CONSERVING NATURAL RESOURCES: TOWARD A COMPREHENSIVE STATE SOLID WASTE RECYCLING PROGRAM UNDER THE FEDERAL RESOURCE CONSERVATION AND RECOVERY ACT

Americans' prodigal attitude toward natural resources was born on the bountiful frontier of the New World[1] and nurtured on the exploitation of the Third World.[2] Today, however, spurred by the threat of materials shortages worldwide,[3] there is a developing trend toward conservation in the United States.[4] Within this broad movement toward conservation, a particularly strong case exists for solid waste[5] recycling,[6] for it entails the conservation of land, materials, and energy.[7]

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1. *See* Young, *Conservation of Natural Resources—Ecology, Economics, and Energy*, 78 W. VA. L. REV. 315, 315-16 (1975-76).

2. *See* A. GUNTER FRANK, CAPITALISM AND UNDERDEVELOPMENT (1969).

3. *See Global Commodity Scarcities in an Interdependent World, Hearings Before the Subcomm. on Foreign Economic Policy of the House Comm. on Foreign Affairs*, 93d Cong., 2d Sess. (1974); D.H. MEADOWS, D.L. MEADOWS, J. RANDERS & W. BEHRENS, THE LIMITS TO GROWTH (2d ed. 1976); NATIONAL COMMISSION ON MATERIALS POLICY, MATERIALS AND THE ENVIRONMENT (1973); Williams, *Running Out: The Problem of Exhaustible Resources*, 7 J. LEGAL STUDIES 165 (1978). *But see* NATIONAL COMMISSION ON SUPPLIES AND SHORTAGES, GOVERNMENT AND THE NATION'S RESOURCES (1976).

4. *See* Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6987 (1976 & Supp. III 1979), *as amended by* Act of Nov. 8, 1978, Pub. L. No. 95-609, 92 Stat. 3081; Solid Waste Disposal Act Amendments of 1980, Pub. L. No. 96-482, 94 Stat. 2334; *and* Used Oil Recycling Act, Pub. L. No. 96-463, 94 Stat. 2055 [hereinafter cited as RCRA]. National Energy Conservation Policy Act of 1978, 42 U.S.C. §§ 8201-8278 (Supp. III 1979); National Environmental Policy Act, 42 U.S.C. § 4331(b)(5), (6) (1976).

5. This Note adopts RCRA's definition of solid waste:

> [A]ny garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 1342 of title 33, or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923) [42 U.S.C. 2001 *et seq.*].

RCRA, 42 U.S.C. § 6903(27) (1976).

6. "Recycling" has no one accepted definition. *See generally* Muchow, *Recycling of Solid Waste: Legal Impediments and a Program for Reform*, 59 CORNELL L. REV. 440, n. 1 (1973-74). In the broadest sense, recycling refers to the transformation of a used product into another state, such as the conversion of waste into energy. In the narrowest sense recycling refers to the reclamation of a resource for use as an input in the production of the same good, as in the recycling of aluminum beverage containers into new beverage containers. "Recycling" for the purpose of this Note encompasses all of these definitions.

7. *See infra* text accompanying notes 22-46.

Recognizing the urgent need to reform longstanding solid waste disposal practices and to foster recycling,[8] the Congress enacted the Resource Conservation and Recovery Act (RCRA),[9] which President Ford signed into law on October 21, 1976. However, RCRA makes no programmatic demands on the states. RCRA delegates to the states the discretion to develop specific programs to further the Act's broad policy objectives.[10] While most states have enacted the solid waste plans required by RCRA in order to receive federal aid,[11] few states have actively promoted recycling, and fewer still have enacted coherent, systematic recycling programs.

The states' failure to achieve the Act's policy goals is compounded by the paucity of serious analysis of the subject. This analytical poverty is twofold. First, no one has systematically evaluated the efficacy of existing state law. Second, because no one has posited a sound theoretical framework through which to guide state recycling activity, no one has advanced a comprehensive, model state program. The purpose of this Note is to offer an analytical framework through which to scrutinize current state laws and thereby to delineate the elements of a comprehensive, model state program. This Note will utilize an economic framework, because the recycling problem is one involving the misallocation of scarce resources.[12] Specifically, this Note will employ the theory of Pareto optimality as its theoretical framework.

Part One of this Note examines RCRA and the case for state support of recycling. Part Two explicates in detail the elements of Pareto resource optimality. Part Three analyzes the causes of Pareto resource misallocation between recycled and virgin-based materials. Finally, Part Four recommends both supply- and demand-related policies which should comprise an economically optimal, comprehensive state recycling program.

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8. H.R. REP. No. 1461, 94th Cong., 2d Sess. 84 and H.R. REP. No. 1491, 94th Cong., 2d Sess. 1, *reprinted in* [1976] U.S. CODE CONG. & AD. NEWS 6238, 6239-43, 6314-18, 6423-27, 6344-480.

9. *See supra* note 4. *See generally* Kovacs & Klucsik, *The New Federal Role in Solid Waste Management: The Resource Conservation and Recovery Act of 1976*, 3 COLUM. J. ENVT'L L. 205 (1977).

10. RCRA, 42 U.S.C. § 6902 (1976).

11. *See* W. RODGERS, ENVIRONMENTAL LAW § 6.7(b) (1977).

12. *See Resource Recovery Implementation: Engineering and Economics: Hearings Before the Subcomm. on Transportation and Commerce of the House Comm. on Interstate and Foreign Commerce*, 95th Cong., 1st Sess. 99-148 (1977); *The Economics of Recycling Waste Materials: Hearings Before the Subcomm. on Fiscal Policy of the Joint Economic Comm.*, 92d Cong., 1st Sess. (1971) [hereinafter cited as *Hearings on the Economics of Recycling*]; Butlin, *Economics and Recycling*, 3 RESOURCES POL'Y. 87, 87-90 (1977); Dower & Anderson, *Futures Markets: An Alternative for Stabilizing Secondary Materials Markets?*, 3 RESOURCES POL'Y. 230 (1977); Blum, *Tapping Resources in Municipal Solid Waste*, 191 SCIENCE 669, 675 (1976); Carlsen, *The Economics of Recycling*, 2 ENVT'L. AFF. 653 (1972-73).

I

Introduction

A. Federal Desiderata: The Resource Conservation and Recovery Act

RCRA, which subsumes the Solid Waste Disposal Act of 1965,[13] represents the first significant federal involvement in solid waste management, historically the exclusive province of state and local governments. RCRA's solid waste provisions[14] and attendant regulations[15] are binding on the federal government, but not on the states.[16] Instead, RCRA encourages State compliance by conditioning federal assistance on federal Environmental Protection Agency (EPA) approval of a state's or region's solid waste management plan,[17] which must be developed and implemented according to specific procedures.[18] To be approved, each plan must, *inter alia*, proscribe new open dumps,[19] provide for the upgrading or closing of current open dumps,[20] and require either the recycling or sanitary landfilling of solid waste.[21] The Office of Solid Waste, which RCRA established in the EPA, oversees compliance, provides federal assistance to eligible states, conducts research and development, and demonstrates new technologies.[22]

B. The Case for State Involvement in Solid Waste Recycling

State involvement in solid waste recycling presents significant potential for land, materials, and energy conservation. Moreover, as detailed below, current technology can effectively tap that potential. The magnitude of conservation from solid waste recycling derives from three sources.

First, solid waste recycling promises to reduce the soaring environmental and economic costs associated with land disposal of solid waste.[23] The quantity of municipal solid waste rose at a rate of five percent per year from

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13. Pub. L. No. 89-272, 79 Stat. 997 (1965), *as amended by* Pub. L. No. 910-512, 84 Stat. 1227 (1970).

14. RCRA strictly regulates hazardous waste management as well, 42 U.S.C. §§ 6920-31 (1976 & Supp. III 1979), but hazardous waste management is outside the scope of this Note.

15. RCRA, 42 U.S.C. §§ 6961-64; 40 C.F.R. §§ 244.100-.200 (beverage container regulation), 245.100-.200 (resource recovery facility guidelines), 246.100-.202 (source separation for materials recovery), and 247.100-.202 (procurement of products that contain recycled materials) (1980).

16. RCRA, 42 U.S.C. § 6947. *Cf.* Clean Air Act, 42 U.S.C. §§ 7401-7642, 7410(a)(1) (Supp. III 1979) (mandatory state implementation plans for national primary and secondary ambient air quality standards).

17. RCRA, 42 U.S.C. § 6943 (1976); 49 C.F.R. §§ 256.01-.50 (1980).

18. RCRA, 42 U.S.C. § 6946 (1976).

19. *Id.* § 6943(2).

20. *Id.* §§ 6943(3), 6945; 40 C.F.R. §§ 257.1-.3 (1980).

21. RCRA, 42 U.S.C. §§ 6943(2), 6944 (1976); 40 C.F.R. §§ 241.100 *et seq.* (1980).

22. RCRA, 42 U.S.C. §§ 6911-12, 6915-16 (1976).

23. *See generally* Blum, *supra* note 12, at 675; Bancroft, *America's Mayors and Councilmen: Their Problems and Frustrations*, NATION'S CITIES April 1974, at 14.

1960 to 1970, from approximately 87 million tons in 1960 to about 130 million tons in 1970.[24] Although the rate of increase of municipal solid waste has slowed to about two percent per year from 1970 to 1978, it is still increasing.[25] At this rate, the future production of such waste may approach 175 million tons per year in 1985.[26] This mass of solid waste is disposed primarily in 18,500 municipal solid waste dumps which cover a total of 500,000 acres.[27] This use of land creates an enormous aesthetic and environmental blight.[28] Furthermore, with general increases in land values, federal environmental restrictions on open dumping,[29] and collection and disposal costs, land disposal of municipal solid waste has become a heavy economic burden on local governments.[30]

The second benefit of solid waste recycling follows from the first. By tapping the solid waste stream, recycling not only eases the burden of solid waste disposal but also adds to the flow of raw materials. Such a recycling-based materials cycle is like a healthy, self-sustaining ecosystem.[31] As indicated above, disposal output is significant, and it contains a wealth of

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24. U.S. COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY: TENTH ANNUAL REPORT 256-57 (1979) [hereinafter cited as CEQ, TENTH ANNUAL REPORT].

25. *Id.* at 256.

26. *Id.* at 257.

27. U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE, SOLID WASTE FACTS 1 (1978), *quoted in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 262.

28. E. MILLS, THE ECONOMICS OF ENVIRONMENTAL QUALITY 161-66 (1978). A 1978 study prepared for the American Paper Institute found "moderate" or "severe" public opposition to new disposal sites in two-thirds of the 23 cities contacted. SCS ENGINEERS, AVAILABILITY OF LAND FOR SOLID WASTE DISPOSAL 1 (Aug. 1978) *quoted in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 262.

29. RCRA, 42 U.S.C. §§ 6941-6945 (1976) and the Clean Water Act of 1977, 33 U.S.C. § 1344(c) (1976) under which the EPA promulgated criteria to identify open dumps, define acceptable and unacceptable disposal facilities in terms of their effects on surface and groundwater, air quality, and public safety, and in terms of their use of a cover material. Disposal facilities located in wetlands, floodplains, endangered species' habitats, or recharge zones for municipal drinking water sources as well as those in which solid waste is openly burned are generally defined as unacceptable and must be phased out. 40 C.F.R. §§ 241.100-.212 (1981).

30. Testifying on behalf of the League of Cities, the Honorable David Shepard, Mayor of Oak Park, Michigan, stated:

> [C]ities today are confronted by a financial crisis making it difficult to carry out the functions of local government . . . efficiently and effectively . . . . In fact, solid waste management costs are frequently the second largest item in many city budgets, second only to public education. We generate approximately 145 million tons of municipal trash a year in the United States, disposal of which takes over $6 billion.

Hearings on S. 276, The Beverage Container Reuse and Reycling Act of 1977, Before the Consumer Subcomm. of the Senate Comm. on Commerce, Science, and Transportation, 95th Cong., 2d Sess. 396 (1978); *see supra* note 12.

31. Carlsen, *supra* note 12.

valuable resources.[32] For example, it is estimated that the amount of paper and glass in municipal waste equals more than two-thirds of the annual national consumption of these materials[33] and that the amount of aluminum in solid waste equals more than one fifth of the nation's annual consumption.[34] Only a fraction of that potential, however, is currently being exploited.[35]

The final benefit of recycling is energy conservation, which can take two forms. On one hand, centralized waste-to-energy projects can produce a number of types of energy: electricity, steam heat, liquid fuels, and gaseous fuels.[36] The Department of Energy estimates that 200 million tons of municipal solid waste, plus an additional 14 million tons of sewage solids,

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32. Estimated Composition of Residential and Commercial Solid Waste, 1977:

(as-generated wet weight in millions of tons and percents)

Materials	Millions of Tons	Percent of Total
Paper	49.5	33.5
Glass	14.7	9.9
Metals	13.6	9.2
Ferrous	(11.8)	(8.0)
Aluminum	(1.4)	(0.9)
Other nonferrous	(0.4)	(0.3)
Plastics	5.3	3.6
Rubber & leather	3.9	2.6
Textiles	3.0	2.0
Wood	4.7	3.2
Total nonfood products	94.7	64.0
Total nonfood products	94.7	64.0
Food waste	25.2	17.0
Yard waste	25.9	17.5
Miscellaneous inorganics	2.2	1.5
Total generation	148.0	100.0

Franklin Associates, Ltd., Post-Consumer Solid Waste and Resource Recovery Baseline 11 (April 6, 1979) (prepared for the U.S. Resource Conservation Committee) *reproduced in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 263.

33. U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, MATERIALS AND ENERGY FROM MUNICIPAL WASTE (final draft, June 1978) 2-5, 2-8 *cited in* CEQ, Tenth Annual Report, *supra* note 24, at 261.

34. *Id.* at 2-8.

35. The Library of Congress, Congressional Research Service, Waste Materials: Recycling and Reuse 1 (Nov. 5, 1980).

36. U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, MATERIALS AND ENERGY FROM MUNICIPAL WASTE (1979); U.S. ENVIRONMENTAL PROTECTION AGENCY THIRD REPORT TO CONGRESS: RESOURCE RECOVERY AND WASTE REDUCTION (1975); Morey & Gupta, *A Review of Resource Recovery Technology*, in ENERGY AND RESOURCE RECOVERY FROM INDUSTRIAL AND MUNICIPAL SOLID WASTES, 73 AMERICAN INSTITUTE OF CHEMICAL ENGINEERS SYMPOSIUM SERIES 162 (1977).

represent a total recoverable Btu content of two quads.[37] Current waste-to-energy technologies can recover about two-thirds of this potential energy.[38] On the other hand, the recycling of used materials requires less energy than the processing of raw, or virgin, materials. For instance, the recycling of metals and glass alone would save an additional quad of energy annually.[39]

Potential for reaping enormous benefits thus exists in solid waste recycling.[40] The realization of that potential, moreover, is possible, as demonstrated by both domestic and foreign solid waste recycling operations. Domestically, forty cities in 1978 had some kind of source separation program for the full range of recyclables, and another 196 had newspaper collection programs.[41] More than 3,000 independent, voluntary community recycling centers were operating, mostly in California and the Northeast.[42] The EPA also estimates that over 500 offices have paper recycling programs.[43] Furthermore, twenty cities in 1970 operated waste-to-energy facilities, and another ten were constructing similar facilities.[44]

Internationally, there are many examples of both source separation and waste-to-energy projects. Source separation in the Federal Republic of Germany, for instance, extends to both waste oil and the major components of municipal waste.[45] Several European countries began recovering energy from waste after World War II when the scarcity of landfill space relative to the bulk of solid waste compelled the effort. In 1977, for example, Denmark was converting sixty percent of its waste to energy, and the Netherlands and Sweden were each converting thirty percent.[46] These cases reveal that the arguments in favor of recycling are not mere pipe dreams.

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37. A quad is a quadrillion British thermal units of energy. Total U.S. energy consumption in 1978 was approximately 78 quads. U.S. Department of Energy, Urban Waste Technology Commercialization Task Force, Urban Waste Commercialization Strategy I, II, and III 1 (draft, July 19, 1978) *cited in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 261.

38. *Id.*

39. *Id.*

40. *See supra* text accompanying notes 23-24.

41. *See supra* text accompanying notes 26-39.

42. U.S. ENVIRONMENTAL PROTECTION AGENCY, SOLID WASTE RECYCLING PROJECTS: A NATIONAL DIRECTORY (1973).

43. U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE, FOURTH REPORT TO CONGRESS: RESOURCE RECOVERY AND WASTE REDUCTION 38 (1977).

44. Summary of Urban Waste-to-Energy Projects in the United States, in Operation and Under Construction, 1977: U.S. GENERAL ACCOUNTING OFFICE, CONVERSION OF URBAN WASTE TO ENERGY: DEVELOPING AND INTRODUCING ALTERNATE FUELS FROM MUNICIPAL SOLID WASTE 11-12 (1979) *reproduced in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 278-81.

45. *See* Zalob, *Current Legislation and Practice of Compulsory Recycling: An International Perspective*, 19 NAT. RESOURCES J. 611, 616-28 (1979).

46. U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE, SOLID WASTE FACTS 10 (May 1978) *noted in* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 261, 309.

Table 4-5
Summary of Urban Waste-to-Energy Projects in the United States, in Operation and Under Construction, 1977

Systems in Operation(20)								
Project Location	Process Type	Capacity (TPD)[a]	Energy Form Produced	Other Resources Recovered	Starting Date	Market for Energy Form	Cost (million dollars)	Owner/Operator
Ames, Iowa	RDF[d]	400	RDF	Paper, Fe, and Al[b]	9/75	Ames Municipal Power Plant	6.3	City of Ames
Baltimore, Md.	Pyrolysis	1,000	Gas to steam	Fe, glass agr.[c]	6/75	Baltimore Gas and Electric Co.	25.0	City of Baltimore
Baltimore County, Md.	RDF[d]	400 to 1,200	RDF	Fe, Al, glass	4/76	TBD[e]	10.0	50% Baltimore County, 50% State of Md./Teledyne
Blytheville, Ark.	MCU[f]	50	Steam	None	11/75	Metal plating industry	0.8	City of Blytheville
Braintree, Mass.	RWI/WWI[g]	240	Steam	Fe	9/70	Weymouth Art and Leather Co., and Sigma Industries	3.0	City of Braintree
Chicago, Ill.(NW)	WWI	1,600	Steam	Fe	Spring 1972	Industrial park	30.0	City of Chicago
East Bridgewater, Mass.	RDF	1,200	RDF	Fe	8/76	Utility plant	14.0	East Bridgewater Associates/Combustion Equipment Assn.
El Cajon, Calif. (San Diego County)	Pyrolysis	200	Oil	Fe, Al, glass	12/77	San Diego Gas and Electric Co.	14.5	San Diego County
Groveton, N.H.	MCU	30	Steam	None	10/75	Diamond International Paper Co.	0.3	Diamond International
Harrisburg, Pa.	WWI	720	Steam	Fe	10/72	Pennsylvania Power and Light	2.8	City of Harrisburg
Lane County, Ore. (Eugene)	RDF	500	RDF	Fe	12/77	Eugene Water and Electric and Univ. of Oregon	3.5	Allis Chalmers Corp. Western Waste Corp.
Milwaukee, Wis.	RDF	1,600	RDF	Paper, Fe, Al, glass agr.	5/77	Wisconsin Electric Power Co.	18.0	American Can Co.
Nashville, Tenn.	WWI	720	Steam	None	7/74	Building complex	26.5	Nashville Thermal Transfer Corp.
Norfolk, Va.	WWI	360	Steam	None	6/67	U.S. Navy Base	4.3	U.S. Navy Public Works

Table 4-5 (continued)

Systems in Operation(20)								
Project Location	Process Type	Capacity (TPD)*	Energy Form Produced	Other Resources Recovered	Starting Date	Market for Energy Form	Cost (million dollars)	Owner/Operator
North Little Rock, Ark.	MCU	100	Steam	None	9/77	Koppers Co.	1.5	City of North Little Rock
Palos Verdes, Calif.	Methane recovery	1.1 MMCF/D	Methane gas	None	6/75	So. Calif. Gas Co.	1.5	Reserve Synthetic Fuel Co.
Portsmouth, Va.	WWI	160	Steam	Fe, Al	8/77	U.S. Navy Base	4.5	U.S. Navy
Saugus, Mass.	WWI	1,200	Steam	Fe	10/75	General Electric Co.	38.3	RESCO (Joint venture of De Matteo Construction Co. and Wheelabrator-Frye, Inc.)
Siloam Springs, Ark.	MCU	20	Steam	None	9/75	Canning plant	0.4	Town of Siloam Springs
Tacoma, Wash.	RDF	500	Steam	Fe	12/77	TBD	3.0	City of Tacoma

Systems Under Construction(10)								
Project Location	Process Type	Capacity (TPD)*	Energy Form Produced	Other Resources Recovered	Starting Date	Market for Energy Form	Cost (million dollars)	Owner/Operator
Akron, Ohio	RDF	1,000	Steam	Fe, non-Fe	12/79	B.F. Goodrich Co., Univ. ov Akron	46.0	City of Akron/Teledyne
Albany, N.Y.	RDF	1,200	RDF	Fe	5/79	N.Y. State Office of General Services	11.0	City of Albany and N.Y. State
Bridgeport, Conn.	RDF	1,800	Powdered RDF	Fe, Al, glass	3/78	United Illuminating	53.0	Occidental Petroleum Corp. and Combustion Equipment Assn.
Chicago, Ill. (Crawford)	RDF	1,000	RDF	Fe, non-Fe	3/78	Commonwealth Edison	19.0	Commonwealth Edison

Hempstead, N.Y.	RDF	2,000	Steam	Fe, Al, color-sorted glass	5/78	Long Island Lighting Co.	81.0	Hempstead Resources Recovery Corp. (Div. Black Clawson/Parsons and Whittamore, Inc.)
Jacksonville, Fla.	MCU	50	Steam	Fe	3/79	U.S. Navy Base	2.0	Scientific Energy Engineering
Monroe County, N.Y.	RDF	2,000	RDF	Fe, non-Fe, mixed glass	Late 1978	Rochester Gas and Electric Co.	50.4	Monroe County/ Raytheon
Mountain View, Calif.	Methane recovery	1 MMCF/D	Methane gas	Fe, paper, glass	7/78	Pacific Gas and Electric	0.7	Pacific Gas and Electric
Redwood City, Calif.	Pyrolysis	100	Gas to Steam	Fe	5/78	Pacific Gas and Electric	1.0	Redwood City/Bayside System Authority
Western Lake Superior District (N.E. Minn.)	RDF	400	RDF	Fe	12/78	Negotiating with Duluth Transit Co.	60.0	Western Lake Superior Sanitary District

[1] Tons per day.
[2] Fe = Ferrous metals; Al = Aluminum.
Glass Agr. = glass aggregate.
[3] Refuse-derived fuel.
[4] To be determined.
[5] Modular combustion unit.
[6] RWI = refractory wall incineration; WWI = waterwall incineration.
Source: General Accounting Office, *Conversion of Urban Waste to Energy: Developing and Introducing Alternate Fuels from Municipal Solid Waste* (Washington, D.C.: U.S. Government Printing Office, February 28, 1979), p. II-2; and Council on Environmental Quality.

II

THE ECONOMICS OF PARETO OPTIMALITY

The formulation of any public policy which is to be internally coherent and externally efficacious requires a systematic framework. Because the problems facing solid waste recycling efforts are primarily economic rather than technical in nature,[47] that framework must necessarily be an economic one.[48] The basic elements of neoclassical economic analysis are the supply and demand functions.[49] At the individual level, the supply function is the relationship between the price of a good or service and the quantity of that good or service which a producer is willing to provide; implicit in this function is the producer's marginal cost (MC) structure, *i.e.*, the change in cost resulting from a unit change in the output of a good.[50] At the individual level, the demand function is the relationship between the price of a good or service and the quantity of that good or service which an individual consumer is willing to purchase; this function is based on the individual's subjective system of marginal utility, *i.e.*, the change in utility, or satisfaction, resulting from a unit change in the quantity of a good consumed.[51]

In perfect competition, which is characterized by numerous buyers and sellers, product homogeneity, perfect information, costless resource mobil-

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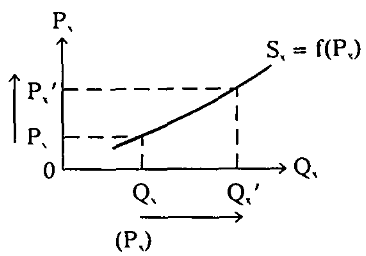
47. *See supra* note 12.

48. *See* MILLS, *supra* note 28, at 159-77; B. ACKERMAN, ET AL., THE UNCERTAIN SEARCH FOR ENVIRONMENTAL QUALITY 206 (1974) *quoted in* Wildavsky, *Book Review*, 29 STAN. L. REV. 183, 191 n.9 (1976); North, *Political Economy and Environmental Policies*, 7 ENVTL. L. 49, 449-52, 456, 461 (1977). *See generally* Posner, *The Economic Approach to Law*, 53 TEX. L. REV. 757, 764-65 (1975). *But see*, Tribe, *Ways Not to Think About Plastic Trees; New Foundations for Environmental Law*, 83 YALE L. J. 1315 (1974).

49. *See generally* R. MILLER, INTERMEDIATE MICROECONOMICS: THEORY, ISSUES, AND APPLICATIONS (1978); P. SAMUELSON, ECONOMICS (10th ed. 1976).

50. A profit-maximizing firm will theoretically produce at a level of output of x where the price of good x (P_x) equals its marginal cost ($MC_x = P_x$). Because a unit increase in the price of good x will induce a firm to increase the quantity which it will supply (Q_x), the slope $\left(\frac{dQ_x}{dP_x}\right)$ of the supply function ($S_x = f(P_x)$) is positive. This relationship is readily demonstrated graphically:



As the price of x increases, the firm supplies a greater quantity of x (Q_x).

51. A utility-maximizing consumer will theoretically demand a quantity of x (Q_x) where the price of x (P_x) equals its marginal utility ($MU_x = P_x$). Because a unit increase in the price of good x (P_x) will cause a consumer to decrease her consumption of x (Q_x), the slope $\left(\frac{dQ_x}{dP_x}\right)$

ity, product divisibility, and the absence of externalities,[52] theoretically all resources will automatically be put to their most efficient uses, thereby maximizing social welfare through the dynamic interaction of supply and demand.[53] In terms of the markets for secondary or recycled materials, this principle implies that an optimal balance should be struck between the amount of solid waste recycled and reused and the amount of virgin products consumed. A number of influences, however, disrupt the market's ability to move toward an optimal allocation of recycled resources relative to virgin resources.[54]

A. Pareto Optimality

The standard of allocative efficiency is commonly referred to as Pareto optimality.[55] Succinctly stated, Pareto optimality is that allocation of scarce resources such that no individual could be made better off through exchange without making someone else worse off. In such a condition it is impossible for all individuals to gain through further exchange in the marketplace.[56]

Critics have attacked this theory as being too conservative in its bias.[57] Rarely, critics argue, could any governmental policy move the economy into a Pareto preferred position, for virtually all policies make someone worse off.[58] As an alternative, one commentator has suggested a new formulation

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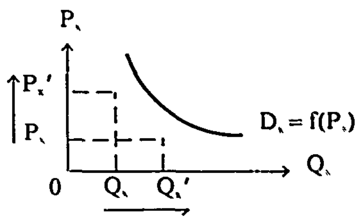
of the demand function ($D_x = f(P_x)$), is negative. This relationship, too, is easily demonstrated graphically.



As the price of x (P_x) increases, the consumer's quantity of x demanded (Q_x) decreases.

52. Negative externalities or external costs are those costs associated with the production of a good which are not included in the final price of that good and borne by its consumer. Instead, such costs are borne by society generally. The classic example of a negative externality is the effluent that results from certain industrial processes which fouls the air or water that is the common heritage of all people. *See infra* note 73.

53. *See* MILLER, *supra* note 49, at 236-37, 534-44; SAMUELSON, *supra* note 49, at 633-34.

54. *See infra* text accompanying notes 72-109.

55. Of all of the contributions of Vilfredo Pareto, the turn-of-the-century Italian sociologist and economist, the best known if not most important is his theory of optimum resource allocation, which has become known as Pareto optimality.

56. MILLER, *supra* note 49, at 435-44; SAMUELSON, *supra* note 49, at 633-34.

57. T. PAGE, CONSERVATION AND ECONOMIC EFFICIENCY 145 (1977); Kaldor, *Welfare Propositions of Economics and Interpersonal Comparisons of Utility*, 49 ECON. J. 549-52 (1939) *reprinted in* K. ARROW & T. SCITOVSKY, READINGS IN WELFARE ECONOMICS 388 (1969).

58. Markovits, *The Causes and Policy Significance of Pareto Resource Misallocation: A Checklist for Micro-Economic Policy Analysis*, 28 STAN. L. REV. 1, 2-3 nn. 2-4 (1975).

of the Pareto optimality principle: a given allocation of resources is optimal if, and to the extent that, no policy can give its beneficiaries the equivalent of more dollars than the policy takes away from its "victims."[59] This Note uses this reformulation of Pareto optimality. It provides theoretical guidance so that states can act rationally and frees policymaking from the traditional, paralyzing formulation of Pareto optimality.

B. The Marginal Conditions of Pareto Optimality

Scarce resources are at their best uses when, and to the extent that, the allocation of those resources satisfies three marginal conditions: exchange, input substitution, and output substitution.[60] First, the marginal condition of exchange is that the ratio of the marginal utilities of any two outputs, or the marginal rate of substitution (MRS), must be equal for all individuals who consume both goods.[61] Theoretically, individuals maximize their total utility by equating their marginal rates of substitution of one good for another to the ratio of their prices.[62] Therefore, the marginal condition of exchange is satisfied when the marginal rates of substitution between any pair of consumer goods is equal for all individuals who consume both goods, which in turn equals the ratio of their prices.[63] In this way, the marginal utilities of all people between any two goods are equal, and no one's total utility can be increased through further exchange.

The second marginal condition of optimality is that of input substitution. A given allocation satisfies this condition when the ratio of the marginal products[64] of the inputs, *i.e.*, the marginal rate of technical substitution (MRTS), is equal for all producers who use both inputs.[65] Insofar as individual producers theoretically minimize marginal costs,[66] each MRTS equals the ratio of the prices of the two inputs.[67] Therefore, the marginal

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59. *Id.* at 3.

60. *See* MILLER, *supra* note 49, at 437-4; Bator, *The Simple Analytics of Welfare Maximization*, 47 AM. ECON. REV. 22, 22-59 (1957).

61. The marginal condition of exchange between two goods, x, a virgin resource-based disposable good, and y, a recycled good, among n individuals is thus:

$$MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}.$$

62. $MRS_{xy} = \frac{P_x}{P_y}$.

63. $\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(\frac{P_x}{P_y}\right)$.

64. The change in output resulting from a unit change in the quantity of the input in the production process (MP).

65. The marginal condition of input substitution between two resource inputs V (a virgin resource) and R (a recycled resource) among n producers is thus:

$$MRTS^1_{VR} = MRTS^2_{VR} = \ldots = MRTS^n_{VR}.$$

66. Marginal cost (MC) is the change in cost resulting from a unit change in the quantity of output produced.

67. $MRTS^1_{VR} = \frac{P_V}{P_R}$.

condition of input substitution is satisfied when the marginal rate of technical substitution between any two inputs is equal for all producers who use the inputs, which in turn equals the ratio of the prices of the two inputs.[68] In consequence, all inputs are used in their most productive capacity.

The final marginal condition of optimality is that of output substitution. A certain allocation fulfills this condition when the marginal rate of transformation (MRT) in production, *i.e.*, the change in the level of one good's production resulting from a unit change in the level of another good's production, equals the MRS in consumption for each pair of commodities and for each individual consuming both of these commodities.[69] Because the MRT is the ratio of the marginal costs of the final products in production and because cost minimizing, profit maximizing firms in perfect competition produce at a level of output at which marginal cost equals price, the ratio of the marginal costs of the outputs equals the ratio of their prices for each producer.[70] Since a consumer's MRS between two goods x and y also equals the ratio of their prices, it follows that the MRT equals the MRS for products x and y. The third marginal condition of Pareto optimality is thus satisfied,[71] resulting in the production of the combination of goods yielding the highest total utility. If an allocation of scarce resources fulfills these three marginal conditions, it is Pareto optimal.

III

The Solid Waste Problem and Pareto Optimality

An economic analysis of the solid waste problem provides a compelling basis for increased governmental intervention to support solid waste recycling. The current economic bias which favors virgin materials over recycled

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68. $\left(MRTS^{1}_{VR} = MRTS^{2}_{VR} = \ldots = MRTS^{n}_{VR}\right) = \left(\frac{P_V}{P_R}\right)$.

69. The marginal condition of output substitution between good x, a primary resource-based disposable good, and y, a recycled good, among n individuals is thus:

$$MRT_{xy} = MRS^{1}_{xy} = MRS^{2}_{xy} = \ldots = MRS^{n}_{xy}.$$

70. $\frac{MC_x}{MC_y} = \frac{P_x}{P_y}$.

71. $MRS_{xy} = \frac{P_x}{P_y}$, and

$$\frac{P_x}{P_y} = \frac{MC_x}{MC_y}, \text{ and}$$

$$\frac{MC_x}{MC_y} = MRT_{xy}; \text{ therefore,}$$

$$MRS_{xy} = MRT_{xy}.$$

materials is nonoptimal[72] because negative externalities,[73] governmental tax subsidies,[74] price discrimination,[75] producer and consumer misperception,[76] and intergenerational inequity[77] have distorted the market.[78] Although the degree of deviation from the marginal conditions of optimality is important in determining the optimal extent of a particular state's financial involvement, such a quantitative analysis is far outside the scope of this Note. Discerning the type of deviation from the marginal conditions of optimality, however, is central to this Note's analysis because it will determine the general nature of the policies that allocative efficiency requires.[79] There is no one "best" solution applicable in detail to every state. In order to meet

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72. PAGE, *supra* note 57, at 4-7, 61-141; Carlsen, *supra* note 12, at 656-61. *See generally* Markovits, *supra* note 58; North, *supra* note 48, at 449-52.

73. MILLS, *supra* note 28, at 160, 166, 170-71, 239-45: PAGE, *supra* note 57, at 6, 83-107; Butlin, *supra* note 12, at 88-89; Carlsen, *supra* note 12, at 660; Note, *Market Incentives for Recycling—The Tax Credit and Product Charge Compared*, 5 ENVTL. AFF. 669, 675 (1976). *See generally* MILLER, *supra* note 49, at 459-64; MILLS, *supra* note 28, at 78-83; SAMUELSON, *supra* note 49, at 476-78; Dahlman, *The Problem of Externality*, 22 J.L. & ECON. 141 (1979); Markovits, *supra* note 55, at 7 & n. 14, 10.

74. Specifically, virgin materials are subsidized by means of preferential tax treatment such as depletion allowances, *e.g.*, CAL. REV. & TAX CODE §§ 17,681-17,689.5 (West 1970 & Supp. 1981), and capital gains advantages, *e.g.*, MISS. CODE ANN. § 27-31-101 (Supp. 1981). *See* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 300; PAGE, *supra* note 57, at 108-31; U.S. RESOURCE CONSERVATION COMMITTEE, CHOICES FOR CONSERVATION 46-54 (1979); *Tax Treatment of Recycling of Solid Waste: Hearings Before the House Comm. on Ways and Means*, 93d Cong., 2d Sess. 231-33 (1974) (statement of Leonard L. Lane) [hereinafter cited as *Hearings on Tax Treatment of Recyling*]; *Hearings on the Economics of Recycling*, *supra* note 12, at 4-7, 14-21, 24-25, 27-37 (statements of Senator Frank Moss and representatives of secondary materials industries); Carlsen, *supra* note 12, at 663-64; Muchow, *supra* note 6, at 456-62; Case, *Waste Paper Wasted: A Non-Response to a Need for Change*, 3 ENVTL. AFF. 221, 229 (1974).

75. Price discrimination between virgin materials and recycled materials occurs in freight rates and also in energy rates, although the Interstate Commerce Commission has recently moved to reduce freight rate discrimination against recycled goods. *See* CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 300-02; PAGE, *supra* note 57, at 61-79; U.S. RESOURCE CONSERVATION COMMITTEE *supra* note 74, at 68-77; *Freight Rates for Recyclable Materials: Hearings on H.R. 6637 and H.R. 12,536 Before the Subcomm. on Transportation and Aeronautics of the House Comm. on Interstate and Foreign Commerce*, 93d Cong., 2d Sess. (1974); *Hearings on the Economics of Recycling*, *supra* note 12, at 4-7, 24-27, 37-40 (statements of Sen. Frank Moss and representatives of the secondary materials industries); Carlsen, *supra* note 12, at 662 & n.14; Muchow, *supra* note 6, at 444-56; Schary, *Transportation Rates and the Recycling Problem*, TRANSP. J., Spring 1977, at 46, 48-50.

76. Producer and consumer misperception of input productivity and utility, respectively occur both because of institutional prejudice in favor of virgin resource use, *e.g.*, Case, *supra* note 74, at 230-35, and because of pejorative labeling requirements, *e.g.*, Muchow, *supra* note 6, at 471-72. *See generally* Markovits, *supra* note 58, at 6-7.

77. Intergenerational inequity arises when the utility of future generations is discounted to near zero by the current consuming population because the property interest of future generations is not recognized so that an intertemporal bias in resource allocation results. PAGE, *supra* note 57, at 146-54; Markovits, *supra* note 58, at 38-40; Solow, *Intergenerational Equity and Exhaustible Resources*, 41 REV. OF ECON. STUDIES 29-45 (1974 Supp.).

78. *See supra* text accompanying notes 60-72.

79. *See* Markovits, *supra* note 58, *passim*.

unique local conditions, individual states must adapt the constituent elements of a comprehensive solid waste recycling program.

A. Negative Externalities

External costs or negative externalities are those costs associated with production which the market does not include in the final product's price and which, consequently, its consumer does not bear. Instead, society as a whole bears these external costs.

Current solid waste disposal practices produce at least two distinct types of negative externalities. First, the direct costs of solid waste disposal (*i.e.*, the costs of collection and dumping) are generally met through set fees levied by municipal governments.[80] Those who generate an amount of solid waste whose real cost exceeds the set fee they pay enjoy a free ride, while those who generate an amount whose real cost is less than the set fee inequitably bear the formers' burden. Second, the aesthetic and environmental costs of current disposal techniques which the pricing mechanism does not internalize are borne by society in the form of scenic blight or polluted groundwater.

These negative externalities pervert the marginal conditions of exchange and output substitution. The marginal condition of exchange is unbalanced because the ratio of the prices of the final products x (a disposable good) and y (a recyclable good), which does not reflect the marginal cost of x's disposal, is artificially low.[81] The marginal condition of output substitution is similarly unbalanced. The MRT_{xy} which equals the ratio $\frac{MC_x}{MC_y}$ is too low because it fails to incorporate x's marginal cost of disposal.[82] The consequences of these imbalances are that consumers demand and producers supply raw materials for disposable good x at a level greater than optimal.

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80. U.S. Resource Conservation Committee, *supra* note 74, at 107.

81. $\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(\frac{P_x}{P_y}\left[\neq \frac{MC_x}{MC_y}\right]\right),$

because the MC of disposal ($MC_{(d)}$) is not factored into the price of disposable good x. The prices of x would rise, and the marginal condition of exchange would be satisfied if the $MC_{(d)}$ were included in the pricing calculus, thus:

$$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(\frac{P_x}{P_y}\left[= \frac{MC_x + MC_{(d)}}{MC_y}\right]\right).$$

82. $\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(MRT_{xy} \neq \left[\frac{MC_x}{MC_y}\right]\right)$

because the $MC_{(d)}$ is again, not factored into the price of good x. The price of x would rise, and the marginal condition of product substitution would be satisfied, if the $MC_{(d)}$ were included in the pricing process, thus:

$$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(MRT_{xy} = \left[\frac{MC_x + MC_{(d)}}{MC_y}\right]\right).$$

B. Governmental Tax Subsidies for Virgin Resource Use

The second factor which has contributed to the current nonoptimal bias in favor of virgin materials use and disposal is the governmental tax subsidy.[83] Due to special tax incentives for virgin materials owners[84] and extractors,[85] the marginal cost of the virgin material input (V) and its price (Pv) and the marginal cost of the resultant product (x) and its price (Px) are lower than they would otherwise be. Hence, all three marginal conditions of optimality are artificially skewed. The marginal condition of exchange[86] is unbalanced because the price ratio of the final outputs, which equals the ratio of their marginal costs, does not reflect the full cost of good x's virgin material inputs.[87] The marginal condition of input substitution[88] is unbalanced, because the price ratio of the virgin material to recycled material inputs which equals the ratio of their marginal costs does not truly reflect the virgin material's total cost.[89] Finally, the marginal condition of output substitution[90] is not balanced because the marginal rate of transformation between the two outputs, which is the ratio of their marginal costs, is again less than it would be if all of x's costs were factored into its price.[91] These

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83. *See supra* note 74.
84. *E.g.*, MISS. CODE ANN. § 27-31-101 (Supp. 1981).
85. *E.g.*, CAL. REV. & TAX CODE §§ 17,681-17,689.5 (West 1970 & Supp. 1981).
86. *See supra* text accompanying notes 61-63.
87. $$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(\frac{P_x}{P_y}\left[\neq \frac{MC_x}{MC_y}\right]\right).$$
To balance the equation, the tax costs of x's virgin material input (V) and y's recycled input (R) must be equalized, that is V's subsidy must be eliminated. Consequently, MC_x which includes MC_V would rise with the increase in V's tax cost. Thus:
$$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(\frac{P_x}{P_y}\left[= \frac{MC_x + MC_{x(t)}}{MC_y}\right]\right)$$
where $MC_{x(t)}$ is the marginal cost of x attributable to V's increased tax cost.
88. *See supra* text accompanying notes 64-68.
89. $$\left(MRTS^1_{VR} = MRTS^2_{VR} = \ldots = MRTS^n_{VR}\right) = \left(\frac{P_V}{P_R}\left[\neq \frac{MC_V}{MC_R}\right]\right),$$
because the tax component of MC_V is lower than that of MC_R which is not subsidized. To balance the equation, the tax cost of the two resource inputs must be equalized. Thus:
$$\left(MRTS^1_{VR} = MRTS^2_{VR} = \ldots = MRTS^n_{VR}\right) = \left(\frac{P_V}{P_R}\left[= \frac{MC_V + MC_{V(t)}}{MC_R}\right]\right)$$
where $MC_{V(t)}$ is the marginal cost of V attributable to the elimination of special tax treatment.
90. *See supra* text accompanying notes 69 & 70.
91. $$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(MRT_{xy}\left[\neq \frac{MC_x}{MC_y}\right]\right).$$
To balance the equation, the tax cost of x's virgin material input V and y's recycled input R must be equalized by eliminating the former's subsidies. Thus:
$$\left(MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy}\right) = \left(MRT_{xy}\left[= \frac{MC_x + MC_{x(t)}}{MC_y}\right]\right)$$
where $MC_{x(t)}$ is the marginal cost of x attributable to elimination of V's tax subsidy.

imbalances cause both supply and demand for virgin materials to be greater than optimal.

C. Price Discrimination

Price discrimination has also contributed to the market bias against secondary resource use.[92] When, for instance, the regulators of common carriers establish a price for transportation in excess of the real marginal cost of shipping, that price discrimination causes a deviation from the three marginal conditions of optimality in much the same fashion as do tax subsidies.[93] In the former case the price of recycled goods is greater than real marginal cost, and in the latter case the price of virgin resources is less than real marginal cost. Such practices lower virgin material inputs' marginal costs and hence prices so that they are out of balance with the optimal input mix.[94] Accordingly, price discrimination improperly reduces virgin material outputs' marginal costs and hence prices in relation to both the optimal product mix[95] and consumer preferences.[96]

D. Producer and Consumer Misperception

Producer misperception of the marginal physical productivity (MPP) of virgin material inputs[97] and consumer misperception of the marginal utility of virgin material-based outputs also cause the current allocation of resources to deviate further from the marginal conditions of optimality.[98] Consumers misperceive the marginal utility of recycled vis-à-vis virgin material-based products[99] due to institutional biases, such as American Paper Institute standards,[100] and pejorative labeling requirements, such as "used" or "reclaimed".[101] Consumer preferences or marginal rates of substitution, consequently, are incorrectly biased away from recycled products, and so consumption of virgin material-based products exceeds optimal quantities.[102] Producers may fall prey to these same influences, though perhaps to

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92. *See supra* note 75.
93. *See supra* text accompanying notes 86-91.
94. *See supra* text accompanying notes 88 & 89.
95. *See supra* text accompanying notes 90 & 91.
96. *See supra* text accompanying notes 86 & 87.
97. Marginal physical productivity is the change in marginal product (MP) resulting from a unit change in input quantity. Mathematically, this relationship is expressed as:

$$\frac{dMP_v}{dQ_v}$$

where MP_v is the marginal product of virgin resource input V and Q_v is the quantity of V.
98. *See supra* note 76. *See generally* Markovits, *supra* note 58, at 5-7, 9-10.
99. *See generally* Markovits, *supra* note 58, at 5-7.
100. Case, *supra* note 74, at 231-32.
101. Muchow, *supra* note 6, at 471-72.
102. $\left(MRS^1_{rv} = MRS^2_{rv} = \ldots = MRS^n_{rv}\right) \neq \left(\frac{P_r}{P_v}\right)$.

a lesser degree since they theoretically act on the basis of more extensive information.[103] Additionally, in seeking stable input markets, producers are reluctant to buy into the widely fluctuating secondary materials markets.[104] Therefore, producers' input mixes, or marginal rates of technical substitution, exhibit a nonoptimal bias against the use of recycled inputs.[105]

E. Intergenerational Inequity

Finally, intergenerational inequity in resource pricing and thus allocation have further subverted the optimal allocation of recycled relative to virgin-based resources.[106] By pricing natural resources lower than optimal in the present through externalities, subsidies, and price discrimination,[107] and by institutionally undervaluing future welfare relative to current welfare,[108] the market allocates natural resource wealth to current generations relative to future generations in a nonoptimal fashion.[109]

IV

Toward an Economically Optimal, Comprehensive State Solid Waste Recycling Program

The marginal conditions of Pareto optimality in the markets for recycled versus virgin resources, therefore, are clearly in a state of disequilibrium. Because RCRA reserves to the states the discretion to solve their solid

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Moreover, if different individuals are differentially affected by these distorting influences, their marginal rates of substitution will not likely be in equilibrium; therefore,

$$\left(MRS^1_{vr} \neq MRS^2_{vr} \neq \ldots \neq MRS^n_{vr}\right) \neq \left(\frac{P_v}{P_r}\right).$$

103. Markovits, *supra* note 58, at 9-10.

104. Dower & Anderson, *supra* note 12, at 231.

105. $$\left(MRTS^1_{VR} = MRTS^2_{VR} = \ldots = MRTS^n_{VR}\right) \neq \left(\frac{P_V}{P_R}\right).$$

Again, if different producers are differentially affected by these influences, their marginal rates of technical substitution will not likely be in equilibrium; therefore,

$$\left(MRTS^1_{VR} \neq MRTS^2_{VR} \neq \ldots \neq MRTS^n_{VR}\right) \neq \left(\frac{P_V}{P_R}\right).$$

106. *See supra* note 72.

107. *See supra* text accompanying notes 81-96.

108. This is achieved by drastically discounting total utility of future generations through the formula:

$$\sum_{t=0}^{n} f\,\frac{(U^{1t}, U^{2t} \ldots U^{nt})}{(1 + i)^t}.$$

In this equation, U is the level of utility of a certain generation, t identifies the period (beginning with the current generation, t = 0, and continuing through generation n), and i is the discount rate over the life of all generations (*i.e.*, through t = n). Future utility is discounted because the present generation has control over resources. *See* Page, *supra* note 57, at 156-63.

109. *See supra* note 77.

waste problems, state governments should adopt policies that further, if not achieve, an optimal allocation of resources, *i.e.*, that give their beneficiaries the equivalent of more dollars than they take away from their victims.[110] By acting in accordance with the precepts of Pareto optimality, states can pursue recycling policies with direction and restraint.

Any comprehensive state solid waste recycling program must address not only the causes of the market's failure to allocate resources optimally but also the institutional biases which have become deeply entrenched over time. Supply-oriented measures must embrace policies aimed at cost (*e.g.*, internalizing externalities and ending price discrimination and governmental tax subsidies) and at state funding of and involvement in solid waste recycling. Demand-oriented measures must include policies to eliminate producer and consumer misperception and to strengthen directly both governmental and private demand for recycled products. Such an integrated approach is essential to the success of any recycling program.

Two assumptions underlie this analysis of potential state solid waste recycling policies. First, no one correct approach exists to the problem of solid waste management and, concomitantly, to the promotion of recycling.[111] Unique local conditions should determine the appropriate approach. Second, any state's solid waste recycling program should have flexibility to employ economic incentives, not statutorily imposed techniques, to foster recycling. For instance, states should not legislate investment in a particular technology but instead should eliminate legal barriers which prevent the free market from determining the appropriate investment. Such a policy facilitates technological innovation and permits the market to move toward an efficient resource allocation.

A. Demand-Oriented Policies

A truly comprehensive state solid waste recycling program must address the problem of demand for recycled goods.[112] A tenet of neoclassical

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110. *See supra* text accompanying note 59.

111. A vigorous debate exists over the merits of centralized waste-to-energy systems vis-a-vis low technology, decentralized source separation and waste reduction. Although each approach arguably has its own particular advantages, certain capital intensive, high technology waste-to-energy systems have simply failed to meet economic and environmental quality standards. The refuse-derived fuel plants at Hempstead, New York, and Bridgeport, Connecticut, for example, have closed because of harmful chemical emissions, the failure to process as much refuse as predicted, and the inability to produce a reliable refuse-derived fuel. N.Y. Times, Aug. 2, 1981, § 4, at 8. In contrast, smaller, European technologies involving simple steam generation have been operating efficiently for years. *Id.* While much of the literature portrays the two approaches as mutually exclusive, some analysts have persuasively argued that an optimal solution to the solid waste disposal problem would integrate both. *See* U.S. OFFICE OF TECHNOLOGY ASSESSMENT, MATERIALS AND ENERGY FROM MUNICIPAL WASTE 69-91, 119-32 (1979).

112. CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 277, 287; ENVIRONMENTAL RESOURCES LTD., THE ECONOMICS OF RECYCLING 6-10 (1078); *Hearings on the Economics of*

economics is that demand calls forth supply, *i.e.*, that supply is a function of demand. Therefore, no state policy which exclusively stimulates the supply of recycled products will remedy the imbalance between recycled and virgin resources. There are three aspects of the demand for recycled products: relative prices, public demand, and private demand.

1. Relative Prices of Recycled and Virgin Resource-Based Goods

First, because demand is by definition a function of price,[113] affecting the relative prices of virgin-based and recycled products will have an important impact on the demand for one in relation to the demand for the other.[114] The cost-oriented supply policies discussed *infra* will have a profound impact on the relative prices between the two products by internalizing external costs of solid waste disposal, eliminating virgin resource subsidies, and ending price discrimination.[115] These policies will tend to increase the prices of virgin-based products vis-à-vis recycled products, thereby increasing the demand for the latter.[116]

2. Public or Governmental Demand

The second aspect of the problem of demand for recycled goods is public or governmental demand. Government at all levels consumes an enormous quantity and variety of goods and services; directly institutionalizing governmental demand for recycled products will therefore strengthen the market.[117] The current status of state procurement law generally, however, works against the purchasing of recycled products. For example, some state laws require low-bidder contracts[118] which discourage governmental purchasing of recycled goods in today's market. While such laws do serve a

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Recycling, *supra* note 12, at 4-7 (statement of Sen. Frank Moss); Blum, *supra* note 12, at 675; Muchow, *supra* note 6, at 443 n.10; Pearce & Grace, *Stabilizing Secondary Materials Markets*, 2 RESOURCES POL'Y. 118 (1976).

113. $D_x = f(P_x)$, where the demand for x is D_x and the price of x is P_x.

114. *But see* U.S. RESOURCE CONSERVATION COMMITTEE, *supra* note 74, at 58-60; Note, *supra* note 73, at 682 (low price elasticity of demand for recyclables).

115. *See supra* text accompanying notes 82-96.

116. The degree of change in the quantities of recycled versus virgin resource based products demanded depends not only on the elasticity of demand for recyclables but also on the cross-price elasticity between the two. The elasticity of demand for good x is the slope of the demand function for x, $\frac{dQ_x}{dP_x}$. It indicates the change in the quantity of x demanded (Q_x) as a result of a given change in the price of x (P_x). Cross-price elasticity, in turn, is the relationship between the elasticities of demand for x, a recycled good, and y, a virgin resource-based good.

117. *See* Case, *supra* note 74, at 235; Muchow, *supra* note 6, at 465-69.

118. *E.g.*, ALASKA STAT. §§ 37.05.230 & .240 (1978); OHIO REV. CODE ANN. § 307.86 (Page 1979); WIS. STAT. ANN. § 16.75 (West 1972 & Supp. 1981). *Cf.* MINN. STAT. ANN. § 16.08 (West 1977) (life cycle costs considered in decision whether or not to encourage governmental procurement).

legitimate state purpose (i.e., minimizing purchasing costs), they nevertheless should be amended to exempt recycled products.[119]

Directly institutionalizing public demand for recycled goods rather than relying on price to determine demand may seem objectionable as being contrary to the precepts of Pareto optimality. However, it is problematical whether such measures would in fact conflict with Pareto optimality. If the measures to alter the relative prices of recycled and virgin resource-based goods decrease the price of the former and increase the price of the latter, then there may in fact be no theoretical problem. If, in contrast, there remains a significant price difference between the two, institutionalizing public demand is nevertheless necessary in the short term to spark the engine of the market and to overcome the past bias against recycled goods.

Other state laws attempt to bolster governmental procurement of recycled products. These statutes, however, range widely over a continuum between woeful inadequacy and potential effectiveness. On the one hand, those schemes which inadequately attempt to increase governmental procurement of recycled goods include mere intergovernmental encouragement,[120] investigation of state purchasing,[121] and purchasing preferences where the recycled product is of comparable quality to and price competitive with virgin-based products.[122] On the other hand, those schemes which are potentially effective in stimulating governmental demand for recycled products authorize preferential purchasing where recycled goods are "reasonably competitive"[123] or where there is no more than a specified price differential.[124]

Other, untried techniques also exist to increase governmental demand for recycled products.[125] State law could require the procurement of certain goods in recycled form exclusively, when available (*e.g.*, paper and oil) and the procurement of other recycled products to the maximum extent practicable. The state could institutionalize a purchasing preference for goods with maximum recycled content which are reasonably price competitive with virgin material-based products. By adopting any of these stronger procurement policies, a state is able to accomplish the goal of increasing recycling demand without massive subsidies.

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119. *See, e.g.*, N.J. STAT. ANN. § 40A: 11-15(4) (West 1980).

120. *E.g.*, WASH. REV. CODE ANN. § 70.95.263 (Supp. 1980); WIS. STAT. ANN. § 35.05(5)(d) (West Supp. 1981).

121. *E.g.*, N.Y. STATE FIN. LAW § 161-a(4) (Consol. Supp. 1982); ARIZ. REV. STAT. ANN. §§ 41-567, 568 (Supp. 1981).

122. *E.g.*, KY. REV. STAT. § 224.895(6) (Supp. 1980) (used oil recovery); MO. ANN. STAT. § 34.032 (Vernon Supp. 1981) (recycled paper); WIS. STAT. ANN. § 144.48(7) (West Supp. 1981) (waste oil recovery).

123. N.J. STAT. ANN. §§ 52:34-21 to -24 (West Supp. 1981) (legislative finding that New Jersey's economy requires a shift to a closed cycle of resource use and recovery).

124. OR. REV. STAT. §§ 279.733-.739 (Supp. 1979).

125. *See* 40 C.F.R. §§ 247.100-.202-1 (1981).

There are, furthermore, three indirect avenues by which to strengthen governmental demand for recycled products. First, state laws could limit the irregularity of demand and reduce wide price fluctuations in secondary materials markets by sanctioning long-term governmental purchase contracts for recycled goods.[126] Such action would not only stabilize secondary materials markets but also enable state, county, and municipal governments to obtain advantageous long-term prices. Second, states could repeal product specifications which restrict governmental procurement of recycled goods to those of comparable quality to virgin-based products. Finally, states could promulgate measures to facilitate cooperative purchasing by state, county, and municipal governments, thereby further buttressing the market and securing more favorable prices through quantity buying.

3. *Private Demand*

The final, and perhaps most significant, aspect of the problem of weak demand for recycled products is private demand encompassing both consumer and business demand. To overcome producer and consumer prejudice against recycled goods, state governments should enact each of three separate policies. First, pejorative labeling requirements, such as "reused" and "reprocessed," should be replaced by more neutral terms such as "recycled." Such a labeling scheme would protect consumers' right to know what they are purchasing yet would not create a psychological disincentive to potential buyers.[127] Moreover, such a scheme would further the fulfillment of the marginal condition of exchange and, consequently, optimality of resource allocation.[128]

Second, states should initiate and finance a broad-based education program concerning the benefits of recycling and of purchasing recycled products. For consumers, such a program could include television advertising, mailings with municipal solid waste bills, and consumer education in the schools. For producers, such a program could include informational materials, teams to conduct seminars for business leaders, and individual consultation.

Finally, state policy should outwardly encourage private purchasing of recycled goods. However, government should not directly subsidize private consumption of recycled products. Although effective in terms of increasing demand by decreasing total price, state recycling subsidies would disrupt the marginal conditions of optimality by reducing price below marginal cost.[129]

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126. *E.g.*, N.J. Stat. Ann. § 40A:11-15(4) (West 1980).
127. *See* Muchow, *supra* note 6, at 471-72.
128. *See supra* text accompanying notes 61-63.
129. *See supra* text accompanying notes 60-71.

B. Supply-Oriented Policies

The second set of state policies to stimulate solid waste recycling addresses problems of supply. The aggregate, industry-wide supply function of any good or service is the sum of individual producers' MC functions, which determines the quantity of goods or services that a particular producer will supply at given prices.[130] One subset of supply-oriented state policies, accordingly, attempts to redress the current, nonoptimal cost imbalance favoring virgin resource use.[131] Another subset of supply-oriented state policies focuses on the financing and structure of public recycling activity and on the financing of private recycling activity.

1. Relative Costs of Recycled and Virgin Resources

a. Negative Externalities

Among cost-oriented state policies, perhaps the most important is the elimination of negative externalities, *i.e.*, the internalization of otherwise external costs.[132] Although there are at least three policy alternatives by which to attain this goal,[133] a quantity-based local user fee best comports with both optimality and equity.[134] The other two primary policy options are product charges or disposal taxes coupled with governmental resource conservation subsidies.

As a policy tool, the local user fee is functionally similar to the product charge or disposal tax which a host of resource analysts have advocated[135] and which a number of states have adopted.[136] However, there are significant differences between the two approaches. First, the incidence of the charge is different; the local user fee is assessed as a function of the quantity of solid waste discarded by a household or firm, while the product charge or disposal tax is levied on products before their sale. Second, the practical effects of the two approaches contrast sharply. Whereas a product charge or

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130. $\sum_{1}^{n}\left(MC_x^1 + MC_x^2 + \ldots + MC_x^n\right)$, is the aggregate supply function, where the marginal cost of good x for firm 1 is MC_x^1 and so forth through MC_x^n.

131. *See supra* text accompanying notes 72-75, 81-96.

132. *See supra* text accompanying notes 73, 80-82.

133. These policies are mutually exclusive. To employ them in conjunction would be to charge twice or three times for the same external costs. Such a condition, increasing a product's marginal costs in excess of society's real marginal costs, would be as non-optimal as permitting externalities.

134. U.S. RESOURCE CONSERVATION COMMITTEE, *supra* note 74, at 107-112.

135. *E.g.*, Case, *supra* note 74, at 235-36; Carlsen, *supra* note 12, at 661-63; Muchow, *supra* note 6 at 472-73; Note, *supra* note 73, at 695.

136. *E.g.*, CAL. REV. & TAX CODE §§ 42,000-42,700 (West 1979) (repealed 1979); N.Y. TAX LAW § 1201(f)(1)-(7) (McKinney 1975); WASH. REV. CODE ANN. §§ 70.93.120-.170 (1975 & Supp. 1980).

disposal tax does generate revenue, it has no marked effect on recycling and resource conservation because it is a front-end charge and because the charge is such a small fraction of a product's price. The price elasticity of demand[137] for recycled goods is generally low;[138] therefore, the price increase resulting from a charge or tax would have to be quite substantial to induce any significant change in the quantity of a good demanded. For example, assuming the price elasticity of demand for canned soft drinks is 0.75, its price must increase 20 percent to evoke even a 15 percent reduction in the quantity of the product demanded. A local user fee, in contrast, would be likely to reduce solid waste disposal and to encourage source separation and recycling since it attaches a price to disposal itself.[139]

Moreover, the economic consequences of the two alternatives are completely different. A product charge or disposal tax is levied against everyone, polluter or not. A local user fee, in contrast, is assessed only against responsible individuals or firms and is a function of the quantity of discarded solid waste. Therefore, the local user fee is distinct from, and superior to, either a product charge or a disposal tax scheme as a means of internalizing costs, although all three are potential tools to achieve this end.

Even if product charges and governmental subsidies were to produce the same result as local user fees, *i.e.*, reducing the aggregate quantity of solid waste disposal and consequently increasing the level of recycling, their implications for optimal resource allocation are, nonetheless, dissimilar. Charging for solid waste disposal as a function of quantity through local user fees instead of as a flat fee[140] will not only decrease disposal and increase recycling[141] but will also allocate to consumers the disposal cost of

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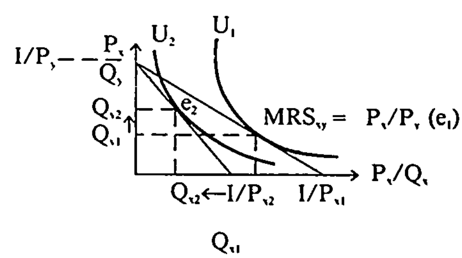
137. *See supra* note 116.

138. U.S. Resource Conservation Committee, *supra* note 74, at 104 (estimated to range between 1.0 and 0.5).

139. *See* U.S. Resource Conservation Committee, *supra* note 74, at 112.

140. Most communities charge a flat fee for waste disposal and do not vary the fee as a function of the quantity of waste disposed. *Id.* at 108.

141. This proposition can be readily demonstrated by applying the microeconomic theory of the consumer. An individual's utility function (U) indicates the combinations of two goods (x and y) which theoretically result in equal satisfaction or utility. There are an infinite number of such functions which imply greater and lesser levels of utility. Assuming a fixed level of income, objective prices constrain the consumer's subjective utility. An individual accordingly maximizes utility by equating MRS with the price ratio of x and y, $MRS_{xy} = \frac{P_x}{P_y}$. This proposition can also be demonstrated diagrammatically:



any remaining unrecycled solid waste. Consequently, the marginal condition of optimality in exchange is satisfied.[142] In contrast, even if a governmental subsidy were to adjust properly the levels of disposal and of recycling, producers would not internalize the cost of their products' disposal. Instead, the tax-paying public would bear the costs of both disposal and recycling.[143] Such a solution is neither optimal nor equitable. Both optimality and equity, then, urge the local user fee approach to the problem of solid waste externalities.[144]

Two other externalities problems warrant independent treatment, since a local user fee will not affect them: beverage container deposits and waste oil regulation. Beverage container deposit laws have been enacted in a number of states,[145] considered by Congress,[146] and studied by a host of commentators.[147] Essentially, the problem is the external cost associated with the explosive growth in the use of nonreturnable containers[148] which a local user fee will not likely affect.

As a local user fee is assessed against good x, its price increases, rotating the price line to the southwest (since a fixed income level is assumed). The consumer equates MRS anew with the changed price ratio, resulting in a new consumer equilibrium. Clearly, the level of x consumed decreases, from Q_{x1} to Q_{x2}.

142. $MRS^1_{xy} = MRS^2_{xy} = \ldots = MRS^n_{xy} = \frac{(P_x + P_{x(d)})}{P_y}$,

where $P_{x(d)}$ is the price of x's disposal.

143. Case, *supra* note 74, at 235-36; Note, *supra* note 73, at 675.

144. RESOURCE CONSERVATION COMMITTEE, *supra* note 74, at 108-12. *See* Muchow, *supra* note 6, at 472-73.

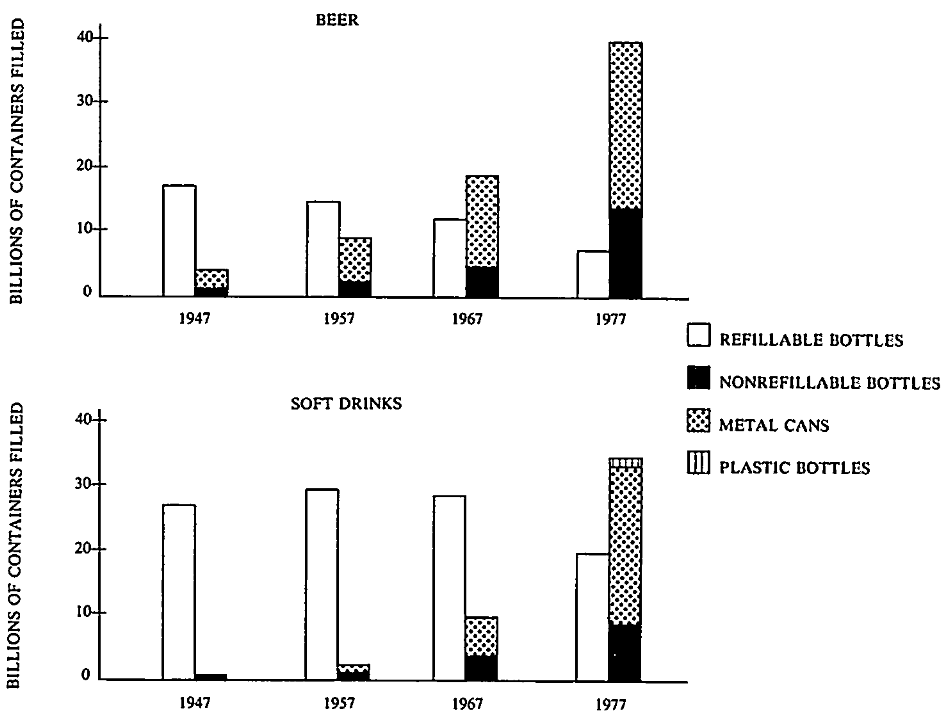
145. CONN. GEN. STAT. ANN. §§ 22a.77-.79 (West Supp. 1981); IOWA CODE ANN. § 455C (West Supp. 1981); ME. REV. STAT. ANN. tit. 32, §§ 1861-1871 (1978 & Supp. 1981-82); OR. REV. STAT. §§ 459.810-.890 (1979); VT. STAT. ANN. tit. 10, §§ 1521-1527 (Supp. 1981).

146. *E.g.*, S.50, 96th Cong., 1st Sess., 125 CONG. REC. S153, S192 (daily ed. Jan. 15, 1979); H.R. 1416 96th Cong., 1st Sess., 125 CONG. REC. H254 (daily ed. Jan. 24, 1979); H.R. 2812, 96th Cong., 1st Sess., 125 CONG. REC. H1326 (daily ed. Mar. 13, 1979).

147. *See, e.g.*, CEQ, TENTH ANNUAL REPORT, *supra* note 24, at 296-97; Gudger & Walters, *Beverage Container Regulation: Economic Implications and Suggestions for Model Legislation*, 5 ECOLOGY L. Q. 265 (1976); Moore, *The Case for the Regulation of Nonreturnable Beverage Containers*, 64 KY. L.J. 767 (1976); *The Question of a Mandatory Deposit Law for Beverage Containers*, 57 CONG. DIG. 68 (1978); Zalob, *supra* note 45, at 613-16; Note, *American Can: Judicial Response to Oregon's Nonreturnable Container Legislation*, 4 ECOLOGY L. Q. 145 (1974); Comment, *Validity of a "Bottle Bill" Encouraging the Use of Standard-Sized Returnable Bottles*, 51 N.D. L. REV. 517 (1974); Note, *Mandatory Deposit Regulations*, 20 N.Y.L.F. 395 (1974); Note, *The Oregon Bottle Bill*, 54 OR. L. REV. 175 (1975); Note, *Beverage Container Legislation: A Policy and Constitutional Evaluation*, 52 TEX. L. REV. 351 (1964).

148. The following charts show the growth in nonreturnable beverage containers between 1947 and 1977:

Oregon has the oldest deposit law.[149] The Oregon law provides that every beverage container sold or offered for sale in the State shall have a refund value of not less than five cents,[150] unless the State Liquor Control Commission certifies that the container is reusable by more than one manufacturer, in which case the refund value shall not be less than two cents.[151] Moreover, manufacturers must imprint on each container an indication of refund value[152] unless the container is permanently marked with a brand name and had a refund value of not less than five cents on October 1, 1972.[153] Neither dealers[154] nor distributors[155] may refuse to accept beverage containers of the kind, size, and brand that they sell or refuse to pay the refund value for the containers, unless the container is not marked with a refund value[156] or unless the dealer and container are included in an order of the Commission approving a redemption center.[157] Finally, the Commis-



RESEARCH TRIANGLE INSTITUTE, BEVERAGE INDUSTRY ANNUAL MANUAL, 1978-1979 *reproduced in* RESOURCE CONSERVATION COMMITTEE, *supra* note 74, at 85.

149. 1971 OR. LAWS 2015, ch. 745 (codified at OR. REV. STAT. §§ 459.810-.890 (1979)).
150. OR. REV. STAT. § 459.820(1) (1979).
151. *Id.* §§ 459.820(2), .860.
152. *Id.* § 459.850(1).
153. *Id.* § 459.850(2).
154. *Id.* § 459.830(1).
155. *Id.* § 459.830(2).
156. *Id.* § 459.840(1).
157. *Id.* § 459.840(2).

sion may approve applications for redemption centers if they provide a convenient service for the return of containers;[158] however, the Commission may review and withdraw its approval if a center either violates its initial order of approval or ceases to provide a convenient service to the public.[159]

The Oregon law has been the paradigm of such legislation. There have been few significant improvements in the Oregon model in other states. Some states require that distributors pay both dealers and redemption centers a per-container handling fee.[160] Also, Michigan has lowered the minimum refund for containers which can be reused by more than one manufacturer,[161] thereby providing an incentive for interchangeable reuse.

The Oregon statute is facially sound, and Oregon's experience with it has been quite positive.[162] There are, however, at least three other improvements which states should make in the Oregon model. First, dealers should have to accept and to pay refunds on all containers which their distributors sell,[163] rather than only on those which the dealer offers for sale.[164] This will tend to maximize the return of recyclable containers. Second, the problem of nonreusable containers is significant because distributors are currently given little incentive to redeem them. The cost of collection is around one cent per container, and a used container has only scrap value. Distributors, moreover, can retain a five cent deposit on each container by not recovering them. To avoid this problem, distributors should be compelled to relinquish unpaid refunds periodically to the treasury of the state in which they operate.[165] Finally, the state should tax the value of all of a distributor's unredeemed containers[166] to spur the collection of recyclable containers.

The second externalities problem involves waste oil regulation.[167] Because waste oil is not disposed of in the same manner as municipal solid waste, a local user fee will neither internalize the environmental cost of disposal nor increase recycling. A number of states have recently enacted

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158. *Id.* § 459.880(3).

159. *Id.* § 459.880(4).

160. CONN. GEN. STAT. ANN. § 22a-79(d) (1981 Supp.) (at least $.01 per container); IOWA CODE ANN. § 455C.2(2) (West Supp. 1981-1982) (at least $.01 per container); ME. REV. STAT. ANN. tit. 32, § 1866(4) (West Supp. 1981-1982) (at least $.02 per container).

161. MICH. COMP. LAWS ANN. §§ 445.571, .573 (West Supp. 1981-1982) (the minimum refund required is five cents less per container for containers which can be used by more than one manufacturer).

162. *See* CONG. REC. S153-79 (daily ed. Jan. 15, 1979) (remarks by Sen. Hatfield).

163. Gudger & Walters, *supra* note 147, at 285 (1976).

164. OR. REV. STAT. § 459.830 (1) (Supp. 1979).

165. Gudger & Walters, *supra* note 147, at 284.

166. *Id.*

167. *See generally* Irwin, *Used Oil: Comparative Legislative Controls of Collection, Recycling, and Disposal,* 6 ECOLOGY L.Q. 699, 699-754 (1978); Reindl, *Waste Oil Recycling,* 40 J. ENVT'L HEALTH 52, 52-55 (1977); *Rerefined Oil: An Option That Saves Oil, Minimizes Pollution,* 193 SCIENCE 1108, 1108-10 (1976).

specific waste oil recyling measures.[168] Generally, these measures may be divided into a strong and a weak approach. The Wisconsin statute epitomizes the strong approach.[169] It requires that any person who sells automotive engine oil to consumers provide waste oil collection facilities[170] and that cities and towns provide a certain number of waste oil storage facilities for each designated population level.[171] The Wisconsin law further requires the licensing of waste oil transporters[172] and recyclers[173] as well as the labeling of recycled oil for sale.[174] The strong approach, in summary, effectively mandates the recycling of waste oil. In contrast, the weak approach, represented by the California statute,[175] prohibits the dumping of waste oil[176] and then relies on the market to provide collection facilities, subject to state licensing, in the number and location demanded.[177]

The market oriented approach is the better of the two approaches in terms of allocative efficiency. When dumping is prohibited, collectors and recyclers will provide their services where demand justifies them, thus ensuring that scarce resources are in their most efficient use.[178] In contrast, complex waste oil recycling systems prescribed by statute will inevitably either over- or underestimate local collection or distribution needs. Licensing guarantees safe and environmentally sound storage, transportation, and recycling practices, but avoids unduly burdensome regulations and record keeping.[179] Finally, labeling[180] and uniform standards[181] will protect consumers while stimulating demand by ensuring reliability.[182]

b. Governmental Subsidies of Virgin Resource Use

Another critical element of the cost imbalance between virgin and recycled resources, in addition to their negative externalities, is governmen-

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168. CAL. PUB. RES. CODE §§ 3460-73 (West Supp. 1981); CAL BUS. & PROF. CODE §§ 20,800-06 (West 1964) (repealed 1974); ILL. ANN. STAT. ch. 96 1/2, §§ 7701-09 (West Supp. 1981-1982); KY. REV. STAT. § 224.895(1)-(14) (Bobbs-Merrill Supp. 1980); MINN. STAT ANN. §§ 325E.10-11 (West 1981); N.Y. ENVIR. CONSERV. LAW §§ 23-2301—2311 & §§ 71-2201 (Consol. Supp. 1981); N.Y. ENERGY LAW § 5-105 (18-a) (Consol. Supp. 1982); OR. REV. STAT. §§ 468.850-.871 (Supp. 1979); WIS. STAT. ANN. §§ 144.48(1)-(8) (West Supp. 1981-1982).
169. WIS. STAT. ANN. §§ 144.48 (1)-(8) (West Supp. 1981-1982).
170. *Id.* § 144.48(2).
171. *Id.* § 144.48(3).
172. *Id.* § 144.48(4).
173. *Id.* § 144.48(5).
174. *Id.* § 144.48(6).
175. CAL. PUB. RES. CODE §§ 3460-73 (West Supp. 1981).
176. *Id.* § 3464.
177. *Id.* § 3467 & 3468.
178. Such a condition optimizes the use of scarce resources.
179. *See* N.Y. ENVIR. CONSERV. LAW § 23-2309 (Consol. Supp. 1981).
180. *E.g.*, KY. REV. STAT. ANN. § 224.895(11), (12) (Bobbs-Merrill Supp. 1980).
181. *Id.;* Energy Policy and Conservation Act, 42 U.S.C. § 6363(d), (e) (1976).
182. *See supra* text accompanying notes 127-29.

tal subsidies for natural resource exploitation.[183] The harm is that subsidies artificially lower virgin input prices, and consequently output prices, below their true marginal costs. Subsidies thus contribute to the non-optimal resource allocation in favor of virgin materials,[184] because profit-maximizing firms will naturally minimize their input costs. The obvious policy implication of these facts is that all such subsidies should be eliminated.[185]

c. Price Discrimination Favoring Virgin Resource Use

The final element of the cost inequality between virgin and recycled resources is price discrimination.[186] Price discrimination unrelated to objective differences in cost or product quality exacerbates the non-optimal resource bias in favor of virgin materials.[187] The two primary forms of price discrimination are railroad freight rates and declining block rates for electricity.[188] For example, the declining block rate pricing of electricity rewards energy intensive manufacturing, such as the processing of bauxite into virgin aluminum, by charging lower per unit prices than those charged to more energy efficient producers, such as aluminum recyclers, who consume less total electricity. Such a pricing scheme has no basis in sound public policy, and like discriminatory freight rates, should be abolished.[189] Such a movement toward marginal cost pricing will tend toward an allocation of resources which is Pareto optimal.

2. The Structure and Finance of Recycling Activity

Separate and distinct from cost-related supply policies is the direct stimulation of recycling activity, both public and private. The responsibility for solid waste has historically rested with state and local government, both of which have a substantial role to play in recycling. The recycling industry is essentially bifurcated, though symbiotic. Municipalities, on the one hand, can utilize solid waste to produce energy and to separate valuable materials. Materials processing and fabrication, on the other hand, are largely private

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183. *See supra* text accompanying notes 83-91.
184. *See supra* text accompanying notes 86-91.
185. *Hearings on the Economics of Recycling Waste Materials, supra* note 12, at 4-7, 14-21, 24-25, 27-37 (statements of Sen. Frank Moss and representatives of the secondary materials industries); *Hearings on the Tax Treatment of Recycling, supra* note 74, at 231-33 (statement of Leonard Lane, Sierra Club); U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, MATERIALS AND ENERGY FROM MUNICIPAL WASTE 155-72 (1979); Anderson, *Public Policies Toward the Use of Scrap Metal,* 67 AM. ECON. REV. PAPERS AND PROCEEDINGS 355 (1977); Carlsen, *supra* note 12, at 662-63; Case, *supra* note 74, at 235-36; Muchow, *supra* note 6; Smith *Prospects for Recycling,* 12 J. INT'L L. & ECON. 185 (1978).
186. *See supra* text accompanying notes 92-96.
187. *See supra* text accompanying notes 86-91.
188. *See supra* note 75.
189. *See, e.g.,* FLA. STAT. ANN. § 323.08(6) (West Supp. 1981); MINN. STAT. ANN. § 218,021(1) (West Supp. 1981) (freight rates).

endeavors. State policies to facilitate the development of the recycling industry must address its public and private components separately.

a. The Public Component of the Recycling Sector

The first facet of a state program to stimulate recycling production must be its public component. State governments have long subsidized solid waste disposal,[190] but the halcyon days of solid waste disposal are near an end. RCRA conditions federal solid waste funds on state action to phase out dumping and to stimulate recycling.[191] As elaborated herein, accepted economic principles dictate such state action. States should accordingly reorient their solid waste policies to facilitate recycling rather than disposal. There are a host of recycling alternatives, but no single alternative is best in the abstract.[192] State statutes financing public recycling activities, consequently, must not be restricted to one particular approach. Instead, state monies should be made available for public recycling with local circumstances dictating the most appropriate approach.

(i). The Financing of Public Recycling Activity

There are at least four means by which to make state money available to local governments for recycling: grants, bonds, loans, and tax incentives. Each has particular advantages and serves a unique purpose and hence will be analyzed separately.

Grants should be used only for limited purposes. As far as possible, projects should pay for themselves, *i.e.*, the rate of return on a state's investment should equal the opportunity cost of capital, or the cost of the foregone alternative uses of that capital. In this way, resources are in their best uses, thus tending to maximize social welfare. For example, states could use grants to finance feasibility studies, initial planning, and engineering consulting which, though essential, do not accrue an immediate return and incur costs that might otherwise be prohibitive to financially strapped local governments.[193]

State[194] and municipal bonds[195] and state loans[196] should be the primary means by which to provide the capital necessary for public recycling

190. *See generally,* U.S. RESOURCE CONSERVATION COMMITTEE, *supra* note 74, at 107.

191. *See supra* notes 17-20.

192. *See supra* text accompanying note 111.

193. *E.g.,* OHIO REV. CODE ANN. § 6123.05 (Page 1877) (surveys and studies); W. VA. CODE § 16-26-9 (1979) (studies and engineering). *But see, e.g.,* FLA. STAT. ANN. § 403.709 (West Supp. 1981) (up to fifty percent of total project cost); PA. STAT. ANN. tit. 35, § 755.7 (Purdon 1977) (up to seventy-five percent of total project cost); S.D. CODIFIED LAWS ANN. § 34A-6-30 (1977) (land, equipment, and operating costs).

194. *E.g.,* FLA. STAT. ANN. § 403.712 (West Supp. 1981); LA. REV. STAT. ANN. §§ 30:1150.8(5), .9-.12 (West Supp. 1982); 1980 N.J. SESS. LAW SERV. CH. 70 (West); N.Y. ENVIR. CONSERV. LAW §§ 51-0103,-0109 (Consol. Supp. 1981); W. VA. CODE §§ 16-26-10 to -13 (1979); WIS. STAT. ANN. §§ 232.25-.31 (West Supp. 1981).

facilities. Because bonds must be repaid, these capital financing devices ensure that states will at least invest in facilities whose revenues will cover their costs, including capital costs. By investing in a project whose return covers the opportunity cost of capital, the economic principle of efficiency is satisfied.

Property, income, and sales tax exemptions could initially provide sufficient operating cost reduction to allow for economical performance of public recycling activities.

An ancillary issue that has a significant bearing on the success of public recycling activity is solid waste transportation. Largely as a public health measure, many states restrict the transportation of solid waste. However, there must be an unrestricted flow of solid waste to regional recycling centers if they are to be effective.[197]

(ii). The Structure of Public Recycling Activity

Another important consideration is the administration of public solid waste recycling activity which should incorporate municipalities' traditional control of solid waste. Municipal authorities' intimate familiarity with local circumstances is significant in deciding whether to go forward with a recycling facility and, if so, what sort of facility to construct. The administration of state financing programs, formulation of state policy, coherent state planning (for example, regionalizing recycling supply and demand and encouraging intergovernmental cooperation), and ongoing evaluation, however, require a substantial state role. To be effective, the state's responsibility should not be fragmented, but centralized within State government. The ideal administrative structure, then, should recognize both values and craft a two-tiered administrative apparatus.[198]

b. The Private Component of the Recycling Sector

The second facet of a state program to stimulate the supply of recycled goods is its private component. Although the private recycling industry has existed since World War II, its total output has been insignificant. There are two theories that support state intervention to bolster the private recycling industry.

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195. *E.g.*, GA. CODE §§ 36-62-9, 36-63-8 to -9 (1982).

196. *E.g.*, LA. REV. STAT. ANN. § 30:1150.8(6) (West Supp. 1982); PA. STAT. ANN. tit. 35, § 755.7 (Purdon 1977).

197. *See, e.g.*, FLA. STAT. ANN. § 403.713 (West Supp. 1981).

198. *See, e.g.*, CAL. GOV'T CODE §§ 66,700-94 (West Supp. 1980); FLA. STAT. ANN. §§ 403.701-.706 (West Supp. 1981); LA. REV. STAT. ANN. §§ 30:1150.1-.26 (West Supp. 1981). *But see, e.g.*, GA. CODE §§ 36-63-1 to -11 (1982) (exclusive local control); WIS. STAT. ANN. §§ 232.01-.55 (West Supp. 1981) (exclusive state control).

The first is the public good theory.[199] Unlike private goods that only one person can enjoy, such as an apple, public goods are those goods which all people can enjoy equally without excluding others. National defense is a classic example of a public good. It is appropriate, under this theory, for government to assume all or part of the cost of public goods on behalf of their consumers, the public as a whole. Inasmuch as private recycling activity produces benefits which society at large can enjoy equally (*i.e.*, decreasing pollution, increasing the potential stock of material resources, and decreasing aggregate energy consumption), it is appropriate, then, that society generally share in its costs. Such a policy is analogous to many states' partial financing of air and water pollution control.[200]

A related theory which supports public aid to private recycling is that of the infant industry. Under this theory, government should nurture critical private industries at their birth in order to foster socially necessary production. Just as the public purse partially funded the railroads in the nineteenth century because they served an important public purpose, the private component of the recycling industry should be publicly supported in some measure today.

The means by which to support the private recycling industry are, logically, not unlike those employed to finance public recycling activity: grants, bonds, loans, and tax advantages. Economic efficiency, however, requires that the use of all resources generate a rate of return sufficient to meet their opportunity costs, that is, their values in other, foregone uses. In this way, an allocation of scarce resources tends to maximize societal benefits.

Two implications arise from the application of these principles to the matter of public financing of private solid waste recycling. First, these projects should not be publicly financed through their entire productive lives; instead, as they become economically viable, public financing in whatever form should end. Second, the amount of public financing should be strictly limited,[201] for the abolition of both virgin materials subsidies and price discrimination will strengthen the private recycling industry.

VI

CONCLUSION

Guided by the principles of Pareto resource optimality, this Note has explicated the constituents of a comprehensive, coherent state solid waste recycling program under the Federal Resource Conservation and Recovery Act. In doing so, this Note has addressed the current market bias against

199. *See,* J. HEAD, PUBLIC GOODS AND PUBLIC WELFARE (1975).

200. *E.g.,* CAL. HEALTH & SAFETY CODE §§ 44,500-50 (West 1979); N.J. STAT. ANN. §§ 40: 37C-1 to -8 (West Supp. 1981).

201. *See, e.g.,* KY. REV. STAT. § 224.215 (Supp. 1980).

recycled products, which in large measure results from untenable state laws and policies. In conclusion, this Note enumerates and analyzes both supply- and demand-based policies which should comprise a comprehensive state solid waste recycling program. Policies to influence the demand for recycled products include measures to affect the relative prices of recycled and virgin resource-based products, to institutionalize governmental demand for recycled goods, and to stimulate private demand. On the supply side, cost-related policies include the internalization of otherwise external costs through local user fees, the elimination of governmental subsidies for virgin resource use, and the termination of statutory price discrimination against recycled products. The final supply-oriented policies involve the structure and finance of public recycling activity and the support of private recycling activity.

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