EFFLUENT TRADING IN THE UNITED STATES AND AUSTRALIA

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I. INTRODUCTION

Over the last twenty years, the American public has come to recognize pollutant trading schemes as a potentially valuable way of reducing the level of pollution in our society at a lower cost than could be offered by conventional means.

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Most of these schemes up until now have concentrated on air pollutants; so-called emissions trading. However, in the last few years, we have seen increasing interest in effluent trading, or the trading in water pollution discharge rights.

According to one definition, effluent trading allows "one entity to remove or prevent additional pollutant discharges while allowing another to discharge more, under the control of an agreement between the two parties involved in the trade."[1] When properly conducted, a trading program can achieve reductions of a particular pollutant or class of pollutants at a lower cost than would be feasible under traditional command and control methods.[2] Effluent trading schemes are virtually certain to proliferate around the world in years to come, yet there has been remarkably little consensus as to what are the necessary ingredients for developing a workable trading scheme.

The goal of this paper is to provide a background of what has been learned to date about effluent trading, primarily garnered from analyzing a handful of the longest running and best studied projects in the United States and Australia. The structure of the paper will include an introduction to the history and theory of effluent trading, followed by an overview of six effluent trading schemes utilized in the United States and Australia. At the end of this discussion, certain lessons from these projects will be presented that should be of use when developing new effluent trading projects.

This paper will be organized in the following manner: Section II will briefly describe the economic theory behind effluent trading. Section III will then describe the historical development of such schemes, primarily in the United States. Section IV will examine in some detail a number of the better established effluent trading schemes in the United States and Australia. Section V will outline some lessons that can be learned from the previously described effluent trading schemes. Section VI will conclude by providing certain recommendations for the development of new effluent trading systems.

II. THE ECONOMICS OF POLLUTION TRADING

In the United States, as in most other countries, pollution regulation has traditionally been based on the command-and-control framework. This involves the imposition of controls and/or emission limits on dischargers in order to meet a desired standard of air or water quality, or a desired level of technological sophistication in terms of pollution control. While the command-and-control framework has produced impressive improvements in environmental quality, from

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1. Wisconsin Department of Natural Resources website on Watershed Based Pollutant Trading, at http://www.dnr.state.wi.us/org/water/wm/nps/pt/index.htm (last visited Oct. 21, 2003). In fact, this definition can be seen as overly simplistic. There are times when a seller may not actually be removing or preventing additional pollution, depending on the initial allocation of permits (Russia's role in the Kyoto regime could turn out to be an example of this). Also, the buyer and seller need not be the actual polluting parties—brokers, middlemen and investors can often participate in effluent trading markets as well.

2. National Wildlife Federation, *A New Tool For Water Quality: Making Watershed-Based Trading Work for You*, available at http://www.nwf.org/watersheds/pdf_documents/newtool.pdf,at 5 (last visited Oct. 21, 2003).

an economic perspective it has a number of important failings. According to one analyst, command-and-control regulation,

> creates enormous economic waste by failing to equalize the marginal costs of control of the same pollutant across different sources. Uniform 'one size fits all' requirements are adopted for categories of industrial facilities, ignoring large variations in the costs of control among different facilities within the same category. In addition, the piecemeal and uncoordinated character of regulation writing results in large differences in the marginal costs of control among different categories of facilities.[3]

Economic incentives for environmental improvement such as pollution taxes and emissions trading were first proposed by economists as alternatives to command-and-control regulation in the late sixties and early seventies.[4] The theory behind tradable permit systems is that given a constraint on the use of a pollutant, tradable permits will maximize the value received from the emission of that pollutant. In a perfectly competitive market, tradable permits will flow toward their highest value use. Those who receive a lower value from the use of the permits have an incentive to trade them to those who receive a higher value from their use.[5] This theory holds true regardless of how the tradable permits are initially allocated.[6] Tradable permits also provide continuing incentives for innovation and investment in less polluting technologies, as sources that succeed in such innovation can profit from trading their excess pollutant credits, thereby gaining a competitive advantage.[7]

As with all markets, the theoretical desirability of pollution trading markets is based on assumptions of a well functioning marketplace. Some economists have pointed out that in the real world marketable permit systems could experience domination from a single firm or small handful of firms or could fail to perform well due to high transaction costs.[8]

A. EFFLUENT TRADING

Water pollution programs are attractive candidates for the introduction of pollutant trading schemes. For a number of reasons, including size, control technology, and characteristics of the incoming waste stream, effluent dischargers

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3. Richard B. Stewart, *United States Environmental Regulation: An Environmental Paradigm*, 15 J. L. & COM. 585, 587-88 (1996).

4. *See* T.D. CROCKER, *The Structuring of Atmospheric Pollution Control Systems*, *in* THE ECONOMICS OF AIR POLLUTION (H. Wolozin, ed., 1966); J.H. DALES, POLLUTION, PROPERTY & PRICES (1968) (proposing a tradable permit scheme specifically geared towards water pollution); D. Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 JOURNAL OF ECONOMIC THEORY 395, 395 (1972).

5. *See generally* W.J. BAUMOL & W.E. OATES, THE THEORY OF ENVIRONMENTAL POLICY (1988).

6. *See* Montgomery, *supra* note 4.

7. Richard B. Stewart, *A New Generation of Environmental Regulation?* 29 CAP. U. L. REV. 21, 99 (2001).

8. Robert Hahn & Gordon Hester, *Marketable Permits: Lessons for Theory and Practice*, 28 ECOLOGY L.Q. 569, 621 (1989). While market domination problems have not arisen in existing effluent trading schemes (and would presumably be covered by the antitrust laws if they did), high transaction costs have posed a problem to some systems, as will be described in more detail in sections IV and V.

can face vastly different costs of compliance.[9] Therefore, effluent trading should theoretically lead to considerable cost savings in achieving a particular level of effluent emissions. According to one commentator, there are five main benefits associated with water pollution trading. These are: 1) cost savings; 2) incentives to reduce pollution beyond the current limits; 3) incentives for technological innovation; 4) an emphasis on water quality rather than the installation of particular abatement technology, and 5) the possibility of the participation of independent groups.[10]

While effluent trading programs are by now widely accepted by economists and policy makers as a valuable option to consider when developing pollution control programs, there is still considerable opposition to the idea from some environmental groups.[11] This is largely based on the idea that polluters should not possess a 'right' to pollute.[12]

Three of the most important issues that must be dealt with in effluent trading schemes are hot spots, monitoring, and transaction costs. These issues will be discussed in greater depth later on, but they merit a brief introduction at the outset. Hot spots refer to local pockets of intense pollution.[13] They can occur with or without effluent trading, but there is concern that poorly managed trading systems can exacerbate this problem. Monitoring refers to the need for regulatory bodies to monitor discharges in order to promote compliance with a trading system. Effective monitoring systems are composed of data, data management and verification components.[14] Transaction costs refer to the costs of actually effectuating trades, and high transaction costs can be a serious barrier to efficient pollutant markets.

Effluent trading schemes can be conceptually divided into "closed" systems (also called "cap and trade" systems") and "open" systems.[15] Closed trading systems contain a mandatory cap on emissions or discharges and individual allowances to

9. Paul Faeth, *Fertile Ground: Nutrient Trading's Potential to Cost-Effectively Improve Water Quality* 13 (World Resources Institute 2000), available at http://pdf.wri.org/fertile_ground.pdf (last visited Oct. 21, 2003).

10. Sandra Rousseau, *Effluent Trading to Improve Water Quality: What Do We Know Today?* ETE Working Paper 2001-26 at 3 (2001), available at http://www.econ.kuleuven.ac.be/ew/academic/energmil/downloads/ete-wp01-26.pdf (last visited Oct. 21, 2003).

11. The Sierra Club Policy on Trading reads in part as follows:"The Sierra Club opposes use of trading. In all cases, if a program is initiated, there must be full public notice, disclosure, participation, oversight, accountability, verification, and effective enforcement, with rights of appeal for affected citizens and administrative and judicial remedies." http://www.sierraclub.org/policy/conservation/trading.asp (last visited Oct. 21, 2003).

12. According to Nancy Stoner, director of NRDC's clean water program: "The EPA's pollution credits trading program is based on the notion that it's okay for some dischargers to pollute at higher-than-legal levels. . .Rather than trade away the Clean Water Act by giving industries the right to pollute, the government should enforce clean water protections." National Resources Defense Council website, at http://www.nrdc.org/bushrecord/health_water.asp (last visited Oct. 21, 2003).

13. Michael Naughton, *Establishing Interstate Markets for Emissions Trading of Ozone Precursors: The Case of the Northeast Ozone Transport Commission and the Northeast States for Coordinated Air Use Management Emissions Trading Proposals*, 3 N.Y.U. ENVTL. L. J. 195, 198 (1994).

14. Rousseau, *supra* note 10, at 7.

15. Faeth, *supra* note 9, at 13; Kurt Stephenson, Leonard Shabman & Leon Geyer, *Toward an Effective Watershed-Based Effluent Allowance Trading System: Identifying the Statutory and Regulatory Barriers to Implementation*, 5 ENVTL. LAW 775, 783, n. 22 (1999).

participating sources. The cap is established by the regulatory agency to achieve the desired environmental quality standards. Under the U.S. Clean Water Act, caps can be set for individual watersheds through the Total Maximum Daily Load (TMDL) process. Allocations in the form of allowances are then established for each discharge site within the trading area. A trading system is said to be "fully closed" when all discharge sites are controlled under the cap and the cap is equal to the total permissible load for the watershed.[16]

Open trading systems rely on existing regulations to establish an emissions baseline; reductions from the baseline generate a credit.[17] Depending on the program, these credits can then be banked,[18] traded, or used to comply with discharge limits established by reducing discharges at an outside site (i.e., a site that does not itself have a discharge limit under the program). Open systems offer greater operational flexibility without the administrative burden of establishing a mandatory cap and allowances for each discharge site. While open systems tend to have higher transaction costs for individual trades, they generally involve fewer up-front administrative costs.

It is important to note that both open and closed trading systems are compatible with technology-based standards. For reasons of both law and policy, all American effluent dischargers must use a certain minimal level of pollution control technology, regardless of whether or not they are also participating in an effluent trading system.[19]

B. POINT SOURCES AND NON-POINT SOURCES

As a practical matter, effluent trading systems are also classified as to whether they allow trading between point sources, trading between point and non-point sources, or trading between different non-point sources. There is no completely satisfactory definition for what constitutes a point source and non-point source, but one simple distinction is that point sources are pollution sources that can be attributed to a discrete conveyance, while non-point sources cannot be attributed to a discrete conveyance.[20] In the United States, point sources are subjected to

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16. Kurt Stephenson & Leonard Shabman, *Effluent Allowance Trading: A New Approach to Watershed Management*, WATER SCIENCE REPORTER (1996).

17. Faeth, *supra* note 9, at 14.

18. Banking allows a user to store its permits for future use. According to standard economic theory, a fully value-maximizing tradable permit scheme must have full temporal fungibility, implying the use of banking. *See, e.g.*, J.D. Rubin, *A Model of Intertemporal Emission Trading, Banking, and Borrowing*, 31(3) JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT 269 (1996); C. Kling & J.D. Rubin, *Bankable Permits for the Control of Environmental Pollution*, 64(1) JOURNAL OF PUBLIC ECONOMICS 99 (1997).

19. This is Principle 1 of the EPA Draft Framework for Watershed-Based Trading. *See* EPA Draft Framework for Watershed-Based Trading, p. 2-4 (1996), available at http://www.epa.gov/owow/watershed/framwork.pdf (last visited Oct. 21, 2003).

20. *See* David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515, at 516 (1996). The EPA defines point source as follows: "A point source is any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, or vessel or other floating craft from which pollutants are or may be discharged." EPA Draft Framework, *supra* note 19, at

mandatory regulation of emissions under the Clean Water Act, while non-point sources have no mandatory regulations. The one exception to this is concentrated animal feeding operations ("CAFOs"), which are feedlots containing over 1,000 animals. Runoff and manure from these feedlots are regulated as if it were from a point source. Important non-point sources of water pollution in the United States include agriculture, silviculture, urban runoff, construction, food processing, transportation, and mining, along with medical and recreational facilities.[21]

The simplest type of effluent trading scheme only involves trading between different point sources, or point-point trading. There has been a good deal of experience with point-point trading of air pollutants, however for a number of reasons point-point trading has been slow to take hold in the water pollution context. In point-non-point source trades, point and non-point sources agree on reductions. Typically, these agreements involve reductions in non-point source pollutant loadings in lieu of additional point source reductions. Trading between point and non-point sources is particularly desirable where there is a wide differential in the costs of controlling water pollution by point and non-point sources. Empirical studies have shown this to be the case in many parts of the United States.[22]

Non-point-non-point trading describes situations where non-point sources that have a responsibility or a commitment to reduce pollutant loads arrange for reductions at other non-point source sites. Non-point-non-point trading can occur when non-point sources meet state or local requirements by "installing best management practices (BMPs) or conducting restoration at" other locations.[23]

Finally, there are two other categories of effluent trading that this article will not dwell on as they present few conceptual differences from the three previously mentioned categories: intra-plant trading and pretreatment trading. Intra-plant trading "allows a single facility that maintains multiple outfalls to allocate pollutant discharges among them in a cost-effective manner."[24] Pretreatment trading refers to agreements that affect the allocation of pollutant loads among facilities that discharge wastewater into treatment facilities.[25]

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21. Walter G. Wright, Jr. & Albert J. Thomas III, *The Federal/Arkansas Water Pollution Control Programs: Past, Present & Future*, 23 U. ARK. LITTLE ROCK L. REV. 541, 562-63 (2001).

22. An independent study of three watersheds in Minnesota, Michigan and Wisconsin found that the cost of controlling phosphorus loadings from point and non-point sources varied considerably from watershed to watershed. This study estimated the cost of phosphorus reduction associated with various policy options and found that the cost of reducing phosphorus from controlling point sources to be considerably higher than those based on trading between point and non-point sources. The estimates for point source controls ranged from a low of $10.38 per pound of phosphorus in the Wisconsin watershed to a high of $23.89 per pound in the Michigan watershed. Using trading between point and non-point sources, these costs can be lowered to $5.95 per pound in the Wisconsin watershed (a reduction of over 40%) and to $4.04 in the Michigan watershed (a reduction of over 80%). Paul Faeth, *Market-Based Incentives and Water Quality*, at 6 (World Resources Institute 1999), available at http://www.wri.org/wri/incentives/pdf/faeth.pdf (last visited Oct. 21, 2003).

23. EPA Draft Framework, *supra* note 19, at 8-1.

24. *Id.* at 5-1.

25. *Id.* at 6-1. One example of a successful pretreatment effluent trading scheme is the Passaic Valley Sewerage Commission Effluent Trading Project. *See Sharing the Load: Effluent Trading for Indirect Dischargers* (Final Report from New Jersey Chemical Industry Project Effluent Trading Team, 1998), available at http://www.epa.gov/oppe/isd/nj/trading/sharing.pdf (last visited Oct. 21, 2003).

III. THE HISTORY OF POLLUTION TRADING

While the economic basis for pollution trading has been evident ever since the publication of groundbreaking economic studies in the late sixties, the transition from theory to practice has been slow and uneven. Although emissions trading programs for a variety of air pollutants have proved very successful in the United States over the past thirty years, effluent trading programs only got under way in the eighties, and have only been established in large numbers over the past few years. Other countries have also been very slow to adopt pollution trading, although over the past few years trading has started to expand beyond America's borders at a more rapid rate.

A. AIR POLLUTION EMISSIONS TRADING

The United States has implemented a number of different pollutant trading programs, with varying degrees of success.[26] The first offset trading program was established in the mid-seventies as a mechanism to allow economic development in areas that failed to meet ambient air quality standards under the Clean Air Act.[27] There have since been major American emissions trading programs dealing with SO_2 and NOx emissions, CFC production, lead in gasoline, oxygenates in gasoline, NOx tailpipe emissions, the sulfur content of gasoline, particulate matter and NOx emissions from heavy-duty truck engines, corporate average fuel economy (CAFE), hazardous air pollutants, and hazardous organic chemicals.[28] A number of states have also established emissions trading programs, mainly dealing with VOC[29] and NOx emissions.[30] This section will briefly describe how emissions trading has been most commonly used in the Clean Air Act, along with three of the more specific examples of nationwide emissions trading in the United States.

The EPA has allowed a number of broad emissions trading options in connection with its implementation of the Clean Air Act.[31] These programs can be broken down into bubbles, offsets, netting and banking.[32]

Bubbles provide a way for a firm to increase emissions at one or more emission sources in exchange for larger decreases at other reasonably interconnected emission

26. *See generally*, EPA, *The United States Experience with Economic Incentives for Protecting the Environment* (1997), available at http://199.223.18.220/EE%5Cepa%5Ceed.nsf/pages/incentives (last visited Oct. 22, 2003).

27. *Id.* at 71.

28. *Id.*

29. Organic compounds whose vapor pressure at 20° C exceeds 0.13 kPa are referred to as Volatile Organic Compounds (VOC). VOC have been implicated as a major precursor in case of production of photochemical smog, which causes atmospheric haze, eye irritation and respiratory problems. VOC emissions are typical for oil processing, petrochemical and chemical plants.

30. Illinois, Michigan, New Jersey, Texas, Pennsylvania, Colorado, and Washington have all implemented trading programs. In addition, the Los Angeles area has developed a significant SO_2 and NOx emissions trading initiative known as "RECLAIM." *The United States Experience with Economic Incentives for Protecting the Environment, supra* note 26.

31. *See* EPA, *The United States Experience with Economic Incentives for Protecting the Environment* (January 2001), available at http://199.223.18.220/EE%5Cepa%5Ceed.nsf/pages/incentives, at 72-74 (last visited Oct. 22, 2003).

32. *See* Robert Hahn & Gordon Hester, *Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program*, 6 YALE J. ON REG. 109, 118 (1989).

sources in the same facility so that the total emissions from the facility do not exceed the sum of all the sources' individual emission limits. The EPA has approved bubbles for firms emitting particulate matter, sulfur dioxides, and volatile organic compounds.[33]

Offsets are a form of emissions trading that can be used when a major new emission source seeks to locate in a non-attainment area. The proposed new emissions may be offset with emission reductions of an equal or greater amount. Offsets can involve either internal or external trades, although studies have shown that external trades take place relatively infrequently.[34]

Netting allows a firm seeking to increase emissions at one source in a plant to avoid classification as a major source by reducing emissions elsewhere within its facility. Netting has been allowed in varying forms since 1974 and has been the most widely used form of emissions trading activity under the Clean Air Act.[35]

Banking enables a firm to hold emissions reduction credits as assets for future use or sale. It has been the least commonly utilized for of emissions trading under the Clean Air Act because it was made dependent on state or local agencies establishing regulatory programs, which few did due to restrictions on the use of banked credits and uncertainty in the nature of the property right being banked.[36]

One example of a truly innovative early emissions trading program was the EPA's Lead Phasedown Program, which was operational from 1979 until 1987. Unlike most emissions trading programs, the Lead Phasedown Program was targeted at the production of a substance (gasoline), rather than the release of that substance into the environment. The EPA initially set quarterly limits on the average lead content of all gasoline sold in the country. If a refiner wanted to exceed the limit on lead content for any quarter, it had to acquire lead rights from a refiner that was producing gasoline with less than the mandated average lead levels.[37] The Lead Program achieved a high level of participation and has been considered a major success by both economists and environmentalists.[38]

A later (and most important) national emissions trading program was the SO_2 allowance trading provisions of the Acid Rain Program instituted under Title IV of the Clean Air Amendments of 1990. This is a closed program, with a cap of 8.95 million tons of SO_2 per year.[39] The Acid Rain program is ongoing and is generally considered to be quite successful. The number of SO_2 emissions allowances traded exceeded one million per year between 1992 and mid-1997.[40] The transaction costs of SO_2 allowance trading has remained relatively low due to the use of electronic

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33. *Id.* at 123.
34. *Id.* at 119-20.
35. *Id.* at 132-33.
36. *Id.* at 130-31.
37. Robert W. Hahn & Gordon Hester, *Marketable Permits: Lessons for Theory and Practice* 16 ECOLOGY L. Q. 361, 382 (1989).
38. *See* Robert W. Hahn, *Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders*, 3(2) JOURNAL OF ECONOMIC PERSPECTIVES 95 (1989);
39. Faeth, *supra* note 9, at 14.
40. Barry D. Solomon, *Five Years of Interstate SO2 Allowance Trading: Geographic Patterns and Potential Cost Savings*, 11(4) THE ELECTRICITY JOURNAL, 58 (1998).

bulletin boards, experienced brokers, and the anonymity of market participants.[41]

Finally, in response to the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer, the EPA developed a program in 1990 for the trading of chlorofluorocarbon (CFC) and halon production rights. As was the case with the Lead Phasedown Program, limits were placed on the production of these chemicals by industry, and not on their eventual release into the environment. Despite the requirement of pre-approval for all trades, the trading program was administered by just four EPA staff persons.[42] The program was eliminated in 1996 because the main CFCs had been virtually eliminated from the U.S. domestic market.

Over the past few years, many other countries around the world have started to show interest in emissions trading of one form or another.[43] Much of this interest has been sparked by the controversial negotiations surrounding emissions trading in the Kyoto climate change regime, which calls for the international trading of greenhouse gas emission rights.[44] This has prompted work on the development of a greenhouse gas emissions trading scheme within the European Union,[45] and some countries are also developing domestic greenhouse gas trading programs.[46] Additional programs that are in the works include a SO_2 trading scheme in Slovakia and NOx trading schemes in New South Wales,[47] the United Kingdom,[48] and the Netherlands.[49]

41. Barry D. Solomon, *New Directions in Emissions Trading: The Potential Contribution of New Institutional Economics*, 30(3) ECOLOGICAL ECONOMICS 371 (1999).

42. David Lee, *Trading Pollution*, *in* OZONE PROTECTION IN THE UNITED STATES 31 (Elizabeth Cook, ed., World Res. Inst. 1996).

43. According to one analyst, other developed countries have been slow to embrace emissions trading primarily because of bureaucratic inertia and satisfaction with their current systems of environmental regulation, and secondarily because of a cultural bias against mixing markets and the environment, which is intensified by the perception that 'emissions trading is an American idea'. Frank Convery, *Emissions Trading and Environmental Policy in Europe*, Paper presented in Goteborg, Sweden, June 2001, at http://www.ucd.ie/~envinst/envstud/CATEP%20Webpage/publications/goteborg.pdf, at 11 (last visited Oct. 22, 2003). European countries have been more active in utilizing pollution taxation. France, Germany, and the Netherlands all have effluent charge systems in place, whereby factories are taxed according to the amount of pollutants they discharge into waterways. However, the level of taxation in these systems are generally set at too low a level to significantly influence discharge practices, and are instead used largely as revenue generation schemes. *See* "Economic Instruments for Water Pollution", Report for U.K. Department for Environment, Food & Rural Affairs, available at http://www.defra.gov.uk/environment/water/quality/economist1/eiwp09.htm (last visited Oct. 22, 2003); Thomas Lundmark, *Systemizing Environmental Law on a German Model*, 7 DICK. J. ENVTL. L. & POL'Y. 1, 40 (1998); Matthieu Glachant, *The Political Economy of Water Effluent Charges in France: Why Are Rates Kept Low?*, 14(1) EUROPEAN JOURNAL OF LAW AND ECONOMICS 27 (2002).

44. *See* Malik Amin Aslam, et. al. *Greenhouse Gas Market Perspectives: Trade and Investment Implications of the Climate Change Regime*. UNCTAD/DITC/TED/Misc.9 (Geneva: United Nations, July 2001). http://r0.unctad.org/ghg/publications/ghg_nktpersp.pdf (last visited Oct. 23, 2003).

45. *See* Peter Zapfel and Matti Vainio, *Pathways to European Greenhouse Gas Emissions Trading: History and Misconceptions*, Fondazione Eni Enrico Mattei, Nota Di Lavoro 85.2002 (October 2002).

46. Domestic greenhouse gas emission trading programs are operational in the United Kingdom and Denmark and are expected to become operational soon in Norway and Sweden. Many other countries are in the process of considering proposals. OECD, *Implementing Domestic Tradeable Permits: Recent Developments and Future Challenges* (2001) at 74.

47. New South Wales Treasury Department, *Experts Group Background Paper No. 1*, available at http://www.treasury.nsw.gov.au/salinity/bgpaper1.htm (last visited Oct. 22, 2003).

48. Convery, *supra* note 43, at 10.

49. *Id.*

B. EFFLUENT TRADING

The development of effluent trading schemes is a fairly recent phenomenon. The first American effluent trading schemes arose in the nineteen-eighties, with the Fox River Program in 1981, the Lake Dillon Program in 1982 and the Tar-Pamlico River Basin Program in 1986. These three programs will be discussed in further detail in the following section.

Although a handful of new effluent trading programs arose in the early to mid nineties, it has only been in the past five years that such programs have begun to proliferate. In large part the slow development of effluent trading programs is probably due to uncertainty over whether trading would be considered legal by the United States Environmental Protection Agency (EPA) under the terms of the Clean Water Act.[50] More recently, trading programs have blossomed under an increased (and explicit) regulatory flexibility on the part of the EPA, as laid out in the 1996 Effluent Trading in Watersheds Policy[51] and 2002 Proposed Water Quality Trading Policy.[52] Today there are approximately 37 effluent trading programs in operation in the United States. A table listing these programs is provided in Appendix 1.

In recent years there has also been increased interest in effluent trading programs outside of the United States. Australia has implemented effluent trading schemes in both the Hunter River Basin and the Murray-Darling Watershed.[53] In addition, there have been proposals for effluent trading schemes in other parts of the world, including Scotland,[54] China,[55] and Sweden.[56]

IV. CASE STUDIES OF EFFLUENT TRADING SCHEMES

This section will examine six of the effluent trading schemes that have been adopted in the United States and Australia.

A. THE UNITED STATES

The following case studies will summarize four of the effluent trading schemes in the United States with fairly long histories: the Fox River Trading Program, the Lake Dillon Trading Program, the Tar-Pamlico Trading Program, and the Grasslands

50. *See* Statement of Benjamin Grumbles, Deputy Assistant Administrator for Water, U.S. Environmental Protection Agency, before the House Subcommittee on Water Resources and Environment of the Committee on Transportation and Infrastructure (June 13, 2002), available at http://www.house.gov/transportation/water/06-13-02/grumbles.html (last visited Oct. 22, 2003).

51. *See* EPA, Effluent Trading in Watersheds: Policy Statement, available at http://www.epa.gov/owow/watershed/tradetbl.html (last visited Oct. 22, 2003).

52. *See* EPA, 2002 Proposed Water Quality Trading Policy, available at http://www.epa.gov/owow/watershed/trading/tradingpolicy.html (last visited Oct. 22, 2003).

53. These schemes will be analyzed in the next chapter.

54. *See* Nick Hanley, Robin Faichney, Alastair Munro & James Shortle, *Economic and Environmental Modelling for Pollution Control in an Estuary*, 52 JOURNAL OF ENVIRONMENTAL MANAGEMENT, 211-225 (1998).

55. *See* Wendong Tao, Bo Zhou, William Barron & Weimin Yang, *Tradable Discharge Permit System for Water Pollution: Case of the Upper Nanpan River of China*, 15 ENVIRONMENTAL AND RESOURCE ECONOMICS, 27-38 (2000).

56. *See* Runar Brännlund, Yangho Chung, et al., *Emissions Trading and Profitability: The Swedish Pulp and Paper Industry* 12(3) ENVIRONMENTAL & RESOURCE ECONOMICS 345-356 (1998).

Area Trading Program. These programs have been chosen because they are examples of the different types of possible effluent trading schemes. The Fox River program, which was recently dismantled, involved simple point-point trading. The Lake Dillon program and Tar-Pamlico program exhibit two different approaches to point-non-point trading, with the Tar-Pamlico program also allowing point-point trading. Finally, the Grasslands Area program only allows trading between different non-point sources.

1. Fox River Trading Program

The Fox River program was begun in 1981, making it the first effluent trading program in the United States. It was dismantled in the year 2000, although a new pilot trading program is being developed currently to take its place.[57] It allowed trading between point sources of permits to discharge wastes that increase biochemical oxygen demand (BOD) within a 6,400 square mile drainage area in northeast Wisconsin.[58] The participants included "fifteen industrial facilities, mostly paper mills, and six municipal facilities."[59]

The Fox River program imposed a number of important restrictions on permit trading. Prior to entering the market, both buyer and seller were required to have put in place certain pollution-lowering technology requirements. Also, the program was divided into three river segments, each with approximately an equal number of participants, with a prohibition on trading between segments.[60] Trading was allowed only if the buyer was a new facility, was increasing production, or was unable to meet required discharge limits despite optimal operation of its treatment facilities.[61] Traded rights had a life of at least one year, but were not to run past the expiration date of the seller's discharge permit, which was, at most, a five year period.[62] Since effluent discharge limits changed with each permit renewal, there was no guarantee that rights that were traded-in during one permit period would be available during subsequent permit periods.[63]

In the long history of the Fox River program, only one trade between dischargers took place. A number of explanations have been suggested for the disappointingly low level of trading activity under this scheme. One reason is that dischargers developed a variety of compliance alternatives not contemplated when

57. James Boyd, *The New Face of the Clean Water Act: A Critical Review of the EPA's New TMDL Rules*, 11 DUKE ENVTL. L. & POL'Y F. 39, 79 (2000).

58. *See Economic Instruments for Water Pollution,* Report for U.K. Dept. for Environment, Food & Rural Affairs, available at http://www.defra.gov.uk/environment/water/quality/econinst1/eiwp09.htm (last visited Oct. 22, 2003).

59. Ann Powers, *Reducing Nitrogen Pollution on Long Island Sound: Is There a Place for Pollutant Trading*, 23 COLUM. J. ENVTL. L. 137, 186 (1998).

60. *Id.* at 187. Narrowing the geographical area within which trades can be conducted is one way to deal with the "hot spot" problem. On the other hand, it also cuts down on the potential cost savings by limiting the trading possibilities.

61. *See* EPA, *The United States Experience with Economic Incentives for Protecting the Environment* (January 2001), available at http://199.223.18.220/ee/epa/eermfile.nsf/vwAN/EE-0216B-07.pdf/$File/EE-0216B-07.pdf at 101 (last visited Oct. 22, 2003).

62. *Id.*

63. *Id.*

the regulations were drafted. Secondly, there were questions about the vulnerability of the program to legal challenge, as the Clean Water Act does not explicitly authorize effluent trading. Thirdly, the requirement that all facilities meet minimum technology-based effluent limits prior to trading has been seen as very restrictive, as have the many other trading restrictions noted in the previous paragraph.[64] Finally, one analyst has claimed that regulators who did not support the concept of effluent trading erected bureaucratic barriers that frustrated the process.[65] The Fox-Wolf Basin 2000 organization, a non-profit watershed alliance, is currently studying how a new and improved Fox River trading program can be implemented.[66]

2. *Lake Dillon Trading Program*

The Lake Dillon Trading Program was the second effluent trading program to be implemented, in 1984, and it has been examined by a number of scholars.[67] Lake Dillon is a reservoir near Denver that is an important source of water for the Denver area and also a tourist attraction. Four municipal treatment plants, sixteen small treatment plants, and many non-point sources discharge waste into the reservoir.[68]

The Lake Dillon Program deals with potassium discharges and currently involves point-non-point trading exclusively.[69] Point sources are allowed to obtain offsets from their load allocations by controlling loads from non-point sources that existed prior to the program's inception in 1984. The trading ratio for point sources is 2:1, i.e., for every two units of reduction that a point source obtains through controlling emissions in a non-point source, it can increase its own emissions by one unit above its load allocation. The "banking" of credits from non-point reductions for future use by point sources is not allowed.[70]

There is disagreement among commentators over the degree to which the Lake Dillon Program can be considered a success. Trading has been infrequent, but this is probably due to lower than expected growth in the region and improvements in point source pollution reduction technology rather than any problems inherent to the

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64. *Id.*

65. *See* Roger E. Meiners & Bruce Yandle, *Clean Water Legislation: Reauthorize or Repeal? in* TAKING THE ENVIRONMENT SERIOUSLY 73, 97 (Roger E. Meiners & Bruce Yandle, eds. 1993).

66. *See Fourth Progress Report on the Trading of Water Pollution Credits*, on State of Wisconsin Department of Natural Resources webpage, at http://www.dnr.state.wi.us/org/water/wm/nps/pt/PT2002.htm (last visited Oct. 22, 2003).

67. *See* Richard T. Woodward, *Lessons about Effluent Trading from a Single Trade*, available at http://ageco.tamu.edu/faculty/woodward/paps/CaseStudy.pdf (last visited Oct. 22, 2003); *Case Studies on the Trading of Effluent Loads: Dillon Reservoir Final Report*, Cambridge, MA, Industrial Economics (1984).

68. *See* Andreas Kraemer, Eduard Interwies & Eleftheria Kampa, *Tradeable Permits in Water Resource Protection and Management: A Review of Experience and Lessons Learned, in* OECD, IMPLEMENTING DOMESTIC TRADEABLE PERMITS, 227, 246 (2002). The primary source of non-point pollution is runoff from towns and ski areas, along with seepage from failing septic systems. Powers, *supra* note 59 at 191-92.

69. Mahesh Podar, *A Summary of U.S. Effluent Trading and Offset Projects,* prepared for U.S. Environmental Protection Agency (Nov. 1999), p. 8, available at http://www.epa.gov/owow/watershed/trading/traenvrn.pdf (last visited Oct. 22, 2003). However, there has been some pressure to also allow trading between point sources. *Id.* Trading between different non-point sources has also been considered in at least three instances. Susan Austin, *Designing a Nonpoint Source Selenium Load Trading Program*, 25 HARV. ENVTL. L. REV. 337, at n. 37 (2001).

70. Woodward, *supra* note 67, at 5.

trading program (although if banking was allowed, that would perhaps have prompted more trades). According to one commentator: "Despite the restrictions that are present in the Lake Dillon trading program and despite its long period of inactivity, a major trade has finally taken place that led to environmental gains while making the participants better off. While it seems unlikely that future trades will be numerous and frequent, the trade shows that when the need arises, the trading option adds valuable flexibility for the control of water quality in the Lake Dillon area."[71]

3. *Tar-Pamlico*

The Tar-Pamlico River Basin Nutrient Reduction Trading Program is an effluent trading program involving aspects of point-point trading and point-non-point trading within the 5,440-square mile Tar-Pamlico watershed in North Carolina.[72] The program was initiated in 1991 to deal with an excess of nutrients (primarily nitrogen and phosphorus) which had resulted in extensive algal blooms and fish kills.[73]

The Tar-Pamlico Program revolves around an association of twelve point source dischargers within the watershed. An effluent cap is set annually for the Association to meet collectively. Within the Association, informal point-point trading regularly occurs so that the Association as a whole can meet its cap. If they fail to meet the cap (which so far has never happened), the dischargers have to pay an offset fee for each unit of pollutant by which they, as a group, have exceeded the cap. These offset funds would then go to a voluntary agricultural cost share program, and would be used to pay participating farmers 75% of the cost of installing nutrient-reducing Best Management Practices (BMPs) on their farms. This can be seen as a variety of point-non-point trading.[74] Trading ratios for non-point source programs are set at 3:1 for cropland best management practices and 2:1 for confined animal operations.[75] This ratio is meant to account for the fact that non-point source loadings are less predictable over time and space and are less reliably controlled than point source controls. All non-point credits have a useful life of ten years unless cost share program contracts with the non-point sources provide for a longer period.[76]

Thus, the Tar-Pamlico program to some extent establishes responsibility at the group level, while allowing for trades between group members. Non-point agricultural sources participate voluntarily through the cost share program. Overall, the Tar-Pamlico program might be described more accurately as an exceedence tax on point sources, the proceeds of which are applied to a more cost-effective method

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71. *Id.* at 13.

72. *See* North Carolina Department of Environment & Natural Resources website, at http://www.enr.state.nc.us/nps/tarpam.htm (last visited Oct. 22, 2003).

73. *Id.*

74. *See* North Carolina Department of Environment & Natural Resources, Frequently Asked Questions about the Tar-Pamlico Nutrient Trading Program, at http://h2o.enr.state.nc.us/nps/FAQs9-01prn.pdf (last visited Oct. 22, 2003).

75. *See* Elaine Mullaly Jacobson, Leon E. Danielson, and Dana L. Hoag, Report on the Tar-Pamlico River Basin Nutrient Trading Program, available at http://www.bae.ncsu.edu/programs/extension/publicat/arep/tarpam.html (last visited Oct. 22, 2003).

76. *Id.*

of achieving the reductions (i.e., through non-point sources).

Despite the lack of point-non-point trading (due to the fact that the nutrient reduction goals for the Association have always been achieved), the Tar-Pamlico program is generally considered to be successful. Nutrient reductions under the first phase of the program were greater than that set as the goal,[77] and cost savings (from the informal point-point exchanges) were considerable, according to one study.[78] However, the program has faced some resistance from farmers who are worried that voluntary regulation under a non-point source trading program would lead to mandatory regulation of non-point sources.[79]

4. Grassland Area Tradable Loads Program

The Grassland Area program involves seven irrigation and drainage districts in the area of California's San Luis Drain that came together to form a group called the Grassland Area Farmers. The purpose of this group was to cost-effectively decrease the aggregate level of selenium released into the San Luis Drain, as had been required by an agreement on the use of the Drain, which is owned by the United States Bureau of Reclamation.[80] The trading program was initiated in 1998.[81]

The initial limit on the aggregate amount of selenium that the Grassland Area Farmers are allowed to discharge is set each year by the state regulatory authority.[82] The Grassland Area Farmers then administer an internal selenium load trading program. Pursuant to the rules of the trading program, the total allowable selenium load is allocated among the member districts. At the end of each year, individual districts pay a fee or receive a rebate if they discharge more or less than the amount allotted to them.[83] The districts can either meet their load allocation or buy selenium load allocation from other districts. Regulatory oversight is important to ensure that the aggregate regional load targets are met. However, trades take place among member districts without regulatory oversight; the Grassland Area Farmers take it upon themselves to monitor discharge from each district.

The Grassland Area program has been quite successful. Selenium discharges were reduced by a third during the first two years of the program. Nine trades were made during the first two years, and transaction costs were kept a minimum through monthly meetings of the districts where information could be exchanged.[84]

The program is considered innovative for a few reasons. Firstly, unlike most

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77. *See* Andreas Kraemer, et al., *supra* note 68, at 245.

78. *See* Great Lakes Trading Network: Projects and Programs, at www.gltn.org/programs/programs.htm (2001).

79. *See* Anne Coan, Natural Resources Director, North Carolina Farm Bureau Federation, Testimony before the Subcommittee on Water Resources and the Environment of the House Transportation and Infrastructure Committee Regarding Trading Water Pollution Reduction Credits, available at http://www.house.gov/transportation/water/06-13-02/coan.htm (last visited Feb. 15, 2003).

80. *See* Austin, *supra* note 69, at 349.

81. *See* Susan Austin, Overview of Tradeable Loads Program in the Grassland Drainage Area, available at http://www.gltn.org/resources/2000conf/grassland2.pdf (last visited Feb. 15, 2003).

82. Austin, *supra* note 69 at 337-38.

83. Podar, *supra* note 69, at 1.

84. Terry Young & Joe Karkoski, *Green Evolution: Are Economic Incentives the Next Step in Non-Point Source Pollution Control?*, 2 WATER POLICY 151, at 4.2 (2000); Kraemer et al., *supra* note 68, at 248.

other effluent trading schemes, it involves purely non-point agricultural sources. Secondly, the combination of a trading scheme with collective fees and a rebate system is unique. Thirdly, the trading system is especially liberal in the possible trades it allows, with load allocations being traded for other load allocations, money, or services.

B. AUSTRALIA

1. Hunter River Valley Salinity Trading Scheme

The Hunter River Valley Salinity Trading Scheme was introduced by the New South Wales Environmental Protection Agency in 1995.[85] It was the first effluent trading scheme set up outside the United States. The scheme's goal is to manage discharges of saline water from coal mines and electricity generators to the Hunter River so that river salinity does not exceed levels that are detrimental to agricultural productivity or environmental quality downstream.[86] Discharge privileges are explicitly based on a quantitative environmental goal, rather than technology-based standards.[87]

The scheme operates only during periods of "high" water flow.[88] Credit holders can either use their credits to authorize their own discharges or trade them with other participating entities. Trades can be permanent or temporary. Through the trading mechanism, new mines and other industries can be established without compromising the environmental goal, thus creating a classic "closed" trading system. The trading scheme operates only during high flows, with unlimited discharges allowed during flood flows except as needed to protect a particular tributary. [89] The scheme relies on an extensive salinity monitoring network in the river and at each authorized point of discharge. "The monitoring gauges automatically report by radio or phone to the [Department of Land and Water Conservation's] central data warehouse."[90]

The Hunter River Valley trading scheme has been seen as very successful at reducing salinity levels at a low cost. Prior to the introduction of the scheme, salinity levels were exceeded by 33%, a level which decreased to 4% as of 2001. There were 31 trades during 2001. While the scheme has been considered a pilot project until now, the EPA has proposed that a more permanent regulatory

85. Kraemer et al., *supra* note 68, at 249.

86. *See* Hunter River Salinity Trading Scheme website, at http://www.epa.nsw.gov.au/licensing/hrsts/index.htm (last visited Oct. 23, 2003).

87. Hunter River Salinity Trading Scheme website, developments section, at http://www.epa.nsw.gov.au/licensing/hrsts/developments.htm (last visited Oct. 23, 2003).

88. Where water levels are low, no saline discharges are allowed, and when water levels reach the "flood" level, unlimited discharges are allowed. Hunter River Salinity Trading Scheme website, *supra* note 86.

89. Hunter River Salinity Trading Scheme website, developments section, *supra* note 87.

90. Hunter River Salinity Trading Scheme website, monitoring section, at http://www.epa.nsw.gov.au/licensing/hrsts/monitoring.htm (last visited Oct. 23, 2003).

framework be set up, and legislation is currently pending to implement this plan.[91]

One innovative aspect of the Hunter River Valley scheme is the use of an on-line credit exchange, which is operated by the New South Wales EPA.[92] Market participants can post offers to buy or sell discharge credits, and can view the holdings, trade potential, and trading history of each member.

2. *South Creek Bubble Licensing System*

In 1996, the New South Wales Environmental Protection Agency introduced a small, self-contained, effluent trading scheme in the South Creek area of the Hawkesbury–Nepean River. This area had historically been prone to eutrophication, and algal blooms were occurring at frequent intervals despite reductions in nutrient loads. The 'bubble' scheme allowed three sewage treatment systems to adjust their individual discharges, provided the total pollutant load limit for the system was not exceeded. "The load limits mandated under the bubble scheme required an 83% reduction in total phosphorus and a 50% reduction in total nitrogen by 2004 when compared to a 'business as usual' scenario."[93]

The scheme must be considered a success in that significant load reductions have been recorded for the eight years following the commencement of the bubble.[94] These reductions have been achieved not by formalized trading, but rather by coordinating plant optimization strategies and by upgrading particular treatment processes to reduce the total nutrient loads discharged in treated effluent.[95] The bubble scheme has allowed considerable cost savings over a uniform effluent reduction approach for each participating plant. According to one analysis, the bubble scheme will result in a savings of $45.6 million (Australian) over the period 1996-2008.[96]

The EPA has discussed expanding the program to include non-point sources as well, but concluded that this would be unwarranted for the time being, as non-point sources are not currently a comparable source of pollution as non-point source stormwater runoff generally occurs only in wet weather, when its impact is lessened by the increased river flow.[97]

IV. LESSONS FROM EXISTING EFFLUENT TRADING PROJECTS

It is important to emphasize that issues relating to water pollution vary

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91. A draft of the proposed regulations is available on the Hunter River Salinity Trading Scheme website, at http://www.epa.nsw.gov.au/licensing/hrsts/r99-325-d09.pdf (last visited Oct. 23, 2003).

92. The Hunter River Valley credit exchange website is located at http://hrs1.epa.nsw.gov.au/default.html (last visited Oct. 23, 2003). Some information is only accessible by members with a password, but much of the site can be viewed by the general public. *Id.*

93. *See* New South Wales EPA web page, at http://www.epa.nsw.gov.au/licensing/bubble.htm (last visited Oct. 23, 2003).

94. *See* Helen Betts O'Shea & Elizabeth Davidson, Innovative Environmental Regulation in South Creek: The Performance of the Bubble Licensing Scheme and Future Directions, Report for New South Wales EPA, at http://www.uws.edu.au/seewrt/research/publications/scrkpapers/betts.pdf (last visited Feb. 15, 2003).

95. *Id.*

96. *Id.*

97. *Id.*

immensely from place to place. Therefore, measures to address pollution in Wisconsin may not be appropriate in North Carolina, let alone in countries with different cultures and political systems. Trading systems must always be adapted to local needs and conditions, and innovation should be encouraged. Nevertheless, by examining the short histories of existing effluent trading projects, one can note certain issues that the current schemes show to be important, and draw certain conclusions regarding what can make an effluent trading scheme successful. In this section, the paper will try to highlight some of these lessons.

A. PUBLIC PARTICIPATION

One conclusion that has uniformly been drawn by participants in current effluent trading schemes as well as academics is the importance of seeking the advice and cooperation of the affected communities. One of the major objections to the use of market-based environmental regulation schemes is that they can be more opaque than standard command-and-control regulation as environmental organizations, for example, may not know how much a particular facility is actually polluting, or is allowed to pollute. However, this need not be the case. According to a representative of the United States EPA: "Public participation in development of trading programs and ongoing access to information about trades is vital. EPA's water quality trading policy states that public participation is provided through federal permit and TMDL requirements and encourages further public participation in development and implementation of trading programs." [98] The American case studies show a range of innovative types of involvement in effluent trading schemes by various governmental entities as well as farmers, industry, and a whole range of non-governmental organizations.[99]

B. REGULATORY STRUCTURE

Another important issue to be dealt with is how the regulatory and statutory structure of trading regimes relates to pre-existing pollution control laws and institutions. Trading regimes tend to be added into a pre-existing superstructure of command-and-control regulations, environmental quality objectives, and other policy instruments. This is probably desirable (and certainly unavoidable) both for political and economic reasons. The use of a variety of different policy instruments provides different weapons that can attack the various aspects of the water pollution problem. Also, the pre-existing regulatory structure has been relatively successful in most countries, and as a political matter could not easily be discarded even if that

98. *See* Statement of Benjamin Grumbles, *supra* note 50.

99. One particular organization of note is the Great Lakes Trading Network, which calls itself "a national clearinghouse for water quality trading projects" and is made up of stakeholders from both the public and private sectors. *See* Great Lakes Trading Network website, at www.envtn.org (last visited Oct. 23, 2003). Other organizations have sprung up around individual watersheds, such as the Fox-Wolf Watershed Alliance, which is an "independent, non-profit organization that identifies issues and advocates effective policies and actions to protect, restore and sustain the water resources of Wisconsin's Fox-Wolf River Basin" *See* Fox-Wolf Watershed Alliance, at http://www.fwb2k.org/main.html (last visited Oct. 22, 2003).

were warranted economically.

However, the American examples show that for effluent trading to be successful, it must be explicitly allowed by the environmental laws and regulations. The many years of lingering uncertainty over whether the Clean Water Act allowed for effluent trading is one of the reasons why trading systems have developed so slowly in America, and why entities have been reluctant to make trades where such systems do exist. This problem has been recognized and addressed in recent years, as evidenced by the EPA's 2002 Proposed Water Quality Trading Policy and the move to introduce legislation in Australia to make permanent the Hunter River Valley Trading Scheme.

C. HOT SPOTS

One caveat that has been stressed by all participants in American effluent trading programs is that they must be defined so as to prevent the emergence of localized "hot spots" or accumulations of pollutants that result in adverse effects on local water quality.[100] Unrestricted effluent trading would have the potential to wreak havoc on areas around particular point sources by allowing these sources to concentrate emissions or discharges through the purchase of allowances from other locations. This problem has been dealt with in a few ways by existing programs. On a large scale, effluent trading schemes have so far been restricted to individual watersheds. This makes environmental sense as it avoids sacrificing the environmental health of one watershed to fund pollutant decreases in other geographically unrelated areas.

On a more local scale, most existing effluent trading programs have provisions that permit the governing body to annul a trade that would lead to destructive localized pollution.[101] For example, Section IV of the Tar-Pamlico Agreement stipulates that if such a localized water quality impact occurs, the Division of Water Quality reserves the right to require nutrient removal from a facility to eliminate the problem. In the future, one would expect to see increasingly sophisticated economic and environmental modeling systems that would take into account upstream or downstream location in determining the trading value of a particular permit.[102]

100. *See* Statement of Benjamin Grumbles, *supra* note 50; Statement of Rena Steinzor, on behalf of the Center for Progressive Regulation, before a Subcommittee on Water Resources and Environment of the Committee on Transportation and Infrastructure in the U.S. House of Representatives (June 13, 2002), available at http://www.house.gov/transportation/water/06-13-02/steinzor.html (last visited Oct. 22, 2003); A New Tool for Water Quality, *supra* note 2.

101. *See* Jonathan Remy Nash & Richard L. Revesz, *Markets and Geography: Designing Marketable Permit Schemes to Control Local and Regional Pollutants*, 28 ECOLOGY L.Q. 569 (2001) (describing this and other means of dealing with the problem of hot spots).

102. For one interesting study, *See* Daigee Shaw & Ming-Feng Hung, "A Trading-Ration System for Trading Water Pollution Discharge Permits", paper presented at 2002 World Congress of Environment and Resource Economists, available at http://weber.ucsd.edu/~carsonvs/papers/100.pdf (last visited Oct. 23, 2003) (proposing a trading ratio system that takes into account water pollution loads transferred from upstream zones).

D. TRANSACTION COSTS AND INCENTIVES TO TRADE

If significant levels of trading are to occur, transaction costs must be kept low, and there must be a sufficient incentive to trade. When there are only a few participants in the trading scheme, as is the case with the South Creek bubble, for example, then transaction costs will generally not be very high.[103] Dischargers will be able to easily locate other dischargers and inquire about trading opportunities. As the number of participants grows, it will become more difficult to arrange trades. The Grassland Area scheme addresses this issue with monthly meetings of the dischargers. The Hunter River Valley program deals with the problem through the use of an on-line trading network. Both of these methods seem to have worked well so far. In the American emissions trading markets, brokerage services have been used quite extensively. This option could be considered for large effluent markets.

Of course, even if transaction costs are kept reasonably low, there still needs to be a built-in incentive to trade. For some American programs, most notable the Dillon Lake scheme and the Tar-Pamlico scheme, the incentive simply did not exist to any great extent because the targeted discharge levels for the body of water were being met even absent trading. From an environmental perspective, this could be a sign of success, rather than failure. However, it is important not to set the initial permitted discharge levels too high.[104] Another disincentive to trading in some point-non-point schemes is the high trading ratios. For example, the trading ratio is 2:1 in the Lake Dillon scheme, and in the Tar-Pamlico scheme the trading ratio ranges from 2:1 to 3:1. While trading ratios may make environmental sense given the uncertainty of non-point reductions, if they reach a level at which trading activity is discouraged to too great an extent, these ratios may defeat the whole purpose of the scheme.[105] An alternative to set ratios that has been tried in some effluent trading schemes is the use of coefficients where effluent reduction is of more value in one part of the watershed than in another, due to environmental conditions.[106] While this strategy may add to the environmental effectiveness of a trading regime, the greater complexity may also increase the administration and transactions costs.

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103. The flip side of small markets is that they reduce the potential financial gains from trading and create potential market power problems.

104. As one analyst notes:

"[s]tationary and point sources [under command-and-control regimes] often achieve reductions in their discharges below the levels of their permits. The phenomenon of actual discharges that are substantially lower than permitted discharges is especially common when a lack of resources to implement a regulatory program results in large numbers of expired permits incorporating limits based on outmoded technologies."

This analyst goes on to recommend that effluent trading rules should not allow local or overall levels of discharges that exceed the actual levels measured prior to the program's implementation. *See* Statement of Rena Steinzor, *supra* note 100.

105. According to one analyst: "Much of the success of a [point-non-point] trading program, as measured by improvements in water quality, rests with the difficult decision of choosing an appropriate trading ratio." Esther Bartfeld, *Point-Nonpoint Source Trading: Looking Beyond Potential Cost Savings*, 23 ENVTL. L. 43, 66 (1993).

106. James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 638-39 (2000) (discussing Long Island Sound Nutrient Trading Program. The article also gives a good general overview of the use of ratios and coefficients in the development of pollutant trading schemes).

E. MONITORING

The U.S. EPA has stated that "[m]onitoring is essential to evaluate program performance and make adjustments as needed to meet water quality goals."[107] According to one study, monitoring has been inefficient in the pilot effluent trading programs in the United States.[108]

With point sources, direct monitoring is often feasible, as is shown by the relatively sophisticated automatically reporting salinity gauges in the Hunter River Valley scheme. However, the issue of monitoring becomes much more difficult when dealing with non-point sources. According to one analyst, "although progress has been made – especially in the Netherlands—in estimating the amount of nutrients that are produced by disparate farming operations, these threshold methodologies remain far more of an art than a science."[109] Evidently, without proper monitoring procedures, enforcement of a regulatory system will be made impossible, whether the system is based on trading or a command-and-control model.

IV. CONCLUSION

The American and Australian effluent trading schemes described in this paper demonstrate a range of innovative solutions that can be applied to the water pollution problem. They show that effluent trading can be a cost-effective means of pollution control. However, the American experience also shows us that effluent trading schemes do not always succeed in producing the level of savings anticipated by economists. While they have produced significant cost savings in some cases, such as the Grasslands Area Tradable Loads Program, other systems such as the Fox River Trading Program have recorded many fewer trades than expected, leading to lower than expected savings. While this has been disappointing given the high expectations of some economists, the relative paucity of trades in some systems should not be seen as damning of the whole effluent trading enterprise. As one economist wrote: "[E]ven though the gains of moving to a TPP [tradable pollution permit] system from command-and-control alternatives may be less than was envisaged in earlier works, these gains are still likely to be positive. In that important sense, TPP markets are a 'no loss' option for Governments to choose in the control of pollution."[110]

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107. *See* Statement of Benjamin Grumbles, *supra* note 50.
108. *See* Faeth, *supra* note 9, at 43.
109. *See* Statement of Rena Steinzor, *supra* note 100.
110. Hanley, *supra* note 54, at 224.

APPENDIX 1

List of Existing Effluent Trading Projects[111]

Effluent Trading Program	Water Body	Location	Activity Description	Pollutant
Bear Creek trading program	Bear Creek reservoir	Colorado, U.S.A.	Watershed trading program	P
Blue Plains WWTP credit creation	Chesapeake Bay	Washington, D.C., U.S.A.	Single trade	N
Boulder Creek trading program	Boulder Creek	Colorado, U.S.A.	Watershed trading program	NH3, pH, temperature
Cargill and Ajinomoto plants permit flexibility	Des Moines River	Iowa, U.S.A.	NPDES permit flexibility	BOD, NH3
Chatfield Reservoir trading program	Chatfield Reservoir	Colorado, U.S.A.	Watershed trading program	P
Cherry Creek Basin trading program	Cherry Creek Reservoir	Colorado, U.S.A.	Watershed trading program	P
Chesapeake Bay nutrient trading program	Chesapeake Bay	Multiple States, U.S.A.	Watershed trading program	N,P
Fox-Wolf Basin watershed pilot trading program	Green Bay	Wisconsin, U.S.A.	Watershed pilot program	BOD, P
Grasslands Area tradable loads program	San Joaquin River	California, U.S.A.	Watershed trading program	Se
Hawkesbury-Nepean River nutrient trading	Hawkesbury-Nepean River	New South Wales, Australia	Bubble license regime for sewage treatment plants	P, N
Hunter River Salinity trading program	Hunter River	New South Wales, Australia	Trading program for coal mines and Pacific Power	Salt
Illinois pretreatment trading program	Illinois waters	Illinois, U.S.A.	Pretreatment program	multiple
Kalamazoo River water quality trading demonstration	Kalamazoo River, Lake Allegan	Michigan, U.S.A	Watershed pilot program	P

111. EPA, *The United States Experience with Economic Incentives for Protecting the Environment*, *supra* note 26, at 104-05; as supplemented by figures from Rousseau, *supra* note 10, at 10-12; Denis O'Grady and Mary Ann Wilson, Phosphorus Trading in the South Nation River Watershed, Environmental Trading Network, at www.envtn.org/programs/ontario.PDF (last visited Oct. 22, 2003).

Lake Dillon trading program	Dillon reservoir	Colorado, U.S.A.	Watershed trading program	P
Long Island Sound trading program	Long Island Sound	Connecticut, U.S.A.	Watershed trading program	N
Lower Boise River effluent trading demonstration project	Boise River	Idaho, U.S.A.	Watershed trading program	P
Maryland nutrient trading policy	Maryland waters	Maryland, U.S.A.	Statewide trading program	N, P
Michigan water quality trading rule development	Michigan waters	Michigan, U.S.A.	Statewide trading program	N, P
Murray-Darling Basin salinity and drainage strategy	Murray-Darling	New South Wales, Australia	State government trading	Salt
Neuse River nutrient sensitive water management strategy	Neuse River estuary	North Carolina, U.S.A.	Watershed trading program	N
New York City watershed phosphorus offset pilot programs	Hudson River	New York, U.S.A.	Offset pilot programs	P
Passaic Valley sewerage commission effluent trading program	Hudson River	New Jersey, U.S.A.	Pre-treatment program	metals
Rahr malting permit	Minnesota River	Minnesota, U.S.A.	Offset for one discharger	P, BOD
Red Cedar River pilot trading program	Tainter Lake	Wisconsin, U.S.A.	Watershed pilot program	P
Rock River Basin pilot trading program	Rock River Basin	Wisconsin, U.S.A.	Watershed pilot program	P
Saginaw River watershed trading	Saginaw River watershed	Michigan, U.S.A.	Watershed program	P
San Francisco Bay mercury offset program	San Francisco Bay	California, U.S.A.	Regional offset program	Hg
South Nation River Watershed Trading Program	South Nation River	Ontario, Canada	Watershed trading program	P
Tar-Pamlico nutrient reduction trading program	Pamlico River estuary	North Carolina, U.S.A.	Watershed trading program	P, N
Virginia water quality improvement act and tributary strategy	Virginia waters	Virginia, U.S.A.	Statewide trading program	N

Wisconsin effluent trading rule development	Wisconsin waters	Wisconsin, U.S.A.	Statewide trading program	P

APPENDIX 2

Annotated Bibliography on Effluent Trading

Susan Austin, *Designing a Nonpoint Source Selenium Load Trading Program*, 25 HARV. ENVTL. L. REV. 337 (2001) (analyzing Grassland Drainage Area selenium load trading program).

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