NOTE

ECONOMICS OF ELECTRONIC WASTE DISPOSAL REGULATIONS

I. INTRODUCTION

The components of municipal solid waste are rapidly changing. Obsolete computers, cellular phones, televisions, and many other outdated electronics, all known as electronic waste, are becoming a greater proportion of the global municipal waste stream.[1] Technological innovation continues to improve, and the lifespan of electronics remains short.[2] As a result, the amount of electronic waste that accumulates quickly increases.[3] It is now the nation's fastest growing category of solid waste,[4] growing at a rate three times that of other usual municipal wastes.[5] Estimates show that 133,000 electronic devices are discarded daily in the United States totaling three million tons of electronic waste per year.[6] Electronics have the potential to release dangerous substances, such as mercury, lead, and hexavalent chromium, into the environment.[7]

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1. *See* Press Release, United Nations Environment Programme, Basel Conference Addresses Electronic Wastes Challenge; Nairobi Conference on Basel Convention to Address the Growing Challenge of Electronic Wastes (Nov. 27, 2006), http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=485&ArticleID=5431&l=en (reporting that (1) twenty to fifty million metric tons per year of electronic waste are produced, totaling more than five percent of all global municipal solid waste, (2) in the United States, fourteen to twenty million computers are disposed of yearly, (3) in the European Union (EU) electronic waste is predicted to increase by three to five percent yearly, and (4) it is anticipated that developing countries will triple their electronic waste output by 2010).

2. *See* Major George J. Konoval, *Electronic Waste Control Legislation: Observations on a New Dimension in State Environmental Regulation*, 58 A.F. L. REV. 147, 150 (2006) (stating that the price of personal computers continues to fall, making replacement more cost efficient for the consumer than repair, and that life spans of electronics, specifically computers and cellular phones, are two to three years).

3. Elizabeth Armstrong Moore, *Momentum Builds for 'Revolution' to Recycle Electronic Waste*, CHRISTIAN SCI. MONITOR, July 31, 2006, at 13.

4. *Maine Makes TV, PC Monitor Makers Recycle*, MSNBC.COM, Jan. 18, 2006, http://www.msnbc.msn.com/id/10910607/from/ET [hereinafter *Maine*]; *see* Silvia Spring, *Recycling: This Old Gadget*, NEWSWEEK INT'L, Nov. 20, 2006, http://www.msnbc.msn.com/id/15675165/site/newsweek/.

5. Linda Roeder, *States Say Federal Action May Be Needed to Address Concerns Over Electronic Waste*, 36 Env't Rep. (BNA) No. 29, at 1509 (July 22, 2005) [hereinafter Roeder, *Federal Action*].

6. *'E-cycling' Puts New Life in Electronic Junk: Toxic Trash Turned into Everyday Objects by Growing Industry*, MSNBC.COM, Jan. 2, 2006, http://www.msnbc.msn.com/id/10642954/ [hereinafter *'E-cycling'*].

7. *See* Linda Roeder, *U.S. EPA Launches Campaign to Encourage Collection, Recycling of Electronic Waste*, 26 Int'l Env't Rep. (BNA) No. 2, at 93 (Jan. 15, 2003) [hereinafter Roeder, *EPA*] (explaining that "'toxic materials contained in [electronic] products can pose risks to public health

Exposure to these substances can have tragic effects on human health.[8]

Electronic waste typically finds its way from America's businesses and homes to landfills.[9] The extent of dangerous chemical exposure to the environment from landfill disposal is not yet conclusively established. Moreover, due to the relatively recent discovery of the problems of chemicals from electronic waste, scientific data is so far largely unavailable.[10] Nevertheless, scientists generally agree that as a

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and the environment if they're not disposed of properly'" (quoting EPA Assistant Administrator, Marianne Horinko)); *see also* Linda Roeder, *E-Waste Mandates Unnecessary, Too Costly, Competitive Enterprise Institute Report Says*, 36 Env't Rep. (BNA) No. 5, at 215 (Feb. 4, 2005) [hereinafter Roeder, *Mandates*] (reporting that, according to the EPA, releases into the environment can occur through landfill leaching and incinerator ash); Press Release, United Nations Environment Programme, Basel Conference Addresses Electronic Wastes Challenge; Nairobi Conference on Basel Convention to Address the Growing Challenge of Electronic Wastes (Nov. 27, 2006), http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=485&ArticleID=5431&l=e (informing that when the 183 million computers become obsolete they will leave behind hazardous wastes such as lead, cadmium, and mercury).

8. *See* ANITA SARAH JACKSON, AARON SHUMAN, GOPAL DAYANENI & THE COMPUTER TAKEBACK CAMPAIGN, TOXIC SWEATSHOPS: HOW UNICOR PRISON RECYCLING HARMS WORKERS, COMMUNITIES, THE ENVIRONMENT, AND THE RECYCLING INDUSTRY 13-14 (2006), *available at* http://www.computertakeback.com/docUploads/ToxicSweatshops.pdf (explaining that (1) mercury exposure can cause permanent kidney and central nervous system damage, (2) hexavalent chromium exposure can cause DNA cell damage and severe allergic reactions, and (3) lead is linked to brain damage, nerve damage, blood disorders, fetal developmental damage and is especially dangerous for children); Layne Nakagawa, EarthTrends Environmental Essay Competition Winner, World Resources Institute, Toxic Trade: The Real Cost of Electronics Waste Exports from the United States (June 2006), http://earthtrends.org/features/view_feature.php?theme=5&fid=66 ("Mercury is the most prevalent toxic metal found in e-waste. It is in circuit boards, switches, medical equipment, lamps, mobile phones, and batteries. Mercury transforms into methylmercury in water, where it can accumulate in living organisms, typically via fish, concentrating in large fish and humans at the top of the food chain. Mercury is readily absorbed by the human body, ultimately inhibiting enzymatic activity and leading to cell damage.") (citations omitted); *see also* Computer Take Back Campaign, The Problem, http://www.computertakeback.com/the_problem/index.cfm (last visited Nov. 17, 2007) (noting that 20 acres of a lake and the fish inside can be contaminated by just 1/70th teaspoon of mercury); *'E-cycling'*, *supra* note 6 (reporting that (1) cathode ray tubes from older televisions and computer monitors can contain four to eight pounds of lead, which can leach from landfills into groundwater, (2) chip resistors and semiconductors contain cadmium, which can cause kidney damage, and (3) mercury, linked to brain damage in humans, is found in thermostats, relay switches, and telecom equipment and can percolate into water bodies and poison food sources).

9. Nakagawa, *supra* note 8 ("In 2003, the United States alone generated 2.8 million tons of electronic waste and only recovered (re-used or recycled) 290 thousand tons, leaving the rest to enter into the municipal waste stream.") (citation omitted).

10. *Compare* UNIV. OF FLA. DEP'T OF ENVTL. ENGINEERING SCI., RCRA TOXICITY CHARACTERIZATION OF COMPUTER CPUS AND OTHER DISCARDED ELECTRONIC DEVICES 5-2 (2004), *available at* http://www.epa.gov/reg5rcra/wptdiv/solidwaste/ecycling/UF-EWaste-Final.pdf, *with* Scott Slesinger, Op-Ed, *Sham Science Debunked*, WASH. POST, July 2, 2005, at A27 (stating that contrary to his institute report, Townsend's studies did not demonstrate that landfill leaching will not affect our environment, but showed that monitors fail EPA's toxic waste testing designed to simulate long-term landfill exposure, and this is why Townsend is continuing his research), *and* BASEL ACTION NETWORK, MOBILE TOXIC WASTE: RECENT FINDINGS ON THE TOXICITY OF END-

prudent precaution, given the risk of harm, we should prevent harmful components of electronic waste from entering landfills.[11]

Options to prevent electronic waste from landfill disposal include recycling, reuse, and disposal bans. Governments around the world are taking several approaches to the problem of electronic waste disposal. This Note examines these systems and conducts an economic analysis of each method. The evaluation from an economic perspective focuses on United States policy and state implementation of electronic waste regulations. Part II explains the realities of the problems associated with electronic waste including export of electronic waste to less developed countries. Part III discusses United States federal policy and its existing regulatory scheme pertaining to electronic waste. Part IV analyzes the California, Maine, and Washington approaches to electronic waste disposal. Part V introduces other possible plans with an emphasis on the European Union's approach to electronic waste and explains why these other strategies may be economically and environmentally preferable to the current United States federal policy. Part VI concludes, based on the results of the economic analysis, that United States emerging electronic waste regulation efforts are not adequate from an economic or environmental perspective, and that federal regulation for electronic waste disposal is necessary.

OF-LIFE CELL PHONES 2-4 (2004), http://www.ban.org/Library/mobilephonetoxicityrep.pdf (finding that (1) EPA is still conducting toxicity analysis on the various electronic waste streams, and (2) cell phones are deemed toxic, and other products are still being studied), *and* Roeder, *Federal Action*, *supra* note 5, at 1510 (EPA states that (1) it has not yet found environmental harm from an electronic waste contaminated landfill, (2) the future environmental harm from electronic waste is difficult to predict due to rapidly changing technology and its evolving nature, and (3) if a landfill leachate protection system failed, contaminants levels "would rise to twice the level of national safe drinking water standards. . . . [but] these contaminants would be rendered harmless by being diluted"), *and* U.S. GOV'T ACCOUNTABILITY OFFICE, ELECTRONIC WASTE: STRENGTHENING THE ROLE OF THE FEDERAL GOVERNMENT IN ENCOURAGING RECYCLING AND REUSE 3 (2005) [hereinafter GAO REPORT] ("Although one study suggests that leaching is not a concern in modern U.S. landfills, it appears that many of these products end up in countries without modern landfills or environmental regulations comparable to those in the United States. Finally, even with uncertainty surrounding the risks associated with toxic substances in used electronics, EPA has identified a number of these substances as priority toxic chemicals for reduction because they do not break down when released into the environment and can be dangerous even in small quantities.").

11. *See* Catherine K. Lin et al., *Globalization, Extended Producer Responsibility and the Problem of Discarded Computers in China: An Exploratory Proposal for Environmental Protection*, 14 GEO. INT'L ENVTL. L. REV. 525, 532 (2002).

II. ELECTRONIC WASTE DISPOSAL

A. Recycling as a Solution

Astronomical amounts of electronic waste sold in the United States are being stored in businesses' and consumers' homes awaiting disposal.[12] Recycling electronic waste is one option customers can choose to dispose of their electronic waste. It has many positive externalities including conserving landfill space, saving energy, decreasing greenhouse gas emissions, reducing toxic chemicals in the municipal waste stream (lead, mercury, arsenic), and preserving natural resources.[13]

For example, precious metals such as gold and silver can be obtained at a higher quality and with a lower environmental impact from electronic products rather than from traditional mining.[14] Due to a decrease in mining capacity, prices of precious metals have skyrocketed in recent years.[15] Additionally, increasing amounts of rare metals are being used in electronics.[16] These metals can be sold and reused when

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12. *See* Hazardous Waste Management System; Modification of the Hazardous Waste Program; Cathode Ray Tubes and Mercury-Containing Equipment, 67 Fed. Reg. 40,508, 40,509 (June 12, 2002) (codified at 40 C.F.R. pts. 260, 261, 264, 268, 270, 273) (stating that "approximately 20 to 24 million computers and televisions are added to storage each year"); Konoval, *supra* note 2, at 150-51 (reporting that (1) "20 million television sets became obsolete in 2003" and a small proportion was recycled or disposed of in landfills, and (2) there is an approximately 92 million annual gap in computers that have become obsolete and what has been accounted for in annual landfill disposal).

13. Roeder, *EPA*, *supra* note 7, at 93; Maryland Department of the Environment, eCycling in MD, http://www.mde.state.md.us/Programs/LandPrograms/Recycling/SpecialProjects/ecycling.asp (last visited Nov. 17, 2007).

14. *See* GAO REPORT, *supra* note 10, at 2-3 ("The U.S. Geological Survey, for instance, reports that 1 metric ton of computer scrap contains more gold than 17 tons of ore and much lower levels of harmful elements common to ores, such as arsenic, mercury, and sulfur. . . . If ultimately disposed in landfills, either in the United States or overseas, valuable resources, such as copper, gold, and aluminum, are lost for future use.").

15. Christoph Hammerschmidt, *UN Seeks to Set Limits on Electronics Waste*, GREEN SUPPLY LINE, Mar. 19, 2007, http://www.greensupplyline.com/howto/198100151.

16. Press Release, United Nations University, UN, Industry, Others Partner to Create World Standards for E-Scrap Recycling, Harvest of Valuable Components (Mar. 6, 2007), http://www.unu.edu/media/archives/2007/files/mre11-07.pdf.

> In addition to well-known precious metals such as gold, palladium and silver, unique and indispensable metals have become increasingly important in electronics. Among them: Indium [is] a by-product of zinc mining used in more than 1 billion products per year, including flat-screen monitors and mobile phones. In the last five years, indium's price has increased six-fold, making it more expensive than silver. . . . [B]ismuth (used in lead-free solders) has doubled since 2005 while ruthenium (used in resistors and hard disk drives) has increased by a factor of seven since early 2006.

Id.

salvaged during the recycling process.[17] Industry could decrease production costs if it could safely and inexpensively recover these metals from outdated electronics and reuse them in new products. This could ultimately result in consumers paying less for their electronics.

B. Utilizing Game Theory Rationale to Support Recycling as a Solution

Despite these benefits, Americans recycle only ten to fifteen percent of their electronic waste.[18] The small proportion of consumers that do recycle endure such transaction costs as inconvenient drop off locations and recycler disposal fees.[19] Yet successful free recycling events at local major retailers have demonstrated that if these transaction costs were reduced, consumers would be more willing to recycle.[20] If true, the consumer here is a rational actor seeking to maximize utility. Consumer "strategy" as referred to in the economic game theory is to minimize costs by avoiding these transaction costs.[21] Consequently, the consumer will choose to either to keep electronics in storage or dispose of them in landfills.

The game theory where each participant's optimal decision, or "strategy," rests on the other participant's reaction is illustrated in the prisoner's dilemma.[22] This hypothetical scenario involves two prisoners

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17. *See* ENVTL. PROTECTION AGENCY, SOLID WASTE AND EMERGENCY RESPONSE, WASTEWISE UPDATE: ELECTRONICS REUSE AND RECYCLING 2-3 (2000), *available at* http://www.epa.gov/wastewise/pubs/wwupda14.pdf.

> Electronic products are made from valuable resources, including precious and other metals, engineered plastics, glass, and other materials, all of which require energy to source and manufacture. Many electronic products also contain parts that could be profitably refurbished and reused with little effort. When we throw away old electronic equipment, we're throwing away these resources and generating additional pollution associated with the need to access virgin materials and manufacture new products.

Id. at 2.

18. *See* GAO REPORT, *supra* note 10, at 1 ("The National Safety Council forecast that in 2003 alone, about 70 million existing computers became obsolete, but it also forecast that only 7 million were recycled.").

19. *Id.* at 4 ("Consumers in Snohomish County, Washington, for instance, may have to travel more than an hour to the nearest drop-off location, which then charges between $10 and $27 per unit, depending on the type and size of the product.").

20. *Id.* at 14.

21. *See* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 20-21 (6th ed. 2003).

22. *See id.* at 174 n.1; *see also* EDITH BROWN WEISS, STEPHEN C. MCCAFFREY, DANIEL BARSTOW MAGRAW & A. DAN TARLOCK, INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 85 (2d ed. 2007).

> In the prisoner's dilemma, there are two prisoners who, during a private interrogation, must decide whether to confess to a moderate crime or to accuse the other prisoner of a serious crime. The accuser goes free unless the other prisoner has also accused him or her of a serious crime, in which case both receive a much heavier sentence than if they had confessed to a moderate crime in common.

who create a collective negative outcome when each acts in only his or her own best interest.[23] One solution to achieve a more efficient outcome is to reach Nash equilibrium. This occurs when neither participant can improve his situation by changing his strategy unilaterally.[24] When Nash equilibrium is reached, both participants have maximized their utility based on the strategy chosen by the other participant.[25] Commentators believe in this context legislation can set an optimal level of pollution at Nash equilibrium.[26] With electronic waste disposal, Nash equilibrium is created when all stakeholders (for example, manufacturers, retailers, recyclers, legislators, and consumers) maximize utility based on each other's strategy. Ideally, the equilibrium point will be set where consumers are motivated to recycle by other stakeholders' strategies.

Another option to mitigate the negative outcome suggested by the game theory is to create a Pareto-optimal solution. "Pareto-optimality is achieved when any further reallocation of resources of goods will benefit one person only at the expense of another person or persons."[27] One way of creating Pareto-optimality is to impose a Pigouvian tax on the participant disposing of the waste.[28] A Pigouvian tax is charged per "each unit of pollution output and the tax amount equals the marginal

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Id.

23. *See* WEISS ET AL., *supra* note 22, at 85.

24. *See* 3 NEW DICTIONARY OF THE HISTORY OF IDEAS 853-57 (Maryanne Cline Horowitz ed., 2004).

> A Nash equilibrium is a strategy combination in which each player's chosen strategy is a best response to the strategies of the other players, so that no player can get a higher expected payoff by changing strategy as long as the strategies of the other players stay the same. No player has an incentive to be the first to deviate from a Nash equilibrium. Nash proved the existence of equilibrium but not uniqueness: a game will have at least one strategy combination that is a Nash equilibrium, but it may have many or even an infinity of Nash equilibria (especially if the choice of action involves picking a value for a continuous variable).

Id. at 854.

25. Jason Scott Johnston, *The Tragedy of Centralization: The Political Economics of American Natural Resource Federalism*, 74 U. COLO. L. REV. 487, 504 n.40 (2003) (stating that "a Nash equilibrium is a set of strategies such that each player's strategy maximizes her payoff given the strategies chosen by the other players") (citing HERBERT GINTIS, GAME THEORY EVOLVING: A PROBLEM-CENTERED INTRODUCTION TO MODELING STRATEGIC BEHAVIOR 12-13 (2000)).

26. *Id.* ("There are papers that demonstrate that by forcing all jurisdictions to the same equilibrium per capita utility level, perfect and costless mobility ensures that the globally optimal level of pollution control is also a Nash equilibrium in the inter-jurisdictional competition game.") (citing Emilson C. D. Silva, *Decentralized and Efficient Control of Transboundary Pollution in Federal Systems*, 32 J. ENVTL. ECON. & MGMT. 95 (1997))).

27. *See* Stefan Schuppert, *Economic Incentives as Control Measures*, *in* INTERNATIONAL, REGIONAL AND NATIONAL ENVIRONMENTAL LAW 861, 864 (Fred L. Morrison & Rüdiger Wolfrum eds., 2000).

28. *Id.* at 864-65. Pigouvian tax is set at the determined costs of the negative externalities. *See id.*

damage the pollution causes to the economic system."[29] This tax deters consumers who seek to avoid the extra cost from a landfill disposal tax and creates an incentive for electronic recycling.

In theory, a tax incorporates into the production costs the social costs of waste disposal and subsequent pollution.[30] The difficulty in setting a Pigouvian tax is accurately assessing the social costs of pollution.[31] The social costs of pollution are used to determine the benefits of avoiding the pollution.[32] This cost-benefit analysis entails possible arbitrary estimating and uncertainty in the calculations.[33] Additionally, when assessing a Pigouvian tax, future discounting is used to determine the costs of environmental harms.[34] Future discounting is an economic term for "time preference" or the preference for receiving the benefit of the resource in the present as opposed to the future.[35] Commentators argue that future discounting inhibits "intergenerational equity." In calculating a Pigouvian tax scheme, intergenerational inequity occurs when a higher value is placed on present generation's benefits, and the benefits that would be conferred to future generations are assigned lower values.[36] Intergenerational inequity and the potential for arbitrary estimating make a Pigouvian tax a problematic option for electronic waste disposal despite its potential to encourage recycling.[37]

C. Profit Maximization in Electronic Waste Recycling

The answer to a successful and responsible electronic waste recycling program is economics.[38] Recycling electronic waste can be profitable for waste processors and second-hand electronic component

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29. *See* P.K. RAO, INTERNATIONAL ENVIRONMENTAL LAW AND ECONOMICS 59 (2002).

30. *See* Schuppert, *supra* note 27, at 864-65.

31. *Id.* at 865.

32. *Id.* Social costs include decrease in human health and environmental damages. *Id.*

33. *See id.* at 865 & n.60. Policymakers must decide which costs to consider in analysis, and data is difficult to collect. *Id.* at 865.

34. *Id.* at 865-66.

35. *See* ALEXANDER GILLESPIE, INTERNATIONAL ENVIRONMENTAL LAW, POLICY AND ETHICS 57-58 (1997) ("Hence, the perceived environmental costs of future damages are considerably less than what they would be if they existed in the present.").

36. *See* Schuppert, *supra* note 27, at 865-66.

37. For further discussion on Pigouvian tax, see *infra* notes 216-18 and accompanying text.

38. *Oversight Hearing on Electronic Waste Before the Subcomm. on Superfund and Waste Management of the S. Comm. on Environment and Public Works*, July 26, 2005 (statement of Scott Slesinger, Vice President for Governmental Affairs, The Environmental Technology Council), *available at* www.etc.org/slesinger_etc_7-26-05ewasteab.doc [hereinafter *Hearings*]; *see also* INTERNATIONAL ENVIRONMENTAL ECONOMICS: A SURVEY OF THE ISSUES 6 (Günther G. Schulze & Heinrich W. Ursprung eds., 2001) ("[E]conomic expertise stands a better chance of exerting a significant impact in the long run, by helping to design political institutions that will result in more satisfactory outcomes of the environmental policy process." (citations omitted)).

dealers.[39] In countries where labor is inexpensive partially due to lack of environmental and worker safety regulations, the electronic recycling industry has seen $72 million in aggregate profits.[40] However, currently in most of the United States, entering the recycling market is cost prohibitive.[41] The value of salvageable materials is not sufficient to cover the costs of collection, processing, transport, and recycling.[42] Recycling fees to offset these costs and correct this disincentive are therefore a necessity. The resale price of the recycled material fluctuates.[43] Unfortunately, when the components market collapses, recyclers often go out of business, all too commonly leaving taxpayers stuck paying to clean up the hazardous remnants.[44] Insurance against business loss would not be an effective solution because the recyclers would have less incentive to run a profitable business.[45] To achieve a responsible recycling program that conserves resources and protects the environment, the government should offer subsidies to recyclers to protect against the fluctuating market.[46]

Why does salvaging valuable material from recycled electronic waste cost so much? One reason is that, because of the way electronic gadgets are designed, disassembly for recycling is a difficult and labor-intensive process.[47] Labor costs could be reduced, however, through design modifications that would make it easier to remove valuable materials.[48] Once the material is removed from the product, there is still

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39. *See infra* text accompanying notes 165-72.

40. C. Hicks et al., *The Recycling and Disposal of Electrical and Electronic Waste in China—Legislative and Market Responses*, 25 ENVTL. IMPACT ASSESSMENT REV. 459, 460, 462-63 (2005) (stating that in Guiyu, China, waste is sold and traded for an industry valued at about RMB 600 million, or approximately $72 million, per year).

41. Roeder, *Federal Action*, *supra* note 5, at 1510 (EPA officials state that "the cost to recycle a desktop computer is about $15, while the value of materials recovered is between $1 and $2.50").

42. Timothy Mann, *Electronic Product Recycling: Overview of Worldwide Requirements and IBM Recommended Approach for Consumer E-Waste Recycling System*, *in* AMERICAN LAW INSTITUTE AND AMERICAN BAR ASSOCIATION, HAZARDOUS SUBSTANCES, SITE REMEDIATION, AND ENFORCEMENT COURSE OF STUDY MATERIALS 145, 151 (2006).

43. *Hearings*, *supra* note 38, at 5 ("The price of lead has fluctuated dramatically over the years.").

44. *Id.* at 3-4.

45. POSNER, *supra* note 21, at 169. Insurance is a disincentive to prevent loss. *Id.*

46. Subsidies allow pricing below marginal cost. *See id.* at 374-75.

47. *See* GAO REPORT, *supra* note 10, at 12 (reporting that "a Hewlett-Packard official told us 30 different screws must be removed to take out one lithium battery when disassembling a Hewlett-Packard computer for recycling" and that "over 50 percent of [HP's] total costs for recycling are labor costs").

48. *Id.* at 12 ("[I]f Hewlett-Packard spent $1 in added design costs to reduce the number of different screws in each computer, it would save [the recycling company] approximately $4 in its disassembly costs.").

further expensive processing to obtain a retail quality material.[49] Technology is available to decrease the expense of these processes, but businesses are unsure of the regulatory scheme that will govern recycling and are therefore wary about investing in these technologies.[50] For now, the recyclers' net revenue (that is, accounting profit) from recycling is less than it could be because of this costly processing. In an attempt to offset the expenses and maintain profit, recyclers charge fees to consumers.

The financial assistance provided by subsidies or by recycling fees, however, will not necessarily offset the recyclers' hunger for more profit. Recyclers may choose between high labor prices in the United States and low labor prices in less developed countries. Unless mandated otherwise, they will ordinarily choose to send the product overseas for disassembly.[51] As recycling in the United States becomes even more costly due to compliance with hazardous waste regulations, the incentive to export increases.[52] The less developed countries often have less stringent environmental regulations (or none at all) and will be a less expensive venue for electronic waste disposal.[53] This lack of environmental and worker safety regulation in conjunction with already inexpensive labor costs entices business to dishonestly export electronic waste to developing countries to avoid United States regulatory cost burden regardless of the financial assistance received.

D. Dangerous Externalities

Negative transboundary externalities exist from the trade of recyclable materials to less developed countries.[54] Negative externalities exist when costs are imposed on an uncompensated third party.[55] The most notable uncompensated third parties are workers exposed to the toxic components of electronic waste and American children exposed to lead from their toys.[56]

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49. *Id.* at 13.

50. *GAO Report Recommends National Electronic Waste Recycling Legislation*, 24 HAZARDOUS WASTE CONSULTANT 1.1, 1.2 (2006).

51. Betsy M. Billinghurst, Note, *E-Waste: A Comparative Analysis of Current and Contemplated Management Efforts by the European Union and the United States*, 16 COLO. J. INT'L ENVTL. L. & POL'Y 399, 405 (2005).

52. Lisa T. Belenky, *Cradle to Border: U.S. Hazardous Waste Export Regulations and International Law*, 17 BERKELEY J. INT'L L. 95, 96 (1999).

53. *Id.*

54. *See* RAO, *supra* note 29, at 48-50 (giving examples of transboundary externalities).

55. *See* CLEMENT A. TISDELL, ECONOMICS OF ENVIRONMENTAL CONSERVATION 56 (2d ed. 2005).

56. *See* Terence Chea, *Tech Firms Go Green as E-Waste Mounts*, WASHINGTONPOST.COM,

Although some countries benefit from the reuse of second hand electronics, their less stringent or nonexistent worker safety regulations place the workers and children at risk for hazardous waste exposure. The electronic devices sent to developing countries for reuse are actually junk, unrepairable and unsalvageable.[57] The unsalvageable electronics are then unsafely disposed or recycled, exposing individuals to the products' toxic dangers.[58] For instance, workers who dismantle electronics are exposed to hazardous substances because they are not provided proper personal protective equipment. Further, plastics from electronics are sometimes sold to toy manufacturers.[59]

This arrangement of hazardous waste trade is inefficient for both the importing and the exporting country in the long run.[60] Transnational realities are more frequently demonstrating that the long-term costs to both countries exceed the short-term benefits. The recently discovered link between lead in imported children's toys and improper electronic waste disposal is a startling example of how these seemingly transboundary externalities can easily become domestic externalities with tragic consequences.[61] "[This] existence of uncompensated and

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Mar. 4, 2007, http://www.washingtonpost.com/wp-dyn/content/article/2007/03/03/AR2007030300648.html ("Among the e-waste that is recycled, activists say, up to 80 percent is exported overseas to dismantling shops where poor workers are exposed to hazardous fumes and chemicals while trying to extract valuable metals and components."); Lin et al., *supra* note 11, at 527, 553 (plastics from electronics are sold to toy companies); Jeffrey D. Weidenhamer & Michael L. Clement, *Leaded Electronic Waste Is a Possible Source Material for Lead-Contaminated Jewelry*, CHEMOSPHERE, May 4, 2007, at 2, 4-5, *available at* http://personal.ashland.edu/~jweiden/EWaste.WeidenhamerClement.pdf (observing American children are dying from lead poisoning and many have lead exposure as a result of playing with toys imported from China); Pat Rizzuto, *U.S. Exits U.N. Forum on Chemical Safety; Secretariat Expresses Disappointment*, 30 Int'l Env't Rep. (BNA) No. 19, at 733 (Sept. 19, 2007) (noting Secretariat's reference to a study at Ohio's Ashland University which found that lead-containing electronic waste is finding its way into consumer products such as children's toys made in China).

57. JIM PUCKETT, SARAH WESTERVELT, RICHARD GUTIERREZ & YUKA TAKAMIYA, BASEL ACTION NETWORK, COMPUTER TAKEBACK CAMPAIGN, THE DIGITAL DUMP: EXPORTING RE-USE AND ABUSE TO AFRICA 2 (2005), http://www.computertakeback.com/docUploads/TheDigitalDumpWeb.pdf.

58. *Id.* at 2-3.

59. Lin et al., *supra* note 11, at 528, 553-55 (noting that (1) China is "one of the favored destinations for waste computers . . . because of its low labor costs," and (2) the dismantling of the computers causes "subsurface contamination, air pollution, incidents of toxic exposure, childhood illness, birth defects, fish kills and other loss of biota").

60. RAO, *supra* note 29, at 221.

61. *See* Weidenhamer & Clement, *supra* note 56, at 2; Rizzuto, *supra* note 56, at 733 (referencing a study considering lead from electronic waste as a probable source for the lead that has been recently discovered in products made in China); *see, e.g.*, Press Release, U.S. Consumer Product Safety Commission, Office of Information and Public Affairs, Reebok Recalls Bracelet Linked to Child's Lead Poisoning Death (Mar. 23, 2006) (on file with Hofstra Law Review), *available at* http://cpsc.gov/cpscpub/prerel/prhtml06/06119.html.

unsustainable environmental externalities is often the single most important reason for policy intervention . . . ."[62]

Similarly, as in developing countries, reuse is not always a viable option for electronics in the United States. These units are usually so old that the parts are not compatible with the newer systems and they no longer present any value to users.[63] Non-profit organizations often incur more expenses than revenue from donated used electronics.[64] Stores such as Goodwill and Salvation Army previously offered consumers free collection for usable electronics, but due to the high costs incurred in disposing of used electronic waste, these stores no longer accept computer or television donations.[65]

E. Landfills Subject to the "Tragedy of the Commons"

Focusing only on dollar signs, it is significantly less expensive to dispose of electronic waste in a landfill rather than to recycle.[66] Therefore, most electronic waste is disposed of in landfills.[67] Since landfills have no clearly defined or enforceable property rights, they are subject to the phenomenon of the "tragedy of the commons." Landfills have the attributes of a commons because there are many users who use them with little cost.[68]

The classic example of the "tragedy of the commons" tells the story of herdsmen using a common pastureland. In an effort to maximize personal utility, they limitlessly increase the amount of cows on a commonly owned pasture.[69] With this system, rational actors are compelled to overuse a restricted resource.[70] Each herdsman receives the positive utility of full profit from the sale of the additional cow but only

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62. *See* RAO, *supra* note 29, at 48; TISDELL, *supra* note 55, at 66-70 (stating examples of ways that government can correct environmental externalities include: taxes, subsidies, prohibition and regulation, auction of rights, tradable rights to natural resource use, state property ownership or control, facilitating private negotiations, strengthening property rights, internalizing externalities, and providing information).

63. *See* Mann, *supra* note 42, at 151 (stating that computers and monitors are typically eight to twelve years old and televisions are typically fifteen to seventeen years old).

64. *See* Jennifer L. Fordyce, *Chapter 526: Out With the Old, In With the New—California Addresses the Growing Problem of E-Waste*, 35 MCGEORGE L. REV. 529, 541 (2004) ("[O]rganizations can lose between twenty-five and thirty dollars for each computer or television that they accept as a donation.").

65. *See id.* at 541-42 (noting that only ten percent of the donated computers could be reused or refurbished).

66. *See* Roeder, *Mandates*, *supra* note 7, at 216 ("[I]t can cost $500 to recycle a ton of electronic waste, but it costs only $40 to landfill.").

67. *See supra* note 18 and accompanying text.

68. *See* RAO, *supra* note 29, at 51.

69. WEISS ET AL., *supra* note 22, at 84.

70. *Id.*

a fraction of the cost. The negative component of an overgrazed pasture is allocated among all the herdsmen.[71] The "tragedy" occurs when eventually the pasture is ruined.[72] Similarly, a rational actor seeking to dispose of electronic waste will find that his utility is initially higher when he shares the cost of disposing in the commonly owned landfill, as opposed to bearing the cost himself to discard safely.

Most economists believe that this "tragedy" of a common resource is market failure caused by the absence of defined property rights.[73] If the resource had clearly defined private property rights and was no longer a commons, agreements between owners would be easier to reach.[74] The owner would be able to demand compensation from users for costs resulting from land use for disposal. In economic terms, the compensated owner is forcing other users to internalize the externalities. When users must recognize and compensate for the use of resources as a means for waste disposal, they are internalizing the costs associated with the disposal.[75] When users are not charged or charges are insufficient, economic waste occurs because there is no incentive to optimize resources.[76] "'For development to be sustainable, consumers and producers will have to pay for services provided by environmental resources,'" such as waste disposal.[77]

In addition to being open access resources, landfills, as commons, do not generate individual wealth.[78] Due to the lack of individual ownership, commons are exposed to under-investment and over-exploitation.[79] Information concerning the consequences of resource exploitation is unavailable because users have been unwilling to invest in obtaining the information.[80] Individuals are not as willing to invest in public resources, such as landfills, as they would in private resources where they alone would profit.[81] The lack of information concerning overuse in conjunction with under-investment in obtaining this

71. *Id.*

72. *Id.* (stating that this is also referred to in the context of pollution as "fouling our own nest").

73. *Id.* at 86.

74. *See* TISDELL, *supra* note 55, at 69.

75. Hon. J. Hugh Faulkner, *The Role of Business in International Environmental Governance*, *in* 9 INTERNATIONAL GOVERNANCE ON ENVIRONMENTAL ISSUES 150, 154 (Mats Rolén, Helen Sjöberg & Uno Svedin eds., 1997) (citation omitted).

76. *Id.* (citation omitted).

77. *Id.* (citation omitted).

78. Carol M. Rose, *Scientific Innovation and Environmental Protection: Some Ethical Considerations*, 32 ENVTL. L. 755, 759 (2002).

79. *Id.* at 760.

80. *Id.* at 761-62.

81. *Id.* at 760-61.

information amounts to users who are prone to exploit the resource (landfill space) by filling it with electronic waste.

One solution to the "tragedy of the commons" is to charge users for their use of the resource based on the amount of their use.[82] Here, the solution would be to charge consumers per unit or by weight for their electronic product disposal. A proper charge would help correct the market failure or "tragedy" by forcing the actor to internalize the cost of electronic waste disposal. The actor would no longer be sharing or, in some cases, not realizing, the cost of overusing the resource. The cost should discourage landfill disposal and slow down the exploitation of landfill space. Often the crux behind environmental economics and policy regulation is forcing actors to internalize their costs.[83]

F. Free Riders and Holdouts

Landfill space is subject to both free riding and holdouts. Relative to the "tragedy of the commons," the free rider phenomenon occurs when the public good is non-excludable[84] and non-rival.[85] In the case of electronic waste landfill disposal with no regulations, the user incurs no additional duties or responsibilities for using the landfill. Anyone can dispose of electronic waste in this public resource. Moreover, in the short term, this disposal is non-rival, meaning the landfill seems so big that one person's use of it does not subtract from another person's use of it, roughly similar to one person's use of public television, which (by watching) does not take away from the satisfaction of or quantity available to any other viewer.

In reality, landfills are not truly non-rival—they are finite. But long before society realizes the limits on landfills, treating them as non-exclusive, non-rival public goods will lead to an environmental externality of "uncompensated infliction of environmental and consequential damage on known or unknown victims."[86] This could be groundwater pollution with subsequent health effects to nearby residents or lack of available future landfill space for unknown users. These potential future failures necessitate an enforceable regulatory scheme which delineates the sharing of responsibilities.[87] Landfill bans of

82. RAO, *supra* note 29, at 51-52.

83. *See* WEISS ET AL., *supra* note 22, at 86-87 (noting difficulty occurs when there are no market incentives for the user to take into account his or her costs).

84. *See* RAO, *supra* note 29, at 52 (explaining free riding is dependant on "whether or not they 'pay' or participate in a 'responsible' manner").

85. *Id.*

86. *Id.* at 54.

87. *Id.*

electronic waste are an essential regulatory key to encourage consumer recycling. Holdouts will continue to exploit landfill space without the bans because there is no incentive for recycling.[88]

III. FEDERAL ELECTRONIC WASTE DISPOSAL SCHEME

A. Current Federal Approach: Product Stewardship

The federal government has not yet formulated a proposed regulation that deals directly with electronic waste.[89] Federal regulations already in place do not adequately address electronic waste disposal.[90] Resource Conservation Recovery Act ("RCRA") regulates disposal of hazardous substances,[91] but RCRA's exceptions usually do not regulate electronic waste. Rather, RCRA allows likely electronic waste disposers (small quantity generators and household waste producers) to escape regulation.[92] Even if RCRA did apply to households and small quantity generators, the implementation and monitoring costs of applying RCRA to electronic waste would be overly burdensome and most likely cost prohibitive to the administration.[93] Keeping RCRA regulations at a manageable standard was Congress's and the Environmental Protection Agency's intent when carving out these exceptions to the Act.[94]

The concept of product stewardship is a voluntary system utilized

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88. Linda Roeder, *GAO Calls National Financing System Critical for Recycling Electronic Waste*, 36 Env't Rep. (BNA) No. 30, at 1559 (July 29, 2005) [hereinafter Roeder, *National Financing*] (noting that the "GAO has found more recycling takes place in states with landfill bans" then states with just recycling programs available).

89. *See 'E-cycling'*, *supra* note 6 ("[T]he U.S. has yet to adopt a consistent policy. The Senate is considering tax incentives for consumers and recyclers who properly handle e-waste . . . .").

90. Linda Roeder, *Report Urges EPA to Draft Legislation to Spur Used Electronics Recycling System*, 36 Env't Rep. (BNA) No. 49, at 2579 (Dec. 16, 2005).

91. RCRA regulates hazardous wastes from cradle to grave. *See* 42 U.S.C. §§ 6901-6992k (2000). A waste is hazardous if it is toxic, ignitable, corrosive, reactive, or if it is specifically listed in the regulations. *See* 40 C.F.R. § 261.3 (2006); 40 C.F.R. §§ 261.20-.24 (2006).

92. *See* 40 C.F.R. § 261.4(b)(1) (2006) (household waste exclusion); 40 C.F.R. § 261.5(f) (2006) (conditionally exempting companies generating less than 100 kilograms of hazardous waste per month). The hazardous waste program "is not to be used to control the disposal of substances used in households or to extend control over general municipal wastes based on the presence of such substances." 45 Fed. Reg. 33,084, 33,099 (May 19, 1980) (codified at 40 C.F.R. pt. 261) (explaining EPA's interpretation of the household waste exception); *see also* 71 Fed. Reg. 42,928, 42,928-29 (July 28, 2006) (codified at 40 C.F.R. pts. 9, 260, 261, 271) (stating that EPA amended its rules to exclude cathode ray tubes and broken cathode ray tubes from hazardous waste disposal requirements).

93. *See* POSNER, *supra* note 21, at 391 (stating that regulation is cost prohibitive at the point where the costs are greater than the benefits).

94. 45 Fed. Reg. 33,084, 33,088 (May 19, 1980) (codified at 40 C.F.R. pt. 261); S. REP. NO. 94-988, at 15-16 (1976).

by the federal government regarding electronic waste disposal.[95] Product stewardship occurs when responsibility for product disposal is shared by customers, retailers, product manufacturers, local governments, and volunteer organizations.[96] The EPA has developed several voluntary programs, such as EPEAT,[97] for manufacturers,[98] and President Bush has signed executive orders that require federal agencies to utilize EPEAT when purchasing electronic equipment.[99] These volunteer programs are an attempt to internalize the cost of disposal to the manufacturer by encouraging the manufacturer to build disposal costs into the price of the product.

Product stewardship is a diluted extension of the "polluter pays" principle. This principle requires the polluter to pay for the damages resulting from polluting acts. The damages are internalized by the principle, which forces the polluter to absorb the costs of pollution and/or pass them on to consumers in the form of higher prices. The "polluter pays" principle ensures that the manufacturer will price his product to reflect the cost of the environmental damage that the product causes.[100] If manufacturers cooperate with these volunteer programs, they will be incurring costs related to design changes and product disposal. Several environmental economists and foreign legislatures promote the "polluter pays" principle as an ideal method to curtail waste disposal by assuring the costs of pollution are reflected in prices paid by the consumer.[101]

Product stewardship may create an opportunity for the market actors to come to an efficient outcome. This possibility would require

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95. *See* Roeder, *Mandates*, *supra* note 7, at 216 ("EPA has stated that its goal is to promote greater product stewardship of electronics.").

96. Grassroots Recycling Network, Product Stewardship: New Policy Direction for Minnesota, http://www.grrn.org/resources/mn.html (last visited Nov. 23, 2007).

97. *See* Joyce Hedges, *Green Computer Database Established with Focus on Large Volume Purchasers*, 37 Env't Rep. (BNA) No. 30, at 1567 (July 28, 2006) (stating that the EPEAT rating lists products by performance level, including bronze, silver, or gold, based on twenty-three criteria including the reduction of materials "such as lead, cadmium and mercury, design for end-of-life and end-of-life management, life-cycle extension, energy conservation, corporate performance, and packaging, according to the EPA" (citation omitted)); Linda Roeder, *EPA Announces New Voluntary Standard with Criteria for Large Computer Purchasers*, 37 Env't Rep. (BNA) No. 19, at 1006-07 (2006) (stating that consumers can use the database to guide their purchasing).

98. *See* GAO REPORT, *supra* note 10, at 25-26 (listing federally implemented programs including (1) the Federal Electronics Challenge, (2) Electronic Product Environmental Assessment Tool (EPEAT), and (3) the "Plug-In To eCycling" campaign).

99. Mike Ferullo, *Executive Order Requires Federal Agencies to Reduce Energy Use, Rely on Renewables*, 38 Env't Rep. (BNA) No. 4, at 198 (Jan. 26, 2007) (remarking that, under the order, agencies must use EPEAT to acquire ninety-five percent of their computers and electronics).

100. ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 28 (5th ed. 2006).

101. *See* Schuppert, *supra* note 27, at 864-65.

that actors share a sense of environmental responsibility and are motivated to negotiate fairly. Unfortunately, product stewardship is not an enforceable solution to the electronic waste disposal problem. All actors except purchasers at federal agencies are free to ignore stewardship devices. However, some companies have implemented programs, although their effectiveness at this point is unknown.[102]

Posner states that some companies may participate in product stewardship programs and voluntarily reduce the amount of pollution because "[t]he demand for pollution regulation is a function, in part, of the amount of pollution."[103] If the amount of pollution is reduced by a certain amount voluntarily, the demand for regulation may decrease.[104] Posner elaborates that customers do not benefit from pollution control spending.[105] They can achieve the same benefit from purchasing the less expensive product whose price does not reflect pollution control costs.[106] He believes that only a monopolist can shift the cost of pollution control onto its customers and maintain profitability.[107] However, even the monopolist will suffer profit loss, reduction in future earnings, and subsequently, a lower share price.[108]

Nonetheless, some manufacturers have voluntarily implemented programs to deal with electronic waste. The CEO of Dell has challenged the electronics industry to implement environmentally responsible programs.[109] In 2006, Hewlett-Packard ("HP") recycled 164 million pounds of electronic waste and met Dell's challenge.[110] HP coordinates free collection drives, and when it does charge for recycling, it gives a coupon redeemable for future products relieving the customer of some financial burden.[111] Further, HP conducts all of its recycling domestically, reducing the potential for international pollution.[112] Dell, HP, and many other electronic manufacturers and retailers joined with the United Nations in the new voluntary initiative called "Solving the E-

102. *See* Jonathan Sidener, *Get the Lead Out: E-Waste Program Helps Recyclers Divert Toxic Metals from the Landfills*, SAN DIEGO UNION-TRIB., Feb. 6, 2006, at C1 (reporting that Dell takes back its products for free and competitors' products for $10).

103. POSNER, *supra* note 21, at 435.

104. *Id.* at 435-36.

105. *Id.* at 436.

106. *Id.*

107. *Id.*

108. *Id.* at 436-37.

109. *See* Chea, *supra* note 56 (quoting Michael Dell as saying, "[i]t's the right thing to do for our customers. It's the right thing to do for our earth").

110. *Id.*

111. *Id.*

112. Specifically, HP recycles electronics at its plants in Roseville and Nashville, Tenn. *Id.*

Waste Problem" ("StEP").[113] StEP aims to propose standardized electronic waste strategies and guidelines.[114] At least nine other manufacturers and retailers participate in other volunteer electronic waste disposal programs and incentives.[115]

To facilitate greater national regulation, some Congressmen have come together to raise congressional awareness of the problem of electronic waste disposal.[116] Representatives from this group have introduced bills in multiple House sessions geared towards federal electronic waste regulation.[117] One would permit the government to fund grants (through fees on new computers) to develop electronic waste recycling programs.[118] Additionally, United States Senator Ron Wyden (D-Or.) and former Senator Jim Talent (R-Mo.) introduced S. 510, a bill aimed at encouraging nationwide electronic waste recycling.[119] S. 510 would give tax credits to both consumers and manufactures for recycling electronic waste.[120] In April 2007, Senator Wyden proposed a meeting with electronic retailers and manufacturers with the purpose of devising legislative solutions that would encourage consumers to recycle electronic waste.[121] Similar to the legislation introduced in the House of Representatives, S. 510 calls upon the EPA to develop a program that would eventually preempt state programs.[122] No bills have yet been successful.[123]

B. The Patchwork Problem

In the absence of a federally mandated solution to the electronic

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113. Solving the E-Waste Problem, Members of the Initiative, http://www.step-initiative.org/pdf/StEP%20Members%20List.pdf (last visited Nov. 25, 2007).

114. *See infra* text accompanying notes 221-23.

115. Computer TakeBack Campaign, Recycling Your Computer: Which Computer Companies Will Take Back Your Old Computer?, 1-8 (Aug. 17, 2007), http://www.computertakeback.com/docUploads/using_takeback_programsv10.pdf.

116. Linda Roeder, *Congressional Resolution Would Direct House, Senate to Recycle Used Electronics*, Daily Env't Rep. (BNA), Nov. 18, 2005, at A-15 (stating that the goal of the E-Waste Working Group is to increase awareness and encourage a federal solution).

117. *Id.*

118. National Computer Recycling Act, H.R. 425, 109th Cong. (2005).

119. Linda Roeder, *Sen. Wyden Calls on Electronics Industry to Join in Developing E-Waste Legislation*, 38 Env't Rep. (BNA) No. 13, at 730 (Mar. 30, 2007).

120. *Id.*

121. *Id.*

122. *Oversight Hearing on Electronic Waste Before the S. Comm. on Environment and Public Works* (2005) (statement of Hon. Ron Wyden, United States Senator from the State of Oregon), *available at* http://epw.senate.gov/hearing_statements.cfm?id=241460.

123. A search on the Library of Congress's website (http://thomas.loc.gov/) reveals that S. 510 has been read twice and referred to the Senate Committee on Finance and H.R. 4316 has been referred to the Subcommittee on Environment and Hazardous Materials.

waste disposal problem, states are left to formulate regulations. Industry would prefer a national regulation rather than the many different state regulations that are developing.[124] The patchwork of policies and their inconsistencies from state to state create onerous compliance costs. In some cases, it is a difficult burden to comply with the extreme variations of the regulations.[125] When faced with two different standards, manufacturers have to comply with both, not just the stricter standard.[126] Even more overwhelming for businesses, if no national regulation is developed, manufacturers may not only have to comply with the different state programs, but with different city and county electronic waste disposal schemes as well.[127] Last year in the United States, fifty-four electronic waste bills were proposed, and sixty were proposed in 2005.[128] One-third of these bills charged the manufacturer or retailer with the duty to recycle the electronic waste, and another fifteen percent were electronic waste landfill bans.[129] The transaction costs of complying with all of these different regulations can have dramatic effects on the electronics manufactures, retailers, and the United States economy.[130]

If the federal government were to promulgate a rule, Posner might suggest that the rule recognize that the economic or social costs of electronic waste disposal are not uniform throughout the country.[131] An

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124. GAO REPORT, *supra* note 10, at 18 (reporting that ninety-five percent of manufacturers and state and local government officials surveyed by the Government Accountability Office (GAO) stated that they would support a national regulation).

125. California electronic waste regulations apply to everyone. In contrast, Maine's only apply to products sold to household users. Thus, Maine manufacturers are currently not responsible for electronic disposal of businesses, medical facilities, educational institutions, or state and local governments. There is also disagreement among states about which devices qualify to be recycled under the various programs. It is estimated $25 million is being spent in compliance and most of that figure is dead weight costs. Jason Linnell, Executive Dir., Nat'l Ctr. for Elecs. Recycling, Panel Discussion at the Consumer Electronics Association (CEA) Washington Forum: Riding the Green Wave: Why Electronics Recycling Compliance is Critical to Your Company (Mar. 26, 2007) (transcript available at http://www.ce.org/events/event_info/downloads/WF07/3.26.07%20Senator%20Wyden%20Keynote%20&%20Electronics%20Recycling%20Panel.doc).

126. *See* GAO REPORT, *supra* note 10, at 17-18 (stating that (1) HP in California has an advance recovery fee on its product and has invested over $3 million to implement and spends $250,000 per year to maintain, (2) HP in Maine participates in a mandatory take back program at $90,000 per year cost, and (3) HP estimates it could cost over $2 million dollars per state if a new state system differs from those currently existing).

127. *See* Anthony DePalma, *Afterlife for Old Computers Is Envisioned in Council Bill*, N.Y. TIMES, May 25, 2005, at B3.

128. *See* Joyce Hedges, *Solid Waste Rule, Recycling Are Priorities; Changes to Tank Program Also on Agenda*, 38 Env't Rep. (BNA) No. 3 (2007 OUTLOOK) at S-18 (Jan. 19, 2007).

129. *Id.* In 2006 and 2005, only seven and five electronic waste bills were enacted, respectively. *Id.*

130. *See* Roeder, *Federal Action*, *supra* note 5, at 1510.

131. POSNER, *supra* note 21, at 392.

accurate tax would be equal to the marginal, not the average, social cost of the electronic waste disposal.[132] Accordingly, a marginal tax would vary with the level of pollution input. As Posner points out, a "staggering amount of information would be required to devise such a tax schedule."[133]

Additionally, the lack of federal regulation can be analyzed from the position of a "game theorist." A "game theorist" would view the management of electronic waste disposal as a multistage game with states performing strategic interactions based on their varying levels of access. Their experiences with free riders and other negative externalities play into their strategic planning.[134] These management problems create entrants in the game on both a local municipality level and on a larger global scale with different regulatory regimes in various countries and regions within countries. Without coordination between all of these stakeholders, a more rapid exploitation of resources will occur.[135] "While admitting the importance of strategic behavior among parties, mechanisms for the design and implementation of relevant policies with cooperative arrangements are significant in the management of global environmental resources."[136] The states agree that coordination among stakeholders is needed. National regulation is the highest level of coordination that can be achieved within the United States. Moreover, national regulation would enhance, not hinder, state regulation. As representatives from Maine and California recently told Congress, although those states already have electronic waste laws, "they could benefit from national leadership."[137] In 2006, Washington passed the most comprehensive and aggressive electronic waste regulation.[138] I will therefore briefly examine the regulatory regimes of Maine, California, and Washington.

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132. *Id.*

133. *Id.* For instance, the effect of pollution from electronic waste disposal varies depending on the geology, hydrogeology, and porosity of the soil in any given area. Likewise, the cost of the environmental effects depends on the cost of living, cost of health care, population affected, and other factors for each local area. Further, the potential ramifications of each electronic unit disposed would need to be calculated.

134. RAO, *supra* note 29, at 81.

135. *See supra* notes 66-83 and accompanying text (explaining why landfills are subject to "Tragedy of the Commons").

136. RAO, *supra* note 29, at 84.

137. Roeder, *National Financing*, *supra* note 88, at 1559 (citation omitted).

138. *See* Linnell, *supra* note 125.

IV. STATE ELECTRONIC WASTE REGULATIONS

The lack of federal regulations assigns, by default, the burden of disposal regulation on state and local governments. As a result, a variety of legislative approaches have developed in attempts to fund electronic waste disposal. Thirteen states have some form of electronic waste regulation, and several have electronic waste regulations pending.[139] This Note examines Maine, California, and Washington.

A. Maine

Maine has a system modeled after the EU approach called Extended Producer Responsibility ("EPR"), which requires the manufactures to pay for electronics recycling costs.[140] The Maine law represents a partnership between the private sector, municipal and state entities, and consumers.[141] The state requires manufacturers to ensure the recycling of their products. "[L]ocal government is responsible for collecting the waste equipment; and retailers are responsible for not selling products of manufacturers that fail to comply with the program."[142] The manufacturer is accountable for the costs of waste consolidators and processors for all of its electronics sold in Maine.[143] Manufacturers are also likely responsible for electronic waste disposal of the residents of nearby states. There is nothing stopping non-residents from entering Maine to dispose of their electronic waste at a reduced cost.

Electronic users in Maine benefit from this EPR approach. The consumer who used to pay twenty dollars to recycle his computer prior to the regulation now pays only two dollars.[144] However, manufacturers and retailers may be economically burdened. The electronic waste provision prohibits the sale of electronics by retailers or manufacturers not in compliance with regulations in Maine.[145] If sales in Maine are not sufficient to cover the costs of disposal, this could take companies out of the Maine electronics market.

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139. LINDA LUTHER, MANAGING ELECTRONIC WASTE: AN ANALYSIS OF STATE E-WASTE LEGISLATION, CRS REPORT FOR CONGRESS (2007), http://opencrs.cdt.org/rpts/RL34147_20070910.pdf. The states that have enacted legislation are Arkansas, California, Connecticut, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, North Carolina, Oregon, Rhode Island, Texas, and Washington. *Id.*

140. *Maine*, *supra* note 4.

141. New Rules Project, The Environment Sector, Electronic Waste Recycling—Maine, http://www.newrules.org/environment/ewasteme.html (last visited Nov. 23, 2007).

142. Roeder, *Federal Action*, *supra* note 5, at 1510 (citation omitted).

143. *Maine*, *supra* note 4.

144. *Id.*

145. ME. REV. STAT. ANN. tit. 38, § 1610(3) (Supp. 2006).

Manufacturers typically price their goods at or above the marginal cost, the cost of an additional unit of output.[146] If disposal costs are added to unit production costs, the marginal cost of the product may eventually increase beyond the price that consumers are willing to pay for the item. This would force some manufacturing businesses to close up shop in Maine, giving consumers less purchasing choice and giving remaining businesses even more of a competitive advantage over the smaller or newer Maine electronic manufacturing businesses. This issue of reduced choice is compounded to the extent that manufactures are forced by rising costs to exit Maine's electronic market.

Moreover, the state will force some manufacturers to leave the Maine market. Manufactures not in compliance with the law after January 2006 are placed on a "do not sell list." Maine retailers are prohibited (under penalty of law) from selling products made by non-compliant manufacturers. The threat to place manufacturers on a "do not sell list" is not an idle one. As of November 2007, Maine retailers cannot sell electronic products from thirty non-compliant manufacturers.[147]

Other criticisms of Maine's program target its so-called "orphan waste" requirement. "Orphan waste" is defined by statute as electronic devices where the manufacturer either "can not be identified or is no longer in business and has no successor in interest."[148] Manufacturers must implement and finance a plan both for the materials that they produce and for "orphan waste."[149] Cost of disposal for orphan units is divided between manufacturers based on a market share theory.[150] Sorting waste to calculate manufacturer responsibility is complicated and creates a significant burden.[151] This will almost certainly add to the

146. POSNER, *supra* note 21, at 7-9.

147. *See* Janet McClintock, *Treatment of Electronic Waste in Maine*, *in* AMERICAN LAW INSTITUTE AND AMERICAN BAR ASSOCIATION, HAZARDOUS SUBSTANCES, SITE REMEDIATION, AND ENFORCEMENT COURSE OF STUDY MATERIALS 155, 158 (2006); *see also* Maine Department of Environmental Protection, Manufacturers (and *their* Brands) That Have NOT Notified (Nov. 5, 2007), http://www.maine.gov/dep/rwm/ewaste/pdf/donotsell.pdf. There is no penalty beyond a retail sales ban. *See* ME. REV. STAT. ANN. tit. 38, § 1610 (Supp. 2006).

148. § 1610(2)(G).

149. § 1610(6).

150. *See Maine*, *supra* note 4 (stating cost of disposing of orphan units "will be shared by the other companies in proportion to their overall costs").

151. *See* National Electronics Recycling Infrastructure Clearinghouse, Maine E-Waste Collection Overview (TVs and Monitors), http://www.electronicsrecycling.org/ncer/UserDocuments/ME%20ewaste%20collection%20overview%20chart%201_18_06%20to%2012_31_06.xls (last visited Nov. 23, 2007) (reporting that 191,879 pounds of orphan waste were collected in Maine from Jan. 18, 2006 to Dec. 31, 2006); National Electronics Recycling Infrastructure Clearinghouse, State Electronics Recycling Law Implementation Status, http://www.ecyclingresource.org/ContentPage.aspx?PageID=23 (last visited Nov. 23, 2007) (reporting that waste consolidators have been approved to charge between $0.19 and $0.48 per

"orphan waste" disposal costs.

B. California

Unlike Maine, which focuses its regulation on the producer, California utilizes an Advanced Recovery Fee ("ARF"), which concentrates on consumers of electronics. California's Electronic Waste Recycling Act of 2003 ("EWRA") requires the consumer to pay a disposal and/or recycling cost at the time they purchase a covered electronic product.[152] EWRA also requires state agencies to buy environmentally friendly electronics.[153] Manufacturers evaluate the costs and benefits of selling environmentally conscious electronic products. Based on these considerations, the manufacturers provide agencies with recommendations for setting the criteria used in choosing approved electronics.[154]

The legislature addressed economic goals "to ensure that any cost associated with the proper management of covered electronic devices be internalized by the producers and consumers of covered electronic devices at or before the point of purchase, and not at the point of discard."[155] The legislature further states that in exchange for the benefit of the convenience of clearing their homes of electronic waste customers will pay six to ten dollars more at the time of purchase.[156]

EWRA opponents disagree with the California legislature. The upfront fee paid by the consumer takes away the manufacturer's responsibility for electronic waste disposal and shifts it to the government. This shift creates more government administrative burdens and reduces the incentive for manufacturers to implement design changes.[157]

The California Manufacturers and Technology Association, with some credibility, has called the provision a "job killer." They fear economic effects will be so severe that jobs will be affected.[158] Consumers who want to avoid the California surcharge can find other

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pound of e-waste). Since the middle price per pound to recycle e-waste is $0.33, the cost to recycle orphan waste in 2006 was approximately $63,320 ($0.33 per pound multiplied by 191,879 pounds).

152. CAL. PUB. RES. CODE § 42461 (West 2007); *see also* § 42490.1 (codifying the Cell Phone Recycling Act of 2004 which aims to internalize the costs associated with cell phone disposal in the price of the product).

153. *See* § 42480 (requiring that state agencies purchase electronics from manufacturers who certified that they are in compliance with this statute).

154. § 42475.3.

155. § 42461(d).

156. § 42464(a)(1)-(3).

157. Billinghurst, *supra* note 51, at 426.

158. Fordyce, *supra* note 64, at 540-41.

places to purchase their computers (such as neighboring states) or delay or forgo purchase. Thus ARF starts a chain reaction beginning with decreasing computer sales which eventually leads to hindering California's economy. The California Chamber of Commerce believes that not only is ARF bad for consumers, but it puts manufacturers at a disadvantage with nearby states.[159] California retailers will lose profits if citizens can purchase electronics online and avoid the fee.[160] This profit loss could inflict severe damage on California's economy.

California is well known for Silicon Valley's technological advances.[161] Perhaps the legislature was trying to balance the interests of California businesses and its concern for environmental welfare by imposing the cost burden on the consumer. If the legislature considered the externality of unemployment from retail profit loss, it might have conducted a cost-benefit analysis and determined that the benefits to the environment outweighed the costs to the state economy. In order to have an efficient cost-effective policy, the policy must include direct and indirect costs, counting transaction costs in the long and short terms.[162] Therefore, if the lawmakers did not consider unemployment as an indirect cost, and if taking unemployment costs into account would change the cost-benefit balance, then EWRA is inefficient.

In addition to the unemployment externality, the legislature may have overlooked other social costs to the consumer as well. The consumer suffers a transaction cost in the form of the time it takes to return the computers to a recycling facility. In order to be an efficient regulation, the benefit of recycling electronics must be greater than the social cost.[163] If the total cost to California consumers of the advance fee at purchase and the transaction cost of their time to return the computer to the accepting location are greater than the social benefits of not having the computer enter the municipal waste stream, then the California regulation according to Posner's reasoning is inefficient.[164]

The economic consequences of California's ARF regulation are not all negative, however. The electronic recycling business in the area is booming.[165] The biggest recycler in the state realized over $20 million in revenue in 2006.[166] In addition to the state payment the recycler receives,

159. *Id.* at 542-43.
160. Roeder, *Federal Action*, *supra* note 5, at 1510.
161. *See* Fordyce, *supra* note 64, at 544.
162. RAO, *supra* note 29, at 58.
163. POSNER, *supra* note 21, at 396.
164. *Id.*
165. Martin Zimmerman, *Old PCs Put Recyclers in Expansion Mode*, LATIMES.COM, Feb. 10, 2007, http://msl1.mit.edu/furdlog/docs/latimes/2007-02-10_latimes_recycling.pdf.
166. *Id.*

he also gains revenue from the materials sold from the devices.[167] California paid out $74.6 million in 2005 and 2006 to electronic waste recyclers.[168] This has attracted additional electronic waste disposal businesses,[169] suggesting that those already in the industry may be earning supernormal profits (that is, a return on capital greater than what is available in other industries). Since the implementation of EWRA, the number of recyclers and collectors has nearly tripled, increasing competition.[170] To keep profits up despite all of the competition, collectors hold recycling events to gather electronic waste.[171] These events lower the transaction costs to consumers by creating more convenient drop off locations. When transaction costs are lowered the consumer is more likely to remove the product from storage and bring it to the event.[172] Thus, the recyclers gain revenue.

These events will attract free riders into the state of California. Free riders would include consumers who wish to recycle and did not purchase a product in California. To prevent this problem, substantial paperwork would be necessary, creating additional administrative burdens.[173] Free riders will inflict these additional costs on the waste disposal system. If no effective mechanisms are implemented to prevent free riders, then in the long run the free rider will suffer with the others "the effects of the lack of optimal provision of environmental goods and services."[174] In this case, they eventually will have no place to safely dispose of electronic waste and/or will be exposed to toxic chemicals from landfill leaching.

C. Washington State

Washington State has a comprehensive electronic waste recycling

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167. *Id.* (reporting that (1) monitors contain four to eight pounds of lead, (2) the going rate is $0.48 per pound, split by the company that collects the waste and the company that recycles it, and (3) a nineteen inch "CRT computer monitor weighs 40 to 50 pounds, so the money can add up fast").

168. *Id.*

169. *Id.*

170. *Id.* "At the end of 2004, there were 150 e-waste collectors and 12 recyclers in the state, the California Integrated Waste Management Board says. Now there are 544 collectors and 62 recyclers." *Id.*

171. *Id.*

172. U.S. ENVTL. PROT. AGENCY, IT'S EASY BEING GREEN! A GUIDE TO PLANNING AND CONDUCTING ENVIRONMENTALLY AWARE MEETINGS AND EVENTS (1996), http://www.epa.gov/epaoswer/non-hw/reduce/grn-mtgs/gm-bklt.txt (recommending holding recycling events near mass transit services).

173. GAO REPORT, *supra* note 10, at 16.

174. RAO, *supra* note 29, at 84.

law.[175] Washington requires manufacturers to pay for all recycling costs of electronics. Costs will cover the expense of collection, transportation, and processing from all electronics consumers in the state.[176] This approach differs from both California's ARF and Maine's EPR. In contrast to California's consumer fee, the Washington program is completely free to residents, businesses, schools, government entities, and charities.[177] Unlike Maine's mandatory EPR scheme, Washington gives manufacturers more flexibility. Manufacturers have the choice to join a central plan run by Washington State or to implement their own recycling program.[178]

Analogous to the Maine electronic waste disposal scheme, this type of EPR legislation places a heavy financial burden on the electronics business. Although Maine requires proportionate responsibility for orphan waste and Washington currently does not,[179] in some ways, Washington's scheme is even more burdensome than Maine's approach. For example, Washington makes the manufacturers responsible for all costs.[180] In Maine, consumers are still responsible to finance some of the recycling process.[181] However, both approaches have the potential to debilitate the electronic business with the high recycling costs burden.[182]

As opposed to California's ARF, Maine and Washington are creating incentives for manufacturers to implement design changes that will make recycling less expensive.[183] Product design that facilitates cost-effective disassembly and high-quality recovery creates the positive externality of reducing toxics throughout the country. To keep marginal costs low, producers are not going to manufacture separate electronic products for different states. Therefore, design changes will benefit the entire United States. Some states, however, are going to free ride on other states' legislative electronic waste disposal scheme and associated costs. Legislation is a product, but states outside Washington state do not

175. Hedges, *supra* note 128, at S-18.

176. S.B. 6428, 59th Leg., Reg. Sess. (Wash. 2006).

177. New Rules Project, The Environment Sector, Electronic Waste Recycling—Washington, http://www.newrules.org/environment/ewastewa.html (last visited Nov. 25, 2007).

178. WASH. REV. CODE ANN. § 70.95N.030(1) (West Supp. 2006).

179. *Compare supra* text accompanying notes 148-51 (discussing Maine's "orphan waste" requirement), *with* WASH. REV. CODE ANN. § 70.95N.270(2) (requiring the Department of Ecology by 2010 to make a report to the legislature regarding the proportion of orphan electronics and, if the proportion is greater than ten percent of all products collected, make recommendations for appropriate legislation).

180. § 70.95N.030(3).

181. *See supra* text accompanying note 144.

182. *See* LUTHER, *supra* note 139, at 9 (identifying one argument against the producer pays model that manufacturers will be forced to increase prices); *supra* note 151 and accompanying text.

183. LUTHER, *supra* note 139, at 9.

pay for that product even though they derive benefits.

Commentators claim that the EPR approach to electronic waste is forcing manufacturers to become experts in the garbage collection industry.[184] This will drive them to reallocate some of their financial resources into recycling, thus hindering production of their own electronic products.[185] Not only must the manufacturers expend financial and human capital, but they are not specialists in recycling, so they are less efficient than independent companies in the recycling business. However, it remains possible that the manufacturers' gains in recycling knowledge may result in a more diversified (and hence more stable) business in the future.[186] Further, critics theorize that design changes will cause product quality to suffer.[187] For example, there is disagreement in the electronics industry about the use of lead-free solder. Some experts state that using lead-free solder in electronics actually increases the long-term reliability of the product, thus extending its life before recycling.[188] In contrast to Washington, another EPR approach, the EU directive, recognizes reliability problems with components like lead-free solders and grants exceptions to certain products.[189] If the lifetime of the product is shortened, this will ultimately increase the amount of electronic waste produced. This may in turn increase the environmental impact, creating a negative externality from design changes which would render the regulation inefficient.

V. ALTERNATIVE APPROACHES

A. EU Approach

The United States approach of encouraging green consumer purchasing and regulating disposal is in contrast to EU regulations. The EU regulations take a dual approach: (1) they aim to stop the chemicals

184. Megan Short, Note, *Taking Back the Trash: Comparing European Extended Producer Responsibility and Take-Back Liability to U.S. Environmental Policy and Attitudes*, 37 VAND. J. TRANSNAT'L L. 1217, 1234 (2004).

185. *Id.*

186. POSNER, *supra* note 21, at 446-48 (discussing the desirability of portfolio diversity to avoid risk caused by fluctuations in the market for one product or resource). Posner's reasoning can be extended beyond securities portfolio design, since risk is inherent in any market.

187. Short, *supra* note 184, at 1234.

188. Dongkai Shangguan, *Lead Free Solder Interconnect Reliability*, 6 GLOBAL SMT & PACKAGING, at 19 (Feb. 2006), *available at* http://www.globalsmt.net/documents/Issue_Archive/global_6.2_us-lr.pdf.

189. Council Directive 2002/95, 2003 O.J. (L 37) 19, 21, 23 (EC) (amended by Commission Decision, C(2005) 4054, 2005 O.J. (L 271) 18, 19) [hereinafter RoHS] (admitting product reliability problems and granting exemptions from regulation, to be reviewed every four years).

from entering electronics, and (2) they demand that manufacturers pay for recycling their products.[190] The EU has produced the WEEE and RoHS directives to control electronic waste disposal.[191]

EU is faced with some of the same problems as the United States with its implementation of the WEEE directive. For instance, the individual EU states must establish collection mechanisms and market share responsibility to run their electronic waste programs.[192] Because each country has to implement its own plan, electronic manufactures will suffer the same burden that U.S. state patchwork regulations create. One cannot say dispositively which approach is better—the EU approach or the United States approach. However, the United States lags behind other countries in electronic waste regulation.[193] One key to success for United States regulation would be to utilize current municipal waste collection systems because this will decrease the marginal cost of recycling each unit.[194]

Although Maine and Washington modeled their electronic waste regulations after the same principle as the EU,[195] there are variations. Unlike Maine and Washington's EPR schemes, the EU placed protections against free riding and "orphan waste" in its directives. Under WEEE, the manufacturers must ensure financing costs through insurance or contribution arrangements.[196] As in Maine and Washington, industry producers are responsible for the costs of treatment, reuse, and recycling of their products.[197] Like Washington manufacturers, EU producers can manage the waste on an individual basis or can contribute funding in central schemes.[198] The local government in the EU (meaning

190. Holly A. Evans & Pamela J. Gordon, *Beyond the Precautionary Principle: Environmental Regulations in the Electronics Global Marketplace*, MANUFACTURING BUSINESS TECHNOLOGY, Jan. 1, 2006, http://www.mbtmag.com/article/CA6296455.html.

191. EU adopted RoHS in February 2003, and it took effect in July 2006. It is not a law; rather it is only a directive. It restricts the use of six hazardous materials in the manufacture of electronics, including lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers. *See* RoHS, *supra* note 189, at 19, 21; *see also* Council Directive 2002/96, 2003 O.J., (L 37) 24, 25 (EC) [hereinafter WEEE] (implementing goals of collection, recycling, and recovery of electronics).

192. *Compare* WEEE, *supra* note 191, at 25, 27, *and* RoHS, *supra* note 189, at 21 (requiring that each member state must implement its own RoHS and WEEE program), *with supra* text accompanying notes 148-51 (Maine's orphan waste requirement), *and supra* text accompanying notes 152-54 (California's advance recovery fee program).

193. Susan McInerney, *Computer Firms Improve E-Waste Scores*, *but U.S. Still Lags Behind Japan, EU Efforts*, 26 Int'l Evt. Rep. (BNA) No. 2, at 109 (Jan. 15, 2003).

194. Mann, *supra* note 42, at 153 (explaining that municipalities have already invested in waste collection systems).

195. *See* LUTHER, *supra* note 139, at 9.

196. *See* WEEE, *supra* note 191, at 30.

197. *Id.* at 25.

198. *Id.*

the particular country) collects the funds and arranges collection points for consumers to drop off their electronic waste. Financing is established not by counting the collected devices and assigning responsibility (as Maine does) but by current market share of electronic products sold.[199]

Under the EU electronic waste disposal scheme, EU consumers will incur these costs, but manufactures retain an incentive to design products that are safer for the environment and can be more easily and inexpensively recycled. United States government and citizens will benefit from these design changes. It would not make economic sense to create two different versions of the same product solely to satisfy different recycling regimes, so many European manufacturers (and manufacturers elsewhere who market heavily in the EU) will sell the "greener" EU model in the United States.[200] Therefore, the United States will be the recipient of a positive externality from the EU directives.

B. Council of State Governments/Eastern Regional Conference (CSG/ERC) and Northeast Recycling Council Approach

The Council of State Governments/Eastern Regional Conference ("CSG/ERC") and the Northeast Recycling Council, Inc. ("NERC") have developed draft legislation for electronic waste disposal.[201] In preparing this model, they gained input from many stakeholders in the electronic waste disposal business (that is, electronics manufacturers, environmental groups, recyclers, and government representatives).[202] Utilizing the extended producer responsibility approach, the model legislation requires electronic manufacturers to finance an "end-of-life electronics management system," which includes collection,

199. *Id.* at 25-26.

200. Steve Bush, *Will the U.S. Play Hardball on RoHS?*, ELECTRONICSWEEKLY.COM, Sept. 28, 2006, http://www.edn.com/article/CA6375985.html?ref=nbra.

201. *See* The Council of State Governments/Eastern Regional Conference, Northeast Regional Electronics Management Project, http://www.csgeast.org/enrgwaste.asp (last visited Nov. 25, 2007) [hereinafter CSG/ERC].

202. *Id.; see also Hearing on Electronic Recycling Before the New Jersey State S. Environment Comm.*, 1-2 (Feb. 8, 2007) (statement of Rona Cohen, Senior Policy Analyst, The Council of State Governments/Eastern Regional Conference), http://www.csgeast.org/pdfs/csgerctestimonynj.pdf [hereinafter *New Jersey Hearing*] (stating participants in the conference were "legislators, legislative staff, and environmental agency solid waste management staff from ten states and the Canadian province of Québec and more than one hundred representatives of electronics manufacturing companies, retail companies, leasing companies, recycling companies, reuse organizations, environmental groups, state recycling organizations, local and state recycling agencies").

transportation, and recycling of electronic waste.[203] Key elements of the model include: (1) a $5000 annual registration fee for manufacturers, (2) state managed funds, (3) a retail ban on non-compliant manufacturers, and (4) the requirement that manufacturers either (i) pay for all recycling costs based on the state calculations or (ii) collect, transport, and process the waste themselves.[204]

The stakeholders in CSG/ERC found that this extended producer responsibility approach was preferable to California's legislation because they believed that retailers should not be charged with fee collection, and the additional fee would equate to another tax. Furthermore, the full financial responsibility on the manufacturers may result in product designs that make recycling easier.[205] This in turn helps to create an economic chain reaction that eventually reduces the costs of recycling and leads to a more efficient market.[206]

If all stakeholders were equally and effectively represented when this model was developed, and if transaction costs were zero, then according to the Coase Theorem this is an efficient regulation that should be adopted. "[T]he Coase Theorem states that if bargaining is costless and cooperative then any choice of an entitlement or remedy will lead to an efficient outcome."[207] This prediction requires that all affected parties engage in cooperative communications, which was a paramount goal of CSG/ERC and NERC meetings. This cooperation would tend to show that under a Coase Theorem analysis, CSG/ERC and NERC devised an efficient outcome. However, they were faced with an inherent challenge, the elevated transaction costs of negotiations. Negotiation costs, especially extended multi-party negotiations, are far above zero, and "imperfect information and strategic behavior make it difficult to reach efficient outcomes."[208]

Further, when transaction costs are significant, the Coase Theorem becomes inapplicable. The theorem assumes that all transaction costs are zero when the rational parties voluntarily bargain their way to Pareto-optimal resource allocation.[209] Thus, the relevance of Coase Theorem to

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203. *New Jersey Hearing*, *supra* note 202, at 2; CSG/ERC, *supra* note 201 (reporting that electronic waste legislation based on the model has been filed in New Jersey, Connecticut, New York, Pennsylvania, Vermont, and Puerto Rico).

204. MODEL ELECTRONIC RECYCLING LEGISLATION 3-4, 7 (The Council of State Gov'ts/E. Reg'l Conference, Northeast Recycling Council, Inc. 2006), http://www.csgeast.org/pdfs/ModelLegislationFINAL.pdf.

205. *New Jersey Hearing*, *supra* note 202, at 2-3.

206. *Id.* at 3.

207. PERCIVAL ET AL., *supra* note 100, at 74.

208. *Id.*

209. RAO, *supra* note 29, at 65.

electronic waste analysis is limited. It will not lead to an efficient outcome in the voluntary cooperative arrangements when dealing with public goods because of the inherent numerous transaction costs. The mere existence of transaction costs suggests that a property rights approach cannot offer blanket solutions to environmental problems.[210]

Transaction costs are further increased when actors misrepresent or miscalculate estimates of the damages caused by pollution. Inaccurate calculations result in further disagreement between parties and hinder the goal of reaching an efficient cooperative agreement. Uncertainty exists when calculating the benefits of polluting activity and the costs of alternatives. "Polluters and their victims can gain strategic advantages by misrepresenting these parameters or by providing estimates that fall at different ends of the range of uncertainty."[211] Participants in coordinating efforts would need to accurately represent information in order to assure an efficient outcome.

The Coase Theorem illustrates that all stakeholders must work together to develop a solution to the electronic waste disposal problem because there is no coordinating entity that by itself could assign efficient property rights regarding environmental resources.[212] However, the Coase Theorem has limited application in the electronic waste disposal problem.[213] The Coase Theorem cannot offer meaningful analytical assistance when maximum social welfare is considered rather than maximum wealth in a negotiating situation.[214] Government entities and manufacturers have both interests in mind during negotiations because typically environmental damage is associated with costs which reduce maximum wealth. Further, the Coase Theorem cannot facilitate efficient regulation in an imperfect market with unpredictable production and consumption settings.[215] Electronic waste disposal is subject to all of these factors, making the Coase Theorem an unrealistic theory for analyzing electronic waste disposal regulation.

The Coase Theorem, however, does support one option to electronic waste disposal: Pigouvian taxes. Again, the Coase Theorem states that "if there are no transaction costs, the most efficient solution is to clearly define the property rights. Thus, property rights and markets offer solutions to problems of externalities."[216] These solutions will

210. *Id.* at 66.

211. PERCIVAL ET AL., *supra* note 100, at 74; *see, e.g.*, Slesinger, *supra* note 10, at A27 (Townsend accused of junk science).

212. RAO, *supra* note 29, at 63-64.

213. *See id.* at 64.

214. *Id.*

215. *Id.* at 65.

216. *Id.* at 63.

include parties negotiating their way to a socially optimal price for the pollution. That price could be a Pigouvian tax. The tax creates an efficient output level, however, only when all information concerning damages and contribution is identified.[217] Pigouvian taxes or per unit taxes may work to provide incentives to reduce the magnitude of the pollutant. Therefore, both Pigouvian taxes and the Coase Theorem imply that there are efficient levels of pollution. The Pigouvian tax is an efficient solution for the right to pollute where the marginal damage of the pollution equals the market price.[218]

C. "Solving the E-Waste Problem": United Nations Approach

The United Nations, in its voluntary initiative called "Solving the E-Waste Problem" ("StEP"), joined with key companies including Microsoft, HP, Dell, Cisco Systems, and Philips to harmonize legislative approaches to electronic waste recycling on a global scale.[219] According to the Coase Theorem, large-scale stakeholder cooperation has the potential to develop an efficient arrangement.[220] According to StEP executive secretary, "'[t]his is an effort to create some consistency across countries' regulations, although the sovereign framework is up to each country.'"[221] StEP task forces will recommend governmental policy guidelines and best industry practices.[222] These guidelines will hopefully relieve the negative economic effects of the developing global

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217. *Id.* at 59-61; *see also* Tomasz Zylicz, *The Role for Economic Incentives in International Allocation of Abatement Effort*, *in* ECOLOGICAL ECONOMICS: THE SCIENCE AND MANAGEMENT OF SUSTAINABILITY 384, 386 (Robert Costanza ed., 1991) ("[C]alculating a Pigouvian tax is an almost impossible task. Cumulative effects and synergism known in environmental sciences make it difficult to estimate the contribution of an individual polluter to a given loss (even provided the loss itself can be assessed properly).").

218. RAO, *supra* note 29, at 66.

219. Solving the E-Waste Problem (StEP), Task Force 1: Policy & Legislation, http://www.step-initiative.org/taskforces/tf1.php (last visited Nov. 25, 2007). The United Nations participants include United Nations University, United Nations Environment Programme, and United Nations Conference on Trade and Development. Other notable participants are recycling and refurbishing companies and governmental, nongovernmental, and academic institutions such as the U.S. Environmental Protection Agency, Vienna University of Technology, and the French National Institute of Telecommunication. *Id.*

220. *See supra* text accompanying notes 207-08.

221. Linda Roeder, *United Nations Joins Industry, Organizations to Develop E-Waste Best Practice Standards*, Daily Env't Rep. (BNA), Mar. 7, 2007, at A-4 [hereinafter Roeder, *United Nations*].

222. *See* Solving the E-Waste Problem (StEP), Five StEP Principles, http://www.step-initiative.org/ (last visited Nov. 25, 2007); *see also* Roeder, *United Nations*, *supra* note 221, at A-4 ("Kuehr said several reports on how to address problems associated with electronic waste would be published as part of the new initiative. The first report, to be published within six months, will focus on criteria for best practices, he said, adding, 'We felt there was an urgent need to harmonize criteria.'").

patchwork that is being created.[223] This reduction of the negative economic effects on a transnational level helps explain the widespread industry support.

The five task forces will seek to expand electronic life expectancy, markets for reuse, and recycling.[224] StEP aims to protect developing countries by devising a guide to maximize recovery and safely control substances while dismantling electronic waste. These goals plan to alleviate the aforementioned negative transboundary externalities.[225] The UN's stated intent of maximum recovery is an attempt to offset the increasing demand for precious metals.[226] StEP also intends to implement logos on products that conform to the harmonized criteria.[227]

VI. CONCLUSION

This Note establishes that electronic waste is a serious and growing problem in the United States and that action needs to be taken to manage electronic waste disposal. Economic incentives do not presently exist to address the problem. If nothing changes, the amount of electronic waste is going to overwhelm landfills as the amount of waste continues to increase. For example, the Federal Communications Commission now requires all new televisions to be equipped with technology for receiving digital signals. This phase out will result in 500 million outdated devices that will have to be disposed in a landfill or recycled.[228] Microsoft's launch of the Windows Vista operating system will render over half of the world's computers obsolete because they will not have the basic system requirements to operate Vista.[229] A recent software study of

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223. *See* Roeder, *United Nations*, *supra* note 221, at A-4; *see also supra* text accompanying notes 192-93.

224. *See* Solving the E-Waste Problem (StEP), 5 Task Forces—Objectives and Projects, http://www.step-initiative.org/ (last visited Nov. 25, 2007); Solving the E-Waste Problem, E-Waste—An Underestimated Environmental Problem, http://www.step-initiative.org/initiative/index.php (last visited Nov. 25, 2007) (listing prime objectives as "optimizing the life cycle of electric and electronic equipment by improving supply chains, closing material loops, reducing contamination, increasing utilization of resources and reuse of equipment, exercising concern about disparities such as the digital divide between the industrializing and industrialized countries, [and] increasing public, scientific and business knowledge").

225. *See* Roeder, *United Nations*, *supra* note 221, at A-4; *supra* notes 54-65 and accompanying text.

226. Roeder, *United Nations*, *supra* note 221, at A-4.

227. *Id.; see also* Hammerschmidt, *supra* note 15 ("'Our dream scenario would be to establish binding, material-specific recycling standards in the geographies in question. StEP could establish these standards, and independent companies and consultants would audit the recyclers, awarding them a seal of approval.' This seal would then become a precondition for getting orders from large industry companies." (quoting HP representative)).

228. Fordyce, *supra* note 64, at 541.

229. *See* Press Release, Greenpeace, After Vista, a Deluge of E-Waste to Developing

global computer brands currently in use found that ninety-four percent cannot run Vista's premium edition and fifty percent of computers do not have the capacity required to support Vista.[230] As consumers seek to upgrade their operating system and find their computers obsolete, the need for an electronic waste disposal solution will become more critical.

Consumers are going to continue disposing of their electronic waste using the method least costly to them. Therefore, in order to encourage recycling and reuse, landfill bans should be imposed and a financing system will need to be developed. From an administration standpoint, the financing system would be more manageable if the extended producer responsibility approach is utilized. The indirect cost is ultimately incurred by the consumer, the co-polluter, when all producers are faced with incorporating disposal costs into the marginal costs of production. Thus, the potential market failure is corrected by accurate product pricing for all electronic products including, to the extent possible, externalities. Also, when producers are charged with financial responsibility product design changes are incentivized as a way to increase profit margins. Manufacturers may eliminate hazardous components or make recycling and reuse easier.

Economic analysis indicates that all stakeholders, including government and industry, should collaborate to develop an environmentally responsible and economically efficient plan. This will require all parties to accurately share and gather information. To avoid the economic waste that a patchwork system creates, the federal government should implement the financing system. The federal government can look to the EU for guidance but should keep in mind that the EU does not have all the solutions. The negotiations should consider the pros and cons of the ERP, ARP, and product stewardship approaches to strike an appropriate balance. Ideally, the most efficient

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Countries, Greenpeace Warns (Feb. 3, 2007), http://www.greenpeace.org/seasia/en/press/releases/after-vista-a-deluge-of-e-was.

230. *Id.* (referring to study by the SoftChoice Corporation).

regulation will protect the environment while allowing all businesses to operate and profit.

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* Thank you to Professors Roy Simon and James Hickey for their insightful guidance in writing this Note, Meredith Ervine for her careful editing, and all my family and friends for their encouragement and support.