CHAPTER 12

INTERNATIONAL MARKET MECHANISMS

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1. Introduction

THE publication of the book *Silent Spring*,[1] by American biologist Rachel Carson, is widely credited with catalyzing the modern-day environmental movement.[2] US Supreme Court Justice William O. Douglas pronounced *Silent Spring* to be 'the most important chronicle of this century for the human race'.[3] Prompted in part by Carson's influential book and aided by growing appeals from scientists to lawmakers to change some of the most obviously harmful industrial practices, the environmental movement quickly became part of the political landscape. Virtually all of the major federal environmental statutes were enacted by Congress in the following decade,[4] including the National Environmental Policy Act.[5] As a result, the earliest forms of pollution regulation were, unsurprisingly, designed by environmental lawyers.

It is much less celebrated (also unsurprisingly, perhaps) that economists were concurrently developing their own ideas about how to address environmental problems. In 1968, Canadian economist John H. Dales wrote *Pollution, Property and Prices: An Essay in Policy-making and Economics*,[6] in which he propounded the idea of pollution permit-trading. Dales argued that instead of regulating pollution on a source-by-source or emitter class-by-emitter class basis (as the legal mandates of the US federal statutes of the 1970s tended to do), a regulatory agency should begin by limiting the overall amount of pollution allowed. Firms could then trade amongst themselves, effectively using the market to determine which of them should be able to pollute, how much, and when.

Dales's insight was that pollution abatement costs are heterogeneous across facilities, firms, and over time.[7] What pollution permit-trading allows, through market trades, is the flow of pollution permits to their highest-valued users—those firms and those facilities for which pollution abatement is the most costly, and which will wind up as *net buyers* of tradable pollution permits. Conversely,

[1] Rachel Carson, *Silent Spring* (Houghton-Mifflin, 1962).

[2] Eliza Griswold, *How 'Silent Spring' Ignited the Environmental Movement*, N.Y. Times, September 21, 2012, at MM36.

[3] 'Are we poisoning ourselves?', September 8, 1962, pp. 36–8, *Business Week*.

[4] For example, the Clean Air Act was passed in 1970 (84 Stat. 485, P.L. 91-604), the Clean Water Act was passed in 1972 (formally, the Federal Water Pollution Control Act Amendments of 1972) (Publ. L. 92-500, October 18, 1972), and the Endangered Species Act in 1973 (87 Stat. 884, Publ. L 93-205).

[5] National Environmental Policy Act of 1969 (83 Stat. 852, Pub. L. 91-190).

[6] John Harkness Dales, *Pollution, Property & Prices: An Essay in Policy-making and Economics* (Toronto, 1968).

[7] Dales, *supra* note 6, at 86; Tom Tietenberg and Lynne Lewis, *Environmental and Natural Resource Economics*, p. 357 (Pearson, 10th edn, 2014).

those firms and facilities for which pollution abatement is cheaper than the market price of the permit will be *net sellers* of permits. In a well-functioning market, emissions reductions are undertaken by those for which abatement is the least expensive, thereby minimizing overall economy-wide pollution abatement costs.

This fundamental tenet of emissions trading—the exploitation of cost heterogeneity to minimize overall compliance costs[8]—has served as the animating theme of a wide variety of environmental initiatives around the world. The centrality of the market in achieving an economic objective—cost minimization—has led to coinage of the term 'market mechanisms' to describe policy instruments that seek to harness market forces to either reduce pollution, reduce compliance costs, or, most commonly, both.[9] This idea has become so powerful that domestic and international environmental laws are now presumed to function more efficiently if they embody some form of a market mechanism. While the environmental statutes enacted in the 1970s tended to create administratively centered, 'command-and-control' mandates, market mechanisms have become a favored approach to regulating at the domestic and international levels. The Montreal Protocol,[10] which reduced the production and consumption of ozone-depleting substances and the Kyoto Protocol,[11] which sought to reduce greenhouse gas (GHG) emissions, were both predicated on an emissions trading model. Further, the European Union Emissions Trading System (EU ETS), created to assist in meeting Kyoto Protocol emissions reduction targets in a way that minimizes costs for industry, was one of the first market mechanisms adopted jointly by a group of States.

Since cost heterogeneity is the predicate condition that must exist in order for market mechanisms to be useful, it would stand to reason that its use in a larger market will yield greater efficiency benefits. If a market mechanism can be designed so that it applies to many States and creates an international market, the cost heterogeneity would be greater, and permit trading should achieve greater efficiency gains. Moreover, trading across countries is also likely to take advantage of a greater variety of heterogeneous conditions than would be the case in a domestic market, even one as large as the United States. Vastly different economic conditions, for example, might make emissions reduction efforts much cheaper in a developing country than in a developed country. Little wonder, then, that market

[8] William J. Baumol and Wallace E. Oates, *The Theory of Environmental Policy*, pp. 21–3 (Cambridge University Press, 2nd edn, 1988); Tom Tietenberg and Lynne Lewis, *Environmental and Natural Resource Economics*, p. 357 (Pearson, 10th edn, 2014).

[9] See, e.g., Shi-Ling Hsu, 'Fairness Versus Efficiency in Environmental Law', 31 Ecol. L. Q. 303, 377–93 (2004).

[10] 'Montreal Protocol on Substances that Deplete the Ozone Layer', 1522 UNTS 3; 26 ILM 1550 (1987).

[11] The Kyoto Protocol to the United Nations Framework Convention on Climate Change, UN Doc FCCC/CP/1997/7/Add. 1 Dec. 10, 1997; 37 ILM 22 (1998).

mechanisms have been at least as popular in the transnational context as they have been in domestic contexts.

Market mechanisms are thus policy instruments that seek to not just reduce pollution, but to minimize the costs of doing so. Whereas a traditional regulatory regime would, in its clumsiest forms, mandate similar methods of emissions reduction for broad classes of emitters, a market mechanism would provide emitters with the flexibility to defer, accelerate, deflect, or even take on additional emissions reductions that a traditional command-and-control scheme might not require or allow. Command-and-control regulatory regimes have evolved considerably to reduce the rigidity that characterized their earlier versions, but fundamentally, these systems depend upon an *administrative adjudication* to determine the legality of emissions, by contrast, market mechanisms decentralize decisions about emissions reductions so that private firms are given considerable autonomy. International market mechanisms, then, are these mechanisms carried out among States. Given the difficulty of setting up a transnational administrative body that could make adjudicatory decisions at an international level, setting up a decentralized trading system would appear to be a less onerous global solution.

Another policy instrument considered to be a 'market mechanism' is a Pigouvian tax. Named after economist A.C. Pigou, a Pigouvian tax is a tax levied per unit of pollution emitted.[12] Pigouvian taxes are meant to internalize 'externalities', generally understood to be positive or negative side-effects from economic production that are not reflected in the price of production. A classic externality is environmental harm from polluting activities that is not properly taken into account by the polluter.[13] By pricing these external costs and forcing polluters to consider them in their private calculus, Pigouvian taxes force polluters to balance the social costs and their private economic benefits of polluting. A Pigouvian tax thus recruits private polluters for the task of making a social determination of the optimal level of pollution.

A Pigouvian tax is a market mechanism that shares many features with emissions trading. First, there is a devolution of abatement decisions to emitters, and away from regulatory agencies. The private emitter now determines, through market decisions based, in part, on the imposition of a tax, how much to pollute, and when. Second,

[12] French economist Alfred Pigou pioneered the idea that through taxes and subsidies, governments could introduce incentives to encourage fewer activities that generated negative externalities, and more activities that generated positive externalities. In other words, through taxes and subsidies, the government could equate the private marginal cost and the social marginal cost of an activity, and the private marginal benefit and social marginal benefit of an activity. A.C. Pigou, *The Economics of Welfare*, pp. 131–5 (1928). Taxes that reflected the extent of negative externality thus became known as 'Pigouvian' taxes. William J. Baumol and Wallace E. Oates, *The Theory of Environmental Policy*, pp. 21–3 (2nd edn, 1988).

[13] An externality is an effect of a decision, on a party other than the decision-maker, that the decision-maker does not take into account. Shi-Ling Hsu, 'Fairness Versus Efficiency in Environmental Law', 31 Ecol. L. Q. 303, 341, n. 157 (2004).

public control over emissions decisions is reduced to one central decision: in the case of emissions trading, the total quantity of permits allowed; in the case of Pigouvian tax rate, the tax rate for emissions. Third, both policy instruments internalize to some extent the external costs of polluting. In the case of Pigouvian taxation, the price paid is directly set by legislative or regulatory action as the tax rate. In the case of emissions trading, the price paid is set by market forces; legislative or regulatory action establishes an emissions 'cap' and private trading for emissions permits will determine the price paid by emitters. There is no guarantee that the Pigouvian tax rate or the emissions cap is socially optimal. Finally, because both instruments impose a marginal cost on polluting, they introduce an incentive to reduce emissions in innovative ways that might not have been the specific course mandated by agency regulators. The extent to which this has actually occurred, and to which innovation has been spurred by market mechanisms, is the subject of some debate.[14] But it is widely accepted that the incentives presented by market mechanisms are generally greater than under the traditional style approach to pollution, even including the more modern flexible and enlightened versions of these systems.[15]

Both emissions trading and Pigouvian taxes have at times been greeted with skepticism by environmental lawyers. For one thing, the objective of these market mechanisms seems more of an economic one, not an environmental one: the point of market mechanisms is to minimize compliance costs, and achieving environmental goals is not obviously related to the trading itself. If emissions reductions can be made less expensive, polluters will be willing to undertake deeper cuts in overall reductions. In that sense, viewing economic and environmental considerations as independent of each other misses the point. Economic savings make environmental benefits more feasibly obtained. This argument has not always been satisfying to detractors of market mechanisms, some of whom have continued to emphasize, not without reason, that the persistent undervaluation of environmental amenities and the difficulty in assessing the value of different environmental amenities complicates this process.

What has been most troubling for such detractors is the notion that decisions that seem public in nature have been devolved to private actors. In a traditional and administratively centered regulatory regime, an agency ultimately controls, through administrative adjudications, the vast majority of pollution abatement decisions. By contrast, under emissions trading and Pigouvian tax regimes, private actors make the vast majority of abatement decisions. This devolution of abatement decisions, many environmental lawyers worry, may have adverse environmental and equity consequences such as the development of pollution 'hot spots',

[14] Suzi Kerr and Richard Newell, 'Policy-Induced Technology Adoption: Evidence from the US Lead Phasedown', 51 J. Industrial Econ. 317 (2003).

[15] Hsu, *supra* note 13 at 381–5.

geographic areas in which a polluter can freely accumulate permits to pollute as much as they wish as long as they are willing to bear the cost of the tax.[16] Finally, environmental lawyers no doubt also worry that with many administrative decisions being devolved to private actors, there could well be less of a need for environmental lawyers with expertise in handling complicated environmental legal questions.

2. Emissions Trading Programs

The most efficient emissions trading system is a 'cap-and-trade' system, in which an established quantity of emissions permits are allocated to emitters, and are traded amongst the emitters (or even non-emitting permit speculators) to determine where and when emissions take place. A cap-and-trade system takes as relatively fixed the overall quantity of allowed emissions in the form of a hard cap, and contemplates a well-defined set of emissions sources that would be covered under the system. In such a closed system, the one central public decision, the overall quantity of emissions, will determine the environmental effectiveness of the program.

However, while the simple idea of emissions trading has spawned the phrase 'market mechanism', over time, the phrase has come to include several variations on this fundamental idea. The Canadian province of Alberta instituted a variation of the cap-and-trade idea by capping emissions *intensity* instead of establishing a fixed quantity of emissions.[17] The Alberta program only requires emitters to reduce the amount of emissions per unit of output. So, for example, Alberta's oil sands industry can increase emissions if their productive efficiency increases by a greater amount. If they can reduce GHG emissions per barrel of oil produced, they can claim some of that efficiency gain as a credit for emissions reductions. Such a program is not really a cap-and-trade program per se, but a performance standard with some added flexibility. That is, emitting industries are—as they often are under more traditional schemes—expected to achieve a certain maximum *rate* of emissions, and if they manage to achieve an even lower rate, they can claim tradable credits for that efficiency gain. But there is no guarantee of an absolute

[16] Jonathan Remy Nash and Richard L. Revesz, 'Market and Geography: Designing Marketable Permit Schemes to Control Local and Regional Pollutants', 28 Ecol. L. Q. 569, 574 (2001).

[17] Climate Change and Emissions Management Act, Statutes of Alberta 2003, ch. C-16.7, s 3; Alberta §§ 3–4 (2007).

emissions decrease; an entity can be more efficient with emissions but still increase emissions overall.

Other variations of emissions trading emerged in the 1970s under regulatory initiatives by the US Environmental Protection Agency (EPA) to introduce some regulatory flexibility for air pollution emitters. EPA's 'bubbling' rule allowed some facilities to measure facility emission rates from combined smokestacks or facilities.[18] The bubbling rule was simply a cap-and-trade system applied to only one firm possessing multiple polluting facilities.[19] As part of this 1970s regulatory flexibility initiative, the EPA also introduced a 'netting' rule that allowed firms to trade credits so that a firm could emit more as part of a change in technology.[20] Credits could be generated by a project or action that supposedly decreased emissions, such as a plant shut-down, or a pollution abatement project.[21] Also as part of this initiative, the EPA created an 'offsets' rule that allowed a new polluting source to begin operations only if it had achieved emissions reductions or obtained emissions reduction credits comparable to the emissions from the new source.[22] All of these rules required the EPA to make a determination as to whether an emitter would be permitted to invoke the rule.

Because these 1970's rules only permitted bubbling, netting, or offset transactions to take place with the approval of the EPA, these rules were not truly 'market' mechanisms, but rather regulatory efforts by the EPA to allow polluters some flexibility over emissions. A 'market' mechanism is one in which transactions are voluntarily made among two or more private parties, and in which one party supplies some environmental benefit. In such a transaction, there is little or no administrative adjudication. In these 1970's EPA rules, transactions are between a private party and the EPA. An environmental benefit is putatively supplied by the private party, but the job of determining the extent of the emissions reduction, and whether it would fully compensate for an emission increase in another time or place, was left to the EPA. The environmental 'value' or benefit of the trade was thus an administrative matter, not readily ascertainable in an open and free-flowing market. This value uncertainty, providing for the *ad hoc* nature of trading, as well as delays by EPA in approving trades, created transaction costs that inhibited the search for cheaper emissions reductions, and limited

[18] US Environmental Protection Agency, Requirements for Preparation, Adoption and Submittal of Implementation Plans and Approval and Promulgation of Implementation Plans, 46 Fed. Reg. 50,766 (1981) (codified at 40 C.F.R. § 52.24 (1984).

[19] Thomas J. Stukane, 'EPA's Bubble Concept After Chevron v. NRDC: Who is to Guard the Guards Themselves?' 17 Nat. Res. Lawyer 647, 648 (1985).

[20] US Environmental Protection Agency, Air Pollution Control; Recommendations for Alternative Emission Reduction Options Within State Implementation Plans, 44 Fed. Reg. 71,779 (1986); *amended*, Emissions Trading Policy Statement, 51 Fed. Reg. 43,814 (1986).

[21] Robert W. Hahn and Gordon L. Hester, *Marketable Permits: Lessons for Theory and Practice*, 16 Ecol. L. Q. 361, 402 (1989).

[22] *Supra* note 20.

the cost savings for firms.[23] By contrast, a more *decentralized* trading system—one in which market transactions could be consummated with little or no clearance from an administrative authority such as the EPA—would take on more of a market character, and be more consistent with Dales's original emissions trading idea.

These EPA rules were also applied erratically, suffering from both underinclusion and overinclusion. Some projects were allowed to move forward even as they caused environmental harm, while other projects were rejected even though they would have reduced emissions and achieved cost savings. That is not to say that a pure cap-and-trade system would always avoid such errors; that would depend on the rules governing formation of emission allowances. But the administrative involvement in determining the value of emissions reduction transactions created legal and market uncertainty.

The EPA was more successful in the 1980s in using a market mechanism to phase out the use of lead as a gasoline additive. The EPA introduced a tradable permit system for refineries, in which refiners were given a performance standard for lead content in the gasoline they produced.[24] Absent trading, refiners were required to produce gasoline containing no more than 1.1 grams of lead per gallon.[25] However, if a particular refiner was able to produce gasoline containing even less than 1.1 grams of lead per gallon, that refiner could sell to other refiners the rights to produce gasoline with lead concentrations *exceeding* the 1.1-gram standard. Over time, the 1.1-gram standard was ratcheted down to 0.1 grams per gallon, and lead was ultimately banned as a fuel additive in 1996.[26] By most accounts, the lead trading system was very successful in phasing out the use of lead as a gasoline additive,[27] and in inducing the kind of technological innovation that accelerated the phase-out.[28]

Market mechanisms made a critical appearance on the international stage with the Montreal Protocol[29] to phase out the ozone-depleting substances (ODS). In 1989, in connection with the Montreal Protocol, the United States banned most uses of chlorofluorcarbons (CFCs) and initiated a phase-out of other ODS by 1996. But like the lead phase-down program discussed above, a tradable permit system was employed to allow producers and consumers of ODS to trade with each other to allocate production and use. The results were, like the lead phase-down, impressive. Actual production was much lower than the permitted

[23] Richard A. Liroff, *Reforming Air Pollution Regulation: The Toil and Trouble of EPA's Bubble* (Conservation Foundation, 1986).

[24] US Environmental Protection Agency, Regulation of Fuel and Fuel Additives, 47 Fed. Reg. 49,322 (1982), *expired*, 50 Fed. Reg. 13,116 (1985).

[25] 47 Fed. Reg. at 49, 322.

[26] End to Trading, 40 C.F.R. §80.20(a), (d)(4) (1988).

[27] Hahn and Hester, *supra* note 21, at 389.

[28] Kerr and Newell, *supra* note 14.

[29] Montreal Protocol on Substances that Deplete the Ozone Layer, 1522 UNTS 3; 26 ILM 1550 (1987).

amounts in every year, and some ODS were completely phased out ahead of schedule.[30]

Some have lauded the lower transaction costs of the lead and ODS phase-down programs as the reason that compliance costs were kept to a minimum.[31] There is certainly some truth to this, as both programs were simpler by degrees and were more akin to a pure cap-and-trade program. Trades in lead did not require pre-approval by the EPA.[32] Trades in ODS did require EPA approval, but the EPA committed to approving each trade within three days.[33] However, the most important factor contributing to the success of both programs appeared to be the ready availability of economically feasible substitutes for the underlying substance. In the case of lead, alcohol, and other additives were already emerging as substitutes for lead as an anti-knocking ingredient, and in the case of ODS, substitutes were already available by the time that the Montreal Protocol was signed. Indeed, some accounts suggest that there was industry obstruction of scientific research and international negotiations *until* the substitutes appeared almost ready for deployment.[34] In any case, it is clear that a variety of factors affect the economic and environmental performance of market mechanisms.

These early experiences with market mechanisms greatly influenced (not always for the better) the design of subsequent programs. The apparent success of the simpler, less administratively complex programs (lead and ODS) led to the development of the sulfur dioxide cap-and-trade program under the 1990 Clean Air Act Amendments (the 'SO_2 program'). Under the SO_2 program, tradable allowances to emit sulfur dioxide were allocated to 246 specifically named coal-fired power plants.[35] The nationwide cap was also specified in the statute, 8.90 million tons,[36] albeit subject to a number of adjustments. For example, firms could 'opt in' facilities not initially covered under the program, and would be allocated some additional allowances for these facilities.[37] Absolutely critical to the smooth functioning and environmental performance of the program was the use of continuous emissions monitors, a technological breakthrough because it allowed constant, automated, remote measurement of sulfur dioxide emissions. Both SO_2 emitters and the EPA thus had accurate and transparent information on emissions, and because allowance trades did not have to be approved in advance by EPA, the program had an administrative certainty that was absent from EPA's 1970s rules.

[30] Richard E. Benedick, *Ozone Diplomacy* 195 (Harvard University Press, 1998).

[31] Hahn and Hester, *supra* note 21, at 390.

[32] David Sohn and Madeline Cohen, 'From Smokestacks to Species: Extending the Tradable Permit Approach From Air Pollution to Habitat Conservation', 15 Stan. Envtl. L.J. 405, 431 (1996).

[33] 40 C.F.R. §80.12(a)(2) (1993).

[34] Some accounts point to the industry obstruction of scientific research and international negotiations *until* the substitutes appeared almost ready for deployment. See Benedick, *supra* note 30, at 119.

[35] Clean Air Act § 404(e); 42 USC § 7651c(e) (1990).

[36] Clean Air Act § 403(a)(1); 42 USC § 7651b(a)(1) (1990).

[37] Clean Air Act § 404(d); 42 USC § 7651c(d) (1990).

The flexibility of the SO_2 program produced some unexpected environmental benefits that might not have occurred under a more traditional regulatory program. For example, by imposing a price for emissions of SO_2, the program induced firms to utilize older, dirtier plants less intensively than they might have had they only been required to comply with the original mandates typically found in the Clean Air Act regulations. While a disappointingly small number of coal-fired power plants were actually shut down, electricity generating firms relied on them much more sparingly, opting for natural gas-fired power plants instead. Natural gas plants soon became a constant, all-day, baseload power source, as well as a source for short-term, peak electricity demands.[38]

Moreover, the SO_2 program generated entrepreneurial activity around the reduction of SO_2 emissions so that the program yielded indirect benefits. Attention towards SO_2 emissions reductions led to more innovation for emissions reductions, both technical and logistical. The costs of emissions reduction lowered to a point that firms could afford to undertake more emissions reductions. Further, cheaper allowances induced firms to establish a reserve of excess allowances, essentially inducing them to 'overcomply' and hold more allowances than required.[39]

Although that the lead program and the ODS trading program were politically salable because affordable alternatives existed, it is an important benefit for a program to create opportunities for cheaper alternatives to be discovered and exploited. When emissions reductions are cheaper, overcompliance becomes cheaper, and the leap to next generation emissions reduction becomes cheaper as well. Lowering compliance costs is thus *very much* connected to lowering emissions. First, to the extent that environmental performance is one of several objectives in a private firm's decision environment, a more cost-efficient way to reduce emissions enhances environmental performance. Second, cap-and-trade programs produce more incentives for innovation for emissions reductions. Finally, cap-and-trade expands the range of opportunities for emissions reductions and engages a larger group of actors in efforts to address pollution reduction and further innovation.

Early experiences with market mechanisms have profoundly influenced efforts to reduce the emissions of GHGs to address climate change. Most prominently, the Kyoto Protocol[40] contemplated a global cap-and-trade system meant to apply to developed countries, and eventually all countries.[41] In addition, some parties to the Kyoto Protocol created their own domestic cap-and-trade programs that could be linked with those of other parties.

[38] A. Denny Ellerman et al., *Markets for Clean Air*, p.130 (Cambridge University Press, 2000).

[39] Ellerman, *supra* note 38, at 148–51.

[40] The Kyoto Protocol to the United Nations Framework Convention on Climate Change, UN Doc FCCC/CP/1997/7/Add. 1 Dec. 10, 1997; 37 ILM 22 (1998).

[41] Tim Profeta, 'Weaker Kyoto Protocol Extended at International Climate Negotiations', Nat'l Geographic (Dec. 13, 2012), <http://newswatch.nationalgeographic.com/2012/12/13/weaker-kyoto-protocol-extended-at-international-climate-negotiations> (accessed 5 August 2015).

The Kyoto Protocol also established a form of offsets, somewhat like those envisioned in EPA's 1970s offset rule.[42] GHG emitters in a developed country could fund projects in developing countries that reduce GHG emissions and obtain offset credits. This is known as the Clean Development Mechanism (CDM).[43] GHG emitters in developed countries can also fund projects in other developed countries, under the Joint Implementation (JI) program.[44] These initiatives were to be overseen by the CDM Executive Board and the JI Supervisory Committee, respectively, both of which were created under the Kyoto Protocol. In the early days of implementation, the CDM and JI programs produced numerous mistakes of overinclusion—approval of projects that did not really reduce emissions—and of underinclusion—the rejection of projects that would have produced an emissions reduction. For instance, a huge number of CDM projects in China purported to reduce emissions of HFC-23, a powerful GHG and byproduct of the production process, generating credits that could be used by emitters in developed countries in lieu of actually reducing GHG emissions. The problem was that the value of the credits far exceeded the value of the captured refrigerants. The plants producing HFC-23 had no real purpose other than the generation of credits; refrigerants were a mere pretense for such generation.[45] The issuance of these credits subjected the CDM Board to considerable criticism and cast doubt on the soundness of the entire offset idea.[46] At the same time, the paucity of approved CDM projects in developing countries other than China and India—those countries that might have the most to offer in terms of inexpensive emissions reductions (and would benefit the most from capital inflows)—suggest that the CDM program is bureaucratically burdensome enough to exclude many meritorious projects.

The underlying problem with the offset concept is that there is rarely a clear counterfactual for the project. What would the emissions have been in the absence of the offset program? If a proposed project does not achieve any real reduction from the 'business as usual' course of events, then any credits issued for the project are sham credits, and only serve to increase the overall cap on emissions.

At the sub-global level, the European Union has instituted its own cap-and-trade program to reduce GHGs. The European Union Emissions Trading System (EU ETS)[47] covers approximately 11,500 stationary sources of emissions, including

[42] Kyoto Protocol, Article 12. [43] Kyoto Protocol, Article 12.

[44] Kyoto Protocol, Article 6.

[45] Michael W. Wara, 'Measuring the Clean Development Mechanism's Performance and Potential', 55 UCLA. L. Rev. 1759, 1783–86 (2008); see also Michael W. Wara and David G. Victor, 'A Realistic Policy on International Carbon Offsets', Working Paper, online at <http://iis-db.stanford.edu/pubs/22157/WP74_final_final.pdf> (accessed 5 August 2015).

[46] Wara, *supra* note 45; Wara and Victor, *supra* note 45.

[47] European Commission, The EU Emission Trading Scheme, online at http://ec.europa.eu/clima/policies/ets/index_en.htm (accessed 5 August 2015).

cement, steel, glass, metal manufacturing, pulp and paper processing, and oil refining facilities, the most carbon-intensive industries. However, the EU ETS still only covers facilities that account for about forty-five percent of the EU's CO_2 emissions.[48]

The history of the EU ETS has also been fraught with mismanagement. In moving from an initial phase of the system to a more permanent one, the transition rules for carrying over allowances were poorly designed, and led to a collapse in allowance prices to nearly zero.[49] Also, because GHG emissions are very highly correlated with economic activity, the global recession of 2008–2009 and continuing economic weakness throughout Europe led to a sharp decrease in GHG emissions, which caused EU ETS allowance prices to collapse again.[50] The EU considered propping up allowance prices in 2013, but voted against it.[51]

Several other cap-and-trade programs exist. The Regional Greenhouse Gas Initiative (RGGI), a program among nine (originally ten) Northeastern American states, requires power plants in those states to participate in a cap-and-trade program. Also, in the United States, California pioneered a regional cap-and-trade system, the Western Climate Initiative, and garnered the participation of seven other American states as well as four Canadian provinces, only to have all except one withdraw. California, with its landmark GHG legislation AB32,[52] established a cap-and-trade program for major industrial emitters in the state.

The discouraging experiences with emissions trading for GHGs, however, are due more to the intractability of climate change politics than any fundamental flaw with emissions trading systems. Indeed, GHGs would seem to be an ideal pollutant for a cap-and-trade program, since all GHGs are globally uniformly mixed pollutants, such that emissions of GHGs have the same effect on the global climate systems no matter where in the world they were emitted. No GHG is toxic enough to form any 'hot spots' that could endanger local populations. Moreover, there is enormous potential for legitimate offset projects such as reforestation and low-impact agriculture, so that emissions reductions could really be achieved for a fraction of the cost of abatement technologies.

However, the politics at every level are fraught. Internationally, the refusal of developing countries, led by China and India, to assume binding caps on their national emissions led to the unraveling of support for GHG pricing among

[48] European Commission, The EU Emissions Trading System (EU ETS) (11 June 2014). ('EUETS [c]over around 45% of the EU's greenhouse gas emissions.')

[49] A. Denny Ellerman and Barbara K. Buchner, *Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005–06 Emissions Data*, 41 Envtl. Res. Econ. 267, 270 (2008).

[50] Bruno Declerq, Erik Dalarue, and William D'haeseleer, 'Impact of the Economic Recession on the European Power Sector's CO_2 Emissions', 39 Energy Pol'y. 1677, 1678 (2011).

[51] 'European Parliament Votes Down Carbon Permit "Backloading" Proposal', 17 Bridges (18 April 2013); <http://www.ictsd.org/bridges-news/bridges/news/european-parliament-votes-down-carbon-permit-backloading-proposal> (accessed 5 August 2015).

[52] Global Warming Solutions Act of 2006, CAL. HEALTH & SAFETY CODE §§ 38500-38599, available at <http://www.arb.ca.gov/cc/ab32/ab32.htm> (accessed 16 June 2014).

developed countries. Regionally, the flagging economic fortunes of the EU made the EU ETS seem like more and more of a luxury, especially when the United States, Canada, China, Russia, and India—collectively accounting for about fifty-five percent of global emissions—were refusing to even consider GHG pricing. At the individual state level, the politics may be smaller and appear more tractable, but they often are trumped by concerns with economic competitiveness and carbon leakage. The very pervasiveness of GHG emissions that makes it such an ideal pollutant for emissions trading also makes the politics of implementation especially complicated.

3. Pigouvian Taxes

The other frequently discussed 'market mechanism' is the Pigouvian tax. Whereas a cap-and-trade program fixes the quantity of pollution and allows the price to be set by the market, a Pigouvian tax fixes the price and allows the overall quantity of pollution to vary. In a world with perfect information, there would be no difference in economic efficiency (including the economic value of environmental quality) between the two instruments. However, if there is uncertainty about either marginal pollution abatement costs or marginal social costs of pollution, then there can be significant welfare consequences in choosing between a cap and trade program and a tax. In his seminal paper, economist Martin Weitzman set out the conditions under which a cap-and-trade program would minimize the risk of deadweight loss—the economic loss resulting from the misallocation of resources due to excess emissions or abatement—and the converse conditions under which a Pigouvian tax would minimize waste.[53] The paper remains relevant today, as economists debate whether GHGs should be subject to a cap-and-trade program or a carbon tax.

As has been the case with emissions trading, the simple idea of a Pigouvian tax has morphed into variants that achieve some, but not all, of its objectives. Gasoline taxes have long been in effect in the United States, but have been considered revenue sources for road construction and maintenance rather than a Pigouvian tax aimed at reducing emissions from driving.[54] At the 2015 American average of less than 50 cents per gallon of gasoline, the United States has one of the lowest gas taxes in the world.[55] The only other levy in the United States that could have been considered a Pigouvian tax was a chemical feedstock tax adopted pursuant to the

[53] Martin L. Weitzman, 'Prices vs. Quantities', 41 Rev. Econ. Stud. 477 (1974).

[54] It is telling that the federal gasoline tax was instituted under the Revenue Act of 1932. Revenue Act of 1932, Ch. 209, § 617(a), 47 Stat. 169, 266.

[55] Ian W.H. Parry, 'Is Gasoline Undertaxed in the United States?' 148 Resources 28, 28 (2002) <http://www.rff.org/rff/Documents/RFF-Resources-148-gasoline.pdf> (accessed 15 September 2015).

'Superfund' law, or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),[56] which imposed a tax on the production of petroleum and on forty-two chemicals.[57] The feedstock tax was used to fund prosecutions for violations of CERCLA and to fund cleanups of contaminated sites, rather than create a price signifying the social cost of producing chemicals. The tax expired in 1996 and was not reauthorized.[58]

Beyond the United States, Europe, which faced enormous revenue needs after the Second World War, is much more accustomed to higher gasoline taxes, and is generally more tolerant than the United States of taxation. The minimum EU tax on unleaded gasoline of 359 euros per 1000 liters translates into $1.76 per gallon in the United States,[59] and every EU Member State, except Romania, exceeds that rate. The rate in the Netherlands is more than double the minimum rate, at 746 euros per 1000 liters.[60] Europe is also where environmental taxes are the most common and have their greatest effect. Taxes are levied on the production or consumption of a broad range of goods with negative environmental effects, such as coal and coke, natural gas, kerosene, heavy fuel oil, mineral oil, and electricity.[61] For instance, the Scandinavian countries impose taxes on nitrogen oxides (NOx) and SO_2.[62] Sweden rebates NOx tax proceeds in proportion to energy output, offering at once carrots to firms that are able to reduce NOx emissions and punishing those that do not.[63] Whereas a pure Pigouvian tax is simply the tax, the Swedish NOx tax is a variant in its recycling of revenues back to producers, presumably to blunt some of the political opposition to the tax.

Most significantly, several European countries have instituted some form of a carbon tax to reduce emissions of CO_2 and other GHGs. A carbon tax is a unitary tax on a fossil fuel or other carbon-containing compound that is levied on the basis of carbon content, on the assumption that all of the embedded carbon would be oxidized in combustion and released into the atmosphere as CO_2.[64] The complication with imposing carbon taxes in Europe is that they are layered on top of a variety of existing electricity and energy taxes. Also, some countries with carbon taxes carve out exemptions

[56] 'Comprehensive Environmental Response, Compensation, and Liability Act of 1980', Publ. L. 95–510, 94 Stat. 2767 (1980).

[57] CERCLA, Subtitle A, Publ. L. 95–510, *amended* Superfund Amendments and Reauthorization Act of 1986 (P.L. 99–499).

[58] Omnibus Budget Reconciliation Act of 1990, P.L. 101–508, §11231 (1990).

[59] Taking the exchange rate at $1 to 0.74 euros, in effect on 13 June 2014.

[60] European Commission, Excise Duty Tables, Part II—Energy Products and Electricity (January 2013); <http://ec.europa.eu/taxation_customs/resources/documents/taxation/excise_duties/energy_products/rates/excise_duties-part_ii_energy_products_en.pdf> (accessed 5 August 2015).

[61] Ibid, at 4.

[62] Jean-Phillppe Barde, 'Implementing Green Tax Reforms in OECD Countries: Progress and Barriers', in 2 Critical Issues in Environmental Taxation, International and comparative Perspectives 8–11 (J. Milne, K. Deketeleare, L. Kreiser, and H. Ashiabor eds, 2005).

[63] Stephen Smith, 'Environmental and Public Finance Aspects of the Taxation of Energy', Oxford Review of Economic Policy, 14(4):64–83, 70–3 (1998).

[64] Shi-Ling Hsu, *The Case for a Carbon Tax: Getting Past Our Hang-ups to Effective Climate Policy* 17 (Island Press, 2011).

for favored industries or industries deemed to be vulnerable to international competition from firms in countries lacking comparable GHG emissions regulation.

Carbon taxes nevertheless exist in some form in Finland,[65] Sweden,[66] Norway,[67] Denmark,[68] Iceland,[69] Ireland,[70] Japan,[71] Switzerland,[72] France,[73] the United Kingdom,[74] Mexico,[75] and Chile.[76] Finland, Sweden, Denmark, and Norway all

[65] Act on Excise Duty on Electricity and Certain Fuels of 30 December 1996 (1260/96) (Fin.). See Org. for Econ. Cooperation & Dev., Inventory of Estimated Budgetary Support & Tax Expenditures for Fossil Fuels 2013 at 153–64, available at <http://www.oecd-ilibrary.org/environment/inventory-of-estimated-budgetary-support-and-tax-expenditures-for-fossil-fuels-2013_9789264187610-en> (accessed 5 August 2015). See also Stefan Speck et al., 'The Use of Economic Instruments in Nordic and Baltic Environmental Policy 2001–2005' at 99–113 (2006), available at <http://www.norden.org/da/publikationer/publikationer/2006-525/> (accessed 5 August 2015).

[66] Act (1994:1776) on the Taxation of Energy (Swe.), available at <http://www.riksdagen.se/sv/Dokument-Lagar/Lagar/Svenskforfattningssamling/Lag-19941776-om-skatt-pa-en_sfs-1994-1776/> (accessed 5 August 2015). See also Int'l Energy Agency, Energy Policies of IEA Countries: Sweden 2013 Review, available at <http://www.iea.org/textbase/nppdf/free/2013/sweden2013_excerpt.pdf> (accessed 5 August 2015).

[67] See Law on Tax on Emissions of CO_2 in the Petroleum Activities on the Continental Shelf, LOV-1990-12-21-72 (Nor.), available at <http://lovdata.no/dokument/NL/lov/1990-12-21-72> (accessed 5 August 2015). See Stefan Speck et al., 'The Use of Economic Instruments in Nordic and Baltic Environmental Policy 2001–2005' at 169–90 (2006), available at http://www.norden.org/da/publikationer/publikationer/2006-525/> (accessed 5 August 2015).

[68] Act. No. 888 of 1991 (Den.), available at <https://www.retsinformation.dk/Forms/R0710.aspx?id=63705> (accessed 5 August 2015); amended by Consolidation Act. No. 321 of 2011 (Den.), available at <https://www.retsinformation.dk/Forms/R0710.aspx?id=133858> (accessed 5 August 2015). See Speck, *supra* note 67.

[69] Government of Iceland, Legislation on Environmental and Resource Taxes (December 23, 2009), available at <http://www.althingi.is/altext/stjt/2009.129.html> (accessed 5 August 2015).

[70] Finance Act 2010, Chs. 1–3 (Ir.), available at <http://www.irishstatutebook.ie/pdf/2010/en.act.2010.0005.pdf> (accessed 5 August 2015).

[71] Government of Japan, Tax Reform Act of Mar 31, 2012, Special Provisions for Carbon Dioxide Tax of Global Warming Measures (31 March 2012), available at <http://law.e-gov.go.jp/cgi-bin/idxselect.cgi?IDX_OPT=1&H_NAME=%91%64%90%c5%93%c1%95%ca%91%5b%92%75%96%40&H_NAME_YOMI=%82%a0&H_NO_GENGO=H&H_NO_YEAR=&H_NO_TYPE=2&H_NO_NO=&H_FILE_NAME=S32HO026&H_RYAKU=1&H_CTG=1&H_YOMI_GUN=1&H_CTG_GUN=1> (accessed 5 August 2015).

[72] Government of Switzerland, *Federal Act on the Reduction of CO2 Emissions* (23 December 2011), available at <http://www.admin.ch/opc/en/classified-compilation/20091310/index.html> (accessed 5 August 2015).

[73] Government of France, Act No. 2013-1279 of December 29, 2013 Supplementary Budget for 2013(1) (27 March 2014), available at <http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000028400921> (accessed 5 August 2015).

[74] Sch. 6, Finance Act 2000, as amended by Finance Act 2013; Climate Change Levy (General) Regulations, 2001, S.I. 2001/838), as amended by the Climate Change Levy (General) (Amendment) Regulations, 2013, S.I. 2013/713), available at <http://www.legislation.gov.uk/> (accessed 5 August 2015).

[75] Government of Mexico, *Diario Oficial*, 11 December 2013, at Second Section, p. 1–10, available at <http://www.natlaw.com/system/files/dbdocs/diario_oficial_2013_12_11.pdf> (authorized access only).

[76] Government of Chile, *Diario Oficial de la Republica de Chile*, 29 September 2014, at I-39; Kate Galbraith, 'Climate Change Concerns Push Chile to Forefront of Carbon Tax Movement', N.Y. Times, 29 October 2014, <http://www.nytimes.com/2014/10/30/business/international/climate-change-concerns-push-chile-to-forefront-of-carbon-tax-movement.html?_r=0> (accessed 5 August 2015).

introduced their carbon taxes between 1990 and 1992. Finland instituted the world's first carbon tax in 1990,[77] while Sweden imposes the highest carbon tax, at about $150 per ton of CO_2.[78] Nominally, the carbon tax rates range among the four Scandinavian countries from about $15 per ton of CO_2 in Denmark to $150 per ton in Sweden. However, all four countries offer significant exemptions and rate reductions for electricity, energy-intensive industries, and other industries deemed to be economically vulnerable to trade competition.[79]

Because electricity must cross borders within the European Union, the EU regulates the amount of taxes that can be imposed by Member States on electricity. EU Regulations thus restrict the Member State's ability to tax electricity in a way that might be discriminatory.[80] The four Scandinavian EU Member States all exempt fossil fuels used for generating electricity from their respective carbon taxes. At least in Sweden, which derives over eighty-five percent of its electricity from either nuclear power or hydropower,[81] and in Norway, which derives almost all of its electricity from hydropower, these electricity exemptions are not highly distortionary. For the most part, the other Scandinavian countries rely on a variety of other policies to try to shift fossil fuel-fired electricity generation away from coal and natural gas. For example, Denmark is one of the leading wind power generating countries in the world, relying upon offshore wind energy for twenty-eight percent of its electricity needs, but has not relied upon its carbon tax to induce change.[82] Thus, the high rates of renewable energy generation in Scandinavian countries are not due to market mechanisms.

Among the EU Member States, the United Kingdom is the most recent country to have adopted something like a carbon tax. The 2001 Climate Change Levy (CCL), however, is a tax on energy consumption, not carbon content, and so is not really a carbon tax.[83] It also excludes residential uses and transportation fuels (which, like all European countries, are subject to high rates of taxation

[77] J. Andrew Hoerner and Benoît Bosquet, *Environmental Tax Reform: The European Experience*, (Washington, D.C.: Center for a Sustainable Economy, 2001), available at <http://www.rprogress.org/publications/2001/eurosurvey_2001.pdf> (accessed 5 August 2015).

[78] Cite exchange rate of 0.15 USD per krona, 110 ore/kg CO_2 http://www.svenskenergi.se/Elfakta/Miljo-och-klimat/Mal-och-styrmedel/ <http://www.sweden.se/eng/Home/Society/Sustainability/Facts/Energy/> (both accessed 5 August 2015).

[79] Annegrete Bruvoll and Bodil Merethe Larsen, Statistics Nor., Research Dep't, 'Greenhouse Gas Emissions in Norway: Do Carbon Taxes Work?' 16 (2002), available at <http://www.ssb.no/publikasjoner/DP/pdf/dp337.pdf> (accessed 5 August 2015).

[80] Philipp Genschel and Markus Jachtenfuchs, *How the European Union Constrains the State: Multilevel Governance of Taxation*, 50 EUR. J. POL. RES. 293 (2011).

[81] Swedish Energy Agency, Energy in Sweden 2013, available at <http://www.energimyndigheten.se> (accessed 5 August 2015).

[82] Danish Energy Agency, Energy Statistics 2012 at 9 (2014), available at <http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/energy_statistics_2012.pdf> (accessed 5 August 2015).

[83] Finance Act 2010 (Eng.) *supra* note 74.

anyway).[84] Similar to what occurs in the Scandinavian countries, the UK consciously shifted electricity production away from coal and towards natural gas using other policies. However, imposing a tax on electricity consumption instead of carbon emissions misses an opportunity to use the levy to encourage renewable energy production.

Beyond early developments in the EU, a second wave of carbon tax laws began in 2008, with Switzerland and the Canadian province of British Columbia (BC) enacting carbon taxes in 2008, Ireland and Iceland in 2010, Mexico and Japan in 2012, and France and Chile in 2014.[85] The taxes are generally modest, ranging in cost from about US$2 per ton of CO_2 to US$30. With the exception of BC, the most broad-based of the taxes all contain very significant exemptions, typically for energy usage or for entities already subject to the EU ETS.

The BC tax is particularly interesting because it is the only carbon tax in North America, as well as being one of the more effective carbon taxes in the world. The BC Carbon Tax Act[86] imposed a gradually increasing tax on emissions from the combustion of fossil fuels and other specified combustibles based on carbon content. As a provincial tax, it applies to emissions only within the Province, and excludes or specifically exempts fuels exported from British Columbia and fuels used for inter-jurisdictional commercial marine and aviation purposes.[87] Introduced in 2008, the tax rate ramped up from an initial rate of approximately $10 per ton of CO_2-equivalent emissions, to its current rate of $30 per ton.[88] The tax was intended to be 'revenue neutral', and so was packaged with reductions in the marginal income tax rates of the lowest two tax brackets, as well as reductions in the corporate income tax rate.[89] However, the BC carbon tax has turned out to be persistently revenue-*negative*, taking in much less in revenues than it is believed to have cost the province.[90] As North America has always been much more hostile to Pigouvian taxes,[91] the BC carbon tax faced several political challenges, but appears to be politically safe from repeal for the foreseeable future.

[84] Sch. 6, Finance Act 2010 (Eng.) *supra* note 74.

[85] World Bank, *Putting a Price on Carbon with a Tax* (no date), online: <http://www.worldbank.org/content/dam/Worldbank/document/SDN/background-note_carbon-tax.pdf> (accessed 5 August 2015).

[86] Carbon Tax Act, SBC 2008, Ch. 40 (2008).

[87] Carbon Tax Act, *supra* note 86, § 10.

[88] Carbon Tax Act, *supra* note 86, Schedule 1.

[89] Kathryn Harrison, 'The Political Economy of British Columbia's Carbon Tax', OECD Environment Working Papers No. 63 9 (2013), <http://www.oecd-ilibrary.org/docserver/download/5k3z04gkkhkg.pdf?expires=1402681242&id=id&accname=guest&checksum=8356A656BB41B72AAF75A3912702F754> (accessed 5 August 2015).

[90] Harrison, *supra* note 89, at 9.

[91] Henrik Hammar, Asa Lofgren, and Thomas Sterner, 'Political Economy Obstacles to Fuel Taxation', 25 Energy Journal 1 (2004).

4. Conclusion

The market-based ideas of Pigou and J.H. Dales have easily stood the test of time as being theoretically the most efficient means of reducing pollution. However, in order for Pigouvian taxation and emissions trading to work in practice, a number of implementation issues need to be addressed. Experience with market mechanisms domestically and internationally have demonstrated that some implementation issues prove especially thorny. For example, while the idea of using offsets as part of an emissions trading scheme may be theoretically sound, care must be taken to ensure that fraudulent projects do not form the basis of emissions reductions credits. The experience with the Clean Development Mechanism under the Kyoto Protocol serves as a stark reminder of that difficulty. Beyond implementation issues, the development of market mechanisms has often encountered stiff political resistance, as opponents have exploited populist fears of high prices and job losses to mobilize opposition to a carbon tax or emissions trading programs. Finally, it is worth noting that in addressing opposition concerns, the environmental objectives of market mechanisms have sometimes been compromised. For example, while Scandinavian countries have led the way in implementing carbon taxes, the many exemptions that are built into those taxes have reduced their effectiveness in reducing emissions. Striking a balance between environmental effectiveness and political feasibility appears to be surprisingly difficult. All that being said, the limited experience to date with domestic and international market mechanisms are cause for optimism: environmental and economic objectives can be simultaneously achieved in one program. Market mechanisms make explicit a truism about international environmental law and policy: that environmental and economic objectives are inextricably linked, and cannot be separated in the pursuit of successful emissions reductions strategies.