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Opportunity in crisis : California's solid waste management challenge

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Olszewski, Bruce Joseph, M.S.

San Jose State University, 1990

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OPPORTUNITY IN CRISIS:
CALIFORNIA'S SOLID WASTE MANAGEMENT CHALLENGE

A Thesis

Presented to

The Faculty of the Department of
Geography and Environmental Studies
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

By

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December, 1990

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ABSTRACT OF THESIS

OPPORTUNITY IN CRISIS: CALIFORNIA'S SOLID WASTE MANAGEMENT CHALLENGE

by Bruce Olszewski

This thesis addresses the topic of solid waste management in California. It recognizes our overdependence on disposal as a solid waste management option, examines the interaction between social, ecological, and physical systems, and identifies a means for improving our relationship with the environment.

Research indicates that only by linking natural processes with human endeavors can we weigh costs and benefits against social, economic, political, and environmental concerns.

California's lack of garbage disposal capacity provides an opportunity to replace the concept of disposing wastes with a new resource-efficient system emphasizing material reuse and recycling. The 1990s are a crucial time to develop, implement, and institutionalize mechanisms that empower economic and political systems to reward resource conservation. Success will be determined by the creation of markets for secondary resources.

Dedicated to the ideals of George Perkins Marsh
(1801-1882), who Lewis Mumford (1931, p. 78) called "the
fountainhead of the conservation movement."

PREFACE

The purpose of this thesis is to address California's solid waste management crisis. The lack of safe places to dispose of our wastes makes the 1990s a watershed decade of opportunity: we can replace our institutionalized throw-away ethic with an ethic rooted in sustainability, or we can entrench short-term, shortsighted solutions. It is up to us. The outcome will be determined by public policy decisions that will have far-reaching implications. The degree to which California decision-makers act together to modify waste disposal habits will impact the rate at which the global environment is altered. The crisis calls for altering not just the management of solid wastes, but the management of natural resources.

The thesis addresses this issue in six parts. Chapter one introduces the topic; chapters two and three discuss the issues of solid waste management; chapter four addresses applicable laws of nature and environmental theory; chapter five introduces the benefits of reusing and recycling resources; chapter six discusses actions that can be taken to establish a solid waste management hierarchy; chapter seven discusses the elements of developing markets for secondary resources; and chapter eight concludes the thesis, recommending a course of action. A glossary has been included to assist the reader in understanding terms

unique to the topic, and descriptive appendices have been added where appropriate.

I would like to express sincere appreciation to professors Gary Klee and Donald Aitken for their encouragement and constructive feedback, and to Richard Gertman for his help in providing valuable documents and professional insight. Special thanks are due to my friend and wife, Marla, whose enduring patience and unselfish support helped me undertake this project, and to our daughter, Kelly Anne, who reminded me to take time out to play.

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CHAPTER I

THE LANDFILL CAPACITY CRISIS AND THE ENVIRONMENT

Introduction

In 1864, George Perkins Marsh's landmark book, Man and Nature, or Physical Geography as Modified by Human Action taught us for the first time that humans are not simply a part of the ecosystem; they are the most powerful influence in it. We are learning that any single change to the ecosystem produces dozens of repercussions, many of them unforeseen and unrecognized. As the twenty-first century approaches, the importance of Marsh's thesis remains undiminished. We live in a finite world, and we must live with the consequences of our actions.

Faith that the natural environment possesses an unlimited capacity to furnish resources and to assimilate wastes is misguided. The practice of natural resource extraction, processing, manufacturing, transportation, use, and the final deposition of wastes into landfills has transgressed environmental thresholds seriously threatening the global ecosphere with pollution and economic instability in resource markets.

Demand for primary natural resources creates a reciprocal need for solid waste landfills where raw trash is put in or on the ground and covered with soil, and garbage burning facilities in which solid waste is reduced

to ash. In California, the demand for disposal capacity has outstripped the ability of industry and state and local government to provide it. Undervaluation of primary resources exacerbates a massive disposal problem. Actions taken by the decision-making bodies charged with solving the disposal capacity crisis will determine whether we perpetuate our throw-away ethic or replace it. Solutions will ultimately address the quality of the environmental condition for current and future generations.

This study identifies the need for an interdisciplinary approach toward solutions to the landfill capacity crisis. Decision-makers must cross proprietary boundaries and seek an integrated solution that is economically viable without compromising environmental quality. The solution must go beyond the disposal shortage problem alone and must embrace a total environmental perspective of the issue.

Statement of the Problem

California has a garbage problem: too much solid waste is produced for too little landfill space. The Assembly Office of Research and the Assembly Natural Resources Committee (AOR 1988, p. 15) expect California's existing landfills to be full by the year 2000. Considering the rate at which solid waste is generated in the state (discussed in Chapter II), the shortage of landfill capacity will soon be of crisis proportions. This

problem is compounded by citizen opposition and government regulation, which have made it virtually impossible to build new landfills.

The institutionalization of alternatives to disposal, such as source reduction and recycling programs, has been largely avoided by local, state, and federal legislative bodies. As a society, and largely without the benefit of debate, California and the United States have drifted into a reliance on disposal: this dependence on disposal has become an unchallenged monopolistic public policy.

Regulators have exacerbated the disposal shortage problem by advocating new and improved technologies, such as "better" landfills and burning waste to create energy. These efforts not only evade the opportunity to replace the disposal option, but divert funds which could be used to research and implement alternatives.

Purpose, Scope, and Limitations of the Thesis

The purpose of this thesis is to address the issue of solid waste management as a resource management problem; solid wastes are, in reality, wasted solids.

This thesis focuses on nonhazardous municipal solid waste--those things which most of us call garbage. The thesis investigates the synergistic relationship between the demand for natural resources and the resulting generation of solid wastes that has prompted the landfill

capacity crisis. It questions the wisdom of continued reliance on disposal and the perpetuation of a throw-away ethic. The thesis identifies economic and environmental relationships associated with resource use and solid waste generation and analyzes the consequences of these relationships.

Elements of the landfill capacity crisis are reviewed to determine a recommended course of action including legislation, rate of waste generation, existing conditions at landfills, remaining landfill capacity, and alternatives to landfills. Recommendations include adopting a comprehensive solid waste management policy that empowers economic and political systems to reward resource conservation instead of resource waste. This action will be a key step in the transition from a throw-away society to a sustainable-earth society.

Methodology

Information from literature reviews, interviews, site visits, and conferences was used in developing this thesis. The primary sources for research were journals, books, public documents, institutional reports, published and unpublished works by private organizations, conference proceedings, magazines, annual reports, federal reports, and reports from the states of California, New York, and Michigan. Due to this topic's broad scope, the literature

review was supplemented by interviews with state and local elected officials, government staff members, and solid waste management and recycling specialists. Site visits to material processing centers provided a practical perspective of the day-to-day operations.

Statement of Hypotheses

The dilemma of solid waste management provides an opportunity to develop and adopt policies that simultaneously address the global environmental condition and the landfill capacity crisis. Alternatives to disposal, such as reducing the amount of materials that require disposal and recycling all other material to the maximum extent possible, will economically and environmentally benefit society. The following assumptions are developed in the thesis:

- o The deteriorating environmental condition of the earth requires that actions be taken to improve the efficiency of resource use.
- o The existing landfill capacity crisis is but one example of the inefficient use and depletion of natural resources. It is also a "limits to growth" signal emphasizing the need to improve the stewardship of the earth's resources for future generations.
- o A throw-away ethic facilitated by a government-supported infrastructure, including tax codes, negatively affects environmental quality and the national economy.
- o Solutions to the landfill capacity crisis provide significant measures to reduce negative environmental and economic impacts caused by inefficient resource use.

- o Decision-making bodies considering solutions to the landfill capacity crisis must carefully and comprehensively consider State, National, and International economic and environmental results.
- o Encouraging waste reduction, recycling, and development markets for secondary recovered materials enables societies to realize the economic and environmental benefits of efficient resource use.

Analysis

The landfill capacity problem is an indicator of deeper social and economic issues. Our society possesses a "throw-away ethic." We enjoy an endless supply of market goods which result in a unceasing stream of waste, and the true environmental and economic costs of those goods are not factored into their price. The potential for recycling natural resources from market goods to waste material and back into market goods is abruptly terminated when waste is buried in a landfill or incinerated. Our reliance on disposal has blinded us to the benefits to the environment, the market, of solid waste management principles that emphasize reuse and recycling of materials.

When we explore a full range of responses to the approaching landfill capacity crisis, we ultimately confront the rationale behind our society's systematic entrenchment in this ethic of disposal. In California, we have a choice between treating a symptom or the cause. The symptom is the vast amount of garbage, which is a problem

because we have no place to put it. The cause is the creation of that garbage. If California is to resolve its landfill crisis, it is vital that we address the cause and explore its relationship to the symptom; then we must develop a solution that addresses all aspects of the problem. This is the opportunity in the crisis.

CHAPTER II

THE PROBLEM: THE FAILURE OF DISPOSAL

Introduction

California's dependence on disposal technologies to manage its municipal solid wastes has led the state into a crisis. Without expansions or new disposal facilities most urban regions in the state will fill remaining landfill space within the next ten years (CWMB 1985a). Twelve counties have fewer than five years of permitted disposal capacity remaining (CWMB 1988, p. 3).

The crisis of diminishing disposal capacity is compounded by administrative inability to apply waste management alternatives that are creative, practical, and environmentally sound. Lacking viable alternatives, landfill disposal became institutionalized. Letcher and Sheil (1986, p. 218) reported that disposal "has become a self-validating structure supported by an internally consistent and highly interconnected set of concepts, systems, definitions, and programs acting to thwart alternatives."

State and local regulators entrusted to protect the public health and the environment and to provide solutions to the landfill problem are overwhelmed with the enormity of their task. The severity of the problem demonstrates that key decision-makers have been deficient in their

ability to understand and apply multi-disciplinary solutions to a multi-faceted situation.

Landfill Capacity

At the rate Californians generate waste, the state's current landfills are expected to be full by the year 2000 (AOR 1988, p. 14). Southern California, which generates over half of the state's solid waste, will exhaust its landfill capacity by 1996 (CWMB 1987b, p. 103).

Creating more landfill capacity is a short term solution. While it may ease the problem now, it is an expensive option, and a landfill's ability to accept wastes cannot continue indefinitely because of its finite amount of space. Furthermore, acceptable locations of disposal sites are severely limited by social and environmental constraints. The geographic and geologic capability of a site to safely contain wastes, citizen opposition to landfills, and high political risks to legislators are limiting factors. The landfill siting and permitting process is slow; a minimum of five years can be expected for completing the process of landfill siting and permit acquisition (AOR 1988, p. 17).

Despite the social and environmental difficulties of disposing of solid wastes, in recent years landfill capacity has been increased in the state. The 122 million tons of capacity added in 1985 and 1986, however, extended

by only eighteen months the statewide landfill capacity (AOR 1988, p. 15). This is an insignificant gain, considering the disposal needs beyond the next decade.

Regional Landfill Capacity Shortages

Of significant importance is the regional impact of projected statewide landfill capacity shortages. Twenty of California's counties account for fifty-three percent of the waste disposed in landfills with eight or fewer years of remaining capacity. These include some of state's most populated counties: Los Angeles, San Bernadino, San Mateo, Contra Costa, and Ventura (AOR 1988, p. 18-19).

Solid Waste Generation

The probability that we will experience a landfill capacity shortage in California and throughout the nation, if steps are not soon taken to avert one, is supported by the amount and rate of solid waste generated in the state and nation. The United States is the world leader in the generation of solid wastes. On a per-capita basis, California is the national leader (Table 2.1), with its people generating fifty-sixty percent more solid waste than the average American (Glazer 1987, p. 474; Cortese 1988, p. 2). A national trend of increasing per-capita solid waste generation (Table 2.2) will only aggravate the situation.

TABLE 2.1
WORLDWIDE SOLID WASTE GENERATION BY WEIGHT

	TOTAL (Thousand metric tons per year)	PER PERSON (pounds)
CALIFORNIA	34,000	2,555
United States	160,000	1,547
Australia	10,000	1,498
Canada	3,082	1,157
Denmark	12,600	878
Finland	2,046	638
France	1,200	636
Germany, Fed. Rep.	15,500	744
Italy	14,041	541
Japan	40,225	757
Norway	1,700	913
Spain	8,028	473
Sweden	2,500	662
Switzerland	2,156	741
United Kingdom	15,816	620

SOURCE: Assembly Office of Research and Assembly
Natural Resources Committee, Integrated Solid Waste
Management: Putting a Lid on Garbage Overload. Joint
Publications, Sacramento. April 1988, p. 3.

TABLE 2.2

TRENDS IN MUNICIPAL SOLID WASTE DISCARDS
IN THE UNITED STATES (PER CAPITA BASIS) 1960 TO 2000

YEAR	POUNDS/PERSON/DAY*
1960	2.32
1965	2.60
1970	2.95
1975	2.88
1980	3.02
1990**	3.10
1995**	3.16
2000**	3.25

SOURCE: Franklin and Associates, Characterization of Municipal Solid Waste in the United States, 1960 to 2000. (Prairie Village, Kansas, 1986), p. 1-21.

* These figures include residential, commercial, and institutional wastes. Per-capita discards from residences alone would be lower.

** Estimated

Composition of Solid Wastes

The United States Environmental Protection Agency (EPA) identifies ten categories of garbage that comprise the solid waste stream (Glazer 1987, p. 485). The composition of solid wastes vary with time (Table 2.3). Paper and paperboard constitute the largest single component, while glass and metal materials account for

a significant portion of the typical garbage dump. However, appearance of these materials in the waste stream is declining as they are being used less and are also recyclable.

TABLE 2.3
CURRENT AND PROJECTED COMPOSITION OF U.S. GARBAGE

MATERIALS	1984		2000*	
	Million tons/yr	% of total	Million tons/yr	% of total
Paper and paperboard	49.4	(37.1)	65.1	(41.0)
Glass	12.9	(9.7)	12.1	(7.6)
Metals	12.8	(9.6)	14.3	(9.0)
Plastics	9.6	(7.2)	15.5	(9.8)
Rubber and leather	3.3	(2.5)	3.8	(2.4)
Textiles	2.8	(2.1)	3.5	(2.2)
Wood	5.1	(3.8)	6.1	(3.8)
Food Wastes	10.8	(8.1)	10.8	(6.8)
Yard Waste	23.8	(17.9)	24.4	(15.3)
Other	2.5	(1.9)	3.2	(2.1)
TOTAL	133.0	(100.0)	158.8	(100.0)

* Projected

SOURCE: Franklin and Associates, Characterization of Municipal Solid Waste in the United States, 1960 to 2000. (Prairie Village, Kansas, 1986), p. S-2.

Plastic

The most significant change in the composition of solid waste in the United States has occurred due to the increased use of plastics. In 1970, plastics made up less than three percent by weight and eight percent by volume of the solid waste stream. By 1984 its use had more than doubled, to 7.2 percent by weight. In the year 2000, the EPA predicts plastic in the country's solid waste to be nearly ten percent by weight, and up to 25 percent by volume (Glazer 1987, p. 485; Gertman 1990).

Plastic is tough, chemically inert, and resistant to attack by microbes and moisture, qualities that explain its growing use. Although plastic remains chemically stable in landfills, biodegradable and photodegradable plastics have been promoted by marketers as being "environmentally friendly" since they will allegedly decompose and theoretically not take up space in landfills. However these claims are doubtful since photodegradable plastics must be exposed to sunlight for a period of days and material taken to landfills is routinely buried under a layer of soil. Biodegradable plastics aren't likely to decompose either. Archaeological work by Dr. William Rathje at landfills across the country indicates that there are insufficient amounts of moisture inside landfills to degrade most materials (Rathje and Wilson 1987).

Plastic materials pose an additional problem as they

are not recycled on a widespread basis. Moreover, the process of recycling plastic materials, as is also the case with paper, includes the necessity to separate different grades prior to recycling. Additionally, biodegradable plastic has been criticized for contaminating plastic that is recycled and for causing damage to plastic recycling processing equipment. The Society of the Plastics Industry claims that twenty percent of the plastic soft-drink bottles produced in the U.S. are recycled (Graff 1988, p. 106) but only about one percent by weight of all plastic products are recycled (CSG 1987, p. 2).

Factors Affecting Solid Waste Generation

Many factors affect the generation of solid waste. Some of the more obvious ones include an increasing population, rising affluence, and a corresponding increase in the purchase of goods and the amount of discards. Other, less obvious, factors include government actions that discourage waste reduction and support resource extractive industries, such as timber and mining interests.

Federal Government Policies

Federally provided tax incentives, subsidies, and depletion allowances financially assist firms involved in the extraction of virgin materials. This assistance encourages exploration for virgin resources. The extractive industries' competitive market advantage comes at the

expense of the secondary materials' market, for these policies effectively discriminate against and discourage the reuse and recycling of secondary resources. The vast majority of goods made from primary or virgin resources, as evidenced by the increase in per-capita waste generation, are ultimately discarded instead of being recycled or reused. Naturally, something must be done with these discards: most of them find their way into landfills, contributing to the landfill capacity crisis.

Virgin materials industries take advantage of tax benefits to maintain the vitality of their operations. Percent depletion allowances provide favored tax treatment to oil, gas, mineral mines, and timber industries by allowing them to deduct a percentage of the value of the resource as an irreplaceable business asset. General corporate tax policy allows deductions for depletion and depreciation of assets that reduce the value of a corporation. The net result is a tax deduction that, in some cases, have timberland owners paying no income tax at all, even when they operate profitably (Bruno 1988, p. 18).

Federal depletion allowances for tax purposes were judged by Tannewald in 1978 to effectively discourage using recycled products to the degree that they subsidize prices of raw materials that compete with secondary materials. Bruno (1988) reported that Tannewald's findings remained accurate in 1988, and that repeal or reduction of percent

depletion would reduce the amount of disposed waste by encouraging the use of secondary materials.

Rail Transport

Bruno (1988, p. 7) reported discriminatory rail rates favoring virgin materials transport which provide an overall disincentive for recycling. Transport costs reduce the economic viability of secondary materials, since rates generally discriminate against the shipment of secondary materials as compared to virgin materials. Transporting a ton of recyclables costs more than transporting a ton of virgin resources. The significant impact of freight charges must be calculated in consideration of potential revenue from recovered materials. In 1980, shipping charges reduced recovered materials revenue by an estimated seventy-nine percent for secondary glass, thirty-eight percent for scrap iron and steel, and five percent for aluminum (Bruno 1988, p. 8). In 1989, most recyclables were transported by truck (Gertman 1990).

Population

California's continuing growth, according to the Demographic Research Unit of the State Department of Finance (1989, p. 1), can be characterized as follows:

- o In the past ten years, California has increased from 10.3 to 11.5 percent of the total U.S. population and has ten million more people than the next largest state, New York.

- o Population has increased 2.4 percent for the third year in a row. This compares to an annual average increase of 2.1 percent from 1980 to 1985.

The rapid population growth in California indicates that people want to live there. A rising state population means increases in the amount of solid wastes as more people purchase and discard more goods. This is a significant factor in California's problem, since a growing population works against factors to reduce or stabilize waste generation (U.S. Bureau of the Census, 1984).

Social Patterns and Technological Change

Growing affluence, fueled by technological change, has increased personal real purchasing power. Purchases of goods have risen from \$129 billion in 1945 to \$1.5 trillion in 1984, an increase of nearly 1,000 percent. The increase in the purchase of goods results in an increase in the amount of materials that are discarded (Franklin and Associates 1986, p. 3-1 and 3-2).

History and Legislation

The problems of California's dwindling landfill capacity and its environmentally unsafe landfills leads one to ask how and why the state's waste disposal system got so bad. The answer is based in history. California has long used a single method of managing solid waste: disposal. Except for some open burning of wastes, which was outlawed

in the late 1950's as causing air pollution, California has exercised one strategy for disposal: dumping wastes into the ground. Hence, most legislation affecting solid waste management refers to regulating disposal and landfill operations rather than encouraging disposal alternatives.

Government involvement at all levels in waste management is rooted in nuisance control to protect the public health and safety. The first federal action, The River and Harbors Act of 1899, eliminated the practice of disposing debris on the banks of and into navigable waterways (CWMB 1985a, p. C17). By the 1930s, municipalities were disposing of their wastes in centralized areas. In the 1940s the concept of "landfills" arose, and by the mid-1950s, the State Department of Health was establishing guidelines on the proper operation of landfills for local health departments (Tchobanoglous 1977, p. 18). Over time, regulatory activity outlawed many disposal options, including plowing wastes into soils, dumping into waterways, backyard incineration, open burning, open field dumping, and feeding waste to animals (Tchobanoglous 1977, p. 17-18.).

Succeeding legislation provided government regulators with the authority to address environmental protection and landfill-related public nuisances. Regulations addressed the protection of air, water, land, wildlife habitats, public health, vector harboring and propagation, odors,

safety hazards, methane gas migration, and hazardous materials dumping in municipal landfills. The "energy crisis" of 1973-74 led to legislation and policies which encouraged substitutes for our dependence on oil, such as burning garbage for energy. Legislation and regulation affecting solid waste management in California is presented in chronological order in Appendix A.

Sanitary Landfill

As regulations mandated the closure of non-compliant landfills, California developed an overwhelming reliance on sanitary landfills, landfills that meet specific design criteria and receive a daily cover of dirt. Like the disposal methods that preceded them, sanitary landfills pose their own set of environmental and public health hazards. They frequently contaminate ground and surface water, and cause air pollution. Regulations have attempted to address these problems by encouraging methane and leachate controls, but the technology for achieving this has not been perfected. Today, ninety percent of California's garbage is disposed of in "sanitary landfills" (CWMB 1985A, p. 2).

Institutionalized Waste Disposal

Letcher and Sheil (1986, p. 217) theorize that "the existence of waste can be seen as a response to the existence of disposal programs, instead of the other way

around." Before 1920, seventy percent of cities in the United States separated recyclable and reusable goods from their waste-streams (Letcher and Sheil 1986, p. 217). Overwhelmed by the volume of material and crippled by inadequate means of processing it, government responded to community cries for relief by "initiating programs intended to move those offensive materials safely distant from human activity" (Huls and Seldman 1982, p. 7).

An infrastructure evolved to support waste collection programs. Open trucks where collected materials were separated for resale were replaced with "packer" trucks that mixed and compacted materials together. Investments in these single-compartment collection vehicles, and landfill processing equipment, and even landfills themselves, created an "economic inertia" that impeded acquisition of equipment appropriate for the collection and processing of separated materials (Letcher and Sheil 1986, p. 217). The result was the institution of a one-way material flow: virgin resources destined for disposal, not reuse.

Environmental and Public Health Risks of Landfills

Landfills are a significant source of risk to public health and environmental integrity. Aware of these risks, special interests, such as residential organizations, have consistently thwarted plans to establish or expand

landfills. These groups have been labeled with anti-landfill acronyms such as NIMBY (not in my backyard), NIMEY (not in my election year), NIMTOO (not in my term of office), GOOMBY (get out of my backyard) and NOPE (not on planet earth). This opposition is generally acknowledged to be the greatest obstacle to establish or expand waste management facilities.

Investigations by the California Waste Management Board (CWMB) and the State's nine Regional Water Quality Control Boards (RWQCB's) identified seven categories of potential problems inherent in landfills (Table 2.4). Additionally, the CWMB (1985a, p. 22-25, and p. C25-C36) has detected in landfills methane gas, which is capable of traveling along underground water sources and consequently threatens the safety of nearby buildings. The possibility of explosion is real (Dunlea 1985, p. 4). A significant number of operating and closed or inactive California landfills exceed the "five percent explosive limit set by the EPA" (AOR 1988, p. 20).

TABLE 2.4

POTENTIAL PROBLEMS OF SOLID WASTE FACILITIES

Water Pollution	Leaking leachate into groundwater and surface water.
Air Pollution	Gases emitted from landfills, primarily volatile organics including methane, which can contribute to the creation of ozone.
Health Threat	Harborage and propagation of disease bearing animals and micro-organisms. Migrating methane gases. Contamination of water sources.
Personal Injury	Solid waste facilities are unsafe places for users and employees involved in the on-site traffic and the hazards of unloading waste.
Public Nuisance	Odors, dust, litter, vector propagation, and unsightly operations.
Loss of Scarce or Valuable Resource	Threats to rare or endangered species and ecologically sensitive areas.
Aesthetics	Landfilling in pristine areas, lowering or elimination of existing hills, modification of ridges, imposing a high level of activity on a once-quiet place, building high structures that obstruct views, denuding a forested and naturally vegetated areas, and leaving barren scars resulting from the mining of cover.

SOURCE: California Waste Management Board, A Comprehensive Plan For Nonhazardous Wastes in California. 1985a, pp. C25-C27, C19-C36.

Leachate

Surface and ground water is often polluted from escaped landfill leachate. Leachate is liquid created when landfilled organic waste decomposes into carbon dioxide, water, nitrogen, ammonia, sulfides, methane, and numerous organic gases (Weiss 1974, p. 6). Other water pollutants include benzene, vinyl chloride, heavy metals, and other toxic compounds (CAW 1988). Groundwater contamination occurs when rain, surface, or ground water passes through landfilled wastes and absorbs leachate. Landfills built without liners under the waste pile and lacking leachate drainage and collection systems allow leachate to flow unimpeded into groundwater supplies under or near landfills.

New landfills are required to include a leachate control and monitoring system. The control systems, however, are not infallible. Five years after opening the Kirby Canyon Landfill, a major new landfill serving the San Jose area, operators discovered three toxic substances seeping under a temporary wall inside the landfill (SJMN 1989a, p. 1B). Fortunately, the monitoring system detected movement of toxics, providing an opportunity for cleanup to begin before serious environmental damage occurred.

Even when linings are used to control leachate, "There is nothing that is absolutely impermeable," according to Steven Ritchie (1989), Executive Officer of

the California Regional Water Quality Control Board. Discussing San Mateo County's proposed Apolino Canyon Landfill, Gil Gossett (1989) explained the danger of a leachate leak affecting nearby underground water supplies: "It may take 300 years to pollute the aquifer, but it will take 300-1000 years to clean it--and the country recently celebrated 200 years of independence."

Hazardous Waste in Solid Waste Landfills

Hazardous wastes are suspected to be significant contributors to landfill pollution problems. This type of waste is now strictly regulated to Class 1 hazardous waste facilities. Older landfills, which operated during a period when there were few if any restrictions on the kinds of waste that could be disposed, received great quantities of toxic wastes (ADR 1988, p. 23). Despite current hazardous waste disposal regulations, documentation of several landfills indicates that illegally dumped hazardous or infectious wastes continue to be disposed along with municipal solid wastes (ADR 1988, p. 23). Simply having a law on the books is insufficient guarantee that the law will be observed. As in other areas of life, some violations may be unwitting, while others clearly are not.

Household Hazardous Waste in Landfills

Household hazardous wastes contribute to the leachate problem. Those common household materials, which very few

people recognize as hazardous and are regularly found in landfills, are listed in Table 2.5. Many of these materials are not permitted in solid waste landfills, but either through ignorance or intention they are regularly included in garbage cans. Not until 1985 did the CWMB begin considering the effect of household hazardous waste in the municipal waste stream. The CWMB (1985c, p. 20) reported that these wastes "could injure the public and refuse workers, and may adversely affect the environmental quality when disposed of in landfills designed to accept only nonhazardous wastes."

The volume of household hazardous waste entering nonhazardous landfills may be significant. A 1986 study by the EPA, which surveyed residential garbage in Marin County, California, and New Orleans, Louisiana for household hazardous materials, showed that approximately one-half of one percent--a household's weekly average of fifty-five to sixty grams--was hazardous. Although this percentage is small, the EPA estimated that Marin County accounted for almost 285 tons of hazardous wastes disposed annually into the solid waste landfill (Rathje and Wilson 1987), an amount the EPA characterized as "substantial." The City of San Jose estimates that oil and paint constitute two-thirds to three-fourths of the household hazardous materials put into landfills (Gertman 1990). The CWMB contends that: "There is no irrefutable evidence to

TABLE 2.5

TYPICAL HOUSEHOLD HAZARDOUS WASTES TYPES

<u>HOUSEHOLD CLEANERS</u>	<u>AUTOMOTIVE MAINTENANCE</u>
Toilet Bowl Cleanser Drain Opener Laundry Soap Bleach Dish Washing Detergents Bathroom Cleaners Ammonia Based Cleaners Polish Floor Finish Air Freshener Other Household (oven cleaners)	Oil Transmission Fluid Engine Treatment Antifreeze/Coolant Auto Wax Other Auto (grease solvents, rust, solvents, refrigerants)
<u>HOUSEHOLD MAINTENANCE</u>	<u>PESTICIDES AND YARD MAINTENANCE</u>
Paint Paint Thinner Stain/Varnish Glue Others	Fertilizer Pesticides Herbicides Pet Maintenance
<u>BATTERIES AND ELECTRICAL</u>	<u>PRESCRIPTION DRUGS</u>
Auto and Flashlight Batteries Solder	Diverse
<u>SELECTED COSMETICS</u>	<u>OTHER</u>
Nail Polish Remover Hair Spray Make-up Remover Dyes	Pool Chemicals Hobby Related Miscellaneous

SOURCE: W. L. Rathje and D. C. Wilson,
Characterization of Household Hazardous Waste From Marin
 County, California, and New Orleans, Louisiana. July 1987,
 pp. 12, 17-20.

confirm or disprove the notion that uncontrolled disposal of household hazardous wastes in municipal landfills creates a significant hazard to human health or the environment" (CWMB 1986, p. 4). Nonetheless, AB 1809, (the Tanner Bill) enacted in 1986, requires each county to assess whether or not a need exists for a community household hazardous waste removal program and establishes state policies and guidelines for the management of household hazardous wastes (CWMB 1986, p. 4-5).

Enforcement of Landfill Regulations

Solid waste landfills are required to meet specified public health and environmental standards. The responsibility for day-to-day enforcement of landfill standards is held in California by seventy-five CWMB approved Local Enforcement Agencies (LEA's) (CWMB 1985a, p. C23). LEAs issue operating permits and inspect waste disposal facilities for compliance with state and federal minimum operational standards. They are authorized to impose fines and demand correction of potentially dangerous situations or issue cease-and-desist orders.

Despite the authority granted to LEAs, violations of minimum standards are common (AOR 1988, p. 25). The most frequent violations are listed in Table 2.6. Although a high rate of violations threaten public health and environmental integrity, investigation and enforcement

actions are minimal. The CWMB (1985a, p. C35) has attributed this lack of enforcement to underfunded, understaffed, and inadequately trained LEA staff. Additionally, the CWMB (1985a, p. C28) reports inspection of solid waste facilities by the nine regulatory Regional Water Quality Control Boards (RWQCB's) to be low priority because many programs are implemented by their boards (CWMBa 1985, p. C28). The CWMB currently provides minimal training for LEAs (Gertman 1990).

Meanwhile, LEAs are hesitant to use existing legal remedies due to the length of time and cost to prepare a case and prosecute a violator in a civil court. LEA authority is further debilitated by the courts. The CWMB (1985a, p. C35) reported that: "Solid waste cases, like other civil offenses, are given a low priority in the existing court system."

TABLE 2.6
MOST FREQUENT VIOLATIONS* OR
THREATENED VIOLATIONS OF WASTE DISCHARGE REQUIREMENTS

<u>Region</u>	<u>Most Frequent Violations (Number)</u>
Central Coast	Inadequate leachate control barriers (17) Inadequate cover (8) Illegal disposal of liquid wastes (7) Lack of proper drainage devices (7) Improperly graded final surfaces (6)
Central Valley	Inadequate leachate control barriers (35) Improperly graded final surfaces (12) Runoff contacting waste (10) Inadequate drainage device (9) Lack of cover (7)
Los Angeles	Improper waste treatment or disposal (8) Inadequately maintained leachate control barriers (7) Lack of proper drainage devices (7) Lack of adequate cover (4)
North Coast	Inadequate leachate control barriers (7) Lack of final cover (4)
Santa Ana	Improperly graded final surfaces (39) Lack of proper drainage devices (17) Improper closure (14) Runoff flowing into disposal area (14)
San Francisco Bay	Improperly maintained leachate control barriers (35) Inadequate waste containment barriers (13) Discharge of waste to ground or surface waters (12) Runoff contacting wastes (11)
Lahontan	Lack of proper cover (55) Inadequate protection from floods (12) Inadequate drainage devices (5) Wastes in ponded water (4) Inadequate leachate control barriers (3)

TABLE 2.6--Continued

<u>Region</u>	<u>Most Frequent Violations (Number)</u>
All regions	Inadequate leachate control barriers (106) Improperly graded final surfaces (85) Lack of proper cover (84) Inadequate drainage devices (60) Runoff contacting wastes (25)

* If any of the top five occurrences by region were 2 or less, they were not counted

SOURCE: California Waste Management Board.
A Comprehensive Plan for Nonhazardous Wastes in California,
July 1985a, p. C29.

CHAPTER III

THE PROBLEM:
INTERAGENCY COORDINATION AND COMMUNICATIONLegislation and Regulation

State legislature created the Solid Waste Management Board (SWMB) in 1972. Renamed the California Solid Waste Management Board (CWMB) in 1982, and renamed again in 1989 as the California Integrated Waste Management Board (CIWMB), it is the state agency responsible for executing state solid waste management policy. In addition to the CIWMB, involved in regulating solid waste facilities are six state agencies, nine regional water quality control boards, forty-three local air districts, seventy-five local enforcement agencies, county supervisors, city councils and commissions, and several federal agencies (Table 3.1).

The chorus of regulators is not without disharmony. The CWMB (1985a, p. C3) reported:

...not only has the participation of the different levels of government increased, but also the number of governmental entities regulating solid waste facilities. It has increased to such an extent that roles at times appear somewhat unclear and duplicative.

Lack of coordination among agencies has been a significant problem for two decades. In 1965, the State Department of Public Health reported the existence of inadequate state standards and fragmented state authority regulating solid waste facilities (U.S.E.P.A. 1971, p.

iii, p. 1-2, p. 11-3, p. 11-4, p. IV, 4-5). Twenty years later, the CWMB (1985a, p. C3) reported the same problem:

Overall, there seems to be a lack of coordination and of any unified policy for regulating these facilities. Each agency regulates facilities based on its own specialized role(s). Frequently, agencies appear to be working at cross-purposes.

TABLE 3.1

SELECTED DEPARTMENTS AND AGENCIES INVOLVED
IN SOLID WASTE MANAGEMENT

Army Corps of Engineers
Air Resources Board
California Energy Commission
California Waste Management Board
Caltrans
City and County Councils and Commissions
Coastal Commission
Department of Fish and Game
Department of Food and Agriculture
Department of Forestry
Department of Health Services
Department of Parks and Recreation
Local Enforcement Agencies
Regional Water Quality Control Board
State Lands Commission
State Water Resources Control Board
U.S. Environmental Protection Agency

SOURCE: California Waste Management Board,
A Comprehensive Plan for the Management of Nonhazardous
Wastes in California. 1985a, pp. D7-D50.

Legislative and Regulatory Contradictions

Despite the best intentions of regulators and legislators, misdirected efforts in the form of overlapping regulatory responsibilities and policy contradictions

result in counterproductive efforts.

Air Quality vs. Solid Waste Management

The Mulford-Carrell Air Resources Act of 1967 created the Air Resources Board (ARB), which established state ambient air quality standards. By 1970, the ARB eliminated open dumps, open burning dumps, and incinerators as waste disposal methods because they violated air quality standards. To control the migration of landfill gases, the ARB encouraged enclosing landfilled wastes in an impermeable seal.

Improved air quality came with a price. Eliminating the option of burning waste led to an overreliance on sanitary landfills, contradicting policy efforts by the CWMB to reduce dependence on landfills. Additionally, landfills were sealed with soil to prevent moisture from penetrating the landfill and creating leachate, and to prevent gases from escaping. The sealed in gases resulted in a build-up of explosive methane gas within landfills (CWMB 1985a, p. C35), mitigating efforts to make landfills safe.

Promoting The Garbage Burning Option

Actions by state and federal legislature, the California Energy Commission (CEC), and the CWMB that encourage the burning of wastes for energy are incompatible with efforts to protect the public health and the

environment.

The CEC was established in 1975 to ensure that a reliable supply of electrical energy is maintained in the state (Warren-Alquist State Energy Resources Conservation and Development Act, PRC, Section 25001). The law establishing the Commission recognized the value of cogeneration technology as a potential energy resource which could reduce dependence on nonrenewable energy resources. As waste-to-energy (WTE), burning garbage for its energy content, is a cogeneration technology, the legislature gave the commission siting and regulatory authority for facilities that produce fifty or more megawatts of power (CWMB 1985a, p. C14).

In 1978, Congress amended the Public Utilities Regulatory Practices Act (PURPA). It sought to lessen the energy shortage by stimulating construction of energy-generating plants through requiring private utilities to purchase power from small energy producers. Anticipating an opportunity to develop WTE, the state legislature passed several laws exempting WTE facilities from specified air pollution requirements and provided the CWMB with funds to initiate six WTE projects (AOR 1988, p. 28-9).

In 1984, the federal government increased its commitment to WTE, amending the Resource Conservation and Recovery Act (RCRA) to exempt WTE facilities from hazardous waste regulations if proper control measures were

implemented to ensure that hazardous materials did not enter a WTE facility. That same year the state adopted similar legislation, AB 2292, which required the Department of Health Services to classify ash residues as nonhazardous if the operator could demonstrate that proper precautions were taken to prevent the unauthorized receipt of hazardous material (SB 2225, 1984, Cal. Stats., Ch. 743, Sections 1 and 2).

These efforts to artificially support WTE by circumventing laws designed to protect the public health and the environment not only reflected state and federal desire for WTE as a landfill alternative and energy producer but also a faith that technology would render WTE air pollution and ash emission minor and controllable. These desires remain largely unfulfilled.

A Failed Disposal Solution

Despite state and federal legislative support, exemption clauses, and financial incentives, WTE in California has proved to be, at best, a premature effort at managing solid wastes and, at worse, a huge failure. Major WTE projects, most notably the Irwindale, SANDER, and LANCER projects in Southern California and the Bay Area Resource Recovery Facility in Northern California, have been plagued with public opposition as well as environmental and economic concerns from regulatory

agencies (AOR 1988, p. 7). A failed WTE project forced Lassen Community College into bankruptcy. By 1990, of the thirty-nine WTE projects proposed in California, three were operational (Long Beach, Commerce, and Wellslly, all in Los Angeles County); four had made little progress; and thirty-two are either dead or had no plans for opening in the near future (AOR 1988, Appendix H; Gertman 1990).

With the possible exception of a WTE facility in San Marcos, CWMB spokesman Christopher Peck (Roach 1988, p. 119) said more trash-burning plants probably will not be permitted in California, pending evaluations of existing plants and those under construction.

Despite the failure of WTE, CWMB official policy maintained that WTE incinerators are the most important element of a solid waste management system designed to reduce California's dependency on landfills (AOR 1988, p. 31).

Action and Inaction

CWMB Leadership

Despite CWMB projections of dramatic state landfill capacity shortages by the year 2000, the failure of WTE, and the near impossibility of siting new landfills, former CWMB Chairman Sherman Roodzant (who left office in 1989) said of the situation:

This is not a crisis. It is an area in a state of serious concern, and local governments

and citizenry need medium-and long-term (landfills), and we don't have them (Roach 1988, p. 114).

In the same interview, and seemingly ignorant of the concerns and resolve of NIMBYs, GOOMBYs and NIMEYs, Roodzant said, "Landfill sites are out there, if local governments will stop bickering and politicians will take action and choose them."

In contradiction of its Chairman's contention, the CWMB recognized a problem and neatly summed up the situation: "The current solid waste facility siting process does not work" (CWMB 1985a, p. 2).

Maintaining Roodzant's position was the 1985 CWMB (1985a p. D1) report to the Legislature. Prepared under Roodzant's chairmanship, it did not offer the legislature solutions to the problem but merely offered a point of view:

With 'close-in' land either unavailable, too costly, or disposal sites unacceptable to nearby residents, the Board has for some time encouraged and even sponsored development of landfill alternatives. These other options (or more accurately stated, these other components of a well integrated waste management system), such as recycling, composting, and WTE facilities, have not evolved nearly quickly enough to make the impact on the disposal problem needed to avert a garbage crisis in some areas.

What Roodzant failed to note was the historical inadequacy of both CWMB and state legislative efforts to develop significant alternatives to landfill and WTE.

In 1982 and 1985, the CWMB recommended an apparently

well-balanced approach to alleviate the impending disposal capacity shortage. A Comprehensive Plan for Management of Nonhazardous Waste In California (1985a, p. 2-3),

recommended:

- o Establishing a twenty year financial assistance program to assist in the capital construction of waste-to-energy (WTE) plants.
- o Developing adequate facility operating standards to ensure that WTE plants do not pose a threat to people or the environment.
- o Providing financial assistance to develop new recycling technologies to improve markets for recycled materials.
- o Using aggressive public education techniques to change people's attitudes about waste use of our resources.

CWMB Support of Recycling

Despite its apparent advocacy for recycling, CWMB support for it has been, at best, mediocre. From 1978 through 1981, the CWMB awarded 88 recycling grants of approximately \$16 million to public, private, and non-profit recycling programs (CWMB 1985a, p. 17). Although many of these programs were successful, financial assistance for curbside recycling has not been available from the Board since 1982 (CWMB 1988, p. 7; Gertman 1990). Reinstating grants is not likely as the CWMB (1985a, p. D4) reported in 1985, "Budget cuts have severely limited its (our) ability to participate directly in bringing on-line new programs in reduction, recycling and

composting."

A Change in Direction

AB 2020, Deposit Legislation

After years of legislative wrangling between grocers, unions, packagers, environmental groups, and legislators, compromise legislation was adopted, resulting in a beverage container recycling measure, AB 2020, The Beverage Container Recycling and Litter Reduction Act which took effect in October 1987. Praised for its innovation and criticized for its inadequacies, its goal is to recover eighty percent of aluminum, glass and plastic containers by enticing consumers with a penny-per-container redemption rate.

Recovering significant amounts of cans and bottles through AB 2020 is not likely to substantially reduce solid waste volumes. The wastes targeted by AB 2020 represent less than five percent of the solid waste stream (Roach 1988, p. 117). In January 1990, when the redemption rate jumped to 2.5 cents per container and glass industries were reluctant to purchase the recovered resource, the markets were overwhelmed and more than 2,000 tons of glass were dumped into local landfills (SJMN 1990, p. 1). The landfilled glass represented less than two percent of the glass recovered during that time. However, during the same period, the recycling rate tripled (Gertman 1990).

Legislative Disagreements

In 1988 as the State legislature became increasingly discontent with the steady decline in landfill capacity, major revisions of California codes regulating the management of solid wastes were adopted. Governor George Deukmejian responded by vetoing ten bills which essentially increased the role of recycling and disposal alternatives (SJMN 1989, p. 24). In January 1989, Deukmejian called for a "comprehensive plan" to solve the state's garbage problem. Legislators responded by reintroducing 1988's vetoed bills.

Current Law

The final year in the decade proved to be a watershed year for solid waste management legislation. In 1989, fifteen pieces of legislation intended to revamp solid waste management were signed by the governor (Table 3.2). The most important of them was AB 939, The California Integrated Solid Waste Management Act. This legislation replaced the nine-member CWMB with a full-time, six-member California Integrated Waste Management Board (CIWMB), and featured:

- strong conflict-of-interest language to discourage Board support of special interest groups (a frequent charge levied at earlier Boards);
- a requirement that each county prepare, adopt, and submit to the CIWMB an integrated waste management plan that includes city and county elements for source reduction and recycling;

TABLE 3.2

1989 SOLID WASTE LEGISLATION

AB 939	Establishes state mandated local integrated waste management programs.
SB 1322	Establishes a comprehensive set of state programs designed to increase recycling and encourage the development of markets for recyclable material.
AB 4	Requires increased procurement of recycled products by state and local agencies and the Legislature.
AB 1306	Requires the Department of Transportation in consultation with the CWMB, to modify all bid specifications for paving and other related materials used in state contracts, to encourage maximum use of recycled materials without compromising quality standards for highway construction. (This law does not establish minimum percentages or goals for the use of these recycled materials).
AB 1570	Requires all state agencies that purchase motor oil, and their contractors, to purchase motor oil and industrial oil containing the greatest percentage of recycled oil meeting specified standards.
AB 2295	Regulates sewage sludge as a fertilizer.
AB 1041	Requires the CWMB to submit a report of specified content on the use, disposal, and recyclability of plastic not subject to the Beverage Container Recycling and Litter Reduction Act (AB 2020).
AB 1305	Requires that all commercial consumers of newsprint ensure that at least twenty-five percent of their newsprint consumption consist of recycled-content newsprint, beginning January 1, 1991. Recycled-content newsprint is defined as that containing at least forty percent post-consumer wastepaper. Mandated consumption percentages shall increase incrementally until they reach fifty percent by January 1, 2000.

TABLE 3.2--Continued

AB 888	Requires that county solid waste management plans be revised to identify a program for the collection, recycling, and disposal of household hazardous waste, thereby mandating such programs by counties and cities.
AB 1843	Enacts a major environmental regulatory program to control the disposal of used tires. Requires tire stockpiles to be registered and permitted.
AB 1308	Provides for bank and corporation tax credits for the cost of equipment used to manufacture finished recycled products. The recycled products must be composed of at least fifty percent secondary waste materials, at least ten percent generated from within California.
SB 432	Identical to AB 1308, except that it applies to personal tax credits as opposed to Bank and Corporation tax credits.
SB 1475	Requires "junk dealers"--those buying and selling used machinery, scrap metals, used furniture etc.--and recyclers (as defined) to keep a written record of all sales and purchases made during the course of business.
AB 1101	Requires local agencies that do not directly charge a fee for solid waste collection, transportation, and disposal, or which charge a fee that equals less than ninety percent of the cost of providing these services, to arrange to inform all residential households at least once every three months regarding the monthly costs of solid waste handling, and the monthly volumes of solid wastes produced within the area serviced.
AB 1196	Authorizes the CIWMB to provide grants from Solid Waste Disposal Site Cleanup and Maintenance Account to local agencies with responsibility for waste management.

SOURCE: California Waste Management Board "California Laws Affecting Recycling," mimeograph, November 1, 1989.

- o a requirement that cities and counties divert twenty-five percent of their generated solid waste destined for landfills through source reduction, recycling, and composting techniques by January 1, 1995, and;
- o a fifty percent diversion of solid wastes by January 1, 2000, or;
- o face up to a \$10,000 per day fine until they meet the diversion requirements.

The act clearly reaffirms a hierarchy of solid waste management options. Cities and counties are required to maximize each component to the maximum extent "feasible" and in the following order:

- 1) source reduction,
- 2) recycling and composting,
- 3) environmentally safe transformation (pyrolysis, incineration, distillation, gasification, or biological conversion other than composting) and land disposal.

Cities and counties may not have to follow the hierarchy mandated by AB 939:

For wastes that cannot feasibly be reduced at their source, recycled, or composted the local agency may use environmentally safe transformation (incineration, pyrolysis, distillation, gasification or biological conversion other than composting) or environmentally safe land disposal or both of those practices (AB 939, Chapter 1095, Division 30; Part One, Chapter One, Article 2, Section 40051 (b)).

"Clean-up" legislation, AB 1820 (adopted in 1990), modified some aspects of AB 939 and clarified others. A key change requires cities and counties to prepare a Source Reduction and Recycling Element (SRRE) by July 1, 1991. Legislation requires that the SRRE include:

- o a waste characterization element that identifies the amount and types of waste generated within the local agency's jurisdiction;
- o a source reduction, recycling and composting element identifying measures the local agency will take to reduce, recycle, and compost waste;
- o a household hazardous waste element, which identifies how the local agency will collect and dispose of household hazardous wastes, and;
- o a solid waste facilities capacity element which identifies how the local agency will collect and dispose of household hazardous wastes.

AB 1820 also clarified the purpose of AB 939:

... to reduce, recycle, and reuse solid waste generated in the state to the maximum extent feasible to conserve water, energy and other natural resources, to protect air and water quality, to improve regulation of existing solid waste landfills... (AB 1820 Section 2, Article 40052).

Undoubtedly, the objective of the immediate legislation will be determined by regulations developed by CIWMB staff to adopt, interpret, and enforce AB 939. Questions will arise when regulation meets reality. Cities desperate for landfill capacity will no doubt force the regulations into the courts, where the regulative interpretation of legislative intent will ultimately be confirmed or denied. Regardless of recent intentions, the legislature has only begun to address the reality of too much garbage and too few places to put it.

Many questions must be addressed, forthrightly, including the following:

- o Are the state mandated 1995 and 2000 reductions in solid waste to be measured by volume or weight? For that matter is it perfectly understood which materials constitute solid waste and which don't? What are the due dates for the plans?
- o How will the CIWMB and the courts define words and phrases in the enabling legislation such as "feasible," "objectives," and "substantial evidence"?
- o Does "the maximum extent feasible" refer to the amount of various materials, volume of materials, or the use of the highest form of technology available to recover recyclables? Is "feasible" determined by the availability of markets for the recovered recyclable material(s) or by the amount of money the market is willing to pay for a recovered recyclable material?
- o Which materials count toward goals? Which don't and why?
- o Is the state willing to support the intent of AB 939 and 1820 with tough legislation that creates markets to absorb the redirected wastes?
- o Are the intentions of AB 939 and AB 1820 doomed to fail because of a legislature that moves too slowly in meeting the demands of a crisis? (In the past, the legislature has consistently underestimated, ignored, and failed to create adequate solutions to a continually unfolding problem).
- o If the recent legislation encouraging waste reduction, recycling, composting and the like fails, or has an inadequate impact, does the legislation, in fact, encourage WTE?

Analysis

It is said that hindsight is 20-20 vision. Being mindful of the history of these concerns and casting a realistic eye toward the future gives us the perspective of legislators and administrators figuratively painting

themselves--and the state--into a corner. The basic premise of adopting solid waste management laws for the protection of public health and safety is unquestionably correct. But as a mechanism to manage solid wastes, legislation has been near-sighted, for it failed to see and address the looming long-term landfill capacity crisis.

Before 1989, California's approach to mandating disposal techniques addressed public health and safety but did not adequately address the future needs of managing an ever-increasing stream of garbage. Whether from lack of political will or legislative failure, the combination of inadequate landfill capacity and a lack of viable alternatives to disposal has resulted in:

- 1) limited locations for new and replacement disposal sites;
- 2) limited solid waste management options;
- 3) increased environmental threats and environmentally unsound solutions;
- 4) lost opportunities to develop methods to recover recyclable wastes, create markets for recyclable waste, research and develop methods to produce products made from recovered consumer wastes; and
- 5) dramatic, system-wide failure which now serves as the impetus for a process change.

AB 939 may be late in coming, but despite some unclear definitions, it is a significant step in a positive direction. Without underestimating the power of regulatory interpretations, success in meeting the twenty-five and

fifty percent reduction goals will no doubt hinge on the availability and strength of markets for secondary materials (markets for the recovered consumer wastes) and the effectiveness of source reduction efforts. The definition of what is "feasible" for a city or county to reduce, recycle, and compost may well be determined by the market demand for those recovered materials. Should efforts to create markets fail, communities faced with 1995 and 2000 deadlines may have no choice other than accepting waste-to-energy technologies as disposal methods for their solid waste.

CHAPTER IV

ECOLOGICAL LAW, THEORY, AND SOLID WASTE MANAGEMENT

Introduction

In Time magazine's "Endangered Earth" issue (1989, p. 30) Thomas A. Sancton wrote, "As man heads into the last decade of the 20th century, he finds himself at a crucial turning point: the actions of those now living will determine the future, and possibly the very survival of the species." In State of the World 1988 (1987, p. 18), Lester Brown draws a similar conclusion: "Never have so many systems vital to the earth's habitability been out of equilibrium simultaneously."

The concept of an ecosystem provides us with a framework for perceiving our relationship with the environment, understanding the influence of our activities on the environment, and developing a reasonable approach to managing our solid wastes. Our fundamental dilemma is that we have built an open system of resource use that consumes resources and ejects wastes in large enough proportions to seriously threaten the habitability of the global environment with a myriad of pollutants and to threaten economic stability with the depletion of natural resources.

The growing problems of pollution and environmental degradation will force decision-makers to question the rationale of the flow of materials from environmental

systems to market systems to disposal sites. Recognizing the relationship of consumption and pollution may be the most significant factor in devising solutions to the immediate crisis of disposal capacity shortage. Society must develop political policies and economic structures that respect natural thresholds in the ecological systems upon which we depend. Solutions to the landfill capacity shortage must replace the disposal ethic with a new and institutionalized ethic based on a total environmental perspective.

The Materials Cycle

Broad-based interdisciplinary perspectives can be achieved by creating and applying solutions to the disposal capacity crisis through an understanding of ecological systems and their interrelationships. In analyzing the relationship between resource use and environmental pollution, it is reasonable to consider pollution and waste the result of a imbalance in which a portion of natural resources are transformed into various pollutants when processed to make consumer goods.

Laws of Nature and Resources

An unalterable law of nature is the law of conservation of matter, which states that matter can neither be created nor destroyed, only changed from one form to another. The study of ecology teaches us that the

ecosphere and ecosystem depend on matter cycling. The second law of thermodynamics refers to the loss of energy entailed in its every transformation. This degradation of energy, as well as the conservation of matter, has important bearing on our social system's use of resources. If we were to be more heedful of these laws, through recycling of aluminum cans which require far less energy to recycle than to create new for example, we would not only save energy and reuse a resource but reduce pollution too. Ecosystems respect these laws, and in natural ecosystems there is virtually no waste (Miller 1985, p.55-56).

However, the political and economic structures of our "social system" interact with the "ecological system" of the physical and biological environment, the biogeochemical cycles, in a much different way. Our social system takes in oxygen from the air, water from rivers and lakes, food and fiber from the biological sphere, and minerals from the land. Because social systems are governed by natural law, as matter is processed, natural resources are transformed into economic and ecological garbage.

The fundamental difference between ecological and social systems is that ecological systems are "closed loop" systems in which resources are recycled, while the social system is an "open loop" system which is dependent on the ecological system for resource inputs and as a waste depository. The social system consumes natural resources

and produces garbage while natural systems produce no "true" garbage, e.g. leaf litter is home to insects which are food sources to higher trophic levels.

Figure 4-1 illustrates the flow of materials from ecological systems to the social system, along with various forms of pollution discharged back into the ecological system. This process can be continued as long as:

- 1) exchanges between the systems are in balance, and;
- 2) the natural systems can absorb the wastes of social systems and transform them into inputs valuable to the human species and life on earth in general.

The relationship of resource use, environmental pollution, and the generation of wastes, demonstrates that a crucial materials balance exists. The planet is dependent on a balance between two systems, and the predatory nature of the social system on the ecological system leads to an imbalance.

Evidence of environmental stress indicates the gravity of the problem. The social system may be charging headlong into to what Garrett Hardin (1968) calls a "Tragedy of the Commons" when individual interests (in this case a system's interest) prevail over community interests, resulting in the exploitation of natural resources.

FIGURE 4-1 SCHEMATIC OF MATERIALS FLOW

Resource Supply and Depletion

Along with energy, materials are the physical basis for virtually all artifacts of society. They are the sources of machines, buildings, and transportation and communication systems--virtually all the commodities used by the social system. Inadequacies or discontinuity of supply would have adverse effects on industry, trade, finance, and the lives of people.

Given its already huge demand for raw materials, society must regard itself at risk with respect to future mineral supplies. Identified supplies of most raw materials, recoverable under 1973 economic and technological conditions, are adequate only for the short term (Table 4-1). Miller (1985, p. 249) has estimated by 2090, eighty percent of sixteen of the world's most important minerals will be depleted and wrote:

In attaining our standards of living, Americans have used more nonfuel minerals and fossil fuels during the past forty years than all peoples of the world have used throughout history.

Available supplies of some minerals are especially critical. The National Commission on Materials concluded in 1973 that the U.S. faces shortages of six of thirteen basic raw materials vital for U.S. industry (Van Deventer 1981, p. 151). There are geologic possibilities of additional deposits, but for many minerals prospective supplies are not large (Gabor 1978, p. 146).

TABLE 4-1

POTENTIAL EXHAUSTION OF SELECTED MINERALS

Resources	Average Annual Growth in Use (%)	Years Remaining	
		Low	High
Aluminum	6.4	33	49
Chromium	2.6	115	137
Coal	4.1	118	132
Cobalt	1.5	90	132
Copper	4.6	27	46
Gold	4.1	6	17
Lead	2.0	28	119
Manganese	2.9	106	123
Mercury	2.6	19	44
Molybdenum	4.5	65	92
Natural Gas	4.7	19	58
Nickel	3.4	50	75
Petroleum	3.9	23	43
Platinum	3.8	41	49
Silver	2.7	15	23
Tin	1.1	62	92
Tungsten	2.5	27	n.a.
Zinc	2.9	76	115

SOURCE: Adapted from Dennis L. Meadows et al., Dynamics of Growth in a Finite World (Cambridge, Mass.: Wright-Allen Press, 1974), pp. 372-373.

The Energy Connection

The materials cycle is a global system with strong three-way interactions among resources, environment, and energy. Energy inputs are required to obtain metals from ores; to make plastics from crude oil; to work and shape metals, ceramics, and plastics; to assemble components and systems; to transport goods at all stages of production and

place the final product into the hands of the consumer (Gabor 1978, p. 138); and to run the machines to bury the wastes. Meanwhile, nonrenewable resources such as coal, oil, natural gas, and uranium are being rapidly depleted in order to provide us with about eighty percent of the world's energy use (Miller 1985, p. 7). The depletion of these resources are compounded by the tax-supported cost of business. Forty-four billion dollars in U.S. power plant loan construction subsidies (a sum equal to one-quarter of the federal budget deficit) masks the true cost of providing large amounts of energy used to process materials (Heede 1985).

The burning of these fossil fuels means that they are gone forever as a useful source of energy, and as they burn they contribute to air pollution. Since 1860, the combustion of fossil fuels has released some 185 billion tons of carbon to the atmosphere (Brown 1987, p. 158).

Despite becoming more energy-efficient from 1973 to 1985, Americans used more energy in 1988 than ever before (Thomas 1989, p. 4P). It is estimated that in 1990 we will be importing about nine million barrels of oil per day, half of our total consumption and an all-time high. The amount of imported oil will increase to two-thirds by 1995, more than twelve million barrels a day (Ford 1988, p. 4P). The economic implications of this voracious oil appetite are enormous; it feeds a federal budget deficit,

which is estimated at \$150 billion for 1988 (Ford 1988, p. 4P).

Risk Assessment:
Environmental Stress and Global Models

Understanding Global Ecosystems

In the context of the global ecosystem, Barry Commoner describes our world as a connected whole in which nothing can be gained or lost. Anything extracted from the ecological system must be replaced, and while payment for that withdrawal can be delayed, it cannot be avoided (Commoner 1971, p. 45, 46). In other words, every gain is won at some cost, and everything cycles in one form or another. Nothing simply goes away.

Commoner's theory reminds us that nature cycles matter. Our fundamental problem is that we, as a society, don't. We are reliant on market systems, which are, in turn, reliant on an open-loop system of resource use. A failure of market mechanisms to provide economic incentives to keep materials out of landfills leads to the social systems' generation of mountainous volumes of waste. The manifestation of this failure is environmental degradation, including air, water, and land pollution, habitat destruction, and the loss of natural resources.

Systems Interaction

Interaction between systems has been modeled to

analyze contemporary problems and form future projections through the use of problem-solving paradigms. With a systems paradigm, it is possible to determine whether a net system feedback is positive or negative (Parsegian 1973, p. 177-178).

Using such a model, the Club of Rome, global modelers and authors of the now famous The Limits to Growth (Meadows et al., 1972), demonstrated with mathematical support that as long as no brakes are placed on the social system, other than those nature alone imposes, great imbalances will occur in social and ecological systems. Their projections are based on the following assumptions:

- o The stock of exploitable, nonrenewable resources is finite;
- o The capacity for the environment to absorb pollutants is finite; and
- o The growth of population, pollution, and industrial output will be exponential as long as resource supplies and interactions with the variables in the system permit.

The basic assumptions validated by their study include:

- 1) exponential (economic) growth can produce sudden and catastrophic (environmental) consequences defying all previous experience and precedent;
- 2) system analysis, employing interdependent variables, is superior to reliance on specialized techniques for understanding the complexity of a living organism, and as a method for providing insight into the dynamics of the social process;
- 3) favorable modifications in the behavior of one or more of eight interdependent variables may grant

us a temporary reprieve from eventual disaster...
(Ulph 1973).

The gloomy neo-Malthusian projection of the model makers is that continued population and economic growth will result in the depletion of resources and increased environmental pollution leading to a collapse of civilization as we know it.

Population research supports the Club of Rome conclusions. Ehrlich and Holdren (1971, p. 1212-1217) link the roles of population and environmental degradation, theorizing that population growth causes a disproportionate negative impact on the environment. If current birthrates hold, the global population of 5.1 billion persons will double in forty years.

The Club of Rome has, of course, attracted critics. Kahn, Brown, and Martel (1976), among other cornucopians disagree with the neo-Malthusians' less-than-optimistic projections of fate. These "technological optimists" believe that if present trends continue, economic growth and technological advances will produce a less crowded, less polluted, more resource-rich world in which most people will be healthier, live longer, and have greater material wealth. Neo-Malthusians believe that if present population, resource use, and environmental trends continue, the world will become more crowded and more polluted, many resources will be depleted or degraded, and

competition for scarce resources will lead to greater political and economic turmoil. Ulph (1973) scrutinized criticism of the Club of Rome and concluded that "much of the adverse criticism has had the beneficial effect of strengthening rather than weakening the arguments advanced in Limits to Growth."

The Club of Rome does not stand alone in its projections. The Global 2000 Report to the President (CEQ 1980), an official U.S. document, projected significant environmental consequences resulting from our current relationship with natural systems, including accelerated deterioration of cropland, deteriorating water quality, widespread loss of forests, rising carbon dioxide rates causing global warming, and worsening acid rain problems. Additionally, in the 1970's, a number of studies and reports addressed the seriousness of environmental stress caused by the demands of the social system. Persistent warnings were sounded by the United Nations, the Worldwatch Institute, the World Resources Institute, the International Institute for Environment and Development, the Conservation Foundation, and the Organization for Economic Cooperation and Development (Miller 1989).

The realities of the 1980's confirmed the warnings from the studies of the 1970's. Focusing attention on worsening world pollution, including global warming, acid rain, ocean dumping, oil spills, and the destruction of

forests, the seven largest industrial democracies ended an economic summit (July 16, 1989) with a harmonious and urgent call for "decisive action" to combat "serious threats" to the world's environment (Ullman 1989, p. 1A). The Worldwatch Institute, a Washington D.C.-based research organization, summed up a series of the Institute's assessments of the earth's physical condition in State of the World 1988 with compelling evidence: the earth's forests are shrinking; deserts are expanding; soils are eroding; and the ozone layer in the upper atmosphere that protects us from harmful ultraviolet radiation may be thinning (Brown 1987, p. 1-19). Brown (1987, p. 5) also wrote:

The results from these annual physical examinations of the earth are not reassuring....The scale of human activities has begun to threaten the habitability of the earth itself.

The information reported by the Institute is not a unique opinion. Departing from its annual "Man of the Year" theme, an annual designation based on an individual's recurring presence in the news, the editors of Time (January 2, 1989) deemed "Endangered Earth" as "Planet of the Year" for these reasons:

- o pollution-caused warming of the atmosphere;
- o toxic and radioactive wastes and dumped garbage that could poison drinking water and despoil the land;
- o chemical pollution that is depleting the atmosphere's protective ozone layer;

- o clearing of tropical rain forests;
- o thousands of species being driven to extinction; and
- o evidence of rising levels of carbon dioxide and other "greenhouse gases," leading to predictions that global warming has begun.

A Finite World

This body of research supports the obvious contention that we live in a finite world with finite resources. Most important, however, the combined research challenges:

- 1) the myth that there are simple solutions to complex problems;
- 2) the belief that technological "fixes" are readily available; and
- 3) the theory that variables and problems cannot be dealt with in isolation from one another.

If policies and practices around the world continue as they are today, evidence indicates a potential for deepening global problems between now and the end of this century. This finding confronts other nations, the United States, and each community with one of the most difficult challenges facing our planet during the coming decades: how to change our relationship with the earth.

On a Threshold?

The problems of resource depletion, environmental pollution, landfill capacity shortage, and the failure of the social system to recognize the interrelationship

between these problems comprehensively suggest that society is fast approaching a critical threshold. The existence of a serious imbalance in the flow of materials through social and ecological systems indicates we are approaching an unavoidable decision-making plateau.

The central issue is not the total exhaustion of our resources or that our planet will become uninhabitable because of unreasonable resource utilization. The issue is assessing a series of risks, the risks of continuing the social system's predatory raids of ecological system assets, and assessing them in an objective manner in order to frame reasonable solutions (Chira 1982).

Interrelationship of Systems

In regard to the relationship of systems, Commoner (1971, p. 33) explained that to change any part of a system is to change the whole system, or that, "Everything is connected to everything else." This concept gives us insights of considerable richness and value that can be used not only to discover solutions to the landfill capacity crisis facing California, but, on a much larger scale, to simultaneously address environmental problems related to material use and society's throw-away ethic.

Bertalanffy's General Systems Theory (1968) derives the following principles, which hold true for all systems:

- 1) systems are composed of many elements;

- 2) the state of any one system element is influenced by the state of others; and
- 3) elements of a system may be linked by reciprocal influences that form feedback loops.

Cybernetics, developed by Norbert Wiener (1961, p. 11), supports Bertalanffy, explaining that systems are not simply a collection of separate elements, but have organization and wholeness, with elements in constant interaction.

These two theories suggest that solutions to the landfill capacity crisis contain integrated independent variables that will inevitably influence other systems.

Developing a Solution

The search for solutions to California's landfill capacity shortage must also address the issues of global pollution and resource depletion. Individually and comprehensively, the problems of solid waste management, resource depletion, and environmental pollution create a complex situation. A suitable "matrix evaluation" would consider and evaluate such goals as environmental quality, resource conservation, and traditional economic objectives. But does such a matrix exist and is there a precedent for it?

Total Environmental Perspective

The National Environmental Protection Act of 1969 (NEPA) declared that the federal government has a

responsibility to restore and maintain environmental quality. NEPA specifies the "use of all practicable means and measures ... to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future Americans." NEPA prescribes an "Environmental Impact Statement" (EIS) as the mechanism to determine the impact of a project on environmental quality. In California a similar device, the Environmental Impact Report, is used, as required by the California Environmental Quality Act (CEQA).

EIRs and EISs are legislatively required to use a matrix to thoroughly understand the environmental impacts caused by a project or policy. They recognize that humans alter and otherwise rearrange the biotic and abiotic components of the physical environment and, in so doing, play a significant role in the earth's ecology. Just as an ecosystem is a community of interacting organisms, the "total environmental perspective" (TEP) employed by EIRs and EISs recognizes the interaction between the components of the physical, chemical, and human social environment--in short, our relationship with the environment (Figure 4-2).

TEP is a means of understanding the relationship between human actions and the environment and can be used as a matrix for considering consequences of human action, such as the development and employment of a solid

waste management policy. A "total environmental perspective" (TEP) recognizes that actions taken by humans must take due account of its impact on the social and physical environments. TEP's strength is that it is a comprehensive, interdisciplinary perspective that includes biotic, abiotic, and ecological components as well as the personal, interpersonal, organizational, and other institutional components of human life into the evaluation and decision-making process (Figure 4-3). With this concept, no individual entity can be fully evaluated in isolation but only as it relates to its total environment.

FIGURE 4-2

COMPONENTS OF THE TOTAL ENVIRONMENT OF HUMANS

	Environmental Products ^^^^			Environmental Processes ^^^
	^^^^^^^^^^^^^^^^^^^^			^^^^^^^^^^
Physical Environment =	Biotic Components	+ Abiotic Components	+	Ecological Components
	Socio-psychology ^^^^			Economics, politics, etc. ^^^
	^^^^^^^^^^^^^^^^^^^^			^^^^^^^^^^^^
Social Environment =	Personal Components	+ Interpersonal Components	+	Institutional Components
TOTAL ENVIRONMENT =	PHYSICAL ENVIRONMENT		+	SOCIAL ENVIRONMENT

FIGURE 4-3 Overview: Putting the Total Human Environment into Decision-making.

SOURCE: Paul A. Erickson. Environmental Impact Assessment: Principles and Applications. (N.Y.: Academic Press, Inc., 1979) p. 18.

The importance of using TEP is that it considers the broad effects of our delicate relationship with the environment. It applies the ecosystem concept of interdependence on the interaction between social, ecological, and physical systems of the total environment to the mechanisms of evaluation and decision-making processes. It helps avoid shortsightedness in planning, while it tends to regulate and modify proposed actions before they become reality and perhaps disasters. Practically, it enables the results of decision-makers' actions to be more viable than they might otherwise be.

In summary, TEP provides a framework for measuring and comparing: 1) society's needs; 2) the benefits of a proposed action on the social and physical environment; 3) the negative effects of actions on these environments; and 4) secondary, or indirect, as well as primary or direct, consequences for the environment (Erickson 1979).

As we move towards a solution to the solid waste dilemma, we need to:

- a) collect and collate appropriate data and information;
- b) use Total Environmental Perspective to evaluate data with respect to decision-making objectives; and
- c) make and apply prudent decisions.

The quality of decision-maker involvement and comprehension of the dynamics involved is critical.

Many theories support the TEP evaluation and decision-making process. Their compatibility to TEP is a testament to the applicability of TEP to address the complicated and interrelated problems of solid waste management, resource depletion, and global environmental deterioration. They can be applied to the TEP process to ensure its completeness:

- 1) Consider environmental possibilities and limitations. When developing a solution to the landfill capacity crisis, a basic principal to understand is that environment describes the possibilities and limitations available to a population (Boas 1928, pp. 229-236).
- 2) Risk assessment. Objectively assess the risks involved to allow an analysis of current issues which will accommodate a reasonable solution (Chira 1982).
- 3) Identify thresholds. By identifying thresholds and their associated costs, decision-makers can narrow options and make long-range planning decisions based on sound economic information (Malisz 1969).
- 4) Assemble components of a problem-solving paradigm. This time-proven procedure is appropriate for evaluating complicated issues and proposed solutions and/or mitigations, such as those presented in this thesis. It is commonly used in preparing environmental impact assessments that consider the total human environment in the decision-making process.
- 5) Determine appropriate future action. Use a process to determine appropriate future action by utilizing scarce resources to maximize the expected attainment of a set of given ends (Hill 1968). In this case, maximizing the use of scarce natural resources will help solve the landfill capacity crisis.

Some critics might maintain that an approach to a solution should be limited to a traditional cost-benefit analysis. However, that method is precluded from developing criteria necessary for developing rational solutions. It is unable to consider intangible and subjective facets of human existence and the natural world. Its inability to recognize significant opportunities for improving the relationship between ecological and human social systems renders it impotent as a method to evaluate the full depth and breadth of alternatives.

Analysis

Survival of an individual organism depends on the flow of matter and energy through its body which, in itself, is a system. The survival of a community of organisms in an ecosystem depends on energy flow and matter recycling within it. Likewise, the survival of the human community also depends on energy flow and matter recycling, as well as the interaction of the socio-economic, psychological, and political systems with biotic and abiotic factors.

Assessing the symbiosis of various human activities with the total environment is a complex task. The complexity is compounded not only by the diversity of social, physical, and biological characteristics but also by our limited knowledge of our environment. First, we

simply cannot identify all the relationships and interactions between our social and physical environments. Second, we do not completely understand how those relationships that we do know can be disrupted. Finally, the total environment includes subjective facets of human existence that cannot be confined within the objective bounds of the tools and devices of technical analysis.

The basic management of solid waste has no alternative but to change, grow, and mature as it meets the needs of social and ecological systems. Alternatives to disposal technologies for California's waste will be suggested, debated, and adopted. The immediacy of the landfill capacity shortage will attract tempting TEP-deficient, short-term solutions that neglect the opportunity to implement long-term, well-crafted solutions. Total Environmental Perspective provides us with the objectivity necessary to fully address the depth of the issues, but the debates will likely be decided in the courts. A solution formulated without TEP will ultimately result in an infrastructure that perpetuates the deterioration of environmental quality.

CHAPTER V

ADVANTAGES OF EFFICIENT RESOURCE USE

Introduction

In developing approaches to solve the landfill capacity crisis, we must question society's systematic entrenchment of the disposal ethic. Mechanisms for environmental decay, resource depletion, and disposal capacity shortages have been institutionalized and are manifested by our failure to build into the economic system reciprocal actions that recycle and reuse resources.

Brown (1987, pp. 1-19) suggests replacing that mechanism with an economy based, whenever possible, on inexhaustible sources of energy; the use of widely available or renewable raw materials; repeated recycling of scarce materials; responsible management of food resources; environmental quality; and low energy-intensive and low materials-intensive technologies. While a full discussion of all these issues is beyond the scope of this chapter and this project, understanding the benefits of potential solutions to the landfill capacity crisis presents us with an opportunity to correct the imbalance of materials flow between the social and ecological systems in ways Brown suggests. This chapter addresses benefits of waste reduction through increased recycling and reuse.

Environmental Benefits of Reusing Resources

The environmental benefits of reutilizing resources are compelling (Table 5-1). There are significant reductions in mining wastes, energy and water use, and air and water pollution. "Enough is known about the relationships involved to indicate that the net national environmental effects will be beneficial in virtually all instances where resource recovery (reuse and recycling) is concerned and beneficial almost by definition for source reduction" (U.S.E.P.A. 1974, p. 16). Potential environmental benefits include:

- o Reduced pollutant levels associated with secondary rather than virgin material processing systems;
- o Reduced virgin material processing sites;
- o Reduced solid waste disposal sites;
- o Reduced public health problems associated with open landfills;
- o Reduced litter due to the increased value of recyclable materials;
- o Extended lifetime of existing landfills due to reduced volumes of waste deposited.

TABLE 5-1
 BENEFITS FROM SUBSTITUTING SECONDARY
 RESOURCES FOR VIRGIN RESOURCES
 (percent reduction)

	Paper	Glass	Steel	Aluminum
Energy	23-74	4-32	47-74	90-97
Air Pollution	74	20	85	95
Water Pollution	35	--	76	97
Mining Wastes	--	80	97	--
Water Use	58	50	40	--

SOURCE: Robert Cowles Letcher and Mary T. Sheil, "Source Separation and Citizen Recycling," in William D. Robinson, ed., The Solid Waste Handbook (New York: John Wiley & Sons, 1986).

Benefits of Resource Conservation

Once discarded, consumer goods may remain as waste, needing disposal, or they may provide a benefit by being recovered, reused, or recycled. New products made from resources removed from the waste stream reduce dependence on waste disposal technologies and virgin resources, and they also improve the efficient use of resources extracted from the earth.

In 1987, California recycled eleven percent of its waste (CWMB n.d., mimeograph). Increasing the use of recyclables in material production processes may reduce the state's dependence for resources on other parts of the

country and the world. This could provide economic benefits to the state by decreasing out-of-state spending for natural resources (Arthur Young and Company 1982, p. II-14).

Resources in the waste stream provide secondary resources as substitutes to primary resources. In many cases secondary materials are price competitive with virgin materials (Table 5-2).

TABLE 5-2
PRICE DIFFERENTIAL BETWEEN VIRGIN
AND RECYCLED MATERIALS

PRODUCT	<u>COST(\$/TON)</u> Virgin	<u>COST(\$/TON)</u> Recycled	Cost Difference (\$)
GLASS	18.50	16.50 to 20.50	-1.50 to +2.00
PAPER LINERBOARD	78.50	81.00	2.50
CORRUGATED	79.50	82.00	2.50
BOXBOARD	152.50	155.50	3.00
PRINTING & WRITING PAPER	92.00	99.00	7.00
STEEL (PIG IRON)	40.50	43.00	2.50

SOURCE: Robert Tannewald. Analysis and Evaluation of Arguments For and Against Percent Depletion. Congressional Research Service (Washington, D.C.: March 22, 1978).

Energy Benefits

When all stages of the production process are taken into account, from resource extraction through product manufacture, the production of goods requires more energy when raw or virgin resources are used than if recycled materials are used. Various studies show this to be the case in at least the metal, glass, and fiber industries (U.S.E.P.A. 1974, p. 16).

Substituting resources recovered from the waste stream (referred to as "secondary materials" or "post-consumer waste") for virgin resources conserves another raw material, fossil fuels, for considerable energy savings (Table 5-3).

Jobs Creation

Recycling is notable for the jobs it creates. The New York State Recycling Forum (1986) estimated that processing 10,000 tons of material creates thirty-six jobs, compared to six jobs created when the same amount of material is landfilled and about 0.9 jobs when it is burned for energy. The downside of employment gains caused by secondary materials recovery and recycling are job losses in the primary materials industries. The recovery and recycling of secondary materials, however, creates new industry. The potential of this new industry in the state will depend on the extent that California provides

incentives to encourage it. The economic activity of new industry will benefit the state by providing it with a source for additional tax revenues (Arthur Young and Company 1982 Phase II, p. II-14).

TABLE 5-3
ENERGY SAVINGS ATTAINABLE
IN THE RECOVERY
OF SOME BASIC METALS

	Virgin Materials requirement (kWh/ton)	Recycled materials requirement (kWh/ton)	Savings for each ton of recycled material (kWh)	Oil saved for each ton of recycled material (bbl)
Aluminum	51,379*	2000	49,379	29.1
Copper	13,532*	1727	11,805	7.0
Iron	4,270	1666	2,604	1.5
Magnesium	90,821	1875	88,946	52.2
Titanium	126,115	52,416	73,699	43.3

SOURCE: U.S. National Association of Recycling Industries, Metal Bulletin, Jan. 7, 1975, p. 20, cited by Dennis Gabor, Beyond the Age of Waste, Pergamon Press Inc., New York. 1978, p. 137.

* These amounts are based on a energy equivalent of 44.2 kcal/g for aluminum and, 11.6 kcal/g for copper.

Economic Benefits

Reducing the waste stream by recovering resources from it is a less costly waste disposal method than

traditional ones, such as landfills (Arthur Young and Company 1982, p. II-13). An unreleased CWMB study reports that, "Overall, curbside recycling costs much less than landfill disposal" (CWMB 1988a, p. 27). The study of twenty-five of the thirty curbside recycling programs operating in California in 1986 reported the average cost of collection and disposal at \$55 per ton, while the net cost of curbside recycling was only \$40 per ton (CWMB 1988a, p. 27). The net result is that the \$40 per ton spent on curbside recycling not only buys a ton of disposal, it also saves a ton of natural resources, accomplishing this for \$15 less than the cost of disposal alone.

Another economic benefit credited to recycling is in avoided landfill costs. Recent research by Browning-Ferris Industries in San Jose, California, reveals that material targeted for recovery by recycling programs conserves considerable amounts of landfill space. For example, when compared to the volume that mixed garbage occupies in a landfill, preliminary data suggest that a ton of corrugated cardboard occupies three times as much space, wood waste 2.4 times, yard waste two times, and refrigerators 1.7 as much (Gavrich 1987). There has been a similar experience in Hamburg, New York, where a twenty-five percent recycling rate has produced a thirty-four percent reduction in landfill needs (Mulvey 1987).

Research by Arthur Young and Company (1982, p. 11-13) concluded that the reduction in the volume of waste should also reduce the cost of collecting and processing waste. Other examples of the price-competitiveness of recycling systems include:

- o the Environmental Defense Fund's analysis of the cost of incineration compared to a full scale recycling program in New York City showed that, given 1985 market prices and efficient collection mechanisms, recycling forty percent of New York's waste would be less expensive per ton than incinerating an equal quantity of waste and landfilling the ash residue (EDF 1985);
- o the City of Seattle calculates the benefits from recycling to be at least \$70-84 per ton, accounting for the avoided costs of landfill disposal and pollution clean-up at landfills, as well as the revenues from selling recycled materials (Kordick 1987);
- o the Institute for Local Self-Reliance reported that total costs per ton of diverting material from landfills to seven large incinerators ranged from \$27-95 per ton, or a \$50 per ton average. For six recycling programs total costs were \$8-35 per ton, or \$25 per ton on average (ILSR 1987);
- o a Pennsylvania Department of Environmental Resources study of the state's curbside recycling programs showed that revenue and disposal cost savings exceeded program costs by an average of \$27 per ton of recycled material (Hursh 1986);
- o a Fillmore County, Minnesota study reported that the tipping fee at a proposed municipal solid waste composting facility would be \$35-\$45 per ton, roughly half the \$70-\$90 ton cost of incineration (BioCycle 1988, p. 30-33);
- o the Massachusetts Division of Solid Waste Disposal estimated proposed recycling centers to have operating costs at \$19 per ton compared to \$40-\$100 per ton for landfilling fees and \$60-\$95 per ton for incineration (MassPIRG 1987).

Planning and operating waste management options to maximize benefits between systems will provide the most economical, political, and environmentally sound waste management techniques possible.

Analysis

Three approaches can be taken in addressing the landfill capacity crisis, developing additional disposal capacity, reducing the amount of materials requiring disposal, or a combination of the two. It is precisely the "opportunity" created by the California landfill capacity crisis that provides the state with the chance to address not only the particular intricacies of that problem, but also the related issues of a deteriorating environment and the depletion of resources. Adopting a "Total Environmental Perspective" mechanism developed to address the landfill capacity crisis must include reciprocal actions that improve the social system's relationship with the ecological system. Solutions must consider the relationship of reducing the impacts of disposing solid waste and the application of reasonable production processes that: 1) reduce or replace raw materials used in industrial processes with materials recovered from the waste stream, 2) have minimal or no negative (polluting) impact on the environment and, 3) provide mechanisms for improving environmental quality and economic stability.

CHAPTER VI

DETERMINING ACTION

Introduction

As the economic and environmental costs of disposal are fully calculated the appeal of reducing the waste stream with source reduction, reuse, recycling, and high technology options, such as burning waste to create energy, inevitably grows. A serious issue that decision-makers, including politicians and solid waste managers, must address is the long-term result of actions taken during what will be a transition period. It will be essential to avoid traumatic changes to ecological and economic systems. Yet solutions must effectively address the immediacy of the landfill capacity problem and take advantage of the opportunity to implement beneficial change as society passes from resource extractive activities to activities that are based on resource efficiency.

Components of an Integrated Solid Waste Management Hierarchy

As we face a transition period in the management of solid waste, we must devise systems that maximize the potential for utilizing wastes. Developing a hierarchy of waste management options enables the economic and industrial structures of society's institutions to adjust gradually to the new reality of waste management that

cycles materials rather than disposes of them. Such a system creates a flexible waste management process and provides communities opportunities to minimize the costs of waste disposal, allow for market fluctuations in the price of recovered materials, and maximize the benefits of reusing and recycling valuable resources. Also, such a system of resource management circumvents the otherwise inevitable constraints placed on industrial and economic structures caused by resource depletion, and minimizes the environmental hazards of waste disposal sites.

The Community Environmental Council (1988), West Michigan Environmental Action Education Foundation Council (1986), and the Environmental Defense Fund (1988), among others, champion the following waste management hierarchy, components of which will be discussed in following sections:

- 1) source reduction;
- 2) reuse;
- 3) recycling and composting;
- 4) burning wastes for energy; and
- 5) sanitary landfill.

Source Reduction

Source reduction is a front-end, preventative approach to waste generation and the problems of landfill disposal. Rather than relying on technologies that deal

with waste after it has been created, the objectives of source reduction are to:

- o decrease the consumption of unnecessary and excessive packaging, containers, and products;
- o increase product lifespan, reusability, repairability, remanufacturability, and recyclability;
- o increase the amount of recycled materials used in products, containers, and packages;
- o reduce the costs of waste collection, transportation, processing, and disposal; and
- o reduce the costs of energy and pollution from the production of goods from materials that would otherwise end up as waste (Relis and Dominski 1987, p. 7; WMEAFC 1986, p. 6).

Before 1920, seventy percent of American cities operated source separation recycling programs (Letcher and Sheil 1986). Since then, growing affluence, cheaper consumer goods, and increased demand for convenience and disposability have worked against reuse and recycling. The success of source reduction requires efforts from packaging and product designers, manufacturers, and marketing people to reduce the amount of disposable packaging. Consumers must also do their part with the dollar vote; buying these goods supports the efforts of industry and commerce.

According to Eric A. Goldstein, senior attorney at the Natural Resources Defense Council in New York, the per-capita amount of packaging has nearly doubled over the past forty years, from 404 pounds per year in 1958, to 800 pounds in 1988 (Killham 1988). Nationwide, packaging

consumes a surprisingly significant portion of the raw materials used in our country: fifty percent of the paper; eight percent of the steel, seventy-five percent of the glass, forty percent of the aluminum, and thirty percent of the total plastics output for materials used solely to wrap and decorate consumer products (WBSWM 1986, p. B-2).

The demand for greater convenience has increased waste generation as more single-serving and disposable products, such as lighters, diapers, cameras, beverage containers, etc. are introduced (Relis and Dominski 1987). For example, an estimated sixteen billion disposable diapers are used and discarded in the United States each year (SJMN 1988).

Elected officials can provide an impetus to reduce the production of materials destined to become waste with policy statements and legislative actions that support source reduction efforts, and they can adopt disincentives to waste generation such as bans, taxes, deposits, or packaging specifications (Relis and Dominski 1987, p. 7; Pollack 1987).

Legislative action has been taken to encourage source reduction. For example, the state of Washington taxes grocery packaging, using revenues for litter cleanup and recycling. New Jersey taxes all persons who manufacture, sell wholesale, or distribute "litter generating products." Nebraska applies a tax structure to discourage waste

generation (Relis and Dominski 1987, p. 20). Seven states and at least as many European countries have introduced bills to limit or ban some plastics (Pollack 1987, p. 118). In many instances, however, waste reduction is dependent upon behavioral changes of consumers.

Reuse

Reuse is the recovery of a material and its subsequent use in its original form. Best known examples include returnable beverage containers. But reuse is not limited to beer and soda bottles. Shipping containers and cartons are examples of reuse.

Salvaging is a method of reuse that provides a second use for materials that are otherwise destined for disposal. Materials not suitable for reuse can be separated for recycling. Communities can boost this form of waste reduction by encouraging and supporting reclamation centers, second hand shops, and appliance repair shops that recover usable household and commercial discards. These businesses not only reduce the waste stream but also create jobs and provide a source of inexpensive or free goods to thrifty and poor citizens.

Urban Ore, Inc. is one example of a successful urban salvaging operation. Located in Berkeley, California, it collects from the floor of Berkeley's transfer station about 70-100 tons of recyclables per

month, including furniture, building materials, steel, tin, glass, and appliances. It also accepts or purchases usable items delivered directly to it. Home appliances are repaired or dismantled and sold for parts. Recovered goods are sold at a flea market located at the transfer station (Olszewski 1984; EDF 1988, p. 38).

Truly, one person's trash is another's treasure. This concept of reuse has been productively illustrated by Materials for the Arts (MFA) located in New York City. MFA is a reuse system that places unwanted materials from individual donors and businesses into the hands of nonprofit arts organizations and artists working on public projects. Materials range from manufacturing scraps such as buttons, fabric, and carpeting, to outdated office equipment--anything that would otherwise be thrown out or sold off at a loss but could be used as a piece in a finished work or aid an arts group in doing its job (Schmidt-Campbell, n.d).

Recycling Collection Systems

Recycling is the recovery of waste or other discarded materials for the purpose of reuse as a new product through reprocessing or remanufacturing. Several communities in New York, New Jersey, Connecticut, Maryland, Wisconsin, and Minnesota have mandatory curbside recycling programs (EDF 1999, p. 49). Ten states have "bottle bills," deposit

strategies that have led to significant reductions in the amount of waste needing to be disposed (EDF 1988, p. 69).

Recycling is limited by what is technically possible and what is realistically achievable and cost-effective. Some materials that, in themselves, are technically recyclable are rendered non-recyclable by contaminants, including oils, glues, or laminates (EDF 1988, p. 8). Also, the market determines what materials retain a value high enough to encourage their recyclability, hence justifying their collection, processing, and sale.

The impact of recycling on reducing the waste stream is highly debated. The CWMB estimates that thirty to forty percent of California garbage may be recyclable (1983, p. 1). Estimates prepared by the Environmental Protection Agency, suggest that at least eighty percent of the overall solid waste stream is technically recyclable and/or compostable (OTA 1979). A third estimate, by the Center for the Biology of Natural Systems, is even higher, estimating that eighty-eight percent of a typical suburban waste stream can be recycled (Quigley 1987).

Recyclables can be recovered from the municipal waste stream in many ways.

Material Recovery Facilities (MRFs)

MRFs are centralized plants where mechanical sorting devices or people remove recyclables from mixed waste or

mixed recyclables. MRFs are attractive to solid waste managers because they require no change in the collection and delivery of solid waste. In practice, however, these facilities are highly capital intensive, segregate only a small portion of the waste stream, and produce 'dirty' secondary materials that are difficult to market (EDF 1988, p. 30)." West Germany's MRFs were plagued by insufficient separation of materials and excessive investment and production costs (Koch et al., 1986). Successful MRFs include Bay Recycling, in Oakland, California, which processes between 300 and 350 tons of waste per day, and Rainbow Disposal, in Huntington Beach, California, which sorts and processes over 40 tons of waste per day (CEC 1988).

Source Separation

Source separation is the segregation of recyclable material at the point of generation. Drop-off and buyback recycling centers and curbside recycling are dependent on source separation and are discussed below.

Drop-off Centers

Drop-off centers are sites where people donate recyclable or reusable materials for reprocessing. A center can be as simple as a bin in a parking lot set up to collect one or two materials such as newspapers or glass or as complex as a multi-material recovery facility that

collects a wide range of materials.

Drop-off centers are popular because they require little capital investment and are inexpensive to operate. They can be particularly effective and convenient when located where concentrated populations generate large amounts of recyclables, such as train stations, city streets, parks, concert halls, churches, lunch rooms, and school campuses.

In spite of their benefits in the specialized situations listed above, drop-off centers are largely perceived as inconvenient and "more trouble than it's worth," because people must make special trips to take items to the centers. As a result, drop-off centers have low participation rates and do not, by themselves, achieve a large reduction in the community's waste stream (OECD 1983).

Buy-back Centers

Buy-back centers are similar to drop-off centers, except that people are paid for the material they bring to the center. Buy-backs include both multi-material recycling centers and beverage container redemption centers. In California, these are located within one-half mile of major retail grocery stores, as required by AB 2020.

Curbside Recycling

Curbside recycling is any recycling effort in which a recycler picks up separated recyclable materials, at the source, on a regular basis. Davis, California started the nation's first citywide program in 1974 (Gertman 1990). Marin County, California, began the first countywide curbside recycling program in March 1980 (CWMB 1983, p. 1). By late 1986, thirty multi-material curbside recycling programs were operating in California (CWMB 1988, p. 2).

Curbside programs operate similarly to garbage collection programs and are known to collect aluminum, glass, newspaper, "tin" cans, used oil, corrugated cardboard, white paper, mixed paper, magazines, wine bottles, polyethylene terephthalate (PET) plastic (commonly used as soda pop bottles) and, high density polyethylene (HDPE) plastic (commonly used as milk, water, and detergent containers) (CWMB 1988, p. iii; Gertman 1990). Curbside collection can either be combined with regular garbage collection or exist as a completely separate activity. Combined collection systems use separation devices, such as racks, trailers, compartmentalized vehicles, or additional vehicles to simultaneously collect and keep apart refuse and recyclable material.

Curbside collection, generally a more effective way to collect recyclable household wastes than drop-off or buy-back centers (Werth 1979), have won a high level of

participation because of their convenience to residents. Curbside collection can be more costly than drop-off or buy-back centers, but the total yield of waste reduction is much higher. Curbside recycling programs in California diverted from 1.0 to 17.3 percent of the waste stream and 4.1 to 57.7 percent of recyclable materials (CWMB 1988, p. iv).

In addition, the Environmental Defense Fund reports that curbside recycling confers economic benefits to rate payers. Over time, curbside collection can reduce mixed-waste (garbage) collection costs, as net costs of collecting garbage decline or hold steady and collection of recyclables rises (EDF 1988, p. 19).

Composting

Composting recycles yard debris, a significant portion of a community waste stream, into a humus-like material that can be used as a soil conditioner. Food waste, paper, and sewage sludge can also be composted. Composting is becoming increasingly attractive because of the high volume of yard debris it diverts from landfills. It also provides the benefit of avoiding the creation of much of the leachate and methane that is otherwise produced by decomposing organic material inside a landfill (Gertman 1990). In addition to avoided landfill or incineration disposal costs, composted soil conditioners

can offset a city's cost of purchasing conditioners for parks and landscaping, providing further avoided cost savings to the community.

Waste Incineration

Waste incineration has the potential to perform a waste reduction function on its own or to be part of a comprehensive waste management strategy. The Assembly Office of Research (1988, p. 31) reported that the CWMB, has consistently taken the position that waste-to-energy (WTE) incinerators are the most important element of a solid waste management system designed to reduce California's dependence of landfills.

Waste incineration gained widespread favor in California in the late 1970s for its ability to reduce the volume of solid waste requiring landfill disposal (CWMB 1987a, p. 1). Ash and residue are about ten percent of the original waste by volume, or twenty-five to forty percent by weight (WMEAECF 1986). In California, burning waste to produce energy, is the preferred method of incineration. From a resource conservation point of view, the Environmental Defense Fund says WTE is superior to landfilling, which consumes resources without any energy recovery, unless methane is recovered from the landfill, and that it does replace some need for fossil fuels.

Two basic methods are used to burn waste to create

energy. Mass Burn Incinerators burn raw municipal solid waste without preprocessing to remove recyclable and reusable items. Refuse-derived fuel (RDF) incinerators, which burn solid waste that has been preprocessed by mechanical shredding, collects some materials for recycling through pre-incineration sorting.

As a solid waste management tool, WTE has several advantages, including:

- o reducing the need for future landfills;
- o extending the life of existing landfills;
- o reducing the potential for groundwater contamination at landfills due to the chemical stability of ash compared to raw refuse; and
- o producing energy recovered from burning refuse that can substitute for expensive fossil and nuclear fuels (WMEAECF 1986).

Waste-to-energy projects proposed in 1985 for California could satisfy about 3 percent of the state's energy demand and reduce the amount of landfilled waste by over thirty percent (CWMB 1985c, p. 7). Burning all combustible solid waste in the United States would provide only one percent of the country's annual energy use (Miller 1990, p. 365). Despite WTE's merit as a means of reducing the volume of solid wastes needing disposal and its ability to generate energy, a comprehensive low-technology recycling program could save five percent of annual U.S. energy use (Miller 1990, p. 365).

Stimulated by incinerator proponents, California has

supported WTE with significant bond activity. By the end of 1985, bonded indebtedness for California waste-to-energy projects had nearly doubled from the previous year, rising from \$446 million in 1984 for projects in Lassen, Commerce, and Irwindale to \$857 million for projects in Long Beach, San Marcos, and Stanislaus (CWMB 1985c).

Disadvantages of Waste Incineration

Incinerator proponents assert that WTE is an environmentally sound waste disposal technology. Many negative factors contradict that assertion. A rapid and widespread conversion to burning garbage raises the troubling possibility that other environmental problems will be created as decision-makers seek to alleviate those caused by landfills.

Air Pollution

Hershkowitz (1987, pp. 6, 34) identified WTE contributions to air pollution that jeopardize public health and formulate acid rain. Hershkowitz found that emissions from burning garbage regularly include pollutants, such as sulfur dioxide, nitrogen oxide, carbon monoxide, hydrocarbons, particulates, heavy metals, and acid gases. He also noted that although no federal or state standards for their control presently exist, these emissions may include varying levels of dioxin and furans, which are among the most toxic of human-made substances and

of great public concern. Scientists have been unable to agree whether there exists any level of dioxin emissions which can be considered safe. Upon discovering high dioxin levels in mothers milk and fish, Sweden, which burns fifty percent of its waste, placed one-year moratoriums on permitting new garbage burning plants in 1984 and 1985 (Hershkowitz 1987, p. 34; Morris 1986).

After less than one year of operation, the largest WTE plant in the nation, located in Detroit, was shut down for two weeks after the discovery of high levels of mercury emissions. The city has since agreed to install air pollution control devices which could cost \$30 million (Schmidt 1990, p. 5).

Ash

Both fly ash and bottom ash from waste incinerators have been tested for heavy metals toxicity. Levels were high enough to trigger a hazardous waste designation for the ash. They may also contain dioxin. California requires that fly and bottom ash be sent to hazardous waste landfills, a disposal method that is expensive and already in short supply. Since ash from a WTE facility may be thirty percent or more by weight of the incoming municipal solid waste, disposing of hazardous waste will undoubtedly be a significant additional cost in employing WTE technology (Franklin and Associates 1986, p. 3-22).

Uncertain Energy Markets

Declining fossil fuel costs negatively impact the economics of WTE operations. Replacement of these fuels with energy recovered from solid waste has traditionally been the major source of revenues to support a WTE facility (Franklin and Associates 1986, p. 3-22). Prices favoring fossil fuel consumption lower the value of energy derived from a WTE facility. Also, the greater the cost of WTE pollution control equipment, the less competitive these plants are with non-incineration forms of disposal (Morris 1986).

Cost Effectiveness

Numerous studies conclude that energy recovery from burning wastes is the most expensive waste management option when compared with landfilling and recycling.

The cost-effectiveness of WTE was reduced by the Tax Reform Act of 1986 (CWMB 1987c, p. 15), which removed many in the benefits that made WTE financing possible. The drop of oil prices (CWMB 1987c, p. 15) and the cost of pollution abatement (Morris 1986) significantly impact WTE economics. Moreover, the cost of developing and maintaining a WTE facility is criticized for monopolizing money and administrative resources that could be applied to other means of solid waste management (WMEAECF 1986, p. 15).

Competition with Recycling

When deciding how much of a municipality's waste should be incinerated, program planners must consider the impacts of controlling the flow of wastes, and the effect on the waste stream if they spent as much money on recycling as they are willing to spend on WTE.

Overbuilt incinerator capacity leads to a greater demand for garbage, which is precisely what needs to be reduced. WTE systems tend to require a guaranteed supply of garbage to run efficiently and have little flexibility in adapting to the many new uses of waste materials. It can also result in large monetary losses. Cynthia Pollack (1987, p. 109) noted;

Excess capacity represents a capital investment that is not used and the desire (or in some cases contract obligation) to deliver a high volume of wastes to the plant curtails the incentive to reduce and recycle waste both now and in the future.

Experience support Pollack's contention. In 1976, Akron required that all municipal solid wastes collected within the city be delivered to the city's WTE plant. In 1987, the Lassen Community College in Susanville became the first community college to seek protection of its assets through bankruptcy procedures because of debt obligation on its trouble-plagued WTE plant. After the construction of Detroit's WTE plant, the state extracted a promise from the city to reduce the volume of garbage being burned (Schmidt 1990, p. 5).

Materials Recovery

The massburn WTE option encourages a waste collection practice that indiscriminately mixes secondary resources into garbage, making material recovery more difficult. Recovering recyclables from front-end materials separation systems at refuse-derived fuel WTE plants has proved to be ineffective: materials are so contaminated as to be generally unsalable except as energy.

Other Considerations

In addition to the above drawbacks of WTE, Relis and Dominski (1987, p. 6) note the power of NIMBY (not-in-my-backyard) attitudes to block WTE plans:

The long record of failure by government and industry to protect the public from toxic chemicals has contributed to a powerful groundswell of public mistrust of new (WTE) facilities, no matter what safety claims and assurances are offered.

Success Stories

Successful recycling programs demonstrate the feasibility of environmentally responsible waste reduction. They also prove that serious commitments to large-scale recycling programs have been made and that they work.

The Environmental Defense Fund published a report, Coming Full Circle: Successful Recycling Today (1988) which, in part, documented recycling success stories from around the world. Foreign successes include:

- o Denmark recycles 99.6 percent of bottles and glass containers and ninety percent of its cardboard (EDF 1988, p. 10);
- o The Netherlands collects more than half of its aluminum, paper, and glass for recycling (Pollack 1987a, p. 26);
- o Austria has tripled its aluminum recycling rate in the past ten years and increased glass recycling; from 1981-1985, the United Kingdom and West Germany increased glass recycling by more than fifty percent (Pollack 1987, p. 109), and;
- o Japan recycled more than fifty percent of its waste paper, (including ninety percent of its newspaper and eighty-one percent of its cardboard), fifty percent of its steel cans, and more than forty percent of glass bottles for an overall recycling rate of fifty percent in 1984 (NYPIRG 1986).

North American Success Stories

Successful on-going community curbside recycling programs in North America have been identified by Peters and Grogan (1988). Table 6-1 provides information on some of these programs in the United States. With a principal goal of diverting material from a landfill or waste-to-energy facility, the success of these programs was predicated on the number and types of materials collected and the number of people participating. The survey demonstrated the importance of custom-developed programs to suit the particular needs of the locale they serve, good administration, public education programs, citizen participation, high recovery rates, and support from both political and private sector community leaders.

TABLE 6-1

CURBSIDE RECYCLING SUCCESSES IN THE UNITED STATES

	Waste Diverted (%)	Popu- lation Served	Start Date	Man- datory	Materials Collected
Wilton, NH	44	8,500	1979	Yes	All
Madison, WI	6	143,000	1968	Yes	NP,AP,YW
Montclair, NJ	23	38,000	1971	Yes	NP,AL,YW,AP
Prairie du Sac, WI	30-50	2,300	N/A	Yes	All
Islip, NY	6	300,000	1980	Yes	All
Marin County, CA	22	255,000	1981	No	NP,AL,GL, MM,MO,AB
Essex County, NJ	15-20	850,000	N/A	Yes	NP,AL,GL, YW,AP
San Jose, CA	5	400,000	1985	No	GL,NP,AL,YW
Austin, TX	4	115,000	1982	No	NP,GL,AZ,MM
Minneapolis, MN	11	270,000	1982	No	NP,GL,AL
Ann Arbor, MI	10	54,000	1978	No	AL,GL,NP,MO
Portland, OR	24	450,000	1987	Yes	All

SOURCE: Adapted from: Anne Peters and Pete Grogan, "Community Recycling What Is Working Best?", BioCycle, May/June, 1988 p. 32-36.

Key: AB = auto batteries AL = aluminum
 All = all of the above AP = appliances
 GL = glass MO = motor oil
 MM = mixed metals MP = mixed paper
 N/A = not available NP = newspaper
 OP = office paper OCC = old corrugated
 cardboard
 PL = plastics YW = yard waste

Analysis

Waste reduction techniques and waste incineration techniques have the same bottom line goal: reducing the demand for disposal capacity. While as disposal techniques, the combination of source reduction, reuse, and recycling possesses almost none of the disadvantages of landfilling or incineration and can be a conduit for the efficient use of natural resources. While waste reduction techniques have some drawbacks, they are minor when compared to the environmental damage caused by resource extraction, manufacturing, and disposal processes, the essence of the disposal ethic.

The vision of waste-to-energy as a quick-fix, single-fix solution to the landfill capacity crisis ignores important realities. The inherent shortcomings of air pollution, hazardous waste creation, uncertain energy markets, questionable economics, and competition with recycling, added to the disharmony created in communities, is surpassed only by the enormous opportunity it eliminates by obviating society's need to address infrastructure mechanisms that promote environmental degradation. Considering our relationship with the environment, energy conservation potential, cost-effectiveness, and proven successes, it is abundantly clear that an integrated program of waste reduction techniques, reuse, and recycling is a superior method of waste management.

CHAPTER VII

DEVELOPING MARKETS FOR SECONDARY RESOURCES

Introduction

Assembly Bill 939 requires cities and counties to reduce the amount of waste disposed in landfills or waste-to-energy facilities by twenty-five percent by 1995 and fifty percent by 2000. To meet these goals cities and unincorporated county areas will increase their efforts to recover recyclables from the municipal waste stream. Without new and expanded markets, however, the influx of materials will flood existing markets, prices will drop, and some recycling programs will undoubtedly collapse in the face of unfavorable economics. Any increase in the amount of materials recovered for recycling will require a simultaneous development of markets.

A failure in the secondary materials marketplace would open the door to the waste-to-energy industry in California. The industry is effectively shut out of the AB 939 mandated waste management hierarchy until source reduction and recycling is no longer "feasible." If the CIWMB determines the "feasibility" of recycling by the availability and health of secondary material markets, the garbage-burning waste-to-energy industry will make a strong comeback in California by 1995, and certainly no later than 2000.

Overview: Markets and Impediments to Markets

Our economic system has long been based on the use of virgin materials in the manufacture of products. Government has historically supported the extraction of virgin, or primary, resources with subsidies in the form of percent depletion allowances and tax credits. These governmental policies and economic practices have encouraged the exploitation of resources by providing an economic advantage to the processors of virgin materials. They also contribute to the generation of solid wastes, oppose waste reduction efforts, and, despite the assumed good intentions of the laws and policies made in the era of supposedly "limitless" resources, they have inadvertently, yet substantially hindered the use of secondary resources as industrial raw material.

On the other hand, a secondary materials market has developed over the decades, operating in the absence of public policy and regulated by the laws of supply and demand. Factors influencing the recovery and use of secondary materials is presented in Table 7-1. The mission for policy makers is to create an economic demand for materials currently viewed as wastes.

TABLE 7-1

FACTORS INFLUENCING THE RECOVERY
AND USE OF SECONDARY MATERIALS

	A reliable supply of secondary matter is necessary.
LOCATION AND QUANTITY OF WASTE MATERIAL	An accumulation of material is necessary before it can be handled economically. Dispersed residential waste generation sites require many pick-up points, which increases cost.
	Residents must be encouraged to participate in recycling programs and to separate materials recyclables to keep them free from contamination.
HOMOGENEITY	The greater the homogeneity of the waste, the greater its potential for recycling and the less need for additional processing and upgrading.
CONTAMINATION LEVELS	Contaminants influence the recyclability of materials. Relatively high contamination decreases cost-effectiveness of collection and processing.
INITIAL SEPARATION SYSTEM	Source separation provides less contaminated wastes but the public's cooperation is required.
	Mechanical separation requiring high investment tends to produce low quality material.
LOCATION AND SIZE OF SECONDARY INDUSTRY MATERIALS	Bulk transport costs are high if distances between generating areas and intermediary or final processing plants are significant.

TABLE 7-1--Continued

	Depends on the technical barriers to substitution and relative prices of secondary and primary materials.
	Industry and consumer attitudes of recycled materials in goods may be more important than quality and price.
	Continuity of supply needs to be guaranteed.
DEMAND FOR SECONDARY MARKETS	New markets need to be developed for certain types of recovered material.
	Foreign demand for secondary materials will impact economics of domestic materials recycling.
	Foreign and domestic supply of virgin materials will impact demand.
	Fluctuating price movements in secondary materials markets will influence demand.
INSTITUTIONAL CONSTRAINTS	Vested industrial interests may prefer traditional primary raw materials sources to secondary materials, (e.g. existing vertical integration of companies).
	Government tax policies economically favor the extraction, transportation and use of virgin materials.

The Marketplace: Primary vs. Secondary Materials

Materials recovered by recycling programs will enter the business arena to face virgin materials in dollar-to-dollar economic combat. The least expensive alternative is certain to claim victory and will be bought by the manufacturing industry and put into production.

Unfortunately for the secondary materials industry, recovered materials have significant initial economic disadvantages shackled by tax codes, pricing mechanisms, subsidies, and marketing practices that discriminate against recycling (Pollack 1987, p. 118). Producers and users of virgin materials enjoy a significant economic advantage over producers and users of recycled materials.

Government Provided Subsidies

Government has a history of influencing markets and market development by providing substantial tax subsidies to encourage production in virgin material industries, such as mining and timber producing firms (Franklin and Associates 1987, p. 4-2, 4-13). Tax subsidies effectively shift a portion of the costs of obtaining virgin materials from the consumer to the taxpayer. As a result of subsidies, price and production of virgin materials appear less expensive than they really are. Additionally, the costs of disposal, an external cost of production, are also transferred to the taxpayer. Government subsidies to the virgin materials market amount to \$2 billion annually, estimates John Ruston, staff economist of the Environmental Defense Fund (Relis and Gitlitz 1988, p. 44).

A good example of how subsidies benefit an extractive industry are those extended to the timber industry. The

U.S. Forest Service, manager of our National Forests and 18 percent of the nation's timberlands, lost more than \$2.1 billion from 1975-1985 in providing timber and fiber resources to the timber industry. It is expected to lose another \$2 billion between 1985 and 1995 (Miller 1989, p. 304; U.S. Bureau of Census 1986). The timber industry also benefits from the capital gains tax, which is "the basis of discriminatory charges by paper recyclers" (Franklin and Associates 1987, p. 4-2). Income from the sale of timber which would otherwise be taxed approximately forty-six percent (corporate rate) is taxed twenty-eight percent, 40 percent less than would a paper recycling company (Arthur Young and Company 1982, p. IV-62).

The distortion of the energy marketplace greatly enhances the economic viability of converting raw resources into goods by keeping production costs low. Heede (1985) estimated that the U.S. government contributed \$44 billion in subsidies to the energy industry in 1984, a sum estimated to be one-quarter of the federal budget deficit at that time. Miller (1989, p. 442) reported energy subsidies and federal tax breaks of \$8.6 billion for the oil industry, \$4.6 billion for the natural gas industry, \$3.4 billion for the coal industry, and \$15.6 billion to the nuclear industry. Between 1952 and 1984, the Department of Energy disbursed \$1 trillion to the commercial nuclear energy industry, an average of \$9

billion per reactor (Miller 1989, p. 404). It is interesting to note that, in 1989, these subsidies continued to exist, while subsidies for energy conservation and renewable energy have been discontinued. Our country may need energy conservation, but its governmental economic policies actively discourage it.

Indirect Subsidies

Many laws and regulations governing virgin materials provide indirect subsidies or incentives. The individual and total impact of laws and regulations may not be as great as tax subsidies, but they do absorb some of the true costs associated with using virgin materials (Arthur Young and Company 1981). Examples include:

- 1) Government procurement policies favoring products made of virgin materials over those made of secondary materials;
- 2) Freight rates charged for some secondary materials which may be higher than shipping rates for virgin materials;
- 3) Federal funding of research and development projects related to the extraction and manufacturing of virgin materials;
- 4) Federal and state forestry activities that lower total costs to timber firms of forestry management and development;
- 5) Federal labeling requirements that may act as a deterrent to the use of products made from secondary materials;
- 6) Foreign tax allowances provide benefits in the form of lower federal taxes to U.S. firms in the virgin materials business that own foreign operations.

Legislation

Legislation in 1989 included specific actions to develop markets for secondary materials (Table 7-2). Senate Bill 1322 created a Recycling Markets Development Commission and requires state agencies to purchase certain recycled goods including high-grade paper, retreaded tires, lead-acid batteries, and compost. The Commission's first hurdle will be finding accurate supply and demand data on the quantity and quality of materials generated and consumed, both for domestic and international markets. This information will aid the state in identifying overall market and submarket conditions for commodities and commodity subgroups and to formulate and implement specific policy actions to encourage the development of secondary materials market.

Although specific solutions were proposed to address impediments to secondary materials development in 1981, as of 1989 there had been virtually no implementation of this plan (Foran 1989). Impediments and solutions to secondary materials market development, listed in Table 7-3, remain crucial factors in making recycling work today.

TABLE 7-2

1989 LEGISLATION ENCOURAGING MARKET
DEMAND FOR SECONDARY MATERIALS

-
SB 1322	Establishes a comprehensive set of state programs designed to increase recycling and encourage the development of markets for recyclable material.
AB 4	Expands current secondary materials procurement of products by state and local agencies and the Legislature to include tires, compost, glass, plastics, paints, and solvents.
AB 1305	Requires all commercial consumers of newsprint to ensure that at least twenty-five percent of their newsprint consumption consists of recycled-content newsprint, beginning January 1, 1991. Recycled-content newsprint is defined as that containing at least forty percent post-consumer wastepaper. Mandated consumption percentages shall increase incrementally until they reach fifty percent by January 1, 2000.
AB 1306	Requires the Department of Transportation, in consultation with the CIWMB, to modify all bid specifications for materials used in state contracts to maximize the use of recycled materials without compromising quality standards for highway construction.
AB 1307	Allows tax-exempt industrial development bonds to be used for the purchase of recycling equipment by private industry.
AB 1570	Requires all state agencies and their contractors purchasing motor oil to purchase motor oil and industrial oil containing the greatest percentage of recycled oil meeting specified standards.

TABLE 7-2--Continued

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AB 1308	Creates a tax credit of up to forty percent for purchases of equipment that are used to manufacture new products from waste material. Equipment must use specified amounts of waste material to qualify for the tax credit. The tax credit limit is \$250,000 and expires in 1994.
AB 1843	Requires the Integrated Waste Management Board to adopt permit regulations for waste tire storage, recycling and disposal. It also creates a \$0.25 fee on tires left for disposal with tire sellers to fund the program.
-

TABLE 7-3

PROPOSALS TO EASE CONSTRAINTS
AGAINST SECONDARY MATERIAL MARKET DEVELOPMENT

OVERALL MARKET CONSTRAINTS

A. Absence of reliable information on market conditions

Solution: 1) Formulate a five-year market program plan.

2) Develop an industry information reporting system.

SECONDARY MATERIALS INDUSTRY

A. Adverse public attitudes and industry preferences.

Solution: 1) Develop a secondary materials marketing education program.

B. Present economics may favor virgin materials.

Solution: 1) Identify and analyze financial incentives to accelerate market development.

C. High Transportation Costs.

Solution: 1) Evaluate actions to alleviate high transportation costs.

D. Wide supply fluctuations.

Solution: 1) Evaluate secondary material marketing devices.

E. Inequities in tax treatment.

Solution: 1) Identify and analyze financial incentives to accelerate market development.

TABLE 7-3--Continued

F. Disposal cost subsidization.

Solution: 1) Identify and analyze financial incentives to accelerate market development.

SECONDARY FIBERS

A. Lack of existing mill capacity to utilize secondary fibers.

- Solution:
- 1) Identify and analyze financial incentives to accelerate market development.
 - 2) Encourage increased exports of secondary fibers.
 - 3) Encourage more paper mills in the state.
 - 4) Encourage the growth and conversion of existing paper mills.

B. Customer specifications preclude or impede recycling of original product.

Solution: 1) Develop a program to raise the consciousness of paper product manufacturers and customers regarding recycling.

C. Unfavorable general market conditions for secondary fiber products.

- Solution:
- 1) Develop a program to increase public acceptance of products made from secondary fibers.
 - 2) Develop a program to encourage state and local governments to purchase paper and paper products made with secondary fibers.

TABLE 7-3--Continued

D. Unfavorable government regulations (environmental, financial, institutional).

- Solution: 1) Identify and analyze financial incentives to accelerate market development.
- 2) Encourage more paper mills in the state.
- 3) Encourage the growth and conversion of existing paper mills.
-

GLASS

A. Color separation problems.

- Solution: 1) Provide additional grant assistance to expedite mechanical-optical color-sorting program.

B. Contaminants in the cullet.

- Solution: 1) Develop a grant to improve/develop effective cullet decontamination equipment.

C. High perceived customer specifications.

- Solution: 1) Conduct a consumer survey to determine acceptable glass container colors.
- 2) Design a customer test marketing project.

D. Relatively high cullet prices.

- Solution: 1) Identify and analyze financial incentives to accelerate market development.

E. Lack of secondary product use by the construction industry.

- Solution: 1) Determine why construction materials made with cullet are not being used.

TABLE 7-3--Continued

-
- 2) Develop a program to encourage cullet as a building material.
-

FERROUS METALS

- A. Already have high commodity demand.

Solution: 1) Encourage increased exports of ferrous metals.

- B. Not economically feasible to recycle tin cans on a widespread basis.

Solution: 1) Encourage more mini-steel mills in the state.

- C. Industry has its own ability to market secondary materials.

Solution: 1) Encourage the growth of existing steel mills.

PLASTICS

- A. Uncertain industrial technologies.

Solution: 1) Develop information on specific potential plastic market demands.

- B. Inadequate quantities of material at reasonable prices.

Solution: 1) Develop a pilot program for large-scale collection of plastic containers.

- C. Source separation problems.

Solution: 1) Develop a grant to research resource recovery for plastic containers.

TABLE 7-3--Continued

TIRES

A. Uncertain technologies for using large quantities.

- Solution:
- 1) Determine the economic feasibility of using rubber asphalt in road construction and repair.
 - 3) Develop a program to expedite modification of state road construction specifications to include asphalt and rubber additive.
 - 4) Identify market for the tire pyrolysis products.
-

ORGANICS

A. Little current market value for yard and kitchen wastes.

- Solution:
- 1) Research and document previous refuse-derived composting operations.
 - 2) Evaluate existing municipal yard waste programs.
 - 3) Determine market potential for vegetative compost.

B. Quality of refuse-derived compost precludes use by agriculture industry.

- Solution:
- 1) Determine market potential for refuse-derived compost.

C. Declining demand for textile wastes.

- Solution:
- 1) Identify and analyze financial incentives to accelerate market development.
-

SOURCE: California Waste Management Board and Arthur Young and Company. Factors Which Inhibit the Demand for Secondary Materials: Phase I Marketing Report. November 2, 1981.

Developing Markets, Achieving
Economic Value, and Stimulating Demand

Secondary Materials Applications

The uses of secondary materials are limited by imagination, practical application, cost-effectiveness, and market development. Although many materials are currently recovered and recycled from the waste stream, ninety percent of what is essentially a resource is now disposed in landfills. Materials that can be recycled into new commodities include newsprint, computer cards, white office paper, corrugated cardboard, plastics, tires, scrap metal (such as aluminum, copper, and tin), motor oil, and glass. An overview of materials commonly found in municipal solid waste, products that can be made from them, and end users for those products is provided in Appendix B.

Stimulating Demand

Government can provide incentives to discourage disposal and encourage waste reduction and recycling.

Mechanisms currently used by states include:

- o increased disposal charges,
- o banning disposal of recyclables,
- o providing grants to develop recycling,
- o taxing non-recyclable packaging or applying advance disposal fees to products made of materials for which markets are weak or don't exist,
- o mandating recycled material content standards for products and packaging,

- o requiring mandatory deposits on all beverage containers, separation of recyclables from household wastes and participation in recycling programs;
- o providing private tax credits for the purchase of recycled material, and;
- o developing incentives for government procurement policies of goods containing recyclable materials.

California can draw from the experience of states already using these methods to formulate an effective approach to waste reduction through recycling.

Disposal Charges

Tipping fees, the per-ton or cubic yard charge for putting material into a landfill or waste-to-energy facility, have been historically low and encourage disposal (Berkman and Dunbar 1987). The costs of leachate control systems, gas migration control systems, water quality monitoring wells, liners, cover material, closure and post closure, and insurance need to be factored into all land disposal facilities to accurately assess the "true cost" of landfills (CWMB 1985a, p. 13). Increases in disposal charges can operate as an economic disincentive to waste disposal and as an incentive to recycling. Recycling programs have increased with dramatic increases in tipping fees. When tipping fees rose from 25\$/ton to \$100/ton in Montclair, New Jersey participation in recycling programs increased significantly (Peters and Grogan 1988, p. 32-36).

A surcharge on the disposal of waste at a landfill or

incinerator can be influential. Disposal fees and a surcharge can:

- 1) provide revenues for recycling programs,
- 2) create a direct economic incentive to participate in recycling programs by increasing disposal costs, and
- 3) result in tipping fees that accurately reflect the real costs of waste disposal in terms of environmental degradation, resource consumption, and the loss of capacity at landfills.

Disposal Bans

Communities can conserve landfill space by prohibiting disposal of easily recyclable materials. Some examples include:

- o Broome County, New York does not accept leaves at the landfill;
- o New Jersey banned leaves from landfills, requiring that they be transported to a leaf composting facility;
- o Delaware County, Pennsylvania banned the delivery of newspaper and other recyclables to the county transfer stations in 1985;
- o Minnesota forbids WTE facilities supported by public funds to accept recyclable materials except for transfer to a recycler;
- o Connecticut forbids landfills or WTE to accept "designated" recyclable materials, and;
- o Maine requires a recycling program to be in operation before an incinerator or landfill can receive a permit (EDF 1988, p. 51-53).

Program or Project Grants

State assistance can be crucial in establishing

capital-intensive recycling facilities such as secondary material processing centers. Grant funds can come from a state's general fund (New Jersey, Connecticut, Vermont and Michigan) or from special mechanisms designed to support recycling. New Jersey, Vermont, and Illinois administer grant programs financed by landfill surcharges (EDF 1988, p.78); New York State "floated" a bond issue for recycling projects in 1972; and New Jersey, Washington, Rhode Island, New Jersey, Connecticut, Massachusetts, Nebraska, and Minnesota have provided financial assistance for recycling facilities (EDF 1988, p. 75-80).

Packaging Tax

Taxes on packaging can be used to encourage packaging with recyclable materials, discourage overpackaging, and pay for recycling programs and litter cleanup. Rhode Island, Washington, New Jersey, Nebraska, and Ohio have established taxes on packaging or "litter generating products" (EDF 1988, p. 80-81).

Mandatory Deposit Legislation

The basic principle behind mandatory deposit legislation, commonly referred to as "bottle bills," is to create an economic incentive in the form of deposits to encourage consumers to return beverage containers. Bottle bills have proven effective at encouraging recycling and eliminating beverage container litter in Connecticut,

Delaware, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont (EDF 1988, p. 69-70). Prior to the adoption of New York State's Returnable Container Act of 1983, fifteen percent of New York's beverage containers were recycled. By the middle of 1984, the rate reached fifty-nine percent, and in 1988 almost all returnable cans were recycled and eighty percent of clear and green glass bottles collected were recycled (Bruno 1988, p. 2).

California has a unique bottle bill (discussed in Chapter III) that differs from other states by imposing a refund, currently two cents per container, paid by beverage wholesalers to the State Department of Conservation. Consumers receive the refund by returning containers to state-authorized redemption centers. The California bill has been criticized for having too low of a deposit value to result in a return rate equivalent to other bottle bill states.

Mandatory Recycling

"Mandatory" recycling laws require residents and businesses either to 1) separate recyclable material(s) from solid wastes for the purposes of collection and processing, or 2) require local governments to set up recycling programs. An example of the latter is the State of Oregon's requirement that cities of more than 4,000 people provide at least monthly collection of separated

materials. California's recently adopted Integrated Waste Management Plan (AB 939, discussed in chapter III) requires recycling as a component of a waste management hierarchy. Other states with some form of mandatory recycling include Wisconsin, Washington, New Jersey, Rhode Island, Connecticut, Iowa, and Minnesota (EDF 1988, p. 65-68).

Data compiled by Peters and Grogan (1988) show that with curbside recycling programs, mandatory recycling achieves higher recovery rates than voluntary recycling and that the best voluntary programs are curbside rather than dropoff. Mandatory programs are netting participation rates of sixty-five percent or better, recovering about 250 pounds of materials per person per year. To date, no city over half a million people has mandated participation in curbside recycling (Peters and Grogan, 1988 p. 32-36).

Actions by Local Government

Local government has many opportunities to support, develop, and encourage recycling programs. In addition to providing curbside recycling programs for its citizens (either voluntary or mandatory), banning disposal of recyclables and yard waste, and increasing disposal fees to encourage recycling, cities can adopt anti-scavenging ordinances, modify zoning ordinances, and pass legislation requiring their purchasing departments to buy products made with recycled materials whenever possible.

Anti-scavenging ordinances clarify ownership of the materials set out at the curbside for collection or in unsecured bins. These ordinances can impose penalties for theft to discourage individuals from stealing valuable materials (illegal scavenging). In California, Downey, Fresno, San Francisco, Santa Barbara, Ontario, Marin, Palm Springs, San Diego, and San Jose have enacted such ordinances.

Zoning ordinances, which typically restrict recycling centers to industrially zoned areas that are inconvenient to citizens can be modified to allow centers located near residential areas. San Jose is recognized for its model ordinance.

Government Procurement Policies

Government exerts direct and indirect influences on the marketplace according to Richard Keller (1988, p. 38-42). The primary reason for this is government's enormous demand for products. Federal, state, and local government purchases are 19-21 percent of the Gross National Product, 7-8 percent for federal purchases and 12-13 percent for state and local purchases.

Standards and specifications set by government agencies influence the demand for recycled products. Keller (1988) cites the requirements developed by the U. S. General Service Administration for using recycled material

in federal paper purchases. Tissue manufacturers responded to the requirements by making significant investments in research and equipment for using recycled materials, and dramatically increased their use of such materials (Keller 1988, p. 38).

At the state level nineteen states and four local governments, serving more than sixty percent of the U.S. population, have laws in place favoring recycling products. In 1988, at least thirteen states considered legislation to establish or expand programs to buy recycled products (Keller 1988, p. 42). Despite the potential to positively influence the market for materials containing recyclable materials, obstacles remain. Many states lack procurement legislation, states with procurement programs are far from having full implementation, purchasing agents lack training for buying recycled goods, and federal programs have not even started.

In 1976, Congress passed the Resource Recovery and Recycling Act (RCRA). Among other things, this act required the USEPA to establish guidelines for federal agencies to buy recycled products. As of October 1987, the EPA had developed only one procurement guideline, for the use of fly-ash in concrete. Several suits were brought against the EPA by the National Recycling Coalition, the Environmental Defense Fund, and other organizations to require the EPA to meet RCRA requirements (Relis and

Gitlitz 1988, p. 36). Encouraged by a resulting court order to complete the RCRA mandate, EPA began preparing guidelines for four major recycled products: paper (amending earlier guidelines), retreaded tires, re-refined oil, and insulation materials (Keller 1988, p. 38-42).

Governments must make vendors and the manufacturing community aware of governmental interest in buying recycled products. There must be sufficient bidders to meet government requirements for competition, and procurement policies should determine testing standards and emphasize quality control. Manufacturers must have recycled products readily available, comparable in quality to equivalent virgin products and economically competitive with virgin products. It is only logical to assume that agencies will seek the best value, therefore efforts should be made to make prices work on a free market. Common specifications, clear definitions, and minimum content standards for recycled products will assist industry in meeting the needs of public and private purchasing agencies.

Tax Incentives

Tax incentives work in a complex environment of economic and regulatory forces, and they can be a powerful tool in encouraging business investments to process and manufacture products from recovered materials. As tax incentives do not act in a vacuum, they have been

criticized for being cost-ineffective and rewarding investment that would have occurred anyway (EDF 1988 p. 117-123).

From 1978 to 1983, federal credits were available to manufacturers who purchased equipment to "sort, prepare, or recycle solid waste to recover useful materials" (EDF 1988, p. 118). Despite the criticism, Oregon, North Carolina, New Jersey, Oklahoma, Wisconsin, Connecticut, Delaware, West Virginia, Tennessee, Indiana, and Florida (until 1987) have adopted various forms of legislation exempting recycling and solid waste reduction activities from taxation.

Export Opportunities

Material dumped in California landfills can be valuable "natural" resources to mineral and fiber poor countries. Secondary materials unable to find domestic markets may find new uses as recycled products made in foreign countries and become export commodities that positively influence the balance of trade. In 1985, waste paper and textile waste were the first and third greatest general cargo exports from the Port of New York and New Jersey. Ferrous scrap was the leading bulk cargo shipped (EDF 1988, p. 114; Pollack 1987, p. 109).

Export market growth in the Pacific Rim suggests that the time is ripe for California to capitalize on this

expanding trade link. With forty-three percent of the world's population and twenty-seven nations (excluding the Soviet Union), the Pacific Rim offers enormous export market potential to California. The California Department of Commerce projects that the Pacific Rim will account for twenty-seven percent of the gross world product by 1995 (Relis and Gitlitz 1988, p. 5).

In addition to looking at the Pacific Rim for markets, James Rinehart, director of the California Office of Business Development at the California Department of Commerce, believes that the state should also consider the European economic community, where several resource-poor countries could provide new secondary material export opportunities (Lockwood and Leinberger 1988).

Countries deficient in natural resources turn to imported wastes after they have developed a recycling infrastructure. For example, Taiwan, Korea, Japan, Mexico, Canada, Italy, West Germany, and Finland import substantial amounts of wastepaper (Relis and Gitlitz 1988, p. 13; Brown 1987, p. 109). The American Paper Institute (API) reported that U.S. exports of all grades of waste paper rose from 408,000 tons in 1970 to 3.75 million tons in 1986, an increase of 818 percent in sixteen years. API (1988) expects the trend of wastepaper exports to continue for two reasons: 1) the U.S. provides the greatest potential for increasing the global supply of waste paper, and 2) despite

recession periods, the long-term demand for fiber will continue to increase in those countries with limited forest resources.

The Problem of Success

Gains in developing markets could be offset by the volume of materials recovered by successful recycling programs. Increases in the supply of secondary materials must be balanced by a market demand for those materials.

Arthur Young and Company (1981, p. 14) reported:

In practical terms, it must be recognized that all of California's potential supply of solid waste cannot be processed for recycling (from post-consumer waste to secondary resource)...In summary, there is a substantial current imbalance between the supply and demand for California secondary materials. The market presently has a tremendous capacity to supply high quantities (disregarding qualities) of secondary material relative to historic demand.

Without strong market demand for secondary materials, waste diversion and material recovery successes (such as municipal curbside recycling programs) will suffer as a result of oversupplied markets. Depressed market prices paid for materials may place some recycling programs in financial jeopardy and jeopardize the financial commitment to recycling from private and public firms.

Analysis

If a reasonable hierarchy of solid waste management is to be encouraged as a realistic method of addressing the

problems presented by the landfill capacity crisis and environmental degradation, then institutional support must be created to meet the comprehensive challenge. Various technical, social, and economic constraints must be overcome to develop markets for secondary materials, materials which are "post-consumer wastes" but not yet disposed of in a landfill or an incinerator.

The availability of markets for secondary materials will determine the depth and breadth of the impact that a solid waste management policy will have on reducing the impact of social systems on natural systems. Overcoming impediments to market development will prove to be a formidable task. For those involved in developing markets for secondary materials, the stakes are clear. A viable economic market for recycled materials is critical to the success of recycling, and if recycling is not successful, we may suffer the consequences of reliance on WTE technology.

CHAPTER VIII

OPPORTUNITY AND CHALLENGE

Introduction

The solid waste management problem is, in reality, a natural resource management problem. How we choose to address it will ultimately affect environmental quality and long-term economic prosperity. If we view the problem with a total environmental perspective, we can find a solution. Only by linking natural processes with the human endeavors that produce goods and services affecting health, safety, and welfare can we weigh costs and benefits against social, economic, political, and environmental concerns.

The Opportunity

By circumstance, we have a chance to address many critical environmental problems by seizing this opportunity to resolve the solid waste management crisis. The lack of landfill capacity makes the 1990s a crucial time to develop and implement policies that provide environmental and economic benefits and encourage alternatives to disposal. Not only can we resolve the landfill capacity and solid waste generation problems, we can also benefit from reductions in energy consumption and pollutants.

The Problem

At the most elemental level, cost, safety, environmental pollution, and the lack of site availability call into question the wisdom of continued reliance on landfill disposal. At the current rate of disposal, unless we expand or create new landfills or find alternative disposal methods, every landfill in the state will be filled and closed by 2000. Many metropolitan areas, especially Southern California, face even more immediate problems.

Additionally, public awareness of past and potential health and environmental risks have exerted strong pressure to close existing landfills, halt expansion of existing facilities, and stymie attempts to develop new landfills or waste-to-energy (WTE) facilities. The public is no longer willing to accept the idea that there must be a choice between environmental quality and the economy.

Meanwhile, federal policies subsidizing the costs of generating energy, cutting timber, and extracting minerals encourage consumption of primary resources and foster a national throw-away ethic with which disposal options, such as landfills and WTE, cannot possibly keep pace.

Shortsightedness

Waste-to-energy's promise to significantly extend the life of existing landfills and reduce California's need to

site new ones also provides the greatest opportunity to further institutionalize waste disposal. Positive aspects are clouded by the fact that WTE elevates the throw-away ethic to a technological high point and that it converts potentially renewable and recyclable resources into economic and environmental liabilities, i.e., toxic ash and air pollutants. Despite the fact that WTEs produce energy, a comprehensive, nationwide, low-technology recycling program could have greater results, saving five percent of annual U.S. energy use. That savings is more than the energy generated by all U.S. nuclear power plants. By contrast, burning all combustible urban solid waste in WTE plants would supply only one percent of the country's annual energy use (Miller 1990, p. 365). Because of unknown energy markets and the generation of hazardous wastes, it is entirely possible that WTE facilities would cause larger economic and environmental problems than they would solve.

Manufacturing industry rhetoric supporting recycling must also be questioned, for, despite some readily-accepted environmental benefits, it is not an end-all solution. An industry seeking to fashion a clean and marketable image to the American consumer can claim responsible environmental behavior under the pretense of doing the "right thing" by recycling. We must beware, however, of selfish motivations. The packaging industry is

all too knowledgeable of society's growing environmental awareness and its budding willingness to tax itself or increase garbage disposal fees to institutionalize the opportunity to recycle. For the plastics, aluminum, glass, and paper industries, programs such as curbside recycling become a publicly financed resource collection system. Their costs are reduced when society agrees to tax itself to collect, sort, and deliver raw resources to those industries which, in turn, will process those materials and sell them back to the consumers.

The Challenge

Where, then, should the emphasis be? The Science Advisory Board to the Environmental Protection Agency has recommended that the emphasis of EPA policy be placed on pollution prevention, public education, and the human impact on environmental degradation (Wall 1990, p. B1). California would be wise to do the same. Of course, this is not a new idea. Remember the adage: "An ounce of prevention is worth a pound of cure."

The Role of Government

Despite the logic of integrated waste management--the hierarchy of reduce, reuse, recycle, and landfill--this combination cannot completely eliminate the need for landfills or waste-to-energy facilities. The hierarchy

will constantly be subjected to political tinkering. Legislation will be the mechanism to undo the hierarchy or to create workable solutions.

Effective legislative solutions to the solid waste problem have missed the mark by being crisis-born. Response to the dual problems of lack of disposal capacity and the hazards of landfills and WTE has been reactive short-term solutions. This "band-aid" approach to solution-making suffered from disregarding interdisciplinary viewpoints, not considering long-term implications, and relying on techno-faith--the belief that a technological solution would solve the problem. The result has done society an unfortunate disservice by missing opportunities to develop and implement reasonable and successful solid waste management strategies that recognize the strong interaction with the environment.

In the midst of the apparent misdirection of legislative policies, dismissing all politicians as incompetent crooks may be part of a great tradition, but the challenges concerning the management of natural resources need government action. Government must take a leadership role, cease its reactive nature, and become proactive in natural resource management. It must work for the benefit of the society it represents. An effective response to the current crisis and confronting unfolding environmental threats will require that the political

perception of our relationship to the earth's natural systems cross a new threshold.

Decision-Making and Implementation

There is clear need for dialogue, consensus, and firm leadership to expedite decisions and actions that can avert a waste disposal crisis in California. For this involvement to be significant, a variety of groups must facilitate the future management of natural resources. The players must be as diverse as the issues. Policy makers, industry, scientists, and citizens must participate in the public debates and be more aware of the relationship between their activities, the problems of society, and the complex nature and constraints of the political process. Consideration should be given to forming policies and strategies and assessing their long-term economic, cultural, and social consequences. Inter-goal conflicts and synergies must be identified. The public must understand that solutions to the problem carry uncertainties. Risks in the decision-making process can be minimized but not eliminated; none will be completely benign. To that end, it is essential to conduct research and, most importantly, to apply a total environmental perspective to provide a strong basis for informed decision-making.

The next hurdle is to ensure that the federal and

state government adopt legislation and provide funding to local governments so that they may implement long-term solutions. While, environmental laws often contain glowing rhetoric about goals, the language is often vague, unrealistic, or offers only indirect guidance about how goals are to be achieved. Implementation details are left up to a regulatory agency and the courts.

When developing effective legislation, a major problem to avoid is treating environmental and resource problems in isolation. In nature, environmental and resource problems interact. Our predicament is that we can perceive a problem, yet, despite considerable knowledge and skill, we do not understand the interrelationships of its many components and are unable to devise an effective response. Treating issues in piecemeal fashion may solve one problem but intensify another. Waste-to-energy, for example, will reduce the volume of garbage, but where will we put the toxic ash it creates? Considering economic and environmental costs, is converting renewable and recyclable natural resources into ash and energy a logical policy? This failure to develop effective solutions occurs, in large part, because we continue to examine single items in the problem without understanding that the whole is more than the sum of its parts and that change in one element means change in the others.

Recommendations

The effective use of legislation and bureaucratic policy to accomplish strategic objectives will largely depend on forging an institutional structure to coordinate decisions effectively, determining an appropriate scope of responsibility for different levels of government, and, perhaps most important, relying on the competence and performance of institutions. Despite the reorganization of the California Integrated Waste Management Board and their required implementation of a host of new laws reordering the state's waste management priorities, mechanisms to support and encourage alternatives to disposal have not reduced the burden on landfills to any appreciable degree. Local government must review, revise, broaden, and implement responsible solid waste management strategies that are true to the hierarchy. Legislation must be well-crafted and adopted to encourage waste reduction and markets for recyclables.

This thesis specifically recommends the following components be included in the drafting of policy and legislation.

- o **Use a total environmental perspective to comprehend the full impact of proposed solutions.** We must address critical environmental problems by taking advantage of opportunities to resolve more than one problem with a single solution, and be wary that we don't create a larger problem in doing so. We must link the natural process and features to health, safety, and welfare so that social costs and benefits related to the natural

environment may be weighed against other social, economic, and political concerns. Decision-making bodies considering solutions to the landfill capacity crisis must carefully and comprehensively consider the long-term effects of their actions.

- o **Foster full participation in the solution-making process.** The public, industry, educators, scientist, and all levels of government must be involved in prioritizing waste diversion schemes, developing markets for post-consumer wastes, facilitating public education, and encouraging research and development opportunities to successfully address the problem.
- o **Recognize the opportunity in the crisis.** The landfill capacity crisis makes the 1990s a crucial period to develop and implement policies that encourage alternatives to disposal and that economically and environmentally benefit society. Governments and individuals who replace disposal with the one-two-three punch of reuse, recycling, and composting to the maximum extent possible greatly benefit society. Their action will increase local employment, maximize use of natural resources, conserve and preserve energy resources, wilderness and coastlines, reduce pollution, and reduce dependence on foreign and domestic sources of minerals and oil.
- o **Require environmental education in all grade levels.** Education is key to effecting change that results in rational decisions to reduce waste and utilize recycling. Environmental education must be on an equal level with math, English, and reading as required curriculum in all levels of education--elementary, middle, and high school, and college. National education policy should include environmental quality, resource conservation, waste reduction, recycling, and sustainable growth so that, in the future, society can enjoy the best of science and technology and live in harmony with nature.
- o **Institute sustainable-earth policies.** All levels of government must implement policies that reduce our overdependence on primary resources. They must eliminate disincentives to reuse and recycling. Business, industry, government, and individual citizens must be encouraged through

the marketplace and education to increase the viability of waste reduction and recovery as mechanisms for resource conservation, environmental protection, and economic development. Implementing these policies would result in less dependence on limited and virgin resources, use of renewable, reusable, and recyclable materials, and place a higher priority on research and techniques to substitute feedstocks of primary materials with recycled and secondary materials. A comprehensive national materials policy could be a mechanism to develop a sustainable system of resource use.

- o **Review and evaluate tax laws.** The legislature should employ policy analysts to regularly review tax laws to identify inequities and undue bias that provide fiscal advantages to the manufacture and distribution of products made from limited resources and virgin materials for the purpose of phasing out such laws.
- o **Replace or decrease exploitation subsidies.** Legislators must reduce or eliminate federal and state subsidies for primary-materials industries because of the long-term economic and environmental implications of their continued use and their direct competition with methods to reduce the stream of natural resources into landfills. They must also remove standards, subsidies, and rate structures that give primary resources an advantage in taxes, transportation, garbage rates, product pricing, and product procurement. Alternatively, the federal and state government could provide subsidies for secondary materials industries, and municipal recycling and waste reduction programs.
- o **Encourage responsible products and packaging.** State laws must encourage industries to fully account for the effects of their products on the environment. They should encourage product design that minimizes waste disposal. Products should be designed to incorporate the largest amount of recycled material content as possible, be repairable, reusable, and, at the end of their useful life, recyclable. Packaging designs should require the minimum input of energy and materials and serve more than one purpose. State law should require that waste disposal costs be factored in the price of all disposable items

(rather than in local taxes) so the market price of an item directly reflects its costs to society and the environment. Advance disposal fees could be collected and distributed by the state.

- o **Develop viable markets for secondary materials.** Government and industry must plan for dramatic increases in supplies of secondary materials and inevitable market fluctuations. Legislation must encourage industry to increase secondary materials processing capacity. Also, investing in recycling industries will create domestic processing and manufacturing jobs.
- o **Enact a national beverage container law.** A national beverage container law would significantly boost source reduction and elevate reuse above recycling, further reducing demand for energy and primary resources.
- o **Restructure garbage rates to encourage materials conservation.** The state must require localities to foster garbage rate structures that encourage waste reduction. Local and state governments should revise contracts, ordinances, permits, and rate structures to encourage industrial, commercial, and residential waste generators to switch from a one-way disposal orientation to one of source reduction, reuse, and recycling. Disposal should be a costly option. All waste generators should be required to sort recyclables from wastes. Fees for waste disposal service could be based on the volume, weight, or number of garbage cans set out for pickup with no fees for collecting compostable or recyclable materials. Rates at landfills should be set to secure funds for replacement space and to encourage waste haulers to reduce the amount of material requiring disposal.
- o **Facilitate information sharing.** Intergovernmental communication must be fostered and maintained. All levels of government should allocate staff and resources to facilitate the transfer of information about existing and emerging technologies for all recyclable commodities. This technology information transfer should include standardized definitions and specifications for use and applications of these materials as well as economic and environmental value of reusing or recycling these materials.

Closing Thoughts

In 1864, George Perkins Marsh--a lawyer, diplomat, Congressman, and scholar--published a book, Man and Nature, or Physical Geography as Modified by Human Action, that helped legislators and influential citizens see the need for resource conservation. Marsh questioned the idea that the country's resources were inexhaustible and showed how the rise and fall of past civilizations were linked to the misuse of their resource bases. Marsh's thesis is still as valid today as it was over one hundred years ago. Recognition of ourselves as a part of nature should inspire new policies, prompt the formation of new institutions, and fuel research to develop and implement sound solutions to the solid waste problem.

Solid wastes are the only raw materials we're too stupid to use. Arthur C. Clarke

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GLOSSARY*

- Bi-metal can:** A can made from two or more types of metals, usually steel or tin combined with aluminum.
- Biodegradable:** A material capable of being broken down by microorganisms into basic elements. Most organic wastes such as paper and food are biodegradable.
- Bottle Bill:** A law which requires refundable deposits on beverage containers to help encourage recycling and reduce litter. This law has been enacted in nine states.
- Brokers:** Purchasers of secondary material who sell the material to manufacturers.
- Buy-back Center:** A facility that purchases secondary material, usually from the public, and resells it to brokers or manufacturers. Buy-back centers may or may not process the recyclables.
- Collection Center:** A facility that collects secondary material, usually from the public, and resells it to brokers or manufacturers. Collection centers may or may not buy material and can be permanent or mobile.
- Commercial Waste:** Waste material which originates in wholesale, retail or service establishments such as office buildings, stores, hotels, universities, and warehouses.
- Compost:** The product resulting from the controlled biological decomposition of organic wastes that are source separated from the municipal waste stream.
- Composting:** Converting organic components of the waste stream into a material usable as a soil amendment or other product. Various composting methods are determined by the composition of the material composted and its end use.
- Construction Waste:** Waste material produced at construction sites. These materials usually include lumber, metal parts, and sheet rock.
- Corrugated Paper:** A structural paper shaped in parallel furrows and ridges (cardboard boxes).
- Cullet:** Scrap glass, usually broken up into small, uniform pieces.

De-inking: A process which removes ink, filler and other contaminants from printed waste paper. This process produces pulp which can be used with virgin paper to manufacture new paper products.

Deposit: Fee added to the purchase price of consumer goods, usually beverage containers, which is refunded upon return of the item to the point of sale or recycling center.

Depreciation Allowance: A tax break given to virgin material processors to compensate for the depletion of their raw materials. The depletion allowance is essentially a subsidy to virgin material production by the federal government.

Disposal facility: Any facility or location where disposal of solid wastes occurs.

Disposal site: Includes the place, location, tract of land, area, or premises in use, intended to be used, or which has been used for the landfill disposal of solid wastes.

Dump: An open land site where waste materials are burned, left to decompose, rust, or simply remain. Because of the problems which they create, such as air and water pollution, unsanitary conditions, and general unsightliness, dumps have been declared illegal in all states.

Energy Recovery: A resource recovery process where a part, or all, of the waste is recovered as a liquid, gas, or solid fuel or burned to produce steam for heating or electricity. This conversion includes pyrolysis, refuse-derived fuel (RDF), and methane recovery systems.

Ferrous: Metals which are predominately composed of iron.

Flow Control Law: Local ordinance controlling, or giving a municipal official authority to control, the collection and/or disposition of a municipal solid waste produced within a particular geographical area.

Glasphalt: A highway paving material in which recovered ground glass replaces some of the gravel normally used in asphalt.

Grading: Sorting of waste into homogeneous categories by type and quality.

Hazardous waste: Waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may do either of the following: (1) Cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, or; (2) pose a substantial present or potential hazard to human health or environment when improperly disposed of, or otherwise managed.

Unless expressly provided otherwise, "hazardous waste" includes extremely hazardous waste and acutely hazardous waste.

HDPE: High Density Polyethylene. Used for items such as milk containers, detergent containers, and base cups for plastic soda bottles.

Household Wastes: Wastes arising at individual dwellings and normally collected by local authorities.

Incineration: The controlled process by which solid, liquid, or gaseous combustible waste are burned and changed into gases with the residue produced containing little or no combustible material.

Incinerator: A plant designed to burn waste materials to reduce the volume of waste needing disposal. Energy can be recovered from incineration heat.

Industrial Wastes: Wastes produced at an industrial plant. It includes "prompt" waste which arises during manufacture of the material and "process" waste which arises during later stages of product fabrication.

Inorganic Wastes: Wastes derived from non-living organisms, primarily minerals. Consist of metals and glass.

Landfill disposal: Refers to the final deposition of solid wastes into or on the land. Landfill disposal regulations include minimum health and safety standards.

Leachate: A liquid containing decomposed waste, bacteria, and other noxious and potentially harmful materials which drains from landfills.

Life-cycle costing: A system of pricing which reflects the full environmental and resource costs of materials and products.

Litter: Waste discarded outside the established collection-disposal system.

Low Technology: The general term for non-centralized resource recovery.

Mandatory recycling: Law requiring citizens to source separate or recycle their trash, or requiring local or county governments to achieve a certain level of recycling. State mandatory recycling laws exist in Rhode Island, Connecticut, and New Jersey. A number of municipalities have local mandatory recycling ordinances which require residents to set out recyclables separately from other trash.

Material recovery: One concept of resource recovery where the emphasis is on separating and processing waste material to be sold for various purposes.

Materials market: The combined commercial interests that buy recovered materials and process them for reuse.

Methane: A colorless, odorless, combustible gas produced by decomposition of organic wastes.

Municipal Solid Waste (MSW): Refuse derived from household, commercial, and industrial sources; as distinct from hazardous waste, sewage or sewage sludge, air pollution control equipment ashes, etc.

Non-Ferrous Metals: Metals which contain no iron, such as aluminum, copper, brass, and bronze.

OCC: Acronym for "old corrugated cardboard," i.e. used cardboard boxes typically used for recycling.

Office Paper: Waste paper generated by offices, including stationary and computer paper.

Open Burning: The burning of waste materials in the open air or in a dump.

Organic Waste: Waste material made from substances composed of chemical compounds of carbon and generally manufactured in the life processes of plants and animals. These materials include paper, wood, food wastes, plastic, and yard wastes.

Particulates: Microscopic particles of waste substances which contaminate air.

PET: Polyethylene Terephthalate. Plastic beverage containers are usually made of PET.

Pollution: A change in the physical, chemical, or biological characteristics of the air, water, or soil, in such quantity, of such nature and duration, or under such condition that the quality, appearance, or usefulness of the water, soil, land, or air is significantly degraded or adversely altered.

Post-consumer waste: Materials that have been discarded after use by consumers. Post-consumer waste can be segregated for use as secondary resources.

Primary Materials: Virgin or new materials used for manufacturing basic products such as wood pulp, iron ore, silica, and bauxite.

Prompt Scrap: Residue resulting from the manufacturing process, e.g. broken bottle or paper trimmings, that is reused for manufacturing.

Pyrolysis: The chemical decomposition of a material by heat in the absence of oxygen. Combustible gas, oil, and char are the main pyrolysis methods.

RCRA: The Federal Resource Conservation and Recovery Act, the basic federal solid waste statute. Enacted in 1976 and amended several times, most significantly in the Hazardous and Solid Waste Amendments of 1984.

Recyclability: The degree to which a discarded material or product can be recycled. A recyclable good is one which requires minimum reprocessing.

Recycling: The recovery and subsequent use of a secondary material for the manufacture and/or fabrication of a material or product similar to that from which the secondary material originated. Usually refers to the cleansing, sorting, treating, and reconstituting of waste or other discarded materials for the purpose of reuse as a new product by reprocessing or remanufacturing.

Recycling Center: A central facility where materials are collected for sorting and transport back to manufacturers for reuse or reconstitution.

Refurbish: To repair, clean, or upgrade goods.

Refuse-Derived Fuel (RDF): The combustible, or organic fraction of waste which has been prepared for use as a fuel by any several mechanical processing methods (e.g. shredding, air classification).

Remanufacturing: The process of disassembly and reassembly of products during which time parts are cleaned, repaired, or replaced.

Resource Recovery: The process of collection, transfer, sorting, separation, decontamination and/or upgrading etc., of materials in waste for the purpose of recycling, reuse, byproduct generation, or use for energy recovery or compost.

Originally referred to any method of recovering materials or energy from waste. So used, for example, in the Resource Conservation and Recovery Act. Now used primarily to refer to the generation of steam or electricity by burning solid waste, as in "resource recovery facility."

Retreading: Tire recycling where worn treads are replaced with new ones and the tire casing is being reused.

Reuse: The recovery of a secondary material and its subsequent use in its original form and for its original use; for example, refilling a soda bottle.

Salvage: Recovery of usable items from the waste stream.

Sanitary Landfill: A method of disposing refuse on land without creating nuisances or hazards to public health or safety. Careful preparations of the fill area and control of water drainage are required to assure proper landfilling. To confine the refuse to the smallest possible area and reduce it to the smallest practical spread, compact and usually cover the waste daily with at least six inches of compacted dirt. After the area has been completely filled and covered with a final two to three-foot layer of dirt.

Scrap: "New" scrap: comprises "prompt" and "process" waste (see waste) arising during manufacture and processing of the material in fabrication of articles.

"Old" scrap comprises wastes arising from municipal and post-consumer sources but may include industrial waste.

Scrap industry: Also called the secondary materials industry. Includes purchasers, processors, and users of recoverable waste materials.

Secondary materials (resources): Post-consumer resources that can be used to replace or supplant primary, or virgin resources.

Separate collection: The collection of materials that have been segregated.

Solid waste: All putrescible and nonputrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste, manure, vegetable or animal solid and semisolid wastes, and other discarded solid and semisolid wastes--solid waste does not include hazardous waste.

Solid waste disposal or "disposal": The final deposition of solid wastes onto land, into the atmosphere, or into the waters of the state.

Solid waste facility: A disposal facility, a disposal site, or a solid waste transfer site processing solid waste.

Source reduction: Any action which causes a net reduction in the generation of solid waste: the first priority in any waste management hierarchy. The reduction in the quantity of waste, as for example, by increasing durability, reducing material weight and volume, reducing packaging, using two sides of paper, etc. Source reduction includes, but is not limited to, reducing the use of nonrecyclable materials, replacing disposable materials and products with reusable materials and products, reducing packaging, composting yard wastes, establishing garbage rate structures with incentives to reduce the amount of wastes generated, and increasing the efficient use of paper, cardboard, glass, metal, plastic, wood, and other materials in the manufacturing process.

Source reduction does not include steps taken after the material becomes solid waste.

Source separation: A process in which individual generators of discards separate them into glass, metal, and paper fractions for recycling.

Thermal conversion: Includes all processes utilized to process combustible materials to free stored energy.

Thermodynamics--(Law): Tells us that systems become more stable as they become mixed. In terms of waste recycling, this means that the more mixed waste becomes, the more energy and effort it takes to separate it and make it recyclable.

Tipping fee: The charge for use of a disposal facility: stated as the fee per ton or cubic yard of waste disposed.

Toxic Substances: Chemicals, metals, compounds, and other substances which pose strong and immediate hazards to living systems. An important fraction of our waste stream contains toxic substances.

Transfer or processing station: Facilities used to receive solid waste, temporarily store, separate, convert, or otherwise process material in the solid wastes, or to transfer the solid wastes directly from smaller to larger vehicles for transport.

Transformation: Incineration, pyrolysis, distillation, gasification, or biological conversion other than composting. Transformation does not include composting.

Vector: A disease carrier and transmitter, usually an insect or rodent.

Virgin material: A natural resource, a "raw material" which has not previously been processed or used in manufacturing.

Waste: Any material which is rejected by the holder as no longer having any value. Post-consumer materials that have no economic value.

Waste Reduction: The process of eliminating part of the waste stream before it is generated. This method includes using less material in manufacturing processes, switching to returnable beverage containers, and prolonging product life.

Waste-to-Energy: Includes a variety of technologies designed to convert the organic fraction of wastes into an energy source. Most systems burn solid waste, producing energy as a side product. Since volume reduction is central to its purpose, refused derived fuels (RDF) and mass burn technologies are included in this definition.

Waterwall incinerator: Incinerator constructed with walls of welded steel tubes through which water is circulated to absorb the heat of combustion. The steam or hot water thus generated may be put to a useful purpose, or simply used to carry the heat away to the outside environment.

White goods: Large household appliances such as refrigerators, stoves, washing machines.

Wood Pulp: The primary material from which most papers are manufactured. It is made up of small, loose wood fibers mixed with water.

* SOURCES: Adapted from California Solid Waste Management Board, Glossary of Solid Waste Management Terms (Sacramento, California, July 1982); Environmental Defense Fund, Coming Full Circle: Successful Recycling Today (N.Y.:Environmental Defense Fund, 1988), pp. 124-126; Arthur H. Purcell, The Waste Watchers: A Citizens Handbook for Conserving Energy and Resources (Garden City, New York: Anchor Press/Doubleday, 1980), pp. 261-267. California, Assembly Bill 939, (Sacramento, California, 1989), sections 40121, 40141, 40201, 40192.

APPENDIX A

LAWS AND ACTIONS EFFECTING
SOLID WASTE MANAGEMENT, 1899-1988

Year	Act and Agency	Federal/State Action
1899	Rivers and Harbors Act of 1899 - Federal	Eliminated disposal of debris on banks of and into navigable waterways.
1933	U.S. Supreme Court outlaws ocean dumping of municipal wastes.	
1950- 1959	California Department of Public Health establishes landfill operation guidelines for local health departments and tries to carry out a program to eliminate open burning dumps.	
1963	The Clean Air Act of 1963 - Federal	Set pollution level standards or limiting emissions or effluents of various types of pollutants.
1965	Solid Waste Disposal Act - State	State Department of Public Health required to identify environmental, public health and safety hazards of solid waste disposal sites.
1967	Mulford-Carrell Air Resources Act - State	Created state Air Resources Board, which regulates landfills.

APPENDIX A - Continued

Year	Act and Agency	Federal/State Action
1969	National Environmental Protection Act - Federal	Requires all federal agencies to file Environmental Impact Statements (EIS) for any proposed legislation or project having a significant effect on environmental quality.
1970	California Environmental Quality Act (CEQA) - State	Requires an Environmental Impact Report (EIR) for any major action and a discussion of mitigation measures.
1970	Porter-Cologne Act - State	Requires Regional Water Quality Control Board to develop water quality plans and to issue discharge permits within their water quality region.
1970	Open burning outlawed.	
1972	Water Pollution Control Act - Federal	Established point source effluent standards for all point sources of water pollution.
1973	Senate Bill 5 - State	Created the Solid Waste Management Board and required minimum standards for solid waste facilities, policy on resource recovery, and required counties to develop comprehensive waste management plans.
1974	Senate Bill 1797 - State	Required solid waste facilities to be in conformance with solid waste management plans.

APPENDIX A - Continued

Year	Act and Agency	Federal/State Action
1975	Energy Resources Conservation and Development Act - State	Created the California Energy Commission which regulates cogeneration facilities that generate fifty or more megawatts including waste-to-energy facilities.
1976	Resource Conservation and Recovery Act of 1976 (RCRA) - Federal	Controls pollution by regulating the disposal of wastes. Requires comprehensive waste management plans, eliminates open dumps, ensures that landfills comply to federal standards.
1976	Solid Waste Control Act (AB 2439) - State	Required periodic review of solid waste plans; established local enforcement agencies (LEA's) and required them to develop local enforcement programs and enforce state landfill standards; LEA's to permit solid waste facilities and to periodically review permits; California Waste Management Board (CWMB) given responsibility for overseeing, and ability to intervene in cases of ineffective enforcement of state and local minimum standards.
1982	Senate Bill 1346 (Presley) - State	Strengthened CWMB by expanding its authority over LEA's; called for development of list of non-complying facilities; required noncompliant facilities to come into compliance within a year of being found in violation of the state minimum standards.

APPENDIX A - Continued

Year	Act and Agency	Federal/State Action
1982	Assembly Bills 3302, 3433 and 1388 - State	Requires solid waste facilities to be designated specifically in local general plans and County Solid Waste Management Plans before establishment. Requires facilities to be compatible with surrounding land uses, prevents noncompatible land uses adjacent to permitted facilities.
1983	Assembly Bill 1807 - State	Directed the Air Resources Board to identify toxic air contaminants, and in cooperation with local air districts develop and adopt control measures for those contaminants.
1984	Amendments to RCRA, Subtitle D - Federal	Exempted waste-to-energy facilities incinerating municipal solid waste from hazardous waste regulations if proper control measures implemented to ensure hazardous materials did not enter facility; requires State to develop a permit/inspection program for landfills receiving small quantities of hazardous wastes.
1984	Assembly Bill 2292 - State	Requires provisions in waste-to-energy permit process to prevent introduction of hazardous materials. Requires Department of Public Health Services to classify ash residues from waste-to-energy as nonhazardous if the operator demonstrates proper precautions are taken to prevent unauthorized receipt of hazardous material.

APPENDIX A - Continued

Year	Act and Agency	Federal/State Action
1984	Assembly Bill 3527 (Calderon), Cal. Stats. (1984), Ch. 1408, Sections 1 and 2. - State	Requires the CWMB adopt regulations to ensure landfill operators provide adequate methods for responding to personal injury and property damage claims resulting from improper design and operation of the facility; to provide Legislature with a report on the best methods for providing financial assurances for proper closure and post-closure for landfills.
1984	Assembly Bill 3525 (Calderon) - State	Established the Solid Waste Assessment Test (SWAT) program to evaluate landfills to determine their impact on air and water quality.
1986	Assembly Bill 1809 - State	Requires the CWMB to set State policy and guidelines regarding the safe handling and disposal of household hazardous wastes; counties required to include disposal options for household hazardous waste in County Solid Waste Management Plans.
1986	Assembly Bill 3989 (Sher) - State	Mandates Environmental Impact Reports for waste-to-energy projects.
1986	Assembly Bill 2020 (Margolin) - State	(The California Beverage Container Recycling and Litter Reduction Act) Establishes one-cent beverage container redemption program which provides for off-store-site recycling centers for glass, aluminum and plastic containers. Program to be administered by the Department of Conservation.

APPENDIX A - Continued

Year	Act and Agency	Federal/State Action
1988	Assembly Bill 1462 - State	
	Requires counties to integrate a twenty percent recycling goal into the County Solid Waste Management Plans.	

SOURCE: Adapted from; California Waste Management Board, A Comprehensive Plan for Managment of Nonhazardous Waste in California, (Sacramento, California, 1985a), pp. C11-C18; California Waste Management Board, 1986 Annual Report, (Sacramento, California, 1986), p. 4; California Waste Management Board, 1987 Annual Report, (Sacramento, California, 1987); California Waste Management Board, 1988 Annual Report, (Sacramento, California, 1988).

APPENDIX B

MARKETS, PRODUCTS, AND END USERS
FOR SECONDARY MATERIALS

Secondary Material: Old Newsprint
Source: Used Newspapers.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Paper Mills	Newsprint	Publishers Products
Paperboard	Recycled Boxboard, Cellulose Wadding,	Packaging Mfg. Mills
	Tube and Core Board	Mfg. of Tissue, Textiles, etc.
Mfg. of Construction Products	Gypsum Wallboard Liner, Roofing Felt, Cellulose Insulation, Reinforced Vinyl Flooring	Builders, Remodelers
Other Mfg.	Animal Bedding	Farmers
	Mulch	Landscapers, Gardeners, Highway Department (Caltrans)
	Kitty Litter	Pet Owners
Exports		

APPENDIX B--Continued

Secondary Material: Old Corrugated Containers
Source: Packaging materials.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Paper Mills	Kraft Paper	Mfg. of Bags, Wraps
Paperboard Mills	Tube & Core Board	Mfg. of Tissue, Textiles, etc.
	Linerboard, Corrugating Material	Mfg. of Corrugated Boxes
	Recycled Boxboard, Molded Pulp Products	Mfg. of Packaging
Mfg. of Construction Products	Gypsum Wallboard Liner, Roofing Felt	Builders, Remodelers

Exports

Secondary Material: Mixed Papers
Source: Office papers, paper packaging, magazines.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Paperboard Mills	Recycled Boxboard	Mfg. of Packaging
	Tube and Core Board	Mfg. of Tissue, Textiles, Etc.
Mfg. of Construction Products	Gypsum Wallboard Liner, Roofing Felt	Builders, Remodelers

Exports

APPENDIX B--Continued

Secondary Material: Office Papers

Source: Computer, colored and white office paper.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Paper Mills	Fine Papers	Printers
	Tissue Products	Paper Towels, Napkins
Paperboard Mills	Recycled Boxboard	Mfg. of Packaging
	Tube and Core Board	Mfg. of Tissue, Textiles, Etc.
Mfg. of Construction Liner	Gypsum Wallboard	Builders, Remodelers Products
Exports		

Secondary Material: Milk Containers (HDPE Plastic)

Source: Beverage Containers

<u>Market</u>	<u>Products</u>	<u>End User</u>
Mfg. of Construction Products	Lumber, Posts, Furniture, Etc. Drainage Tile Pipe, Traffic Cones	Builders, Retailers, Contractors, Highway Department
Mfg. of Other Products	Beverage Container Base Cups	Soft Drink Bottlers
	Flower Pots, Pails	Nurseries, Retailers

APPENDIX B--Continued

Secondary Material: Plastic Beverage Containers
Source: Food and beverage packaging.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Mfg. of Fiberfill	Fiberfill	Mfg. of Pillows, Jackets, Etc.
Mfg. of Other Products	Strapping, Paint, Paint Brushes, Toys Drainage Products, Boats, Carpet Pads	Wholesalers, Retailers

Secondary Material: Glass Containers
Source: Food and beverage glass packaging.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Mfg. of Glass Containers	Glass Containers, Bottles, Jars	Food and Beverage Packagers
Mfg. of Building Products	Fiberglass, Terrazzo, Brick Insulation, Foamed Glass, Masonry Blocks, Thixite, Pipes, Pozzolan (Concrete Additive), Bulk Paint Fillers	Builders, Remodelers, Public Works Department
Mfg. of Road Building Materials	Glass Beads (Asphalt Additive), Glasphalt, Slurry Seal (Asphalt sealant), Road Repair Material	Highway Dept. (Caltrans), Public Works Dept.

APPENDIX B--Continued

Secondary Material: Used Textiles

Source: Used clothing, garment
manufacturing waste.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Textile Mills	Wiping Rags, Felt Goods, Padding and Upholstery Filling, Floor Mops, Writing Paper	Retailers, Wholesalers

Secondary Material: Organic Waste

Source: Leaves, tree trimmings, yard
clippings, wood chips, straw,
manure, food scrap.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Composters	Mulch, Compost	Landscapers, Homeowners, Retailers
	Landfill Cover	Landfill Operators

Secondary Material: Motor Oil

Source: Used oil from autos, trucks and
machinery.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Refineries	Motor Fuel, Fuel Oil, Lubricating Oil.	Retail and Wholesalers.
	Asphalt Shingles	Builders

APPENDIX B--Continued

Secondary Material: Used Tires
 Source: Automobiles and trucks.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Retreaders	Retreaded Tires	Retailers
Energy Production	Tire-derived Fuel	Boiler Operator
	Door Mats, Inner Tubes, Conveyer Transmission and Automotive Belts, Automotive Hoses	Retailers
	Asphalt Additive	Contractors, Highway Departments
	Vehicle Impact Attenuators	Highway Departments
	Athletic Court Surfacing, Play equipment	Sports Clubs, City Recreation Departments
	Artificial Reefs	Commercial and Sport Fishing Interests
	Erosion Control	Highway Departments

Secondary Material: Aluminum
 Source: Cans; foil and pie trays;
 aluminum wire, aluminum scrap.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Aluminum Fabricators	Sheets for Can Manufactures, Cans	Food Packagers
Aluminum	Doors, Window Frames, Extrusions	Builders, Fabricators Remodelers

APPENDIX B--Continued

 Secondary Material: Other Non-Ferrous Metals

Source: Lead batteries, lead scrap and alloys, nickel alloys, copper wire, brass and bronze scrap, zinc scrap.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Various Fabricators	Pure Lead and Lead Alloys, Fishing Sinkers and Net Weights, Solder.	Commercial and Sport Fishing Industry, Various Metals Foundries and Fabricators.

Secondary Material: Ferrous Metals

Source: Steel cans; tin, bi-metal and non-tin cans; iron and steel scrap; scrap automobile.

<u>Market</u>	<u>Products</u>	<u>End User</u>
Steel Mills	Steel Sheet, Steel Tubes and Castings	Various Mfgs. and Fabricators
Iron Foundries	Iron Castings, Manhole Covers	Various Mfgs. and Fabricators
Detinners	Detinned Steel	Steel Mills, etc, Copper Precipitators
Foundries	Tin, Tin Ingot	Mfgs. of Tin Chemicals, Other Products

SOURCE: Arthur Young and Company, Factors Which Inhibit the Demand For Secondary Materials: Phase 1 Marketing Report. (Sacramento, California, 1981), pp. 39, 56, 77, 95, 97-109; California Glass Recycling Corporation, Untitled brochure, 2 Embarcadero Center, Suite 2700, San Francisco; Porter, R., Energy Savings by Waste Recycling, (New York: Elsevier Applied Science Publishing Co., Inc., 1985), p. 173; Franklin and Associates, Feasibility of Tax Incentives for Purchases of Recycling Equipment or Recycled Products, (Prairie Village, Kansas, 1987), pp. 3-9 - 3-15.