. L. J. 69, 73-77 (2004) (explaining that a federal requirement that electric utilities purchase power from renewable energy sources played a "significant role" in expanding renewable power generation); *cf.* Choi, *supra* note 5, at 891 n. 86 (claiming that the acid rain program has discouraged use of renewable energy, in spite of the establishment of reserve allowances to provide incentives to use it).

[130] *See* Frederic C. Menz & Stephan Vacon, *The Effectiveness of Different Policy Regimes for Promoting Wind Power: Experiences from the States,* 34 ENERGY POL'Y 1786 (2006) (finding that renewable portfolio standards have stimulated increased production of wind power); 2004 Commission Energy Evaluation *supra* note 110, at 19 (finding noting that wind power grew by 23% in 2003, exceeding EU wind target); *see also* Ford et al., *supra* note 111, at 92 n. 4 (explaining that the Texas renewable portfolio standard produced the "Texas Wind Rush," the installation of 10 new wind projects in 2001 producing 930 megawatts of power).

[131] Jeffrey Greenblatt *et al., Baseload Wind Energy: Modeling Competition Between Gas Turbines and Compressed air Energy Storage for Supplemental Generation,* 35 ENERGY POL'Y 1474, 1474 (2007) (attributing a 30% annual increase in installed wind capacity to a "twofold drop in capital costs between 1992 and 2001" and "government initiatives."); 2004 Commission Energy Evaluation, *supra* note 110, at 19 (finding that wind costs have fallen by 50% over the last 15 years).

[132] *See* 2004 Commission Energy Evaluation, *supra* note 110, at 20-21.

[133] *See* Mona Hymei, *The United States Experience with Energy-Based Tax Incentives: The Evidence Supporting Tax Incentives for Renewable Energy,* Arizona Legal Studies Discussion Paper No. 06-21 (2006), http://www.ssrn.com/abstract=896987 (discussing United States subsidies for fossil fuels and renewable energy); Bert Metz & Detlef van Vuuren, *How, and at What Costs, can Low-Level Stabilization be Achieved?- An Overview, in* AVOIDING DANGEROUS CLIMATE CHANGE 339 (Hans Joachim Schellnhuber et al. eds. (2006)) [hereinafter DANGEROUS] (noting that renewable energy today represent one of the most expensive options for greenhouse gas mitigation); Bernardo Barreto & Socrates Kypreos, *Emissions Trading and Technology Deployment in an Energy-Systems "Bottom-up" Model with Technology*

We have also seen an obvious innovation in vehicle technology, as many companies have begun offering hybrid vehicles that reduce reliance on gasoline, using a battery's electricity to help power the vehicle. These vehicles typically offer increased energy efficiency and reduced carbon dioxide emissions.[134] Manufacturers have introduced hybrids in order to comply with California regulations requiring Low Emission Vehicles (LEV).[135] These regulations at their core involve a performance standard, which is sufficiently stringent to make it very difficult to rely on conventional technology as a compliance method. The LEV regulations, however, generally permit each manufacturer to average its vehicles' emissions to meet the standards.[136] This fleet-average approach represents a limited use of the trading concept, since it does not allow credits from non-vehicle emission reductions to count toward meeting the LEV obligation.[137]

California has very recently adopted regulations directly limiting carbon emissions from vehicles sold in that state.[138] And China has promulgated ambitious energy efficiency requirements for vehicles.[139] These standards, not the Kyoto mechanisms, seem the most likely drivers of meaningful technological change in the motor vehicle industry.

Learning, 158 EUR. J. OPERATIONAL RES. 243, 246-48 (2004) (estimating an 86% progress ratio for solar photovoltaics, representing the rate of cost decline per doubling of production).

[134] *See Plugging Into the Future*, THE ECONOMIST 30 (June 10, 2006) (discussing the fuel efficiency gains of the Toyota Prius and other hybrid vehicles).

[135] CAL. CODE REGS. tit. 13 § 1960.1 (2006).

[136] *See* Motor Vehicles Mfrs. Ass'n, v. N.Y. State Dep't of Envtl. Conservation 17 F.3d 521, 528 (2d Cir. 1994) (describing the fleet average approach), *on remand*, 869 F. Supp. 1012 (N.D.N.Y. 1994), *aff'd*, 79 F.2d 1298 (2d Cir. 1996).

[137] *See* Keeth, *supra* note 102, at 726-27 (explaining how manufacturers can comply with averaging requirements that relaxed the technological demands in the original program's zero emission vehicle requirement).

[138] CAL. CODE REGS. tit. 13 § 1961.1(a)-(g) (2006).

[139] *See* Keith Bradsher & David Barboza, *Pollution from Chinese Coal Casts a Long Global Shadow*, N.Y. TIMES A1, A12 (June 11, 2006) (noting that vehicles sold in China must meet stricter fuel efficiency standards than those of the United States).

Traditional regulations and demand-side management programs have increased energy efficiency.[140] In the United States, for example, energy efficiency standards for appliances have enormously decreased electricity use and associated carbon dioxide emissions even as appliances have grown in size and their features have improved.[141] Demand-side management programs implemented by European governments and state utility regulators in the United States require electric utilities to choose the most cost effective approach to matching supply and demand.[142] Demand reducing investments in energy efficiency generally cost less than supply increasing investments in energy production, so utility demand size management programs have required investments in energy efficiency.[143]

Thus, the data suggest that the Kyoto trading mechanisms have primarily encouraged cheap end-of-the-pipe technologies, which do not significantly change prevailing development patterns.[144] On the other hand, some targeted regulatory programs have produced more fundamental technological changes. For a decision to deploy solar power or another renewable energy source in lieu of burning coal changes the fundamental choice about which fuel to use in producing energy. And energy efficiency improvements reduce energy consumption, thereby reducing demand for more energy production, the fundamental driver of climate change.

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140 David S. Loughran & Jonathan Kulick, *Demand-Side Management and Energy Efficiency in the United States,* 25 ENERGY J. 19, 34 (2004) (utilities reported 180,000 M Wh annual energy efficiency savings from demand-side management between 1989 and 1999).

141 *See* Robert R. Nordhaus & Kyle W. Danish, *Assessing the Options for Designing a Mandatory U. S. Greenhouse Gas Reduction Program,* 32 B. C. ENVTL. AFF. L. REV. 97, 107 (2005) (DOE's appliance efficiency program has produced roughly an annual one quad reduction in energy use).

142 *See* Ralph Cavanagh, *Least Cost Planning Imperatives for Utilities and Their Regulators,* 10 HARV. ENVTL. L. REV. 299 (1996) (justifying such a comparison, explaining how to carry it out, and surveying state programs).

143 *See* Loughran & Kulick, *supra* note 140, at 25 (showing that generating a kilowatt hour costs more than twice as much as saving a kilowatt hour through energy efficiency).

144 *Cf.* Choi, *supra* note 5, at 951 (arguing that "addressing global climate change requires fundamental changes in human behavior").

IV. ON THE RELATIONSHIP BETWEEN SUSTAINABLE DEVELOPMENT AND MARKET LIBERALISM

Our person in India and others like her have been choosing traditional end-of-the-pipe technologies as the principal means of earning carbon credits. This result will surprise many readers of the instrument choice literature. For that literature generally associates "end-of-the-pipe" technology with high cost "command and control" regulation and links emissions trading to innovation and pollution prevention.[145]

The failure to choose renewables suggests that minimizing short term cost does not maximize productive long-term technological change. This part argues that positive spillovers not captured by the actor making the change make technological innovation very important to sustainable development, but that global emissions trading markets do not adequately take spillovers into account. It then presents a theory explaining why global trading has not encouraged renewable energy as well as more targeted government programs. Finally, this part draws lessons from emissions trading's neglect of positive spillovers for the relationship between sustainable development and market liberalism. It explains that environmental law must address an unacknowledged tension between maximizing near-term efficiency and promoting sustainable development.

A. *Is Expensive Innovation Desirable?: Spillovers and Sustainable Development*

Even if our entrepreneur would choose a cheap command and control technique over a more innovative solar energy technology, we might not regard trading's favoring of that choice as proof of a conflict between market liberalism and sustainable

[145] *See, e.g.*, Richard B. Stewart, *Environmental Regulation: A Failing Paradigm*, 15 J.L. & COM. 585, 592 (1996) (contrasting the "existing technology-based system['s]" emphasis on "end-of-pipe" controls with trading's encouragement of "process changes and conservation"); Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. L. 153, 155, 166 (1988) (technology-based regulation requires installation of "pollution control" technology, while "economic incentives" encourage "new products or production technologies").

development. If we employ soft versions of both market liberalism and sustainable development we can rationalize a comfortable marriage using the trading approach. As already suggested, soft market liberalism accepts some role for government regulation, especially when it uses economic incentives. A soft version of sustainable development would demand nothing more than some actions addressing environmental problems with significant future consequences. In that case, the choice to control HFC combines cost effective market liberalism with sustainable development, since the choice cost effectively realizes a real reduction in greenhouse gas emissions. On the other hand, if we give greater weight to future generations' interests, we may find sustainable development and market liberalism in some tension, even in the emissions trading realm.[146]

1. Technological Innovation's Importance to Sustainable Development

Technological innovation is crucial to efforts to protect future generations' interest.[147] For that reason, both Agenda 21, an international agreement sometimes described as sustainable development's blueprint, and the Brundtland Report emphasize the needs for renewable energy, like the solar project our entrepreneur considered.[148]

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146 *See* Michaelowa & Butzengeiger, *supra* note 87, at 3 (suggesting that renewables policies might be justified without carbon benefits because of falling costs over time) *with* Jos Sijm, *The Interaction Between the EU Emissions Trading Scheme and National Energy Policy*, 5 CLIMATE POL'Y 79, 94 (2005) (suggesting that energy security , equity, "raising fiscal resources," ancillary environmental benefits, and dynamic efficiency may justify energy policy, but that allowance trading makes it unnecessary for carbon reduction purposes).

147 I define technological innovation as use of a technology that significantly advances the state of the art. *See* DRIESEN, *supra* note 34, at 75-77; David M. Driesen, *Design, Trading, and Innovation*, *in* MOVING TO MARKETS, *supra* note 53, at 437-38. While I frame much of my argument about spillover neglect in terms of technological innovation, market-neglected positive spillovers can arise from high quality non-innovative technology as well.

148 U.N. Conference on Environment and Development, Agenda 21, U.N. Doc. A/CONF.151.26 ¶ 9.9 (1992) (calling for increased use of renewable energy and energy efficiency); WCED, *supra* note 9, at 188 (calling for giving the "highest priority" to the development of renewable energy).

This idea of a key role for technological innovation in sustainable development focuses significant attention upon choices about "economic development" itself, which includes fundamental choices about how to produce goods and services. The economist Herman Daly has argued that sustainable development should aim to reduce, or at least stabilize, "through-put" - the use of natural resources and inputs and waste streams as output.[149] He opposes economic growth defined in terms of increased throughput, because he finds such growth unsustainable.[150] He favors, however, economic development, which he defines as improvements of living standards that come without increased through-put.[151] This vision seems to require changes, such as increased use of solar power, that enable us to produce goods and services without consuming non-renewable fossil fuels and generating excessive waste. Making changes that allow for economic development without using up non-renewable resources requires significant technological innovation.[152]

We need not go as far as Daly would to find that protection of future generations in the climate change context requires significant innovation in how the world produces and uses energy. Indeed, climate change experts seem to agree that seriously addressing climate change requires significant changes in energy production and use.[153] Recently, several climate scientists have attempted to estimate the amount of carbon dioxide

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[149] Herman E. Daly & Kenneth N. Townsend, *Sustainable Growth: An Impossibility Theorem, in* VALUING THE EARTH 271 (1992).

[150] Id. at 267-68.

[151] Id. at 268.

[152] *See* DRIESEN, *supra* note 34, at 89 (explaining the link between Daly's idea of reduced throughput and technological innovation)

[153] Interview with Lewis Milford, Clean Air Group, Clean Energy Group (July 5, 2006) (claiming that experts agree that the world needs significant innovation in how energy is produced to adequately address climate change). *See, e.g.*, DESSLER & PARSON, *supra* note 1, at 102-106 (discussing technological options to address climate change with emphasis on options involving significant technological changes); Baumert, *supra* note 3, at 388 (stating that effectively addressing climate change requires "large-scale technological and behavioral changes.").

reductions needed to avoid some of climate change's key dangers. While estimates vary, they envision cuts on the order of 50% below global 1990 levels by the year 2050.[154] Since the world's most populous countries, China and India, are currently building new coal-fired power plants to service their rapidly industrializing countries, realizing such sizable cuts will require dramatic changes in how the world produces and uses energy.[155]

A moderate version of inter-generational sustainability might not countenance the damage to future generations that a failure to produce this drastic reduction would cause. For scientists associate a 3°C increase in global temperatures (an increase well within the range scientists expect) with drastic consequences.[156] From the standpoint of sustainable development, a technological change that contributes to a process of technological development leading, in the long term, to significant fossil fuel displacement has much more value than deployment of a conventional technology that contributes nothing to this long-term process.[157] The cutting edge technology offers more protection to future generations, even if both, in the short term, deliver equivalent direct greenhouse gas emission reductions.

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154 *See* DESSLER & PARSON, *supra* note 1, at 155-158 (suggesting that avoiding a 3 °C temperature rise may require a 40% cut from 2010 levels by 2050 and more than a 60% cut by 2100); James E. Hansen, *A Slippery Slope: How Much Global Warming Constitutes "Dangerous Anthropogenic Interference*, 68 CLIMATE CHANGE 269, 277 (2005) (stating that a 2°C temperature rise "almost surely takes us well into the realm of dangerous" climate change); Malte Meinshausen, *What Does a 2°C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates*, *in* DANGEROUS, *supra* note 133, at 269-70 (estimating that limiting temperature rise to less than 2°C likely requires a 55% reduction below 1990 emission levels by 2050).

155 *See* Bradsher & Barboza, *supra* note 139 (explaining that Chinese coal-fired power plants will probably increase greenhouse gas emissions by 5 times the amount of cuts from Kyoto and that India is following suit).

156 *See* James E. Hansen, *Global Warming: Is There Still Time to Avoid Disastrous Human-Made Climate Change? i.e. Have We Passed a Tipping Point?* 26-29 (2006), http://www.columbia.edu /~jeh1/nas_24april2006.pdf (providing maps of areas that would probably be under water if temperature increased by 3° C).

157 *See generally* Choi, *supra* note 5, at 872 (claiming that development of renewable energy and increased energy efficiency can move the world toward sustainable development).

This implies that governments should choose strategies to meet Kyoto targets that help make realization of more ambitious future targets feasible. Nobody believes that Kyoto's contemplated 5% cut in developed country emissions meets the Framework Convention's goal of avoiding dangerous climate change. The countries ratifying the Kyoto Protocol saw it as a first step toward seriously addressing this goal.[158] Technological choices under the Kyoto Protocol advance sustainable development when they contribute to making more ambitious future goals feasible.

2. *Positive Spillovers' Importance*

The economic concept of a spillover helps explains innovation's value. When somebody advances the state of an art, these advances often fuel positive "spillovers" – benefits that do not generate rents for the original innovator, such as contributions to further advances by competing firms.[159] Economists have long recognized that firms and individuals under-invest in innovation for several reasons. First, undertaking innovation often involves substantial expense with an uncertain payoff.[160] Second, potential innovators tend to underinvest in technological change because the innovating firm cannot capture all of an innovation's positive benefits.[161]

Patent law allows innovators to keep some of the rents from innovation in order to address markets' failures to adequately stimulate innovation.[162] At the same time, patent

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[158] KOLBERT, *supra* note 71, at 166.

[159] *See* Brett Frischman & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 258-261 (2007).

[160] *See* POSNER, *supra* note 16, at 123 (commenting that uncertainty lies at the "core" of technological innovation, because "scientific progress is unpredictable.").

[161] *See* ID. at 123-24 (third parties' ability to use information makes it difficult for inventors to keep all the value their inventions create); Gregory N. Mandel, *Promoting Environmental Innovation and Intellectual Property Innovation: A New Basis for Patent Rewards*, 24 TEMPLE J. ENVTL. L. & TECH. 51, 56 (2006) (if a person "builds a better mousetrap," others may copy it).

[162] Id. at 283 (explaining that intellectual property law allows innovators to capture some, but "not all" of innovation's value).

law (and intellectual property law generally) recognizes positive spillovers' value and seeks to encourage realization of spillovers' benefits by allowing some open access to information embedded in intellectual property.[163] In exchange for a patent giving an innovator a monopoly in an invention's production, the patent law requires publication of the patent, which discloses the invention's design details to competitors.[164] Publication facilitates other firms' efforts to build on the advances justifying the patent.[165] Other intellectual property law features, limits on the term of property rights, the lack of property rights in ideas and facts, and allowance for fair use of copyrighted material also reflect recognition of positive spillovers' value.[166]

Positive spillovers from technological choices in addressing climate change (or other long-term environmental problems) play a vital role in advancing sustainable development. An advance in solar energy technology, for example, may fuel other advances increasing solar energy's utility (perhaps for cloudy climates) or lowering its future costs.[167] Increasing the utility of renewable energy makes it a more viable substitute for fossil fuels exacerbating global warming, thus making an important long-term contribution to addressing global warming above and beyond the carbon reduction associated with a particular renewable energy project's relatively direct carbon reduction benefits.[168]

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[163] Id. at 282-93 (explaining that both copyright and patent law create a "semicommons" combining private property rights and commons elements).

[164] Id. at 291 (explaining that patent law "requires the patent owner to teach the public how to make and use the invention").

[165] Id. at 292.

[166] *See* id. at 282-293 (explaining why these features and others promote positive spillovers).

[167] *See generally,* Steffen Kallbekken & Nathan Rive, *Why Delaying Emission Cuts is a Gamble, in* DANGEROUS, *supra* note 133, at 315 (explaining that technological change can influence pollution abatement's cost and feasibility).

[168] *See* Eban Goodstein, *Prices Versus Policy: Which Path to Clean Technology, in* THE LONG-TERM ECONOMICS OF CLIMATE CHANGE: BEYOND A DOUBLING OF GREENHOUSE GAS

Facilitation of long-term switches from fossil fuels not only helps protect future generations from climate change's environmental and economic harms, but avoids more direct economic problems associated with fossil fuel use. Fossil fuels cannot supply energy indefinitely and may prove very costly over time. Because fossil fuel resources are finite, their price will eventually rise.[169] Current investment in alternatives to fossil fuels reduces the cost of making these switches later with less technological history[170] and also avoids potential supply shortages during a transition. Switching before fossil fuels run out or become scarce reduces the economic damage and environmental harms future generations will suffer.

In addition to these long-term positive spillovers, renewable energy generates near term positive spillovers. For example, selection of solar power as a method of reducing carbon will also reduce emissions of conventional air pollution.[171] These conventional pollutants have made big contributions' to many developing countries' failure to provide a healthful life for their people, i.e. to meet the current generation's needs.[172] Thus, positive spillovers can serve sustainable development not only by advancing future generations' interests, but also by better meeting the current generations' basic needs.

CONCENTRATIONS 225 (Darwin C. Hall & Richard B. Howarth eds. 2001) (identifying early investment in clean technology with avoidance of "ongoing residual damage from carbon emissions").

[169] *Cf.* Choi, *supra* note 5, at 951 (claiming that recent crude oil prices indicate that "fossil fuels have already begun to be in short supply.").

[170] *See* id. at 233 (explaining in detail why earlier investment in clean technology reduces costs).

[171] *See* Luis Mundaca & Hakan Rodhe, *CDM Wind-Energy Projects: Exploring Small Capacity Thresholds and Low Performances*, 4 CLIMATE POL'Y 399, 405 (2005) (wind energy reduces harmful sulfur dioxide emissions to zero); Douglas A. Kysar, *Some Realism About Environmental Skepticism: The Implications of Bjorn Lomborg's `The Skeptical Environmentalist' for Environmental Law and Policy*, 30 ECOLOGY L. Q. 223, 263 (2003) (noting incidental reductions in sulfur dioxide, nitrogen oxides, volatile organic compounds, and particulates).

[172] *See* UNCED, Rio Declaration on Environment and Development, princ. 1, U.N. Doc. A/CONF.151/26, Annex I (1992) (recognizing a human right to a "healthy life" based on the centrality of human beings to sustainable development).

If our entrepreneur's solar energy project generates sufficiently valuable positive spillovers, then our entrepreneur should invest in the solar option.[173] While a calculus based only on least cost carbon reductions directly associated with current projects favors HFC 23, a broader consideration of positive spillovers and sustainable development may favor the more expensive carbon abatement choice.

3. *Valuable Innovation May Prove Initially Expensive*

The adage "you get what you pay for" suggests that often technological choices producing significant positive spillovers will prove initially expensive. While our entrepreneur's choice offers but one example of the tradeoff between near term cost effectiveness (narrowly defined) and realization of positive spillovers' benefits, this tradeoff may be quite widespread. Solar energy constitutes a high quality environmental product offering a significant array of advantages not just a cheap fix to a single problem. These advantages include avoidance of a variety of forms of conventional air pollution, enhanced energy security, and avoidance of environmental damages associated with extracting fossil fuels from the earth. This high quality product, however, commands a price that reflects significant research and development costs, which often are needed to develop major technological advances. Cars, computers, and many other products stem from technological advances that produced expensive luxury goods that ultimately become cheap enough to enjoy a mass market. It is likely that some crucial innovation significant enough to make a major difference for a serious long-term environmental challenge like global warming while simultaneously addressing other environmental and

[173] *See generally* Palmer & Burtraw, *supra* note 113, at 62 ("providing a jump start to technology learning" can yield significant future benefits).

developmental needs will prove initially expensive. Certainly, renewable energy seems to conform to the model of an initially expensive good offering high quality.

High short-term costs do not, however, necessarily imply high long-term costs. Today's expensive technology can become tomorrow's cheap routine way of offering a better life. Economists studying innovation have noticed that firms learn from the experience of manufacturing new products and that this learning by doing can lower costs and improve product quality over time in unpredictable ways.[174] Learning seems to have occurred in the case of renewable energy, even with rather modest use of it, for renewable energy's price has generally fallen over time.[175] The tendency of firms to learn from efforts to make products implies that choosing environmental instruments that encourage initially expensive innovation can provide experience lowering long-term costs.

The solar example illustrates another feature of the tension between long-term and short-term costs. Solar energy requires an expensive capital investment, but no fuel costs. This means that as time goes on, the total costs can become cheaper than that of an approach like fossil fuel generation, which generates fuel costs year after year, costs that will rise when fossil fuel becomes scarce.[176] Hence, expensive innovation may have high

[174] *See* Patrick Matschoss & Heinz Welsch, *International Emissions Trading and Induced Carbon-Saving Technological Change: Effects of Restricting the Trade in Carbon Rights*, 33 ENVTL. & RESOURCE ECON. 169, 172 (2006) (associating learning by doing with assuming that learning comes from production); Barreto & Kypreos, *supra* note 133, at 245-46 ("learning . . . plays an important role" in improving technologies' cost and performance).

[175] *See* Michaelowa & Butzengeiger, *supra* note 87, at 3 (most forms of renewable energy are "undergoing a strong cost decrease"); Palmer & Burtraw, *supra* note 113, at 17, 51-52 (explaining that the potential for learning by doing is high for renewable energy); Leo Schrattenholzer, Experience Curves of Photovoltaic Technologies 3 (2000), http://www.iiasa.ac.at/Publications/Documents/IR-00-014.pdf (photovoltaic modules experienced a 20% cost decline with each doubling of installed capacity on average).

[176] *Cf.* DRIESEN, *supra* note 34, at 83-85 (providing a numerical example to illustrate how long term and short term costs may diverge)

value and low long-term costs, which should make it highly desirable from a long-term perspective.

The neoliberal perspective tends to deny the value of initially expensive innovation through the technique of discounting future benefits.[177] Because current technological improvement's costs occur today and many of the benefits accrue far in the future, reliance on discounting tends to produce analysis disapproving of significant near term efforts to protect future generations (like the employment of solar energy).[178] Economists favor discounting because it reflects the observed preferences of market participants, who tend to value current costs and benefits more highly than future costs and benefits.[179] But sustainable development proponents tend to treat this preference for short-sightedness as a problem to be overcome, not something to institutionalize in formal CBA.[180] Hence, neoliberals and sustainable development advocates diverge, to

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[177] *See generally* Kysar, *supra* note 171, at 266 (stating that economic models used to estimate the costs and benefits of mitigating climate change "use a mathematical discount rate . . . to significantly reduce" future harms' value); Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives,* 99 COLUM. L. REV. 941 (1999); Kenneth Arrow et al., *Intertemporal Equity, Discounting, and Economic Efficiency, in* CLIMATE CHANGE 1995: ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 125 (James P. Bruce et al. eds. 1996).

[178] *See* POSNER, *supra* note 16, at 151-52 (recognizing that application of a discount rate tends to "obliterate" future generations' interests in contexts like that of global warming, because the discounting drastically reduces valuation of future harms).

[179] *See* John L. Donohue, *Why We Should Discount The Views of Those Who Discount Discounting,* 108 YALE L. J. 1901, 1905 (1999) (a person would prefer saving ten lives today over saving ten lives seven years from now).

[180] *See, e.g.,* Kysar, *supra* note 171, at 266-67 (questioning the "moral basis" for discounting human lives saved and other future benefits of climate change policies); Douglas A. Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality,* 31 B. C. ENVTL. AFF. L. REV. 555, 578-585 (2004) (discussing discounting's moral issues in the climate change context); David A. Dana, *A Behavioral Economic Defense of the Precautionary Principle*, 97 NW. U. L. REV. 1315 (2003) (defending the precautionary principle as a means of correcting for cognitive bias favoring short term cost avoidance over long-term risk avoidance); *see also* Lisa Heinzerling, *Discounting Life,* 108 YALE L. J. 1911 (1999); Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 VAND. L. REV. 267 (1993); Edith Brown Weiss, *The Planetary Trust: Conservation and Intergenerational Equity*, 11 ECOLOGY L. Q. 495 (1984). *See generally* Kysar, *supra* note 8, at 2134 (noting that sustainable development proponents do not accept existing preferences as immutable).

some degree, in how much value they attach to positive spillovers generating future benefits.

B. *Why Global Emissions Trading Does Not Favor Valuable Innovation*

Carbon markets encourage people like our entrepreneur to "internalize" some of the value of carbon savings from environmental projects. In this, a carbon trading program resembles conventional performance standards and pollution taxes aimed at carbon, both of which would also add a price to goods and services reflecting costs associated with global warming. This section focuses on the question of whether global carbon markets tend to stimulate valuable innovations as a major means of realizing carbon reduction benefits.

I make a weak and a strong claim regarding global carbon markets and innovation. The weak claim is simply that global carbon trading markets do not systematically remedy the underinvestment in innovation that spillover analysis reveals. The strong claim is that a global trading program stimulates valuable innovation more weakly than a performance standard **of identical stringency.** These claims imply that environmental law must address a tradeoff between near term efficiency and long-term sustainability.

1. *Global Emissions Trading's Failure to Remedy Spillover Neglect*

Rational actors in the carbon markets will take direct carbon benefits into account as they choose projects, but they will not necessarily take into account projects' positive spillovers. And these spillovers will vary. For example, the HFC project seems to offer no long-term technological development prospects (owing to the phase out of the production process to which it is attached) and no collateral environmental benefits. Still, our Indian entrepreneur may not choose the solar project, because she receives no economic benefit from competitors building upon lessons learned from her solar installation or from lowered conventional pollution associated with her choice. This failure of global trading markets to encourage rational actors to take positive spillovers into account, means, at a minimum, that emissions trading provides no panacea for the problem of insufficient investment in environmental innovation.

By contrast, targeted renewable energy programs have a specific goal of stimulating sufficient investment in renewables. By either requiring deployment of renewable energy or offering a high tariff for it, they pay for long-term economic development. Indeed, they do this precisely because of recognition of some of the broader non-carbon benefits of renewables, such as long-term technological development, heightened energy security, and reductions in conventional pollution.[181] Thus, items that appear as spillovers, not internalized in carbon markets, become rationales for expenditures aiding sustainable development in targeted energy programs. This suggests that targeted programs aimed at producing positive spillovers may provide better incentives for valuable innovation than global trading programs.

2. *Global Trading Programs Provide Weaker Incentives for Valuable Innovation than Performance Standards of Identical Stringency*

Indeed, for any given level of stringency, a global emissions trading program offers a weaker incentives for valuable innovation than a performance standard of identical stringency. Emissions trading proponents have claimed that trading provides

[181] *See* Marc Ringel, *Fostering the Use of Renewable Energies in the European Union: The Race Between Feed-in Tariffs and Green Certificates,* 31 RENEWABLE ENERGY 1, 4-5 (2006) (discussing these factors as aims of EU policy on renewables).

stronger incentives for innovation than traditional regulation.[182] I confine my contrary claim of global trading's inferiority to *relatively expensive innovation*. Furthermore, I do not argue that trading is incapable of stimulating expensive innovation if sufficiently stringent. I only argue that for any given level of stringency, *e.g.* a given carbon reduction target, a performance standard creates better incentives for valuable innovation than a trading program. Holding the level of stringency constant allows one to explore the fundamental attributes of emissions trading, by eliminating variables other than instrument choice. My claim implies that global emissions trading generally loses important positive spillovers.

The conventional claim that trading encourages innovation better than traditional regulation generally relies upon the observation that emissions trading, unlike traditional regulation, encourages polluters to go beyond compliance.[183] This suggests that an emissions trading program would provide a better incentive for innovation than a traditional regulation implementing the same underlying emission limit.

This analysis, however, focuses on credit sellers alone and ignores buyers.[184] Credit buyers face weaker incentives to innovate under a trading program than they would face under a performance standard of identical stringency that does not allow for

182 *See, e.g.*, ENVIRONMENTAL LAW, *supra* note 17, at 19 (stating that "economic incentive systems," including emissions trading, have an advantage over command and control regulation in stimulating "continuing innovation."); Robert N. Stavins, *Policy Instruments in for Global Climate Change: How Can Government Address a Global Problem?*, 1997 U. CHI. LEGAL F. 293, 302-03; Robert W. Hahn and Robert N. Stavins, *Incentive-Based Environmental Regulation: A New Era for an Old Idea*, 18 ECOLOGY L. Q. 1, 13 (1991); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 217, 234-35 (1988); Stewart, *supra* note 144, at 160.

183 Adam B. Jaffe *et al.*, *Environmental Policy and Technological Change*, 22 ENVTL. & RESOURCE ECON. 41, 51 (2002) (economic incentives stimulate innovation by paying firms to clean up "a bit more."); David A. Malueg, *Emissions Credit Trading and the Incentive to Adopt New Pollution Abatement Technology*, 16 J. ENVTL. ECON. & MGMT. 52, at 8-9 & n. 33 (1987).

184 *See* Driesen, supra note 147, at 434-35 (explaining how the traditional focus on sellers biases theory).

trades.[185] Those who buy credits would do so because they face relatively high control costs. Trading allows buyers to escape from implementing expensive control measures at their own facilities. Without trading, however, they would face significant incentives to innovate, as innovation would provide the only way of escaping a conventional approach's high control costs. Thus trading provides inferior innovation incentives for owners of half of the sources in a perfect trading market.

Precise analysis of trading's impact on innovation requires us to ask the following question: Does trading shifting emission reductions from high cost to low-cost facilities provides better net incentives for innovation than those an identical performance standard would provide if regulators allowed no trading?[186] A growing numbers of economists have questioned the claim that emissions trading always provides superior incentives for innovation.[187] And a recent detailed empirical analysis of sulfur dioxide controls in the utility industry argues that more innovation occurred under the command-and-control regime in place prior to 1990 than under the more recent acid rain trading program.[188] The acid rain program, emissions trading's poster child, generally encouraged

185 Barreto & Kypreos, *supra* note 133, at 259 (finding that trading hinders the development and deployment of low carbon technology in permit buying regions).

186 *See* Driesen, *supra* note 184, at 433-34 (presenting and defending this analytical framework); Schwarze, *supra* note 108, at 56-57 (recognizing that a "fair comparison" between trading and traditional regulation requires "the same standard").

187 *See, e.g.,* Joel F. Bruneau, *A Note on Permits, Standards, and Technological Innovation,* 48 J. ENVTL. ECON. & MGMT. 1192 (2004); Juan-Pablo Montero, *Permits, Standards, and Technological Innovation,* 44 J. ENVTL. ECON. & MGMT. 23 (2002); Juan-Pablo Montero, *Market Structure and Environmental Innovation,* 5 J. APPLIED ECON. 293 (2002) (trading, taxes, or traditional regulation can best encourage research and development when firms' products are strategic substitutes); Malueg, *supra* note 131; W. A. Magat, *Pollution Control and Technological Advance: A Dynamic Model of the Firm,* 5 J. ENVTL. ECON. & MGMT. 95 (1978); *see also* David M. Driesen, *The Economic Dynamics of Environmental Law: Cost-Benefit Analysis, Emissions Trading, and Priority Setting*, 31 B.C. ENVTL. AFF. L. REV. 501, 519-20 (2004) (stating that trading may have an overall negative affect on innovation); David M. Driesen, *Does Emissions Trading Encourage Innovation?,* 33 ENVTL. L. REP. (Envtl. L. Inst.) 10094 (2003) (arguing that trading may encourage less innovation than a comparable performance standard, but suggesting that it may change the type of innovation).

188 Margaret R. Taylor et al., *Regulation as the Mother of Invention: The Case of SO_2 Control,* 27 L. & POL'Y 348, 370 (2005) (concluding that trading encouraged less innovation than command and control).

inexpensive but traditional compliance strategies, namely use of scrubbers and low sulfur coal.[189]

Since most economists tend to focus on efficiency, rather than sustainable development they generally discuss innovation under the rubric of "dynamic efficiency."[190] This term refers to the capacity of a program to lower costs through innovation to maximize net benefits to the current generation.[191] Economists do not usually focus on a program's capacity to induce high cost innovation for the benefit of future generations.

Emissions trading provides inferior incentives for relatively expensive innovation, because emissions trading lowers routine compliance's cost.[192] This means that trading lowers the price point where innovation becomes cost effective. To see this imagine two pollution source owners. One of these polluters, who we'll call Buyer, has marginal control costs of $1,000 per ton of carbon reduction. The other, who we'll call Seller, has marginal control costs of $500.00 a ton. If we require each of these sources to meet a carbon reduction target of 100 tons, a performance standard approach, then Buyer will acquire an incentive to seek out innovations costing less than $1,000.00 a ton. If we allow trading, however, Buyer will be able to purchase 100 extra $500.00 per ton reductions from Seller instead of achieving compliance locally. Under this scenario only

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[189] *See* id. (discussing reliance on wet scrubbers and low sulfur coals); Choi, *supra* note 5, at 887 (stating that the acid rain program has encouraged reliance on low-sulfur coal and scrubber installation); Swift, *supra* note 60, at 10332 (describing scrubbing and low-sulfur coals as the principle compliance means, but finding innovation in blending techniques and scrubber design); *cf.* David Popp, *Pollution Control Innovations and the Clean Air Act of 1990*, 22 J. POL'Y ANALYSIS & MGMT. 641 (2003) (finding more patenting of scrubber technology under command and control than under the acid rain trading program, but finding a shift in the type of innovation encouraged under trading).

[190] *See* DRIESEN, *supra* note 34, at 71.

[191] *See* ID.

[192] *See* Driesen, *supra* note 52, at 336 (pointing out that spatial flexibility makes it easier "to deploy a well understood control method").

innovations costing less than $500.00 a ton begin to penetrate the industry.[193] Hence, trading eliminates incentives for relatively costly innovations that would be economic in a non-trading program of comparable stringency.

Trading proponents point out that vast differences in marginal control costs are common. This is the reason that trading generates substantial costs savings. This means that trading should lower the marginal control costs for an industry substantially, thereby significantly reducing incentives for relatively expensive innovation.

The observation that reducing the cost of routine compliance should reduce incentives for valuable innovation is consistent with a hypothesis economists commonly employ in analyzing innovation, the induced innovation hypothesis. This hypothesis assumes that rational actors innovate when adhering to routine becomes too costly.[194] That assumption would suggest that lowering routine compliance costs through trading would reduce, not augment, incentives for relatively expensive innovation.

Our entrepreneur's choice can illustrate the reasons for trading's tendency to favor cheap routine measures over valuable innovation. As she decides whether to employ solar energy or an end-of-the-pipe control she probably thinks about her potential customer, the German electric utility owner. The rational actor model would predict that this customer will only want to pay for credits costing less than his utility's marginal

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[193] In reality, marginal control costs usually rise as a facility increases reductions. Thus, this example is oversimplified. But this simplification does not influence the results. Even if the low cost facility generates incurs higher costs for the reductions sold to buyer than for the reductions made to merely achieve compliance, these extra reductions must still cost substantially less than the cost of routine compliance at buyers' firm to make trading worthwhile.

Indeed, the example in some ways understates the depth of global trading's weakness in stimulating expensive innovation. One would expect trading to lower the marginal control costs of a large group of buyers, which might constitute about half of the participants in a trading program. And it would systematically lower the costs, and hence the price points innovators must meet, to the level of the cheapest reductions available anywhere within the universe of sources eligible to generate credits. In a global market, that universe is likely to be large and the opportunities for cheap routine reductions enormous.

[194] *Cf.* Matschoss & Welsch, *supra* note 174, at 173 (referring to this hypothesis as the assumption of "induced factor-saving technological change").

control cost. Hence, if a solar installation costs more than the marginal cost of local control in Germany, our entrepreneur cannot hope to recoup her investment if she invests in solar energy. Renewable energy often costs a lot and innovative new renewable energy technology may reflect significant research and development costs.[195]

Even if local conditions in sunny India are so propitious for solar energy that our entrepreneur can generate carbon credits costing less than the German utility's local costs,[196] she may think twice before investing in a novel solar energy technology. When she sells her credits, she may have to compete with other entrepreneurs for the sale. This competition may induce her to choose the cheapest option, even if both options cost less than the German utility's marginal cost.[197] In other words, competition may pressure our entrepreneur to choose the end-of-the-pipe approach. Market reports do claim that HFC reduction costs much less than renewable power, so the available data support the theory that trading disfavors relatively expensive innovation.[198]

This analysis helps explain why targeted regulatory programs should perform better than global emissions trading in encouraging renewable energy. The Kyoto Protocol contemplates a 5% drop in developed country emissions. Achieving this target through a global trading program should encourage a whole series of projects like the

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195 *See* Paolo Bertoldi et al., White, Green & Brown Certificates: How to Make the Most of Them, paper # 7203, at 11 (2005), http://energyefficiency.jrc.cec.eu.int/pdf/publications/ECEEE%202005%20paper%207%20203%20final.pdf (stating that the ETS will probably do little to encourage renewable energy because "renewables have higher marginal abatement costs" than other carbon mitigation options).

196 *See* DESSLER & PARSON, *supra* note 1, at 103 (pointing out that solar power is "already cost competitive in some niche applications").

197 *See* CDM Watch, *supra* note 124, at 16 (buyers and investors favor projects requiring the least investment).

198 *See* Ellis & Karousakis, *supra* note 125, at 8 -9 (stating that renewable energy projects typically have relatively high abatement costs; industrial gas projects have low costs); *cf.* Capoor & Ambrosi, *supra* note 7, at 9 (discussing the lack of an internationally recognized price index and the tendency to keep prices and contract structures confidential). *See generally* Michaelowa & Butzengeiger, *supra* note 87, at 3 (predicting that the "EU emissions trading will not induce development of technologies that currently have high . . . costs," such as renewable energy, because of low allowance prices).

HFC project, which cost much less than renewable energy projects. If, however, the world creates a renewable portfolio standard demanding that new renewable energy deployment create a 5% drop in carbon emissions, thus limiting the range of reduction options, this will create more valuable innovation – innovation with significant positive spillovers. Hence, recognition of the tension between global cost effectiveness and targeted innovation efforts can help explain why the data presented should not be surprising.

Some project developers acting in the global carbon markets, however, have chosen to develop renewable energy projects, albeit on a relatively small scale.[199] The existence of these projects suggests that market actors may not fully conform to the rational actor model, which assumes that actors maximize their profits by seeking low cost projects.[200] Some credit purchasers may wish to enhance their reputations by purchasing credits reflecting renewable energy projects.[201] Indeed, sustainable development advocates have developed a "gold standard" for CDM projects, giving projects advancing sustainable development an environmentalist seal of approval.[202] This approach suggests that these advocates see market decisions as susceptible to social and political influences, not only profit maximizing behavior.[203]

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199 *See* Ellis & Karousakis, *supra* note 125, at 8.

200 *See generally* White, *supra* note 20, at 65 (firms make decisions to maximize profits). It is also possible that in some locations renewable energy proves extremely cost effective.

201 *See* Pearson, *supra* note 124, at 15 (suggesting that "some buyers" will pay a premium for renewables credits for public relations reasons).

202 *See* http://www.cdmgoldstandard.org/.

203 The NGO strategy involves persuading stakeholders that gold standard credits offer greater value and less risk than credits reflecting projects that NGOs have not specifically endorsed. *See* id. *cf.* Iain McGill et al., *Some Design Lessons from Market-Based Greenhouse Gas Regulation in the Restructured Australian Electricity Industry*, 34 ENERGY POL'Y 11, 17 (2006) (markets have discounted credits for renewable energy produced by burning native forest waste in response to NGO opposition). *See generally* Kysar, *supra* note 8, at 2156 (identifying "infusing public policy elements into markets" as an important phenomenon that has attracted little attention); Douglas Kysar, *Preferences for Processes: The*

I do not claim that a categorical rule prohibits trading from stimulating renewable energy. Indeed, as governments impose more stringent caps on sources raising their control costs, the ability of renewable energy projects to play some role should increase. The data in this paper generally represent a very early picture of the trading market's response to the EU's phase one emission limits and the inchoate possibility of stricter limits in phase two. The insight at the core of my claim, however, that lowering cost does not increase incentives for valuable innovation is fully consistent with standard economic models that show a correlation between technological incentives and permit prices.[204] Nor do I claim that traditional regulation does a wonderful job of stimulating innovation, although it sometimes has done so when sufficiently stringent.[205] I make only the narrow claim that a performance standard encourages greater use of valuable innovation than a trading program of identical stringency. This claim suggests a tradeoff between short term cost effectiveness and investment in long-term environmental and economic development.[206]

Process/Product Distinction and the Regulation of Consumer Choice, 118 HARV. L. REV. 525, 529 (2004) (explaining that information about how goods are produced can influence consumer choice).

204 *See, e.g.*, Pedro Linares et al., *Impacts of the European Emissions Trading Scheme Directive and Permit Assignment Methods on the Spanish Electricity Sector*, 27 ENERGY J. 79, 88, 91 (2006) (forecasting switches to natural gas combined cycles but no other "new" technology, because "the permit price is not high enough").

205 *See* Schwarze, *supra* note 108, at 57-58 (stating that demanding traditional regulation produces strong incentives for innovation); DRIESEN, *supra* note 34, at 52-53 (discussing cases when traditional regulation has encouraged innovation); Kurt Strasser, *Cleaner Technology, Pollution Prevention, and Environmental Regulation*, 9 FORDHAM ENVTL. L. J. 1, 28-32 (1997) U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, GAUGING CONTROL TECHNOLOGY AND REGULATORY IMPACTS IN OCCUPATIONAL SAFETY AND HEALTH- AN APPRAISAL OF OSHA'S ANALYTICAL APPROACH, OTA-ENV-635, at 6, 89-90, 95 (1995); Nicholas A. Ashford et al., *Using Regulation to Change the Market for Innovation*, 9 HARV. ENVTL. L. REV. 419, 440-41 (1985); Nicholas Ashford & George R. Heaton Jr., *Regulation and Technological Innovation in the Chemical Industry*, 46 L. & CONTEMP. PROBS. 109, 139-140 (1983).

206 Emissions trading's failure to stimulate projects increasing energy efficiency stems from the peculiarities of the Kyoto trading design, rather than a general failure of trading to encourage cost effectiveness. *See* Bertoldi et al., *supra* note 195, at 11 (pointing out that end-use energy efficiency provides "low-cost" carbon reduction); Bryner, *supra* note 101, at 271 (describing making energy efficiency investments as a "no regrets" policy). The parties' decision to allow trades with sources whose emissions

C. Implications for Sustainable Development and Market Liberalism

Recognizing the value of positive spillovers exposes the tension between the short-term cost effectiveness markets favor and long term economic and environmental progress. This tension has implications for the conceptual relationship between sustainable development and market liberalism, for environmental policy, and for institutional design, which I address in turn.

1. On Sustainable Development's Relationship to Market Liberalism

If we employ a weak sustainability concept, than any use of technology that addresses climate change advances sustainable development and the cost effective HFC solution is fine. If we employ even a moderately strong version of the concept, however,

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remain uncapped threatens the program's integrity, because it creates a potential to give up reductions from regulated sources in exchange for positive changes that would happen even without a trading program. *See* Sandra Greiner & Axel Michaelowa, *Defining Investment Additionality for CDM Projects-Practical Approaches*, 31 ENERGY POL'Y 1007, 1007 (2003) (linking the lack of targets for reductions in developing countries to potential problems with CDM's integrity). In order to avoid this danger, the Kyoto Protocol requires that credit only be granted for projects yielding "additional" emission reductions. Kyoto Protocol, *supra* note 2, art. 12(5)(c); Marrakesh Accords, January 21, 2002, FCCC/CP/2001/13/Add.1-Add., Decision 17/CP.7, Annex para. 43. *See* KYOTO MECHANISMS, *supra* note 90, at 193 (explaining that certification of credits for energy efficiency projects that would have been used anyway would lead to increased emissions). Because many energy efficiency projects are economically attractive on their own, they have difficulty satisfying this criterion. K. Umamaheswaran & Axel Michaelowa, Additionality and Sustainable Development Issues Regarding CDM Projects in Energy Efficiency Sector, HWWA Discussion Paper 346, at 2, http://www.hwwa.de (characterizing additionality analysis of energy efficiency projects as "cursory."); KYOTO MECHANISMS, *supra* note 90, at 193 (using introduction of "improved energy efficiency technologies that would have become widely used" anyway as the example of an additionality problem). The Kyoto Protocol's language suggests a "project additionality" test, that the project produce real additional reductions, but the regime has included to some degree a "financial additionality test" that would require that the credit purchases are essential to making the project go. *See* Michael Dutschke & Axel Michaelowa, *Development Assistance and CDM- How to Interpret `Financial Additionality,'"* 11 ENVT. & DEV. ECON. 235 (2006) (discussing an interpretive issue with regard to financial additionality's relationship to foreign aid); CDM Watch, *supra* note 124, at 22-23 (quoting an EU program elaborating additionality testing as acknowledging a general recognition that only projects that would not have taken place without the purchase of credits meet additionality criteria); Umamaheswaran & Michaelowa, *supra*, at 22 (noting that the CDM Executive Board has required evidence that CDM revenue was considered at the design stage for "prompt start projects"). A design that only allowed trades with sources subject to caps might well encourage energy efficiency. *See* Robert N. Stavins, *Implications of the US Experience With Market-Based Environmental Strategies for Future Climate Change Policy, in* EMISSIONS TRADING, *supra* note 55, at 66-67 (recognizing that programs allowing "an unregulated source" to generate credits require review lest credits be given for reductions "that would have taken place in any event").

a rift opens between the partners to Kyoto's conceptual shotgun marriage. For initially expensive technological innovation has a vital role to play in sustainable development by facilitating the protection of future generations from shortages of finite resources and serious climate change risks. Market liberalism has defects in encouraging future economic welfare and environmental protection, because it fails to correct private actors' unwillingness to pay for important positive spillovers.[207]

2. *Lessons for Environmental Law*

A moderately strong version of sustainability requires that environmental policy address the tradeoff between short-term cost effectiveness and long-term sustainable development.[208] The existence of a tradeoff between near-term cost effectiveness and long-term technological development does not dictate abandonment of global trading, but it does suggest that an assumption that liberal trading serves as a panacea for failures to innovate has little justification.[209] This tradeoff generates three lessons for environmental policy.[210]

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[207] Our entrepreneur may consider the value of receiving a longer stream of direct carbon benefits from the solar project than the HFC project would generate. She may sharply discount the value of future carbon reductions, even though their value to future generations might be nearly as high as the early reductions. The parties to Kyoto have not yet agreed to targets beyond 2012, which lessens incentives to think about long-term streams of reductions. Even if she considers long-term benefits that she can realize profits from, there remains no reason for her to consider spillovers, such as the value of her technological contribution to other suppliers' future development of solar energy.

[208] *Accord* Schwarze, *supra* note 108, at 53 (recognizing "a general tradeoff between the goals of "stimulating new technology and . . . dynamic efficiency"); DESSLER & PARSON, *supra* note 1, at 170-71 (explaining that emissions trading exploits "cheap opportunities" to deploy "presently available" technology, but undermines the incentives to develop the new technologies that may reduce long-term costs); *see, e.g.*, Palmer & Burtraw, *supra* note 113, at 59 (explaining that the most cost effective way to encourage renewable energy employs a carbon trading design that is more costly than a standard design).

[209] *See* Stavins, *supra* note 206, at 71-72 (stating that "little is known empirically about the impact of these instruments on technological change" and that "there is . . . no policy panacea").

[210] For further discussion of possible approaches to innovation. *See* David M. Driesen, *Sustainable Development and Air Quality: The Need to Replace Basic Technologies with Cleaner Alternatives*, 32 ENVTL. L. REP. (Envtl. L. Inst.) 10277, 10285-10290 (2002) (discussing various alternatives); DRIESEN, *supra* note 34, at 151-161, 183-201.

First, policy-makers must consciously seek to encourage innovation, especially expensive innovation, and not assume that it will come about from just any market-based approach.[211] This lesson is important for climate change policy, because sectoral programs aimed at stimulating technological innovation can clash in some respects with global trading. A danger exists that policy-makers may weaken or even eliminate successful innovation stimulating program to address those tensions. Making innovation a goal implies respecting the value of a mixture of policy tools, including some that favor technological innovation over cost effectiveness.[212]

Second, policy-makers and scholars should more creatively explore the use of economic incentives and traditional regulation to encourage innovation.[213] For example, consider the idea of an Environmental Competition Statute.[214] Instead of relying on government standard setting (as in emissions trading) or taxation, such a statute would authorize any company making a pollution reduction to recoup its cost plus a pre-set premium from competitors with higher emissions.[215] Such a system would encourage firms to compete to maximize environmental quality, rather than respond only to the limited incentives sometimes timid government officials create by regulatory or taxation decisions.[216]

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211 *See generally* Richard B. Stewart, *Regulation, Innovation, and Administrative Law: A Conceptual Framework*, 69 CAL. L. REV. 1256, 1260-61 (1981) (concluding that innovation is needed just to keep environmental problems from getting worse as economic growth continues).

212 *See* Choi, *supra* note 5, at 934 n. 308 (calling renewable portfolio standards “the most effective policy tool” for increasing renewable energy’s market share).

213 *See, e.g.*, Mandel, *supra* note 160, at 64-69 (proposing a “patent rewards system” for environmental technology).

214 *See* DRIESEN, *supra* note 34, at 151-161.

215 *See* ID. at 151-54 (explaining that both emissions trading and pollution taxes depend upon government decisions to drive pollution reduction and suggesting mandatory payments to less polluting competitors as an alternative).

216 *See* ID. at 154 (explaining that the Environmental Competition Statute relies on polluters hopes of besting competitors and fears of losing out to them to motivate reductions).

Third, concern for innovation should play a major role in the design, not just the selection, of instruments, for innovation depends not just on the selection of regulatory instruments, but also on rather technical design considerations.[217] The LEV program provides an example of one aspect of design, showing that a narrow trading markets may better stimulate costly advances in the state-of-the-art than global trading programs. By limiting averaging to vehicle fleets, instead of fully embracing a global free market model, California regulators limited trading's capacity to undermine innovation necessary to meet stringent performance standards.[218] Auto-makers could surely avoid the high costs of making hybrid vehicles if they could make up the emission reductions by purchasing cheap credits from any source of relevant emissions in the world.[219] The restriction of trading, however, makes it harder to rely on cheap routine solutions.[220]

[217] *See* Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L. 795, 836 (2005) (characterizing "careful attention to design" as "crucial"); McGill et al., *supra* note 201, at 23 (explaining that absent appropriate design poor quality credits can crowd out high quality credits); *see, e.g.*, Atle Midttun & Kristian Gautesen, *Feed in or Certificates, Competition or Complementarity*? *Combining a Static Efficiency and a Dynamic Innovation Perspective on the Greening of the Energy Industry*, 35 ENERGY POL'Y 1419, 1420 (2007) (green certificate systems "with free competition between all renewable technologies" will not support "the broader technological development necessary to further subsequent generations of renewable technology."); EMISSIONS TRADING AND BUSINESS 46-49 (Ralf Antes et. al. eds. 2006) (discussing the effects of auctioning allowances, providing free allowances to new entrants, and preserving allowances for owners of closed plants on innovation); Palmer & Burtraw, *supra* note 113, at 25 (advocating allocating carbon allowances based on output, which favors renewable energy providers with the opportunity to sell all of their allowances).

[218] *See* James MacKintosh, *The Car Industry Needs Carbon Trading*, FIN. TIMES, July 3, 2006, at 17 (suggesting that a broader trading scheme would allow car manufacturers to avoid manufacturing hybrid vehicles and vehicles using biofuels).

[219] *See* California Environmental Protection Agency Air Resources Board, Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles vii (2004) (prohibiting use of credits from non-vehicle measures or for measures outside of California to avoid diluting carbon reduction regulations' technology forcing effect).

[220] *See* Matschoss & Welsch, *supra* note 174, at 170 (noting that a number of writers have argued that placing limits on trades increases incentives for technological innovation); Choi, *supra* note 5, at 937 (recommending a cap on credits from foreign countries to address "deterrence of long-term technological improvements").

Design plays a critical role in both traditional and "market-based" regulation's capacity to stimulate innovation.[221]

While these principles of making innovation a goal, more creative exploration of mechanisms, and conscious design for innovation may seem obvious once stated, scholars and regulators frequently overlook them. This design principle merits further treatment here, for government's role in design provides a link between the trading case and broader institutional issues about the proper roles of governments and markets.

Selection of regulatory targets constitutes one of the most important design considerations for an emissions trading or traditional regulatory program.[222] An emissions trading scheme depends for its efficacy on standard government decisions about regulatory stringency, i.e. the amount of reductions to require.[223] Some have criticized EU members for allocating too many allowances to industrial sources during the EU Trading Scheme's first phase.[224] By setting a cap near, or in some cases, above then current emission levels the EU arguably lost an opportunity to make significant

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[221] *See* Michael Grubb et al., *Technological Change for Atmospheric Stabilization: Introductory Overview to the Innovation Modeling Comparison Project*, 27 ENERGY J. 1, 14 (2006) (highlighting the need for clear signals through long-term targets and characterizing the policy implications of considering innovation as "far more subtle" than questions of choosing between trading and traditional regulation); DRIESEN, supra note 34, at 183-201 (explaining principles of regulatory design and making illustrative reform recommendations). The acid rain program sought to encourage renewable energy by setting aside allowances for renewable energy. *See* 42 U.S.C. § 9651c(f),(g). But this feature had little effect. *See* Choi, *supra* note 5, at 891 n. 86. We need more research about designing trading programs to encourage innovation. *Cf.* id. at 936-37 (opining that "direct allocations of allowances to renewable energy sources would function as a much more powerful tool for accelerating the commercial development of renewable energy technologies.")

[222] *See* Michael Grubb, et al., *Allowance Allocation in the European Emissions Trading Scheme: A Commentary*, 5 CLIMATE POL'Y 127, 127 (2005) (describing the "allocation of allowances" as "the most . . . important step" for "any emissions trading system").

[223] *See* id. (allowance allocation determines the total emission reductions and the magnitude of incentives for change); *see, e.g.*, Choi, *supra* note 5, at 902-03 (describing California's RECLAIM program as a "failure" because the South Coast Air Quality Management District set the cap too high).

[224] *See* Grubb, et al., *supra* note 222.

carbon reductions in phase one and to provide some incentives for innovation.[225] Conversely, if governments set ambitious caps for emissions trading schemes, these can greatly increase pressure for significant technological changes. This relationship between regulatory stringency and incentives for technological advancement is not unique to emissions trading.[226] Government decisions determining the stringency of performance standards or the amount of pollution taxes also influence the magnitude of incentives to innovate.[227] But proponents of "innovative market-based mechanisms" sometimes suggest that emissions trading automatically reduces emissions, thereby obscuring the importance of collective political decision-making in setting caps.[228]

One can address trading's weakness in stimulating innovation by increasing the stringency of the cap. A trading program reducing pollution by X tons encourages expensive innovation less well than a program of performance standards providing for X tons of reduction. But if one establishes an innovation premium in the cap, call it I, such that the cap requires X + I tons of reduction, then innovation performance would improve. In order for a trading program achieving a reduction of X + I to match the innovation performance (with respect to high cost innovation) of a performance standard requiring X tons of reduction, X + I must raise marginal control costs so that they equal the marginal control costs of achieving X through performance standards. Since trading

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225 Id. at 131-32 (finding the allocations in phase one inconsistent with serious effort meet Kyoto targets and unlikely to encourage innovation); *Gaming Gases*, THE ECONOMIST 69 (June 10, 2006) (because of overallocation of allowances and other design features the EU Emissions Trading Scheme "failed to boost alternatives.").

226 *See* Palmer & Burtraw, *supra* note 113, at 31 (explaining that the stringency of a renewable portfolio standard affects the prospects of different classes of renewable energy).

227 *See* DRIESEN, *supra* note 34, at 197 (explaining the link between stringency and innovation).

228 *See, e.g.*, EMISSIONS TRADING, *supra* note 55, at 4 (describing "cap-and-trade systems" as representing "a transition to market-based instruments which rely totally on market-based forces to create the necessary . . . incentives").

significantly lowers marginal control costs, the innovation premium necessary to meet this condition would be quite high.

In principle, the choice to use emissions trading should make it easier to set more stringent caps than regulators would set for a traditional regulation.[229] Since emissions trading lowers compliance costs, government officials making cost sensitive decisions should feel more comfortable setting ambitious goals when it uses trading than when it employs a traditional performance standard. Market liberalism in the selection of regulatory means may contribute to governments' willingness to establish regulatory goals compatible with sustainable development.

Yet, it would be a mistake to assume, without further research, that an inexorable political economy law always makes instrument choice a critical determinant of stringency. The European Union, for example, favored stringent targets while opposing broad liberal trading.[230] And the United States in the past has supported bans on some chemicals and stringent standards for other pollutants without fully exploring costs and with little or no reliance upon trading.[231] This suggests that factors other than cost effectiveness may influence government policy choices.[232]

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229 *Accord* Thomas Sterner & Henrick Hammar, *Designing Instruments for Climate Policy, in* EMISSIONS TRADING, *supra* note 55, at 18.

230 *See* DESSLER & PARSON, *supra* note 1, at 15 (explaining that many European countries wanted less flexibility to use foreign emission reduction credits than the U.S., Russia, Japan, and Canada wanted); *cf.* Michaelowa & Butzengeiger, *supra* note 87, at 2-3 (the EU opposed trading in the run-up to Kyoto but embraced it afterwards).

231 *See, e.g.*, Environmental Defense Fund v. EPA, 489 F.2d 1247 (D.C. Cir. 1973) (upholding a ban on DDT).

232 I am providing general thinking about the political economy of trading, not a comprehensive empirical analysis of the particulars of Kyoto's political economy. Emissions trading did prove essential to the Kyoto Protocol's entry into force, but not sufficient. It became necessary to grant extra allowances to Russia to obtain ratification, thereby potentially coupling trading with weaker limits. This suggests that once countries treat costs as critical, trading alone may not be sufficient to get them on board, but rather laxity may be necessary. *See* David M. Driesen, *Choosing Environmental Instruments in a Transnational Context*, 27 ECOLOGY L. Q. 1, 47 (2000) (raising the possibility of relaxing stringency to buy assent to a regulatory regime).

Governments' sensitivity to estimates of future costs may vary with their leaders' attitudes toward neoliberalism. The United States' opposition to Kyoto in spite of its use of trading and statist Europe's support for targets without global trading suggest as much.[233] Trading cannot save an agreement from a government determined to eschew regulation altogether and it may not be necessary to persuade other governments to sign up. The idea that sensitivity to cost may vary with ideology is also congruent with empirical research on risk perception, showing a correlation between individual attitudes toward risk and more general attitudes toward governments and markets.[234]

Furthermore, trading's cost savings can only influence goal setting if policy makers consider those cost savings before they materialize.[235] If trading succeeds in uncovering cost effective reductions not obvious to regulators, it follows that it further weakens the officials' ability to predict future costs. Hence, setting goals that take trading's cost savings into account may require a leap of faith that some may not be prepared to make.[236]

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[233] *See* Michaelowa & Butzengeiger, *supra* note 87, at 1-2 (explaining that the EU supported "stringent absolute emissions targets for industrialized countries" and opposed international trading for a long time).

[234] *See* Dan M. Kahan et al., *Fear of Democracy: A Cultural Evaluation of Sunstein on Risk*, 119 HARV. L. REV. 1071, 1072 (2005) (book review) (finding that "cultural worldviews" influence risk perception); *cf.* Cass Sunstein, *Misfearing: A Reply*, 119 HARV. L. REV. 1110, 1111 (2005) (agreeing that cultural cognition influences risk perception, but arguing that officials should correct misperceptions of facts). Professor Kahan and his coauthors explain that "egalitarians" tend to favor environmental regulation and that "individualists" tend to trust markets and react skeptically to environmental risks. Kahan et al., *supra*, at 1083-84. Their empirical research confirms previous research finding that the egalitarians are more concerned about global warming and other environmental hazards than the individualists. Id. at 1086.

[235] *See* Driesen, *supra* note 232, at 49 (pointing out that the availability of lower cost abatement options in foreign countries will only affect the stringency of limits for a trading program if the government considers those cost savings); *cf. Ratification Aside*, *supra* note 71, at 2117 (states reducing greenhouse gas emissions report that doing so creates new jobs, develops new technologies, and lowers energy costs).

[236] Id. at 1088 (explaining that cultural world views influence perceptions of both the costs and benefits of dangerous activities); Terry Barker *et al.*, *Avoiding Dangerous Climate Change by Inducing Technological Progress; Scenarios Using a Large-Scale Econometric Model in* DANGEROUS, *supra* note 133, at 362-64 (discussing the wide divergence of results in economic models assessing the costs of climate

The literature on political economy explains that polluters may favor grandfathered trading programs over pollution taxes, because only taxes leave them with costs for residual emission.[237] But a preference for trading does not inexorably make industry supporters of strict targets.[238] Industry federations in many countries have fought for weak caps, greatly weakening the EU's trading scheme's first phase.[239]

It is unlikely that the political economic advantages of trading will make it feasible to adopt a cap with an innovation premium sufficient to offset the innovation losses from trading (for expensive innovation). The increased stringency deprives polluters of the cost savings that trading would otherwise provide. Moreover, since polluters will likely have little or no information about the marginal cost of reductions at others' facilities that they might purchase, they may evaluate a proposed cap of X + I in terms of the cost of making all of the reductions at their own facilities, attributing little or no cost reduction to the market. Their own abatement costs (not taking into account cost savings from trade) will be much higher for limit X+1 than for limit X. And vigorous industry opposition to a more stringent cap decreases the likelihood of government

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change abatement). Professor Kahan argues that differences among experts reflect their divergent world views. Kahan, *supra* note 234, at 1092-1094. He also argues that experts may "screen arguments and evidence" to protect their status and beliefs. Id. at 1094. This suggests that economists may neglect learning by doing in economic modeling, because recognizing the importance of something difficult to quantify threatens their status, but others may create numbers because their worldviews favor doing something about global warming.

[237] *See* Nathaniel O. Keohane et al., *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVTL. L. REV. 313, 348-51 (1998) (explaining that polluters must pay taxes on residual emissions, but need not pay for those emissions under trading); James M. Buchanan & Gordon Tullock, *Polluters' Profits and Political Response: Direct Control Versus Taxes*, 65 AM. ECON. REV. 139, 141-142 (explaining why polluters may prefer regulations to taxes).

[238] *See* Michaelowa & Butzengeiger, *supra* note 87, at 5 (explaining how lobbying in the EU lead to goals in phase one providing little departure from "business as usual" levels of carbon emissions).

[239] *See* Grubb, *et al*., *supra* note 222, at 132-33 (describing industry lobbying's contribution to the EU's overallocation of phase one emission allowances); Michaelowa & Butzengeiger, *supra* note 87, at 3 (pointing out that German industry lobbied against the EU emissions trading directive and that the chemical and aluminum industries lobbied, successfully, for their exclusion from the scheme); *see also France Haggles over Banking Rules as Second NAP Set to Miss Deadline*, POINT CARBON (June 15, 2006), *available at* http://www.pointcarbon.com/article16056-868.html?articleID=16056&categoryID= (mentioning a French industry's advocacy of a high phase two cap).

compensating for innovation lost through increased stringency. An innovation premium is a good idea, but it may be difficult to obtain a reasonably ambitious premium.

Market liberalism might ideologically undermine setting goals necessary to achieve sustainable development, even though free market mechanisms lower costs that can impede ambitious goal setting.[240] Neoliberalism's political economy may prove more complicated than many analysts have assumed.[241]

It would require a book to fully evaluate the myriad ways one might employ instrument choice and design to address the tension between short term cost-effectiveness and long-term technological progress. But policymakers must confront this tension both in choosing and designing instruments.

3. *Institutional Relationships (of Government and Markets)*

Broadly speaking, market liberalism's advocates usually envision a broad role for markets and sustainable development advocates tend to rely more heavily on collective decision-making. The emissions trading case suggests that the question of the proper role of governments and markets is much more complicated than generally assumed.

All serious efforts to address environmental protection involve a significant role for markets and for government. Traditional regulation establishes markets by demanding environmental improvements that require firms to hire people and/or purchase equipment to reduce pollution.[242] And an economic incentive, in the form of a civil

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240 *See, e.g.*, Choi, *supra* note 5, at 950 (attributing the U.S. failure to implement to Kyoto to "an economic way of thinking," which stresses "short-term costs rather than long-term benefits.").

241 *See* Driesen, *supra* note 232, at 47 (explaining that no economic reason exists for a polluter to agree to emissions trading, unless government is willing to impose a more costly alternative).

242 Driesen, *supra* note 52, at 293; *see* Samuel P. Hays, *The Future of Environmental Regulation*, 15 J. L. COM. 549, 565-66 (1996) (characterizing traditional standards as the most significant "market force" in environmental protection).

penalty for violations of regulatory requirements, encourages them to do so.[243] On the other hand, "free market mechanisms" require active government roles in establishing goals and in enforcement.[244] Ignoring either the economic incentives that regulatory programs create or government's role in designing and enforcing them can lead to serious failures.[245]

The Kyoto emissions trading case raises questions about the notion that government should absent itself from oversight of technological choices made in pursuing environmental goals. Sustainable development advocates believe that technological choices made in pursuit of one environmental objective, such as carbon reduction, implicate broader sustainable development concerns that merit consideration when these choices are made. They tend to evaluate technological choices not only in terms of their carbon reduction potential, but also in terms of their contribution to long-term technological solutions and their collateral impacts on communities.[246] From the perspective of market liberalism, government processes to consider public comments and review projects generating credits for their impacts on sustainable development constitute "transaction costs" impeding markets, which governments should minimize.[247] Serious

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243 Driesen, *supra* note 52, at 336.

244 *See* Robert W. Hahn & Gordon L. Hester, *Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program*, 6 YALE J. REG. 109, 111 (1989) (monitoring and enforcement issues play a critical role in trading program design); Ackerman & Stewart, *supra* note 52, at 1352-59 (linking trading to a system that provides for democratic goal setting).

245 *See, e.g.*, Ruth Greenspan Bell, Choosing Environmental Policy Instruments in the Real World CCNM/GF/SD/ENV(2003)10 (arguing that emissions trading may not work well in countries lacking the capabilities to define and implement complex systems); Driesen, *supra* note 10, at 22 (discussing the collapse of a New Jersey emissions trading program because of efforts to delegate monitoring to a private agency).

246 *See, e.g.*, Haripriya Gundimenda, *How Sustainable is the Sustainable Development Objective of CDM in Developing Countries Like India*, 6 FOREST POL'Y & ECON. 329, 333 (2004) (project developers are likely to overlook micro level issues that determine whether afforestation and conservation projects for credit harm or help the poor).

247 *See* Stavins, *supra* note 206, at 66 (referring to government approval of individual trades as transaction costs); David M. Driesen & Shubha Ghosh, *The Functions of Transaction Costs: Rethinking*

regard for sustainable development, however, requires some consideration of positive and negative externalities inherent in technological choices.[248] This suggests that governments should not reflexively reduce transaction costs (such as opportunities for public comment) without considering the corollary benefits the transaction costs purchase, such as the opportunity to consider spillovers benefiting future generations and intragenerational equity.[249] More fundamentally, the existence of these externalities raises questions about the neoliberal assumption that single-minded cost effective pursuit of a single goal through emissions trading constitutes an adequate vision of technological choice for sustainable development.

The positive spillovers and negative externalities stemming from technological choices also raise questions about the internal consistency of market liberalism. Many advocates of CBA's use in defining environmental goals defend it, in part, by pointing out that government must evaluate risk/risk tradeoffs.[250] This tradeoff concept refers to the danger that industry response to a mandate to reduce one form of pollution may increase other more serious risks, a danger sustainability advocates have cited in

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Transaction Cost Minimization in a World of Friction, 47 ARIZONA L. REV. 61, 79-82 (2005) (reviewing transaction cost minimization's role in emissions trading).

[248] *See* James E. Krier, *Risk and Design,* 19 J. LEGAL STUD. 781, 782 (1990) (explaining that externalities arise when A & B "mistransact" with respect to C, whose interest they do not take into account).

[249] *See* Driesen & Ghosh, *supra* note 247, at 92-98 (discussing the tension between the impetus to reduce transaction costs to encourage trading and the need to preserve effective government oversight to protect environmental quality from poor quality trades); *accord* Stavins, *supra* note 206, at 66 (the negative effects of transaction costs "should be balanced against any anticipated benefits due to required government approval"); Michael S. Barr, *Credit Where it Counts: The Coummunity Reinvestment Act and its Critics*, 80 N.Y.U. L REV. 513, 602 (2005) (arguing that transaction costs generated by public involvement in Community Reinvestment Act processes should be weighed against the benefits of "civic engagement").

[250] *See, e.g.,* Cass Sunstein, *Health-Health Tradeoffs,* 63 U. CHI. L. REV. 1533 (1996); John D. Graham & Jonathan Baert Wiener, *Confronting Risk Tradeoffs, in* RISK VERSUS RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT 1 (John D. Graham & Jonathan Baert Wiener, eds. 1995); Symposium, *Risk-Risk Analysis,* 8 J. RISK & UNCERTAINTY 5 (1994); Randall Lutter & John F. Morrall III, *Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation*, 8 J. RISK & UNCERTAINTY 1 (1993); AARON WILDAVSKY, SEARCHING FOR SAFETY 212 (1988).

opposing CDM projects like the eucalyptus plantation mentioned previously.[251] NYU Dean Richard Revesz has responded to the risk/risk critique by pointing out that reducing a targeted risk often *reduces* another corollary risk.[252] For example, if our entrepreneur chooses a solar project to reduce carbon, her project will also displace smog-producing pollution from a nearby coal-fired power plant that severely threatens health in the near term. Of course, firms' technological choices determine the existence and scope of ancillary risks and benefits. This implies that in order to use CBA to evaluate collateral risks (and benefits), government must know in advance what technologies firms will use to comply with government standards and must consider the associated risks (and collateral benefits). Yet, the use of a global market reduces the government's ability to predict technological choices, thereby undermining CBA.[253]

Indeed, global trading fundamentally undermines even a sharply circumscribed CBA focusing only on projections of direct costs and targeted benefits. For the cost of reducing any environmental risk depends on the technological choices made in addressing it.[254] If the government uses a trading mechanism, it undermines its ability to estimate these future costs.[255] For increasing spatial flexibility widens the universe of possible technological options thereby complicating prediction of technological choices.

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251 *See* Kysar, *supra* note 171, at 258-59 (defining risk-risk analysis as focusing decision-makers on the secondary ancillary harms that come from regulating a chosen harm).

252 *See* Richard L. Revesz, *The Biases of Risk Tradeoff Analysis: Toward Parity in Regulatory Policy*, 69 U. CHI. L. REV. 1763, 1766 (2002) (faulting risk tradeoff analysis' neglect of "ancillary benefits").

253 *See* David M. Driesen, *Trading and Its Limits*, 14 PENN ST. ENVTL. L. REV. 169, 173 (2006) (leaving the choice of technologies to regulated parties leaves the government with "no timely means of evaluating risk/risk tradeoffs").

254 *See* Driesen, *supra* note 232, at 49-50 (government must consider data of polluters' abatement costs if it wishes to consider cost in setting a cap for a tradable permit program). *Compare* Wiener, *supra* note 43, at 775 (suggesting that only "technology-based regulation" depends upon agency consideration of abatement costs).

255 *See* Kysar, *supra* note 171, at 268 (noting that analysts expected acid rain permits to cost $1,500 a tone, but that they have traded for as little as $66.05 a ton).

Of course, policy-makers can reduce this tension by not relying on cost calculation in setting goals or by eschewing broad liberal trading. But broad liberal trading reduces government's capacity to accurately estimate future costs and benefits in setting goals.[256]

Trading's capacity to undermine CBA suggests a tension between market liberalism's institutional preference for markets and its analytical concepts. For these concepts demand a comprehensive consideration of costs and benefits, while markets rely on the decisions of private actors, who may only consider their actions' costs and benefits to themselves.[257]

On the other hand, sustainable development advocates have not shown how their preferred concept should concretely guide government regulation. Its vagaries may serve well as a framework for democratic debate.[258] But the rubric does not function precisely as a guide to macro-level decisions.[259] This imprecision may constitute a virtue in some settings, but it leaves sustainable development open to charges of irrationality.

The trading case reveals that sustainable development advocates face some other challenges in seeking to apply collective decision-making to technological choices. Richard Stewart has likened "command-and-control" regulation to discredited Soviet style central planning.[260] This charge clearly exaggerates the depth of technological control regulators exercise through traditional regulation. As a rule, traditional regulation

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256 *See* Driesen, *supra* note 253, at 173 (pointing out that CBA is more likely to be wrong when a trading approach is used than when it is not used, because it is difficult to predict the magnitude of the trading program's cost savings).

257 *See* EMISSIONS TRADING, *supra* note 55, at 3 (stating that once government allocates allowances its "action is limited to supervising the market, monitoring, and applying sanctions in the case of non-compliance.")

258 *See* SEGGER & KHALFAN, *supra* note 45, at 4 (noting that sustainable development's 'inclusiveness" helped it guide diverse local, national, and international communities).

259 *See* ID. (explaining that sustainable development does not function as a "scientific blueprint" for decision-makers and that this has caused "difficulties" in recent years). *Cf.* White, *supra* note 20, at 27-39 (explaining sources of great indeterminacy in efficiency determinations).

260 *See* Richard B. Stewart, *Economic, Environment, and the Limits of Legal Control,* 9 HARV. ENVTL. L. REV. 1, 6 (1985).

only demands a specified improvement in environmental performance from a particular industry.[261] It does not fix production quotas, nor does it commonly dictate fundamental technological choices, such as fuel choice for power production.[262]

But sustainable development's call for collective decision-making and integrated planning seems to require substantial community control over fundamental technological choices, much more control than either traditional regulation or emissions trading usually offers. While both sustainable development and economic rationality may require some role for collective decision-making in making fundamental technological choices, it is not clear that government should make key technological choices by itself.[263] Public choice theory, another contribution of neoliberal thinking, predicts that special interests will heavily influence government decision-making.[264] Many sustainability advocates would agree with that analysis.[265]

Sustainable development advocates seek to overcome special interest dominance through public participation, greater transparency, and integrated planning. Some of the insights of neoliberalism suggest that these efforts face challenges going beyond the

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261 *See* Richard B. Stewart, *A New Generation of Environmental Regulation*, 29 CAP. U. L. REV. 21, 94 (2001) ("command-and-control methods . . . limit . . . the quantity of residuals that each actor may generate).

262 *See* Swift, *supra* note 60, at 10336-37 (explaining that traditional regulations have accommodated different base technologies for power generation, instead of encouraging shifts to cleaner fuels and boiler designs).

263 *See* POSNER, *supra* note 16, at 160 (referring to government's "well known" inability to pick "technological winners"). *See generally*, Kysar, *supra* note 8, at 2147-48 (detailing a host of reasons to be skeptical of government's ability).

264 *See generally* KENNETH J. ARROW, SOCIAL CHOICE AND INDIVIDUAL VALUES (1963) JAMES M. BUCHANAN & GORDON TULLOCK, THE CALCULUS OF CONSENT: LOGICAL FOUNDATIONS OF CONSTITUTIONAL DEMOCRACY (1962); *cf.* JERRY L. MASHAW, GREED, CHAOS, AND GOVERNANCE: USING PUBLIC CHOICE TO IMPROVE PUBLIC LAW (1997); Mark Kelman, *On Democracy-Bashing: A Skeptical Look at the Theoretical and `Empirical' Practices of the Public Choice Movement*, 74 VIRGINIA. L. REV. (1988); Daniel A. Farber & Philip E. Frickey, *The Jurisprudence of Public Choice,* 65 TEXAS L. REV. 873 (1987); ARMATYA K. SEN, THEORY OF COLLECTIVE CHOICE (1970).

265 *See, e.g.,* Jim Vallette & Steve Kretzman, The Energy Tug of Ward: The Winners and Losers of World Bank Fossil Fuel Finance, at 2 (2004) (chiding the World Bank for funding projects benefiting "Northern fossil fuel corporations").

power of special interests. Even if the economists' call to discount future benefits is at war with sustainable development, their recognition that people tend to discount future benefits reflects a widespread reality. This suggests that sustainable development's procedural allegiance to integrated planning may not lead to achievement of sustainable development's substantive aspirations. For many people participating in collective decision-making may prove reluctant to incur costs in order to protect future generations' welfare.[266] The sustainable development project, however, represents a belief that collective participation can increase willingness to incur short term costs in order to achieve long-term benefits.

The question of how to design institutions to make wise fundamental technological changes presents a puzzle, a puzzle that lies sadly buried under much simplistic rhetoric about "economic incentives" and "command and control" regulation. The puzzle arises from market actors' systematic tendency to view such choices too narrowly coupled with the tendency of governments to avoid visible short term costs and offense to special interests. It's likely that the proper solution to this puzzle will vary from country to country and will involve some mixture of government choices and private initiative. In contexts like climate change, where we ultimately lead major technological changes, the appropriate choices will recognize and address the tradeoff between market liberalism's preference for cost effectiveness and the need for investments advancing sustainable development to protect future generations.

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[266] *See* Cass Sunstein, *Irreversible and Catastrophic*, 91 CORNELL L. REV. 841, 864 (2006) (stating that public resistance to paying now to reduce future risks fits standard claims about discounting).

V. CONCLUSION

The emissions trading experience under the Kyoto Protocol suggests that weak market liberalism might manage to co-exist with weak sustainability. Either a strong preference for markets (as opposed to economic concepts) or a strong concept of sustainability, however, tends to sever the union. Liberal markets, even markets designed for environmental protection, often fail to encourage expensive investments leading to long-term benefits because of positive spillovers.

This implies that environmental law must address a tension between cost effectiveness maximization of long-term technological capability. This tension should influence both instrument choice and design.

The problem of the proper role of collective decision-making in technological change poses a puzzle requiring much closer attention. Emissions trading's tendency to undermine CBA suggests that neoliberalism's institutional direction conflicts with its analytical predilections and with sustainable development. On the other hand, collective decision-making does not provide a panacea either, as shortsightedness can infect both public and private spheres. Study of the emissions trading experience under the Kyoto Protocol yields fascinating insights about the relationship between sustainable development and market liberalism. We can only hope that the nations of the world will build on these insights as they move forward in addressing climate change and other major global challenges.