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Integrated solid waste disposal pricing : a solution to solid waste management for Hollister, California

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**INTEGRATED SOLID WASTE DISPOSAL PRICING:
A SOLUTION TO SOLID WASTE MANAGEMENT
FOR HOLLISTER, CALIFORNIA**

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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May, 1993

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ABSTRACT

INTEGRATED SOLID WASTE DISPOSAL PRICING: A SOLUTION TO SOLID WASTE MANAGEMENT FOR HOLLISTER, CALIFORNIA

by Phil Woodward

As a result of Assembly Bill 939, many communities are considering economic incentives that financially reward residents who reduce their curbside solid waste. These disposal schemes should incorporate the goals of waste planners, support diversion programs, and reflect motivating factors of local residents.

How should such fee schedules be structured? An answer is sought for a small California town. Research methods include a literature search, a summary of economic theory, and a survey of 265 residents regarding reduction and diversion incentives.

This thesis concludes that it is better to increase diversions through a combination of intrinsic and extrinsic rewards, rather than relying upon a steep variable disposal rate to force residential diversions. If a steep rate is implemented, there is greater incentive to illegally dump, greater economic inequality and greater uncertainty about system revenues. For Hollister, a modest rate variation seems adequate if accompanied by recycling opportunities and "clean sweep" days.

TABLE OF CONTENTS

ABSTRACT	i
LIST OF FIGURES	vi
LIST OF TABLES	vii
INTRODUCTION	1
CHAPTER 1	5
Objectives of Thesis.....	5
Statement of Thesis	5
Thesis Methods.....	6
Summarize Economic Theory.....	6
Related Works Search	8
Conduct Iterative Statistical Survey	8
Reduce, Analyze & Interpret Data.....	9
CHAPTER 2	12
Introduction	12
A Brief History of Economics	14
Classical Economics	15
Neoclassical Economics	17
Humanist Economics	19
Environmental Economics.....	21
Techniques of Environmental Economics	25
Methods of Achieving Resource Efficiency	27
Direct Regulation	27
Taxation and Subsidization.....	28
Incentive Pricing.....	29
Economic Approaches for the Environment.....	30
Property Rights Solutions to Environmental Pollution	31
Limitations and Detractions of Economic Incentives	32
Public Property Resources	34
Solid Waste Management-A Public Property Resource?	36
Local Waste System Utilities?	38
Summary of Background Economics.....	40
CHAPTER 3	43
Introduction	43
Factors That Affect Solid Waste Generation	44
Intrinsic and Extrinsic Incentive Schemes.....	50
Types of Economic Incentive Structures	53
Flat Fees.....	53
Bag/Tag System	54
Variable Disposal Rates.....	55
Designing an Incentive Scheme that Works.....	57
The Problem of Illegal Dumping	59

Fee Structure.....	61
Financial Penalties for Illegal Dumping.....	62
Hard-to-Dispose Items.....	63
Theft of Disposal Capacity.....	64
Burning Solid Waste.....	64
Conclusion	65
San Jose's New Variable Rate Scheme.....	65
Attitudes About Solid Waste And Recycling.....	69
Hispanic Opinions About Solid Waste and Recycling.....	71
Summary of Related Studies.....	73
CHAPTER 4.....	76
Introduction	76
Background To Study	77
Hollister Background	77
Prior Studies of the Hollister Wasteshed.....	80
Survey Development.....	86
Reasons for Survey.....	86
Target Population.....	88
Sampling Methods	89
Expected Data Quality.....	90
Questionnaire Development.....	91
Survey and Results.....	94
Initial Telephone Survey.....	94
Spanish-speakers.....	95
Subsequent Door-to-Door Survey.....	96
Data Input and Analysis	105
Data Quality	113
Survey Findings.....	114
Additional Analysis of Hollister's Data.....	120
Measures of Association.....	120
Survey Conclusions.....	123
CHAPTER 5.....	127
General Conclusions.....	127
Unresolved Questions and Future Studies	130
Specific Recommendations to Hollister.....	132
LIST OF REFERENCES	136

LIST OF FIGURES

Figure	Page
1. Map Showing Location of San Benito County and Hollister.....	4
2. Pricing Study Methodology Flowchart	11
3. Human Economy As Dependent Upon Planetary Economy.....	22
4. Map of Hollister's Census Tracts.....	79
5. Solid Waste Disposed at John Smith Landfill 1988-1992.....	81
6. Survey Questionnaire Used in Study.....	92
7. Response Rates for Survey Question C.....	97
8. Response Rates for Survey Question 2	98
9. Response Rates for Survey Question 4	99
10. Response Rates for Survey Question 6	100
11. Response Rates for Survey Question 9	101
12. Response Rates for Survey Question 10.....	102
13. Response Rates for Survey Question 11.....	103
14. Response Rates for Survey Question 12.....	104

LIST OF TABLES

Table	Page
1. Hollister's Diverted and Disposed Materials 1991.....	83
2. How Hollister's Solid Waste Is Managed 1990	84
3. Where Recycled Materials Went 1990	85
4. How Hollister Will Meet AB 939 Requirements.....	87
5. Combined Survey Counts and Percentages	106
6. Survey Response Percentages By Sampling Event.....	111
7. Response Distribution (in percent) to Selected Question Sets.....	122

INTRODUCTION

With the passage of Assembly Bill 939 by the California Legislature in 1989, most California communities are now facing mandated reductions in their solid wastestream. The new law and its related bills require California jurisdictions to divert 25% of their solid waste away from landfills by the year 1995, and 50% by the year 2000. Attainment of these goals in small jurisdictions is limited by the availability of funding for source reduction and recycling programs. New mechanisms for encouraging reduction and diversion of solid waste are needed. Some communities are imposing higher tipping and disposal fees, but rural jurisdictions have fewer options. With the availability of large areas of open land and the historic attitude of residents, a rural population is less dependent upon waste disposal services and can resort to illegal dumping if fees are perceived to be exorbitant. For this reason, many rural communities are hesitant about encouraging recycling and diversion through solid waste fees.

The following chapters explore how solid waste planners could motivate rural residents living in Hollister, California, to minimize and recycle their solid waste through economic incentives. The term "economic incentive" refers to the use of financial gains to motivate changes in residents' waste disposal behavior. Economic incentives provide residents with the choice of either paying increased costs for unsorted waste disposal, or paying reduced rates when they reduce and recycle. Moreover, the use of variable disposal rates signal the environmental cost of residents' actions. Variable disposal rates can only succeed as part of a larger integrated waste management program. Integrated waste management focuses on all aspects of waste materials management, from educating residents and providing convenient recycling and composting programs, to pricing of

disposal rates. Residents will only choose diversion over more expensive unsorted disposal if convenient diversion opportunities are available and residents are aware of them. A community must also have education and awareness programs that publicize the variable disposal rates and which inform residents of available alternatives. Unless residents know about diversion programs, they cannot participate.

Comprehensive fee scheduling, where the cost of disposal is related to the amount of solid waste that is disposed, can provide both incentives for waste reduction and recycling, and disincentives for unsorted disposal. Fee scheduling that worked together with diversion services and which provided opportunities to minimize household disposal costs, would encourage waste minimization and recycling. In rural jurisdictions, comprehensive fee scheduling may offer a method to significantly increase solid waste diversions without implementing expensive centrally planned curbside recycling programs. A waste fee schedule that worked together with curbside recycling programs might encourage a shift from unsorted disposal to curbside recycling programs. But disposal fee schemes should reflect local waste disposal alternatives and the perceived value of waste disposal services to local residents. Fee schedules should also minimize illegal dumping.

What is the optimum disposal fee that will encourage diversion without inducing illegal dumping? What amount will provide sufficient incentive to encourage recycling without angering local residents? The cost of disposal has implications for every resident, business, and landowner in a local area. Solutions must provide less costly disposal alternatives that meet the reduction and diversion objectives of local planning bodies while also funding residential waste management services. The existence of disposal alternatives are crucial to any pricing scheme that attempts to modify residents' behavior because they allow a resident to use disposal alternatives to reduce his garbage bill. A carrot-and-stick approach can provide cheaper waste management methods to households while penalizing unsorted disposal. This thesis suggests methods to find appropriate pricing schemes that

encourage reduction and diversion of solid waste from a small central California town:
Hollister, California (Fig. 1).

Map Showing Location of Hollister
& San Benito County

Figure 1

CHAPTER 1

BACKGROUND TO THESIS

Objectives of Thesis

The objectives of this thesis are: (1) to summarize and discuss relevant background issues regarding variable disposal rates; (2) to summarize and critique economic theory that is used to support economic policies for environmental protection; (3) to conduct a statistically relevant survey of Hollister residents regarding their disposal and recycling habits, and their preferences to differing economic schemes; and (4) to suggest appropriate changes in Hollister's solid waste system in order to increase solid waste diversions without increasing illegal dumping.

Statement of Thesis

This thesis investigates the hypothesis that variable disposal rates can encourage waste diversion and reduction by residents in a small central California town. It investigates how to motivate residents to recycle and reduce their solid waste through economic incentives that are part of an integrated waste management scheme. The term "variable disposal rates" refers to disposal fees that are related to the type, volume, or weight of waste that is disposed. Landfills have historically charged self-haul and commercial customers disposal fees that are based on the type, weight, or volume of solid waste received, but residential service subscribers have, in the recent past, been exempt from this fee mechanism. This is partly due to the history of landfill disposal and the simplicity of administering fixed-fee schemes. In addressing health management issues, waste collection services have given residential service subscribers unlimited disposal service

levels, and in so doing may have encouraged less-than-optimal use of disposal resources. Because of cheap and convenient disposal for large quantities of mixed solid waste, recycling and diversion incentives may be thwarted. If disposal fees are charged based on volume or weight of disposed materials, and inexpensive recycling is available to residents, waste reduction and diversion may increase.

If solid waste disposal services are a "normal" economic good, increases in the cost of service would be expected to decrease the amount of solid waste that is disposed. Solid waste that would otherwise be disposed might, instead, be diverted from garbage collection to recycling. This thesis proposes that increases in the cost of disposal will be offset by recycling and legal diversion only when convenient and inexpensive diversion alternatives are available to residents. If residents are aware of convenient recycling choices, and if they are charged disposal fees based on the volume of solid waste that is disposed through unsorted landfilling, residents will find other methods to manage their waste and reduce their disposal costs. A community must be very careful that the pricing mechanism it adopts doesn't encourage illegal dumping. Illegal dumping has continued to be a problem in many communities, and the imposition of variable disposal rates may have an adverse effect on levels of illegal dumping. This thesis also investigates the causes and solutions to illegal dumping within the context of an integrated waste management scheme. This thesis surveys Hollister's residents to determine if there are motivating factors that can be exploited by the city in pricing and providing solid waste services and diversion opportunities for its residents.

Thesis Methods

Summarize Economic Theory

This thesis will briefly summarize the historic precedents for environmental economic incentive schemes. Our treatment of the environment, such as the ability to

conveniently and cheaply dispose of large amounts of solid waste, is a reflection of past and current economic world-models and their valuation of the environment and its services. Changes in our treatment of the environment reflect our changing perception about the value of the environment and how to mesh its services with economic models. One reason to use economic incentives in solid waste management is that it promotes efficiency in the management of solid waste resources. Economic incentives are broadly described in this thesis and the concept of efficiency in the marketplace is criticized from the standpoint of equality. Trade-offs exist between equality and efficiency in the marketplace and before economic incentive schemes are adopted as a solution to environmental degradation, their underlying economic theory must be understood.

The use of economic incentives to protect the environment assumes that humans make decisions primarily as they relate to their economic well-being: the rational economic model for human behavior. It is widely recognized that this model doesn't fully explain human behavior. There are other drawbacks to using this behavioral approach for the environment. Economic incentives such as variable disposal rates can be regressive: poorer members of society are more impacted by increased disposal costs. Although a well-designed system would offer convenient alternatives to unsorted disposal, a wealthy household can simply pay higher disposal costs, while a poorer household does not have that option; they must reduce, divert or illegally dump their waste. Finally, a presentation about public property resources is provided that offers a utility-like arrangement for the operation and maintenance of solid waste systems similar to local power and telephone utilities. Utility models have been proposed for municipal services such as solid waste management, where a local regulated monopoly may provide greater good by working within constrained profit margins and using conservation as a demand management tool.

Related Works Search

To place this study in the context of other recent work in this field, a literature search was conducted. Prior studies about the demand and elasticity-of-demand for solid waste services are summarized. A brief description of different types of economic incentive structures is given, and methods that should be employed when developing an incentive scheme are summarized. Focusing on journals, books, articles, presentations, and agency reports, prior studies that impact this thesis were sought. Theories and models are borrowed from the field of economics in order to describe this public property resource question. Agencies and jurisdictions that have already implemented variable disposal rates were sought. The City of Seattle implemented a variable disposal fee in 1981, while locally, San Jose's Recycling Plus! fee schedule will be implemented in July, 1993. These jurisdictions' experiences were evaluated and applied, where appropriate, to the local conditions in San Benito County and Hollister. Finally, the general public's opinion about variable disposal rates and the opinion of Hispanics is described. Because Hollister has a large population of Hispanics, their opinions and concerns are essential to the success of any variable rate scheme.

Conduct Iterative Statistical Survey

This thesis also conducts a statistically relevant survey of Hollister's residents to determine their preferences among various incentive schemes and diversion and recycling programs. Before Hollister was surveyed, its population was characterized in terms of ethnic and economic make-up. Economic and demographic characteristics of local census tracts provided this information, and appropriate sampling methods were devised for surveying its residents. An initial telephone survey of about a dozen residents revealed general attitudes and knowledge of residents about recycling and garbage disposal. Feedback from this survey was then used in developing a questionnaire for the full survey.

Questions in the full survey focused on qualitative as well as quantitative issues that were very important to residents. The research sought candid, honest, answers to questions pertaining to various types of alternative waste system arrangements and costs.

Future possible waste management systems were described, and residents were asked to predict their response to various waste systems. This study sought to quantify the value of waste disposal to residents and to predict their response to variable disposal rates. Questioning focused on the possible costs of disposal, the costs of alternatives, and the residents' preferences from among these alternatives. Two types of interviews were conducted: telephone interviews and door-to-door interviews.

Residents' personal values and preferences must be described before an incentive scheme can be developed and expected to work. By understanding these motivating factors, residents' behavior can be predicted and influenced through an incentive scheme. Questions that probed the value system of residents and asked participants to rate possible waste disposal systems were devised and used. This thesis surveyed existing research on the subject, devised and conducted appropriate sampling studies of Hollister, interpreted the results, and characterized anticipated behavior of residents in response to planned fee scheduling and diversion alternatives.

Reduce, Analyze & Interpret Data

Data was collected and tabulated in an Apple Macintosh® computer using the spreadsheet program Excel.* Data from each sampling event were collected and analyzed as a separate event and taken together with the other data as a whole. All results that were clearly unusable were discarded. Data that was usable was analyzed in a statistically sound manner and grouped according to similar and dissimilar characteristics. Statistical coefficients were generated and used in the interpretation of the data. Response sets were

* The spreadsheet program for the Macintosh.

also analyzed for associativity between sets of question answers. Collected data was analyzed and interpreted in light of other studies and in light of the goals of increased diversion as set forth in the Source Reduction and Recycling Element (SRRE). Future possible scenarios for recycling and diversion programs were anticipated based on these AB 939 planning documents.

The population of waste system users was subdivided into groups that share similar responses to, and concerns about, new pricing and waste management systems. These concerns and values determined pricing and service schemes that might meet with success in Hollister. Based on the interpretation of the data, suggestions were made for future pricing and diversion systems for the local jurisdictions, and a framework for future waste management and pricing was outlined. Finally, follow-up studies were suggested that can be used to glean further information regarding the behavior of users of the waste system.

The preceding methods are illustrated in Figure 2, which shows an integrated waste management system that is built from the motivations of local residents, AB 939's diversion requirements, and knowledge of other variable rate systems.

Building an Integrated Waste Management Scheme

Figure 2

CHAPTER 2

THE IMPORTANCE OF ECONOMICS

Introduction

Assembly Bill 939, the Integrated Waste Management Act of 1989, mandates a 25% reduction in the amount of solid waste disposed in California landfills by the year 1995, and a 50% reduction by the year 2000. In response, California communities are considering new disposal fees that rise with disposal volume and therefore encourage participation in diversion programs. Variable disposal rates, as they are known, will play an important part in helping communities meet future diversion goals. Hollister, California, is a rural community that is facing required diversion goals as part of AB939 planning. However, variable disposal rates are new, and their effect in rural jurisdictions is unknown. Because rural areas have large amounts of land and have traditionally self-managed their waste, there is a concern that variable disposal rates may increase illegal dumping.

As background to the relationship between disposal fees and recycling rates, this chapter gives a short survey of major economic ideas and outlines the economic models that drive current solid waste disposal and recycling practices. The survey illustrates the thread of past and present economic thought that has become environmental economics: the incorporation of ecological considerations into economic theory. Economic principles that are used in solving environmental problems are discussed, and the nature of resource depletion as an economic problem is explored. Public property resources are described and methods of achieving economic efficiency are presented. The merits of defining waste management as a public good to be provided by a public utility, similar to other publicly

owned local disposal utilities, are also summarized. Lastly, a discussion outlines the limitations of using economic incentives in seeking changes in residents' behavior.

A complaint that is frequently leveled against economic incentives and market solutions to social issues is that they are not fair because they do not fall equally onto all segments of society. A discussion of variable disposal rates must consider the equity of economic incentives. Will costs be uniformly felt across society, or will diversions be achieved principally through those who have the least money and are most impacted? This chapter has only outlined the issue. Economic incentives, by their nature, may be unequal to residents because of the unequal distribution of wealth in society. Poorer members of society will be more impacted by these new rates than wealthy residents. A community may need to plan for this unequal impact when developing economic incentives.

A discussion about the economics of variable disposal rates can begin with a summary of the evolution of contemporary economic thought and its role in society's perception of natural resources. The use of landfills to accommodate society's solid waste, and the present landfill-based disposal system, can be understood through a retrospective look at the fact that, historically, the environment has been economically treated as if it offered unlimited disposal opportunities for human activities. The history and practices of landfill disposal reflect larger resource questions about public property resources and our treatment of the environment. Social issues, economic questions, and environmental impacts are part of the discussion. This analysis does not resolve the questions "Should landfills exist?" or "What are their environmental impacts?" It presents the economic conditions that give rise to current landfill and solid waste practices. It describes the underlying economic assumptions that support current disposal methods and proposes a new pricing scheme that will encourage less wasteful materials management. These suggestions were formulated for Hollister, California, but much of the work can apply to other jurisdictions, particularly rural jurisdictions.

A Brief History of Economics

Economics is the study of resource allocation. The American Heritage Dictionary defines economics as the "science that deals with the production, distribution, and consumption of commodities," while economy is defined as the "careful or thrifty use or management of resources" (American Heritage Dictionary 1985). James C. Hite, an economist, defines economics as;

the science of values and choices. As a field of scholarly pursuit, it is concerned with the way in which individuals and society allocate the scarce resources which are available in order to obtain the maximum satisfaction of human wants. For reasons of convenience, most economic discussion centers around pecuniary values and pecuniary choices. But that is only because money is a useful index for expressing values. There are many other values which are not easily translated into the money index but, nevertheless, are amenable to economic analysis. Among these are the values associated with environmental goods (Hite 1972, p. 11).

G. Tyler Miller, in his environmental studies textbook, Living in the Environment, gives a broader definition of economics. He says "economics is the study of how individuals and groups make decisions about how to meet their needs and wants" (Miller 1990, p. 568). Miller makes the distinction between those requirements that are basic to life, the "needs," and those that are desired, the "wants." Economists have traditionally defined two branches of economics when addressing the question of resource allocation: positive economics, which is concerned with the production and distribution of goods, and normative economics, which is concerned with the ethical issues surrounding these activities. Economist Tom Tietenberg says "positive economics attempts to describe what is, what was, or what will be. Normative economics by contrast, deals with what ought to be" (Tietenberg 1988, p. 19). Most economists are concerned with positive economics, and shy away from what they perceive as moral arguments in normative economics.

Several distinct phases can be seen in the evolution of economic thought. Economic historian A. K. Dasgupta in his book, Epochs of Economic Theory, lists three periods of economic thought: classical, marginalist, and Keynesian (Dasgupta 1985, p. 4).

David Pearce, an economist, in his 1990 book, Economics of Natural Resources and the Environment, traces a similar history as he describes several periods that correspond to changes in resource allocation. His major periods are: classical, neoclassical, Marxian, and humanist (Pearce 1990 p. 5-16). These names describe broad schools of economic thought dominated by preeminent theorists. In its time, each economic school helped define governmental policy and has influenced resource allocation.

The history of economics is important in this thesis because it shows the changing content of past economic discussions and the perception of value. Each period found different paradigms to explain resource allocation issues and world events. The discussion that follows summarizes these periods to give the reader a better understanding of the evolution of economic thought and the precedence for today's discussion about charging polluters for their actions.

Classical Economics

Classical economics has its roots in the European industrial revolution. Classical economists saw the world in terms of resources, labor, and markets. Early thinkers like Adam Smith, Thomas Malthus, and David Ricardo all witnessed the transformation of mercantile Europe into an industrial society, and their ideas were products of the age. The upheaval occurring in 18th and early 19th century Europe provided a backdrop to their individual perceptions and economic models of the world. The Cornucopian and Malthusian world views that emerged at this time are still debated today between economists and environmentalists. Cornucopian economists believe in the increasing well-being of humankind: a belief that with a free market, things will only get better. Malthusians argue that things are not guaranteed to get better. Increasing human population and increasing demands on a limited resource base dictate a bleak future. Thomas Malthus saw that limited growth in food supply would be outstripped by an exponentially growing

population, while David Ricardo saw a steadily decreasing yield from new agricultural land. These three early economists gave shape to economic models that continue today.

In his essay, The Wealth of Nations, Adam Smith (1723-1790) described the principle of the "invisible hand," that invisible force that emerges when everyone seeks self-interest. He argued for the desirability of self-interest in promoting general social welfare. He based his beliefs on the free exchange of goods between buyers and sellers, and he argued that any voluntary private exchange of money for goods left each party better off, since otherwise they would not have made the transaction. His "free market," a free arena of transactions, could answer social resource allocation questions such as "What to produce?" and "How much to pay?" Whatever was demanded by consumers, the market would provide. If individuals sought personal benefit through their personal transactions, he argued, general society would also benefit since social benefit is nothing but the sum of private benefits.

Thomas Malthus (1766-1834) published his Essay on the Principle of Population, As It Affects the Future Improvement of Society in 1798, and it was this work, rather than his other economic writings, that brought Malthus his fame. This work was a critique of the Poor Laws that were in place at the time. The Poor Laws that had been enacted in England were intended to bring relief to the growing poverty of the working class. In an argument similar to modern criticism of welfare payments, Malthus argued that the Laws actually did more harm than good, and tended to stifle initiative (Bell 1967, p. 182-3). Malthus saw a future of unchecked populations seeking limited food and thus a future of declining living standards. Malthus' essay, written almost 200 years ago, disputed Adam Smith's arguments of the free market providing increasing welfare for humanity. In today's discussion, his theory about limited food supply now has expanded to encompass all resources, and environmentalists who challenge growth-centered economic theory are called "neo-Malthusian" in their beliefs. Although his original argument did not foresee

declining population growth rates in western post-industrial countries, Malthus' population theory might today describe many third-world countries.

A third classical economist was David Ricardo. He lived, like Smith and Malthus, in late 18th and early 19th century Europe. His view was more sophisticated than either Smith's or Malthus' in that he saw more subtle underlying issues in resource questions. His constraints on unlimited economic growth involved the diminishing returns on increasingly marginal land. New land that is brought under the plow is less and less productive, and any increases in the food supply are gained by greater and greater efforts. John Stuart Mill, a contemporary of Ricardo and Malthus, saw a race between limited natural resources and human science and technology. In Mill's economic model, humankind's future was dependent upon human ingenuity and the ability to use science to serve human needs. Science and technology were seen as the buffer between natural resource limitations and the needs of an expanding population.

Marxian Economics

The early economic models were influenced and shaped by Marxian economics and the emergence of labor oriented paradigms. In these economic models, pursuit of profit as described by Smith, underlaid a system that exploited the workers. A struggle existed between those with capital (the capitalists), and those without capital (the proletariat). Human labor elevated raw materials into things of value, the value of which was only dependent upon the accumulated labor in that good. The economic struggle, as defined by Marx, was between those who labored and those who possessed capital. Those with capital would invest in profit-driven factories and they would seek to pay the lowest wage to those who worked.

Neoclassical Economics

Around 1870, a re-emergence of classical economic thought began to see the

scarcity of a good, rather than its accumulated labor, as the indicator of value. Pricing was a dynamic process between those with the good and those who wanted the good: the Law of Supply and Demand. This process set prices and determined production levels. New manufacturing methods, whose management demanded more refined financial analysis, prompted the emergence of neo-classical marginal analysis. Neoclassical economists began considering the incremental cost of production versus price, in a new system of "marginal analysis" (Pearce 1990, p. 10). Marginal analysis provided a financial framework that was based on classical economics to decide economic questions. Marginal analysis answered investment questions such as "Should production be increased?" or "Should additional capital be invested?" Investments made sense if the marginal cost was less than the marginal benefit and a profit could be made.

Marginal analysis is not value-free as is often claimed; marginal analysis seeks only profitable ventures based on profit-oriented decision making. Pearce says of the marginalists:

The neoclassical theory of the market was supposed to be neutral and value-free. The basic aim had been to define a set of economic laws which governs economic activity (in much the same way as physicists had done following Newton's discoveries). Rational individuals were seen in terms of seeking to satisfy substitutable wants (or preferences) and this pursuit of individual self-interest was also believed to be improving societal welfare; thus, within the 'hard-core' of the neoclassical system was a particular model of human nature—the 'rational and egotistic person' (Pearce 1990, p. 10).

For the marginalist approach to make sense, the rational egotistic/economic person was introduced as a model for human behavior. In the model, individuals rationally seek personal benefit in their economic and personal decisions. To the marginalists, social benefit was equal to the sum of all private benefits, and if all individuals sought private gain through their individual economic decisions, social welfare would result. Unsatisfied wants—the desire to make their lives better—were the driving force of society. The flow of financial resources would go towards creating and selling those goods that fulfilled the

wants of individuals. If all individuals were allowed to pursue individual self-interest, their collective actions would maximize social welfare. Governmental intervention in this process was wrong because it interfered with the free market and hindered the achievement of individual, and thus, societal welfare. Swiss economist Vilfredo Pareto coined an expression at the turn of the 20th century to describe that condition where resources were optimally allocated: Pareto optimality.

Allocations are said to be Pareto optimal if there exists no rearrangement of that allocation that would benefit some people without any deleterious effect on someone else (Tietenberg 1988, p. 25).

In theory, Pareto optimality would result if all individuals sought their respective individual private gain. Some market intervention might be justified in a neoclassical system when market failures existed, when the free market condition clearly did not maximize collective social welfare. However, for the most part, Neo-Classical economists, like their Classical predecessors, believed in minimal governmental interference in the free market system—a laissez-faire attitude that prevailed throughout the last half of the 19th century in both the United States and Europe. An outcome of this laissez-faire attitude was social disruption and economic depression during the early years of the 20th century.

Humanist Economics

The reformist economics movement in the early 20th century reflected social history. The excesses of the previous century's capitalism—the large scale misery brought on through poor working conditions, low wages, and wild swings of the financial markets—all pointed to the need for some sort of governmental intervention in the free market. Individual pursuit of self-interest was tempered by those who believed capitalism also had to meet social needs. These economists wanted to harness market forces to provide social goods that could not be supplied through individuals seeking individual self-interest. Pearce calls this school of thought "humanist economics," while others might call

it Keynesian economics (Pearce 1990, p. 12). Humanists did not seek to abolish the free market system; rather, they wanted to harness it for increased social welfare, which was to be achieved through governmental regulation and intervention.

In the 1930s the first large scale social institutions designed to protect individual and social well-being were created. The wild swings in the financial markets—the cycles of boom and bust experienced by Europe and America —demanded some curtailment in the previous laissez-faire approach to western economies. In his book, The General Theory of Employment, Interest and Money, economist John Maynard Keynes asked why there were large swings in business cycles and why unemployment plagued nations that had essentially free markets. He believed governmental intervention was essential to control forces in the market, and his prescription for the boom-and-bust market cycles was governmental spending and the creation of institutions that would regulate and control market economies. Dasgupta writes:

If classical political economy was the product of the Industrial Revolution, Keynesian economics is a product of the depression of the thirties (Dasgupta 1985, p. 125).

Social problems, such as unemployment, were not the only shortcoming of the free market system. Some economists began to point out other difficulties with Adam Smith's free market economic model. Allen Kneese, in his book Economics and the Environment, says:

A few economists, voices in the wilderness, argued that while the model provided a highly useful insight into the functioning of market processes, there were other serious departures from the model besides unemployment. They particularly claimed, although they did not put it that way in their day, that the third structural assumption indicated above, the holding of all valuable assets in discrete units of private property, was a severe simplification of reality for actual existing economies (Kneese 1977, p. 23).

Externalities, a concept proposed by economist Alfred Marshal in his book Principles of Economics, was another shortcoming in the market system. Externalities were costs and benefits that were not included in the traditional cost/benefit assessment,

they were external to it. Some of the first examples of externalities proposed by Marshall were environmental in nature: sparks from a locomotive setting a farmer's field on fire, or bees pollinating a neighboring orchard. But, it was not until after World War II that environmental science was able to assess the nation's environmental damage. Impacts were by that time so visible they could no longer be ignored. Large scale environmental problems such as worsening air pollution, dying rivers, and undrinkable water were starting to attract economists' attention. These surely needed to be included in economic models. A new school of economic thought began to seek methods to include the environment in economic considerations— it was called environmental economics.

Environmental Economics

The introduction of ecological concerns in economic analysis is, at first glance, unnatural. Indeed, many arguments against environmental decisions are economic in nature. Yet inefficient resource allocation and depletion of natural resources are both environmental and economic issues. Pearce, in his description of its evolution, says environmental economics emerged against the backdrop of increased awareness of environmental pollution and increased concern about the feasibility and desirability of unlimited economic growth (Pearce 1990, p. 13). Local and global economies are ultimately dependent upon natural resources, the laws of nature, and the environment's waste absorbing capabilities. When these are not maintained, economies can collapse from resource depletion, environmental degradation, or other human-induced natural catastrophes. Tietenberg shows the planetary environmental economy supporting the human economy (Fig. 3). In this way, human activity and economic conditions are dependent upon the environment for resources and for its waste absorbing capabilities. When the environment's resources or waste absorbing capabilities are overwhelmed or excluded from economic decisions, or when total damages and costs to an ecological system are unknown, resources cannot be efficiently allocated.

Human Economy As Dependent Upon The
Planetary Economy

Figure 3

Services that the earth provides must be valued and included before the market system will perceive the true cost of goods. Environmental economics is founded on the idea that natural resource considerations must be included in economic decision-making.

G. Tyler Miller describes three categories of economic resources: (1) natural resources, those provided by the earth's natural processes; (2) capital or intermediate goods, those manufactured from natural resources and used as inputs for final economic goods; and (3) labor, the physical and mental talents of people (Miller 1990, p. 569).

Economics as a study of resources, mostly concerns itself with resources that can be assigned a monetary value. Hite addresses the ability of economists to assign value to goods and services provided by human activity, but other things of value are not readily translated into monetary terms or included in their models. He writes:

Economists have considerable experience in dealing with pecuniary goods. A body of theory has developed which provides criteria for evaluating the efficiency of the allocation of resources when the products of those resources can be priced in a competitive and free market. If the market is purely competitive, the values of society can be imputed from the market exchange price. But, since environmental goods are not completely marketable, their value is more difficult to impute in any objective way. The lack of reliable market mechanisms for defining the value of environmental goods, however, does not imply that their value is zero, nor does it imply that it is infinite. An unfinished task of economists is to determine the appropriate value of particular environmental goods so as to judge better how natural resources should be allocated among all the potential users who desire their services (Hite 1972, p. 12).

In addition to calls for better pricing of environmental services, many environmental economists question the desirability of unlimited traditional economic growth. To Cornucopian economists, the continued expansion of economic activity—growth—guarantees increasing wealth for humanity. The analogy of a rising tide that lifts all boats is used to describe how a growing economy will benefit all members of society. Early ecological economists began to question the plausibility of an indefinitely expanding economy. Studies in the early 1970s focused on the possible outcome of continued resource depletion and environmental degradation. The Club of Rome modelers suggested in the 1972 Limits to Growth report that unchecked economic expansion would eventually

produce imbalance and decline in the world's social and ecological systems, and was therefore unfeasible (Meadows et al. 1972). Another major study, performed under President Carter in 1980, was the Global 2000 Report. This report made an assessment of future trends in global environmental quality and human population. The report analyzed resources, material affluence, and population. In summary:

If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now (Council on Environmental Quality 1980, p. 1).

Many of these effects, the report suggested, were caused by traditional growth-centered economic policy.

Neo-Malthusian studies, as both of these studies were labeled, did not go unchallenged by traditional economists. Cornucopians pointed to their own studies for support of their opposing view. Herman Kahn presented his analysis in a book entitled The Next 200 Years: A Scenario for America and the World. He concluded that in the 200 years since the founding of the United States, per capita income (in constant dollars) had grown from \$200 in 1776 to \$1,300 in 1976. Future growth of per capita income in a free market economy was assured. Interference with this natural growth process was unwarranted and unethical since interference would limit the ability of the poorer residents to better their incomes, and thus their welfare (Herman Kahn & Assoc. in Tietenberg 1988, p. 8).

Environmental economists vary in their economic approaches to environmental issues. Models range from calls to completely privatize most ecological resources in hopes of producing free market solutions, to "deep ecologists" who believe a fundamental earthward shift must occur in the perception of desirable human economic activity. Between these views, most environmental economists believe better pricing techniques are needed to change the perception of what makes economic sense. A new perspective is needed on society's wasteful practices, practices that are continued only because they are

able to turn a profit. In the words of economist Allen Kneese:

A profound asymmetry has developed in the effectiveness and efficiency of the [current] system of economic incentives inherent in market systems. On one hand, it works well in stimulating the exploitation of basic resources, and processing and distributing them, but it fails almost completely in the efficient disposal of residuals to common property resources...The total result of market failures and government policy is that the economic incentive system makes virgin materials too cheap, stimulates too much materials flow through the system, generates inadequate reuse of secondary materials, and produces a vastly excessive discharge of dispersed and degraded materials to environmental media (Kneese 1975, p. 29).

This description almost exactly describes the state of today's solid waste management systems, where fixed fee systems encourage over-production of solid waste and do not encourage resource conserving behavior. Kneese, like other economists, believes new economic models and techniques which value conservation and encourage less wasteful or polluting practices are needed. New economic methods developed by environmental economists have injected environmental concern into the field of economics. Techniques of quantifying and including environmental concerns are discussed below.

Techniques of Environmental Economics

Just as neoclassical economists developed their techniques to represent marginal-cost considerations, environmental economists have begun developing tools and models that allow the representation and inclusion of environmental damage in economic decision-making. Environmental economist James Hite has written of the need for more accurate pricing of environmental damage and of tools to assay external costs of economic decisions (Hite 1972, p. 12). Some of the tools are already in existence. Concepts such as efficiency, intergenerational equity, and sustainability help determine the most environmentally desirable choice.

Thomas Tietenberg describes the terms "static" and "dynamic" efficiency and uses them to consider environmental resource questions. An allocation of resources, says Tietenberg, yields static efficiency if there is a maximization of net benefits (benefits less

cost) by the allocation of those resources (Tietenberg 1988, p. 21). Static efficiency refers to the benefits and costs in a single period, while dynamic efficiency concerns net benefits that accrue over successive periods. Dynamic efficiency refers to how future benefits coming from preservation of resources should be weighed against benefits gained today. Economic methods to maximize future streams of benefits attempt a balance between preservation of resources for tomorrow's benefit and use of the resource today. The criteria that assign value to resources are decidedly anthropocentric. Costs and benefits are only valued relative to humans, over a human time frame. Nature is rarely assigned a value in these analyses, except where it benefits humans in ways that can be given a monetary value.

Public property resources are those resources that cannot be owned by an individual, or those resources that provide for the common good. Many environmental goods, such as air and water, have been recognized as public property resources. Determination of their value, however, is inexact and often shortsighted. Uncertainty about the future hinders economists' ability to assign future value to public property resources. The traditional economic view is that future benefits are worth less than benefits obtained today, and economists usually employ a discount rate in valuing tomorrow's use of resources. Inappropriate weighting of future needs and benefits can cause waste and depletion of resources far more quickly than is optimal for a sustainable world.

Sustainability, the ability of future generations to live at least as well off as present generations, is another goal of many environmental economists. Tietenberg discusses what he believes should be the basis for intergenerational equity. "If all individuals did not know into what generation they would be born, all would seek equitable intergenerational distribution of benefits." Accordingly, it is fair for current generations to use resources today, "as long as," says Tietenberg, "future generations remain at least as well off as current generations" (Tietenberg 1988, p. 33). For Pearce, sustainability involves

"maximizing net benefits of economic development, subject to maintaining the services and quality of natural resources over time" (Pearce 1990, p. 24). Sustainability, for Pearce, is directly related to the environmental capacity and pollution cleansing abilities of the earth. Sustainability requires more efficient use of resources and it must occur within the constraints of the earth's ecology. Economic methods to induce more environmentally sustainable and efficient resource management are discussed below.

Methods of Achieving Resource Efficiency

Pearce's sustainability criterion, maximizing net benefits subject to the constraints of ecology, is also an efficiency criterion. Efficiency might be defined as economizing on a resource by maximizing the net benefit from that resource. Economists seek efficient solutions to environmental problems where hidden external costs, borne by society rather than the individual, are eliminated and where all costs are considered so that more fully informed decisions can be made. Where environmental degradation occurs, feedback is needed to educate consumers of the true cost of their actions. Feedback should discourage behavior where total societal costs are greater than the sum of private benefits.

Goldman lists three methods for encouraging environmental quality when he writes:

What are the ways to cope with external diseconomies? How can social and private benefits and cost be brought into closer conformity? There are at least three ways to solve the problem: 1. Direct Regulation; 2. Subsidization; 3. Incentive Pricing. An efficient solution would undoubtedly involve all three techniques (Goldman 1972, p, 31).

Goldman's three different general approaches to resource management are discussed below.

Direct Regulation

Direct regulation uses the regulatory power of government to intervene in the free market to solve social problems. Regulatory remedies include legal prohibitions and the

licensing of permissible actions, or requiring regulatory review of proposed actions. Most pollution abatement laws are regulatory in nature. The Clean Air Act, the Resource Conservation and Recovery Act (RCRA), the California Environmental Quality Act (CEQA), the Comprehensive Emergency Response and Liability Act (CERCLA), and many other laws approach pollution control through regulation. However, regulatory solutions are not always effective or efficient. Command-and-control regulation requires regulatory bodies, standards, discretionary review, and enforcement. Legal remedies that are unenforceable usually give rise to unwanted side effects.

Taxation and Subsidization

Historically, taxation has been used to dissuade the public from unwanted behaviors while subsidization has been used to encourage desired activities. Environmental taxation typically involves the assessment of pollution fees that are paid to a regulatory agency, thereby encouraging less polluting (and untaxed) actions and processes. The monies from the fees do not necessarily offset the social costs of the unwanted behavior. They may go towards funding the bureaucratic organization that regulates and collects the tax. The creation of large bureaucracies to regulate pollution and environmental degradation has been cited in recent years as a drawback to taxation methods. The imposition of a user fee or tax may be appropriate to signal social costs which cannot be imparted to the private citizen in any other way. Like regulation, taxation requires assessment, collection, and enforcement. In subsidization schemes, instead of tax being paid to a government agency, the government pays some fraction of private costs to encourage the desired behavior. Similar to taxation, subsidization can help offset private cost incurred by desirable behavior.

Incentive Pricing

Incentive pricing can be used to encourage resource conserving behaviors and the development of alternate, less polluting technologies. When fees are charged based on the type and amount of pollution that is emitted, market forces tend to find solutions that are cheaper and more profitable. Incentive pricing can also be used to create pollution markets where pollution rights can be traded in a free market fashion. The government's role would be to set prices at a level that encouraged reduction of pollution. If rights are apportioned properly, and if pollution prices are appropriate, profit-oriented behavior will naturally tend to reduce pollution. The profit motive can be stimulated by government subsidies and discounts. Economists who seek a market solution to environmental problems prefer this approach over bans or other direct regulation. Goldman, however, points out that the incentives in a free market system must be managed if they are to achieve the desired results.

The mere imposition of a fee for the use of air and water, however, does not guarantee an end to their irrational use. There is still the risk of excess consumption if the fee is not directly related to the benefits or cost of using the water. This can best be illustrated by an example. Assume that 100 people agree to share a phone and the phone bill. Each person would feel strongly tempted to make an unlimited number of long distance phone calls because he would have to pay only 1/100th of the bill. Unfortunately each of the other participants would feel exactly the same, and the result would be a flood of long distance calls and an unusually large phone bill. We abuse our air and water resources in exactly the same way" (Goldman 1972, p. 18).

Goldman's example points to the need for pricing structures that signal to consumers the complete cost of their choices. In the example, each individual pays only a set amount for unlimited phone use. Each person seeks to maximize his or her individual benefit and the result is a large phone bill. A system with flat fees can encourage waste and excessive use of the resource. Similarly, flat solid waste fee structures encourage overuse of convenient curbside waste service. Since most municipalities use landfill burial as their primary management method, flat fees encourage overdisposal. Incentive pricing such as variable disposal rates that encourage recycling and diversion over unsorted disposal, are

examples of economic approaches to solid waste management.

Economic Approaches for the Environment

Most early efforts to curtail environmental damage employed pollutant standards. Governing bodies attempted to regulate polluters through standardized goals—standards which were universally applied with little flexibility. Such solutions to complex local environmental problems can produce costly, inefficient, and ineffective results. Signals showing the environmental costs of an economic decision are needed. Environmental degradation is an externality, the consequences of which may not affect the individual making the economic decision, but may ultimately cost another person or society in general. If these costs were known and borne by the polluters, a less polluting market decision would be made. Part of the difficulty in providing accurate environmental costs is in the assignment of rights to public resources. Who, or what, controls the rights to resources such as air or water? If compensation is to be paid, who determines the appropriate amount? And to whom should it be paid? Marshall Goldman echoes these questions when he states:

It is also essential, if the price system is to function properly, that someone or some group control and sell or otherwise allocate all the factors of production. Thus, whether they be landlords, bankers, laborers, or managers, fees are collected for the use of an input which presumably provide proper compensation for the cost of reproducing the article or for the revenues foregone by not taking advantage of opportunities available elsewhere (Goldman 1972, p. 18).

The use of rights and negotiations to compensate for environmental degradation is known as the "property rights solution" to environmental pollution. It is a solution in which humans decide the fate of ecologic systems through a valuation process based on human standards and goals. Few rights are given to nature. Nature is represented only by humans speaking for it.

Property Rights Solutions to Environmental Pollution

A property rights approach to environmental problems can, in theory, yield decentralized and flexible pollution abatement. Proponents believe that if rights are established for polluters and pollutees, and if there is a free exchange of rights for compensation, a free market solution can emerge to solve environmental pollution problems. Property and pollution rights would be the commodities traded in this new market. Moreover, as Horst Siebert writes,

The property rights approach suggests that if property rights are adequately defined, optimal environmental allocation will be reached. Governmental intervention, if necessary, is needed only in assigning environmental property titles (Siebert 1981, p. 87).

Property rights theory is based on the Coase Theorem. Coase, an economist, stated that if property rights are defined and freely transferable, and if people maximize their environmental utility through non-altruistic bargaining, a Pareto optimal allocation will naturally result (Coase 1960, p. 1-44 as found in Siebert 1981, p. 89). Allen Kneese, in his 1977 book Economics and the Environment, also lists criteria required for an efficient free market solution. These criteria are echoed by other economists. Kneese lists:

1. All markets are competitive. No particular firm can manipulate the market to its advantage. All companies are on equal footing in competing for profit.
2. All participants in the free market are fully informed.
3. All valuable assets can be owned by individuals and all costs of production and consumption are borne by the consumer and producer (Kneese 1977, p. 19).

These conditions reflect Adam Smith's original ideas about a free and open market where participants engage in individual pursuits of benefit through a voluntary exchange of goods and services for money. Thomas Tietenberg lists four similar property rights which must be established before the free market can correctly establish the price of a good:

Universality—All resources are privately owned, and all entitlements completely specified.

Exclusivity—All benefits and costs accrued as a result of owning and using the resources should accrue to the owner, and only to the owner, either directly or indirectly by sale to others.

Transferability—All property rights should be transferable from one owner to another in a voluntary exchange.

Enforceability—Property rights should be secure from involuntary seizure or encroachment by others (Tietenberg 1988, p. 39).

For the free market approach to work, all resources must be owned by private individuals, everyone must be fully informed, and all markets must be fully competitive. These are ideal conditions which may never materialize. Proponents believe, however, that some of the better aspects of the property rights approach can be applied to some environmental problems, whether or not the pricing system is perfect. However, the property rights approach can only work for rights and assets that can be privately owned. There are many environmental resources that cannot be privately owned. Goldman speaks of these requirements in discussing two common property resources, air and water.

One of the reasons that air and water pollution is hard to control is that no person or organization is normally considered to be the owner of the air and water. With few exceptions those resources are considered to be readily available to those who want to use them. It is difficult to attach a value to either clean or dirty air and water. They are often treated as if they are free goods (Goldman 1972, p. 18).

This is a central criticism of the property rights approach—that it does not work for many environmental resources. Goods which are available to all and are not privately owned, or which cannot be valued in a monetary sense, will not be properly priced. Landfills and solid waste management may be included as a public property resource that cannot be privately owned. There are other limitations to economic solutions to environmental problems. Other criticisms of market solutions involve equity among social groups and motives behind economic decisions.

Limitations and Detractions of Economic Incentives

The use of economic incentives for environmental problems is not without

criticism. In What Price Incentives?, Steven Kelman asserts that economic incentives are imbedded in a larger economic paradigm and he raises other ethical questions in the use of economic incentives. These four concerns about economic incentives are:

1. A cost driven incentive structure does not concern itself with the motives of offenders. A self motivated system can further endorse the idea of self pursuit producing social welfare.
2. The use of pricing offsets does not offer any stigmatization for offenders. If pricing is used to offset pollution, pollution becomes just another cost of doing business.
3. Using economic incentives brings environmental quality into an arena established for pricing of other goods. Many feel that the economic valuation of many environmental/ecological goods is impossible or undesirable.
4. The use of incentives can be better borne by the wealthy. A tax or fee can more easily be absorbed by the wealthy as a cost of living (Kelman 1981, p. 27-8).

Much of the criticism of "market" solutions to social problems centers on how the effects of added costs will be borne by different social groups. In his essay Equality and Efficiency, The Big Tradeoff, Arthur M. Okun states:

Contemporary American society is, in a sense, a split level structure. Its political and social institutions provide universally distributed rights and privileges that proclaim the equality of all citizens. But its economic institutions rely on market determined incomes that generate substantial disparities among its citizens in living standards and material welfare. The resulting mixture of equal rights and unequal incomes creates tensions between the political principles of democracy and the economic principles of capitalism.....At many different points along the way society confronts choices that offer somewhat more equality at the expense of efficiency or somewhat more efficiency at the expense of equality. In the idiom of the economist, a tradeoff emerges between equality and efficiency (Okun 1975, p. vii).

David Pearce believes economists may not pose the right questions. Other issues must be addressed before society should embrace a "market" solution to environmental problems. He says:

It may well be that finding the economically 'optimal' provision of environmental assets is not the dominant concern of individuals or societies. Issues

such as fairness of access to those assets, both within a time period and over time, could be of equal and possibly greater significance.

He continues by saying also:

Much of the literature that questions the role of economic analysis and the environment does so, we believe, because it is not convinced that economics has come to terms with ecological conditions for sustainability. Put another way, economics does not appear to have an 'existence theorem' which enables us to be sure that whatever economy we devise will be sustainable ecologically (Pearce 1990, p. 27-28).

Sustainability, as described earlier, is intimately bound with an economic system that can exist indefinitely and can provide public property resources that sustain life on the planet. It may be that current economic systems and their definitions of value cannot do this. Many of the criticisms listed above involve the introduction of market principles in an area that may be unsuitable for market methods. In the next section, public property resources will be discussed; these are resources that are needed by all, they sustain life on the planet, and they do not readily fit into private market solutions.

Public Property Resources

Not all resources can be privately owned by individuals. Miller uses the terms private, common, and public property to describe resource ownership (Miller 1990, p. 570). Private property resources are those that can be fully owned and enjoyed by specific individuals or groups of individuals, while common property resources are those that cannot be fully owned by individuals, but rather belong to society as a whole. His definition of common-property resources would include air, the oceans, and the earth's ozone layer. The economist James C. Hite writes of common property resources:

Certain natural resources have remained common property resources either because it has not been technically feasible to appropriate and defend the resources for private use, or because, if it were technically feasible, the expected returns from such private use would not justify the cost associated with doing so (Hite 1972, p. 13).

Common property resources that are managed by a public agency in the public's interest are called public property resources. Buchanan says public property resources are

"those goods that are demanded and supplied through political institutions rather than through market institutions" (Buchanan 1968, p. 11). Some examples of public property resources are clean air, groundwater, off-shore fisheries, and timber on public lands. These resources are managed by agencies for the public interest—a public good. Paul Samuelson gives a more traditional view of public goods (public property resources) as those "which all enjoy in common and in the sense that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good" (Samuelson 1954, p. 387). We are finding that many goods which were thought to fit this definition are actually finite resources that can be impacted by the actions of others. Siebert states the difference between public goods (public property resources), and common property resources when he says "public good denotes an analytical classification, the common property resource is a historical term which defines a given institutional arrangement allowing the use of a resource" (Siebert 1981, p. 62).

If these resources cannot be held by individuals, and the property rights approach is unfeasible, how can public property resources be managed? Horst Siebert writes of a different management approach for public goods such as environmental quality:

This approach starts from the premise that property rights cannot be defined for environmental quality. Then the market cannot allocate the environment, and government intervention becomes necessary. How does the government determine the desired environmental quality? One approach is to assume a social welfare which allows us to specify the benefits and costs of environmental quality. In a similar way, benefit/cost analysis implicitly presupposes a social welfare function as a guideline for evaluation. Another approach is to base the evaluation of environmental quality on individual preferences. A Pareto optimal allocation requires individualized prices of environmental quality to be assessed according to the individual's willingness to pay (Siebert 1981, p. 61).

Thomas Tietenberg, in his text Environmental and Natural Resource Economics, calls upon "resource taxonomy" to distinguish between those public resources that are depletable and those which are replenishable on the human time scale (Tietenberg 1988, p. 118). If humans could recognize whether resources were depletable or renewable,

perhaps the resources would be better managed. Tietenberg lists as depletable resources most energy sources (such as oil, coal, and gas), while renewable resources are timber, off-shore fisheries, solar energy, agriculture, and water. Proper management for each requires a method of bringing the social cost of resource depletion back to consumers and investors. For each resource, depletable or renewable, a different method of perception and management will produce the best mix of conservation and development. All resources, including public property resources, should be managed so the environmental and other external social costs are included in their private costs. Solid waste disposal capacity might also be considered a public property resource that requires management in the public's interest.

Solid Waste Management-A Public Property Resource?

For much of human history, solid waste management was given little thought beyond where to dump it out of sight. The result was unsanitary disposal that provided an excellent breeding ground for unwanted animals and insects. As cities grew and their waste increased, sanitation and its role in the spread of disease became more important. In response, sanitation laws were enacted that focused on landfills and their disposal practices as a public health issue, not a public resource question. Today's landfill disposal practices have evolved over the past 40 years in response to these sanitation considerations. As open pit dumping and burning of solid waste was replaced by burial and cover practices that discouraged vector populations, the rate of filling increased and little attention was paid to wasted resources. Today's result is large-scale landfill burial of solid waste in more secure landfill units away from ground and surface water. In controlling the sanitation problem, we have ignored the wasted resources.

Landfills, similar to other local utilities, perform a necessary function for municipalities, that of waste management. Because of the traditional health considerations

and the emerging resource issues associated with disposal, proper waste management could almost be seen as a public-property resource—a resource essential for the functioning of a municipality—one whose residents shared a common interest in maintaining. Landfill systems collect and store large amounts of unsorted waste materials in large centralized waste facilities. In the process, materials are mixed, degraded and removed from resource recovery possibilities. Most communities in California offer curbside solid waste disposal, and most of these offer unlimited, or nearly unlimited disposal for a flat monthly fee. Some waste planners question the logic of a system that competes with recycling through inexpensive land burial. These planners believe disposal pricing to be an effective way to encourage conservation and to support recycling programs because in the short term, centralized collection and disposal programs will remain central to most waste management systems. Eventually, the infrastructure of waste systems can become incorporated into material recovery systems.

Recycling programs need material processing facilities, and composting facilities require large amounts of land away from the public. Landfills and their infrastructure may evolve into these new waste processing facilities, where weekly disposal service would evolve into weekly material collection services. Waste services are essential for the health of a community, and the current system of hauling waste to central facilities offers a method to collect, transport, and process large amounts of waste from municipal waste generators. Some recyclers point to the infrastructure (land and equipment) of landfills, saying these will evolve into material recovery and recycling facilities.

For all of these reasons, management of solid waste can be considered a public property issue. Waste management satisfies criteria described for public property resources; individuals cannot own and operate individual landfills with sufficient care to alleviate health hazards, nor can the equipment and land required for proper management of solid waste be divided between residents. Members of the public all enjoy the health

benefits of a waste management system that is performing properly. Conversely, if all individuals dumped their waste individually, impacts would not be exclusively felt by dumpers. All would see litter and roadside trash and might be exposed to health hazards. Some argue that because of its public property attributes, waste management might be better managed through local utilities that are similar to local energy utilities. They would be chartered to work in the public's interest and pursue conservation as a strategy for demand management.

Local Waste System Utilities?

Some solid waste experts believe the present system of private companies operating local franchise agreements with individual municipalities will evolve into a system closer to the regulated monopolies of local utility companies. Local utility companies, which operate city-wide monopolies within regulated guidelines, work for the benefit of local communities. The management of a necessary service such as waste collection calls for recognized social institutions working on the public's behalf. Utilities, it is argued, would better manage solid waste, more in line with conservation goals, and within a regulated profit margin. Energy utilities in particular are models for the waste service sector. Their experience can provide solid waste planners guidance in the management and pricing of public property resources.

One such advocate of this approach is Gary Fiske of Barakat & Chamberlin, an economic and management consulting firm in Oakland, California. Fiske spoke on the similarities between energy utilities and the solid waste/recycling service sector at the 1991 Pacific Recycling Exposition. The solid waste service sector (landfills and recycling), says Fiske, will follow an evolution similar to local utility companies: a scarcity of resources, followed by conservation management methods. He said there is a strong natural monopoly for local waste management utilities, similar to energy and water, which could

produce economies of scale and better service for customers. Fiske described five phases of the energy sector's evolution after the initial energy shocks of the 1970s. In each of these phases, he likened the power industry's evolution to the solid waste sector. These phases, says Fiske, are:

1. Dramatically higher prices, followed by quickly launched responses to price rises
2. Acceptance that higher prices are here to stay; utilities then begin offering broader options, and focus on demand forecasting
3. Utility companies recognize conservation reliability, show more careful program design and conduct market research
4. Utility companies become full service organizations, offering consumers better conservation choices
5. Conservation becomes the primary way to meet societal resource needs
Sophisticated analyses are used in the transition from an energy wasteful society to an energy conserving society.*

Gary Fiske believes the development and use of better solid waste management tools, similar to those required under AB 939, is the first phase of that evolution. Similar to the use of rate differences in energy prices, the use of variable disposal rates will help solidify conservation and recycling as a waste management policy. Fiske believes rate structures are integral to overall conservation efforts. There are three considerations when using disposal rates to encourage conservation, says Fiske:

1. Price incentives must limit the consumption of scarce resources;
2. Rates must signal the higher cost of landfilling; and,
3. Customer response to price changes are uncertain.

* From author's handwritten notes, taken at the Recycling Exposition

These three considerations are important when a community considers a variable disposal rate system. Fiske stated that accurate predictions of public response to price increases are difficult to make. Since communities are dependent upon convenient waste disposal services and the revenues collected for waste services, planning and caution should be exercised by any municipality considering variable disposal rates. Fiske listed five different variable rate structures that encourage resource conserving behavior by the public, in ascending effectiveness:

1. Flat monthly charge
2. Declining per can charge
3. Fixed per can fee
4. Increasing per can charge
5. Weight based fee

Each rate communicates a different signal to customers about the use and disposal of resources. In the flat disposal rate, there is no greater cost for greater waste disposal. In the second case, there is greater cost associated with greater waste production, but the cost is unrelated to the larger disposal amounts. In the third rate, the cost is directly related to the amount of waste produced. In the fourth rate, a progressive fee increases with increasing amounts of waste, signaling increasing wastefulness. Appropriate fee structures can be employed in different communities according to individual circumstances.

Summary of Background Economics

The preceding chapter traced changing economic perceptions about resource value from the classical period to modern times. It gave a brief history of major periods in economic thinking and described how important ideas from these periods relate to the environment. The history reflects the importance of economics in making societal decisions about resources. As new ideas developed in economics and in the perception of

value, they were incorporated into business practices and governmental policy. The United States is predominantly a market economy, and decisions are made based on their economic implications and profitability. Recent regulations have recognized the usefulness of market solutions to pollution abatement. Long-lasting changes seem to stem from financial penalties that are associated with undesirable behavior. When the bottom line is affected, behavior is changed.

The history of economics leads to a description of environmental economics, which attempts to incorporate ecological considerations into economic decisions, melding human economic activity with nature's economy. Techniques of environmental economists were described and explored, as were differing resource management methods. The discussion was concluded by describing some of the limitations of economic approaches to environmental problems. Some resources cannot be adequately managed in a traditional market economy. Public property resources are resources, like air and water, that cannot be wholly owned by individuals or properly priced in a market system. Solid waste disposal, too, may be considered a public property resource that cannot be individually owned. Most California cities have recognized the essential nature of solid waste disposal from a public health standpoint, and have some sort of exclusive franchise agreement to provide waste collection service to residents. For the most part, these services are paid for by monthly service fees assessed for each household, a flat monthly rate that covers all collected waste. These disposal fees do not reflect the need for diversion and reduction, nor the waste of resources that present disposal methods squander. Their signal to consumers is, instead, that disposal capacity is plentiful since its cost isn't even tied to the amount of solid waste that is disposed. Today, the vast majority of municipal solid waste in the United States is still managed by landfill burial. No recycling programs achieve 100% diversion, so landfills may always be needed to safely dispose of residual materials. Some method to encourage recycling and diversion is needed that will communicate to

residents the need for conservation.

In the near future, as communities seek diversion for their solid waste, landfills and their infrastructure may evolve into material collection systems that would still provide curbside collection of materials from residents, but instead of relying exclusively on landfill disposal, they would recover and recycle the collected material. The pricing structure of such a waste system should reflect local goals and concerns. The continuing role of public waste management systems in the functioning of municipalities assures that the land and the infrastructure of present-day landfills will be with communities for some time. These waste systems may shift away from landfill disposal, to diversion and recycling. A key part of this transition will be the use of disposal rates that more accurately reflect the environmental cost of unsorted disposal and that encourage recycling.

CHAPTER 3

RELATED STUDIES

Introduction

This chapter summarizes previous studies on the use of economic incentives to stimulate a community's recycling rate. It examines past attempts to quantify the production equation for solid waste and the possible effects variable disposal rates may have on this rate. Extrinsic and intrinsic incentive schemes are discussed, and their incentive approaches are reviewed. The financial requirements of a typical solid waste system are summarized. Illegal dumping and how it relates to incentive-based disposal fees is discussed. An example of a successfully designed incentive scheme is provided by describing San Jose's new Recycling Plus! scheme.

This chapter also discusses the general population's attitudes toward variable disposal rates and recycling, and the attitudes of Hispanics. It is meant to provide background for the survey of Hollister that is described in the next chapter. In the first section of this chapter the attempts of previous researchers to define a household solid waste production equation is presented. These demand equations are usually the outgrowth of economic studies and employ statistically-based survey methods. The solid waste production equation is the mathematical equation that uses demographic information and social indicators to forecast household production of solid waste. The equation may provide clues about how incentive schemes, investigated in Hollister's survey, may be able to reduce Hollister's demand for disposal services.

Factors That Affect Solid Waste Generation

What factors contribute to the demand for solid waste disposal services and how are variable disposal fees expected to influence the generation of solid waste? An analysis of household garbage generation rates usually links social indicators to household garbage generation rates. This sort of analysis falls within the discipline of economic analysis, which has statistical tools to identify the relationship between solid waste production and economic and social indicators. The following is a summary of past studies of this production equation.

The United States Environmental Protection Agency (US EPA) studied factors affecting the demand for municipal refuse collection in 1973 in 50 political wards in Chicago, Illinois. In a report entitled Socio-Economic Factors Affecting Demand for Municipal Collection of Household Refuse, the EPA's researchers found that two socio-economic variables significantly impacted the demand for waste collection service: household income and household race (EPA 1973, p. v). The EPA also found a distinct seasonal variation in the production of solid waste and suggested two components for solid waste generation may exist: a core component that is independent of race and income, plus a second component that is greatly dependent on race and income (EPA 1973, p. 41). Kenneth L. Wertz in his book Economic Factors Influencing Households' Production of Waste, states that a prior analysis of the same data that was used by the EPA (Quon et al. 1968, p. 403-420) showed that households that were serviced twice per week set out almost 30% more refuse (by weight) than households in the same ward that were serviced only once per week (Wertz 1976, p. 267). Households may tend to generate more solid waste if it is easy and cheap to discard. Other factors that may influence a household's production of solid waste include the number of residents in the household, their sexes and ages, the household's total income, and the activities of the residents. Wertz also collected and analyzed waste generation data from Detroit, Michigan, where garbage collection

procedures were very uniform and data about weight generation was available. In six neighborhoods of Detroit, Wertz states, "theory and observation suggest the expected: residential refuse quantities should decline as [the unit cost of disposal service] increases" (Wertz 1976, p. 266).

The United States has the largest per capita garbage generation rate of all industrialized nations. "Americans generated 4 pounds of solid waste per person per day in 1988 and this figure is expected to grow to 4.2 pounds by 1995." (EPA Journal Vol. 18, p. 12). Wertz believes our typically low waste collection fees may contribute to our large demand for this service and consequently, society's expenditures. He states:

Suppliers of service, by eschewing pricing, have induced households to generate larger quantities of waste; as a result, larger quantities of resources have been expended to provide given frequencies of collection at given sites of collection (Wertz 1976, p. 269).

During the period between 1950 and 1972, Americans produced 2.25% more refuse per person per year, and expenditures for solid waste and other municipal services have grown by a similar or greater amount (Wertz 1976, p. 263). This increase has required more time from refuse collectors and therefore higher labor costs. In 1966, payments to refuse collectors constituted at least one half of refuse collection and disposal costs (Wertz 1976, p. 263). Clearly, actions to reduce the amount of solid waste that is collected and disposed can save communities money. One important point brought up by Wertz is that littering and illegal dumping caused by increased garbage fees may be far more expensive to control than collecting the extra garbage generated because of inexpensive disposal. It may be worth collecting extra garbage from residences if, by doing so, the amount of littering is reduced. Will illegal dumping and littering increase with higher or variable rates? Any community considering a change to variable rates should consider this question. It is discussed in later sections of this chapter.

Peter Kemper, in his book The Economics of Refuse Collection, lists other factors

affecting the solid waste generation rate. Kemper says household income, household size and demographic composition, disposal cost, collection service and frequency, all in addition to what he calls "other factors" (geographic and climatic), influence a family's solid waste disposal rates (Kemper 1976, p. 76). Kemper developed an equation for solid waste production as a function of income and other socioeconomic variables, and after studying data that were available, Kemper found that a 1% rise in household income was associated with a 0.31 to 0.45% increase in the amount of generated refuse (Kemper 1976, p. 83). Households with higher incomes generate larger amounts of solid waste. Smaller households produce more per capita waste than larger households, but their absolute amounts are smaller. He also found that there is a small but significant variation in household waste generation with respect to neighborhood density (Kemper 1976, p. 83).

Kemper summarizes his study by saying:

There is a substantial amount of variation in the amount of refuse generated by urban households and thus in their demand for refuse collection services. The average amount of refuse generated per household is about 1.11 tons [per year], but the coefficient of variation is about 0.29 (Kemper 1976, p. 88).

Kemper goes on to list three reasons why variable disposal rates for solid waste disposal may be undesirable:

1. The administrative costs associated with the new fees may be too high.
2. Regressive user fees may adversely impact poorer members of the community.
3. Because collection costs are billed as user fees and not taxes, residents will not be able to deduct them from Federal taxes and therefore their tax burden increases (Kemper 1976, p. 96).

In conclusion, Kemper states:

In particular, it appears that user charges which vary with the type of service and the frequency of collection are likely to result in an improved allocation of resources. Charges which vary with the amount of refuse generated by households could also lead to improved efficiency, but because they create an incentive for increased littering, they should probably not be imposed in high density areas (Kemper 1976, p. 107-8).

Another study by the EPA, Impact of User Charges on Management of Household Solid Waste, was conducted in 1979. In discussing what comprises an efficient solid waste disposal system, the report included aspects of pricing. The report developed a list of communities that employed user fees in their residential waste collection system, it grouped similar systems together, and developed case studies for each. The EPA empirically analyzed data from the communities and reported their findings. Although Impact of User Fees took a very mathematical approach to the question of waste system efficiency and the costs that are associated with waste collection and disposal, the report summarizes by saying that there is still much uncertainty in this area:

The qualitative effects on households that result from imposition of (or an increase in) service charges or changes in quality of service can be developed from economic theory. Similarly, the cost of collection/disposal systems can be determined from engineering data. However, the quantitative effects of service user charges on behavior of households are not yet well understood (EPA 1979, p. 1).

Similar to Kemper's results, the EPA found significant production elasticity with respect to household income in the three cities that the EPA studied. "Production elasticity with respect to income" is the economic term describing the relationship between the production of solid waste and a household's income. As a household's income increases, residents produce more garbage.

If solid waste collection/disposal is a service that obeys the general law of supply and demand, as garbage fees increase, households might be expected to demand less disposal service, i.e., dispose less garbage. In these studies, the term "waste production" refers to the waste that is generated and removed from the household as part of the on-going activities of the household. The term includes that portion of materials that are actually diverted from curbside garbage collection and into recycling programs.

The question remains: is waste disposal service a normal good, and will residents generate less solid waste if the cost of disposal increases? Although higher prices for a normal good usually means the demand for the good will decrease, the EPA's study found

that there was little price elasticity between waste production and the cost of service to households. There did not seem to be a significant reduction in the amount of generated materials if the price of disposal increased. This seeming contradiction with expected behavior for a "normal" economic good might have been caused by several factors. For most people, the cost of garbage services is insignificant when compared to other costs such as food, shelter, etc. Increases in disposal costs are insignificant with respect to increases in other goods and services, and there is little financial incentive for ending wasteful behavior. Because the cost of disposal only comprises a small fraction of any good's purchase price, households might not consider the benefits of reduction and recycling worth the increased effort. Additionally, garbage-generating behavior is disconnected from decisions about disposal options, and although disposal costs are real costs, they are not incurred or considered when garbage-generating behavior such as shopping is conducted.

In Tacoma, Washington, production elasticity with respect to the level of service required (one, two, or three cans/week), was noted by the EPA, but the total amount of disposed waste was unchanged. For whatever reason, residents did not significantly change the amount of consumed goods and resultant waste. Although the amount that was disposed in landfills decreased a little, this was because more was being recycled. In Seattle, the amount of solid waste that was recycled increased after implementing variable disposal rates as did the amount that was self-hauled to the landfill. In addition to recycling, residents elected to self-haul to the landfill rather than pay higher monthly service charges (EPA 1979, 4). In conclusion, the EPA states that "the quantity of solid waste produced is highly inelastic with respect to incremental pricing" (EPA 1979, p. 6). The EPA uses the word "produced" to refer to the total waste materials that are generated, including those materials that might be diverted and those that are ultimately disposed. The EPA also concludes in this report that there is no adverse littering effect as a result of higher

disposal fees.

Robin Renee Jenkins, in her doctoral dissertation, investigated factors influencing the demand for solid waste services. Jenkins found that income, household size, population age distribution, and population density are all factors that affect demand for disposal services. She states that:

Income, though not always correlated with the quantity of aggregate waste disposed, does seem to vary systematically with the various materials and products that make up household waste, such as yard waste and packaging waste. The number of members of a household is positively correlated with the aggregate quantity of waste discarded by the household but there are economies of scale for the household. Additional household members should contribute declining quantities of waste. An important reason for this is that large households may re-use items many times by passing them from one household member to another. Estimates of the relationship between the age distribution of the population and the quantity of waste that households discard are contradictory so we do not draw conclusions. Finally, the aggregate quantity of waste discarded by households is not clearly related to the population density of a region, a proxy for the extent of urbanization (Jenkins 1991, p. 60-61).

It should be noted that curbside recycling was not an option available to solid waste service subscribers in most of the previous studies (Seattle being the one exception), and much past research leaves unanswered questions about schemes that offer and encourage recycling through variable disposal rates. It is generally recognized that the relative costs of garbage collection services are trivial when compared to costs for food, shelter, and other material possessions, and marginal increases in the cost of disposal may not cause re-evaluation of garbage-producing behavior. Although previous economic studies about disposal costs versus production of solid waste have been performed, they fail to consider the behavior of residents when easy and convenient alternatives (such as curbside composting and curbside recycling) are available. When these alternatives are easily available, and when a variable rate fee structure is present, the amount of unsorted disposal may significantly decrease as materials are diverted to recycling and composting activities, as was the case in Seattle.

Intrinsic and Extrinsic Incentive Schemes

If the preceding are factors that contribute to the generation of solid waste, then what can be done to reduce the amount of solid waste that is disposed and to increase the amount recycled? Garbage disposal services and recycling services treat solid waste in fundamentally different ways. In garbage collection all materials, recyclable and otherwise, are taken from the resident and landfilled. In curbside recycling programs, a convenient alternative to unsorted disposal is provided for some of the materials found in residential solid waste. If the cost of unsorted disposal rises, and if recycling is less expensive than unsorted disposal, residents should take advantage of recycling to manage their waste. Although absolute per capita generation of solid waste may not significantly decline when a variable pricing mechanism is instituted, more will be diverted away from curbside disposal and into more desirable recycling and composting. It is this carrot-and-stick approach that may be successful by providing both disincentives to dispose and incentives to divert.

The use of incentives to modify the public's behavior falls into the behaviorist school of human psychology. E. Scott Geller, in Applied Behavior Analysis and Social Marketing: An Integration for Environmental Preservation, discusses the application of behavior analysis to environmental preservation.

Applied behavior analysis (ABA) is based on the approach to behavioral science developed by B.F. Skinner. Geller states that behavior analysts

design interventions according to the antecedent-behavior-consequence (ABC) model, a conceptualization that has been referred to as behavioral engineering. Behavioral engineering is an approach toward behavior change focusing on environmental arrangements (i.e., behavioral antecedents and consequences) that increase the occurrence of desired behaviors and decrease the occurrence of undesired behaviors (Geller 1989, p. 20).

Geller says social marketing is an example of behavioral analysis being used to encourage socially desirable behavior. Most often seen in public awareness campaigns for forest fire prevention, litter control, and smoking deterrence, social marketing has

applications in resource conserving behavior as well. Successful recycling programs often point to public awareness campaigns as the cornerstone for their success. Geller speaks of the four P's of marketing when discussing social awareness campaigns: "The right product, endorsed by the right promotion, put in the right place, and at the right price" (Geller 1989, p. 28).

The intrinsic satisfaction derived from socially desirable behavior has also been investigated. Intrinsic motivation refers to satisfaction and good feelings obtained from an action that is socially encouraged, as opposed to extrinsic motivation such as financial or material gain. In Encouraging Environmentally Appropriate Behavior: The Role of Intrinsic Motivation, Raymond DeYoung surveyed motivating factors behind resource conserving behavior.

The findings support the notion of a strong relationship between intrinsic motivation and everyday conservation behavior. These findings suggest our understanding of why people conserve resources may be improved by investigating intrinsic motivation and the personal satisfactions derived from conservation activities (De Young 1985, p. 281).

In De Young's study of Ann Arbor, Michigan, respondents answered a series of questions about resource conserving behavior. Three scales were incorporated into these surveys: behavior, satisfaction, and motivation. Survey respondents "clearly linked intrinsic motivation to conservation behavior" (De Young 1985, p. 288). He concludes that intrinsic motivation may be equal to, or more important than, extrinsic motivational factors.*

* Paul Stern, Study Director of the National Research Council, Commission on Behavioral and Social Sciences and Education, is also critical of the over-simplification of consumers into rational economic beings. Although his area of expertise is the energy sector, some of his criticism about over-reliance on economic models can be applied to all areas of social marketing that use economic incentives to motivate the public. He states:

Reliance only on economic concepts of consumer behavior misleads analysts by focusing attention on a few of the important bases of energy demand and away from several others that are also critical for understanding and for policy. Economic concepts create significant blind spots for analysts, and policy models build on economic assumptions about consumer behavior have served to add detail to a distorted vision (Stern 1986, p. 200-201).

In designing social marketing campaigns, De Young summarizes

one need not feel constrained by existing behavioral change strategies that treat people as subjects in need of manipulation by extrinsic incentives. It may be wise to resist incorporating extrinsic incentives in a new conservation program under the assumption that this is the only way to encourage environmentally appropriate behavior. The best use of program funds may not be to use them as a one-time reward. A more frugal approach might be to use these funds to enhance people's discovery of the satisfactions which can be derived from conservation activities (De Young 1985, p. 289).

The best use of scarce funding may be to promote diversion programs through public awareness campaigns and encourage self-motivated people to participate rather than attempt to induce others to participate by offering financial reward.

In a similar study, The Comparative Effectiveness of Reward and Commitment: Approaches in Motivating Community Recycling, Richard D. Katzev and Anton U. Pardini write about commitment versus incentive as a reason to recycle. This study was specifically geared to increasing residential participation in an existing curbside recycling program. Some residents received a token of appreciation for their participation, which could be exchanged for prizes (extrinsic reward), while others signed a pledge to recycle and received no economic incentive. In comparing the actual participation rates of these groups, Katzev and Pardini found that the rate of participation was far higher among those who made a pledge to recycle, than among those who only collected the token for their participation. In conclusion they state:

we question the necessity of incentives, especially highly attractive extrinsic incentives, in promoting resource conservation in general, and recycling, in particular. At the same time we suggest that behavior influence techniques derived from the minimal justification principle, where incentives play a somewhat limited role and where intrinsic controls are emphasized, may be more effective in initiating and maintaining behavior (Katzev 1987, p. 93-94).

The preceding discussion primarily focused on intrinsic rewards as an incentive for residents to perform socially desirable behavior. Intrinsic rewards must be provided when designing an incentive scheme, but incentive schemes must also work within a fee structure that pays for the incentive scheme system. A second type of incentive scheme is explored in

the next section, that of economic incentives.

Types of Economic Incentive Structures

Economic incentives are usually considered when a community begins providing curbside recycling services for its residents. Curbside recycling can be expensive, and by providing residents with inexpensive curbside disposal that competes with recycling for a household's solid waste, a city is working at cross purposes to itself. A community's disposal pricing scheme usually reflects past problems with the community's ability to regulate and charge for solid waste disposal. Extrinsic rewards, which are discussed in this section, can also be used for social marketing, and they are easily implemented within a capitalist society that uses pricing to signal scarcity. There are a number of different ways that a fee structure can financially encourage the diversion or reduction of solid waste. They usually fall into the following three categories: volume based rate structures, bag/tag systems, and flat-fee structures that give some sort of credit for households that recycle. These fee structures are discussed below.

Flat Fees

Single-fee curbside garbage disposal is the predominant form of garbage fee structure in the United States today. This sort of billing is simple, it requires little administration, provides a very consistent prediction of system revenues, and because it distributes operational costs across the widest group of users, fees are minimized. Flat fees represent workable solutions to problems that plagued early waste systems: sanitation and fire hazards resulting from illegal dumps caused by residents resisting paying distance-based disposal fees. In addition, the administration of flat fees is much easier and less complicated than variable disposal fees.

In the flat fee system, there is little financial incentive to illegally dump because

generous disposal capacity is provided for a fixed monthly fee that is paid whether larger amounts of garbage are generated or not. However, neither is there much economic incentive to reduce garbage volume in single fee systems, which is why they are being reconsidered in light of reduction and diversion requirements mandated by AB 939. In a fixed-fee system there is little incentive for a resident to recycle or divert, since it is neither convenient (in the absence of curbside recycling), nor financially attractive, and since it will not reduce the garbage bill. When a community implements curbside recycling programs that typically cost \$2.00 to \$3.00 per household month, the community must stop providing inexpensive and convenient unsorted disposal, since this will compete with curbside recycling programs and residents will receive conflicting signals about garbage generation versus recycling.

Bag/Tag System

Some communities have implemented what are called bag/tag or sticker systems in which residents purchase stickers for their garbage. Residents attach the stickers to garbage containers or use easily identifiable bags in setting out their refuse, and only properly marked garbage is collected. Because stickers or marked bags must be purchased and used for all garbage that is collected, bag/tag systems are essentially a variable disposal rate. This type of a system provides the same incentive for reduction of garbage volumes as the per-can fee, but it also assists garbage collectors in their job by easily identifying paid containers. Additionally, the process of purchasing stickers and bags may solidify the connection between cost of disposal and garbage generating purchases. Residents may begin to find ways of reducing the amount of garbage they put out each week if they must continually purchase stickers for their garbage. Bag/tag systems are considered a variation of variable disposal fees that are discussed below. Bag and tag systems can be thought of as more of a method to implement fees, rather than a different fee system altogether.

Variable Disposal Rates

Variable disposal fees that are based on the volume (or weight) of solid waste a household disposes, provide incentives for households to reduce and divert solid waste from curbside collection, since these efforts will reduce that household's garbage costs. Volume-based fees typically assess costs depending on the number of garbage cans a household disposes each week. The fee increases for larger disposal volumes, and most systems allow for the occasional change in service level. Residents, so the theory goes, will seek to maximize their disposal benefit by finding ways to stay under their paid disposal service level through recycling or otherwise reducing the amount of garbage they dispose. A recycling program should be implemented before a variable disposal rate takes effect so residents will be aware of opportunities to divert their waste. Some communities provide standardized garbage containers to assist in the collector's job of identifying paid cans while others use existing garbage cans in the new system and a "can" is a "can" regardless of size. Volume-based fees may encourage the "stuffing" of garbage cans and weight-based disposal fees are being considered. The development of variable disposal rate-fee schedules must be done carefully while assessing the attitudes of the community. It is the community which must live with, and react to, an incentive structure.

The consulting firm of Deloitte & Touche presented a seminar on variable disposal rates at the Pacific Recycling Expo of 1991. In their handout they describe six types of rate-based incentive programs: progressive rates (versus flat fees or proportional rates); mini-can rates; weight-based rates; sticker purchase systems; bag purchase systems, and recycling surcharge stabilization systems. They also discussed some new alternatives such as zero, or half-can options, biweekly pickup, and recycling credits. They stressed that each locality will have unique circumstances that dictate the most workable solution to its needs.

Within the broad area of volume based structures, disposal fees can be regressive,

proportional, or progressive. Similar to regressive tax schemes, regressive disposal schemes charge less per can for increased amounts of waste. If the weekly collection of one can of solid waste costs \$8.00 per month, in the regressive system, the second can might only cost \$5.00 extra, while the third can might cost an additional \$3.00. In the progressive disposal pricing system, a second can would cost more to residents than the first can, i.e., \$11.00, while the third can might cost even more. A proportional system maintains the same cost per can for each succeeding service level, e.g., all cans cost \$8.00 per can per month to service. However, a community is also bound to a pricing scheme that will cover all required service costs. Underlying any discussion about variable rates is the requirement that new fees cover operating costs for the collection and disposal of solid waste and any recycling programs that a community operates. This condition must be satisfied before a community can begin to discuss incentives that will encourage reduction and diversion.

Deloitte & Touche also discuss some of the issues surrounding differing fee structures and alternative methods of funding recycling programs. A program can be funded by public funding, subsidized by operators, subsidized through garbage rates, or through direct surcharges (Deloitte & Touche 1991, p. 47).

They summarize by saying:

While a variety of recycling incentive programs are being tested, specific local conditions and politics must be considered in the program design. Funding, implementation issues and the relationship with the operator must be planned and managed. Recycling programs require monitoring, analysis and revision over time as costs, local conditions and politics change. Finally, long term planning should integrate the design of recycling programs and the future of collection and landfill operations (Deloitte & Touche 1991, p. 60).

The following section summarizes costs that must be covered by any billing structure a community implements. A community must consider the impact of the disposal pricing scheme on its local populace and revenue base when developing an incentive structure. It must meet all system costs and provide an incentive that appeals to local residents.

Designing an Incentive Scheme that Works

A successful transition to volume-based disposal fees can be accomplished if local governments consider the population they are serving, what services are needed, and the costs associated with those services. In Volume II of Variable Disposal Rates in Solid Wastes: Handbook for Solid Waste Officials, the EPA discusses what sort of information is required about a local waste system before a change to variable disposal rates can be expected to succeed.

The manual begins by introducing financial analysis into the discussion of solid waste management and the provision of solid waste services. A waste system's bottom line must be satisfied before any fee structure can be expected to succeed. The EPA shows how a community can determine the financial implications of each waste management alternative by comparing the per-ton cost of diversion programs to the per-ton cost of landfill disposal. Using these methods, a community can determine how much it is willing to spend on recycling and find the least-cost solution to its needs. By implementing diversion schemes a community will benefit by not paying "avoided costs." Avoided costs are those costs that are saved through more judicious use of landfill space, costs that are avoided by not having to collect and dispose of solid waste. The actual dollar figure for avoided costs differs depending upon the type of financing structure the landfill operates under and the local region. Each community must calculate its individual avoided costs.

The EPA's manual describes different types of refuse collection arrangements throughout the United States: municipal collection, contract collection, franchise collection, and private collection. The potential savings in collection costs for each system will be different depending upon its particular contractual arrangement. The potential savings of avoided costs to municipalities that collect waste themselves are most substantial, since savings result from both municipal labor savings and reduced equipment purchases. For cities that have contracts with private haulers, the savings from avoided costs can only be

realized if the new scheme is written into a new contract and savings are passed along to residents. The costs of landfilling solid wastes as outlined by the EPA include:

1. Transfer Station Costs
2. Hauling Costs
3. Current Tipping Fees
4. Future Tipping Fees
5. Landfill Closure and Re-siting
6. Environmental Costs (EPA 1990, p. I-21)

The costs of recycling programs are, on the other hand, represented by the following equation:

$$\begin{aligned}
 \text{"Recycling Cost"} = & \\
 & \text{Program Administration Cost} + \\
 & \text{Recycling Collection Cost} + \\
 & \text{Transfer and Hauling Cost} + \\
 & \text{Recycling Processing Cost} - \\
 & \text{Net Revenue from Sale of Materials"} \\
 & \text{(EPA 1990, I-30).}
 \end{aligned}$$

The manual states:

as a rule of thumb, a jurisdiction should increase its recycling programs (which should increase convenience and the diversion rate) until the cost of diverting one more ton to recycling is equal to the cost avoided by not disposing of that ton (EPA 1990, I-31).

When a jurisdiction implements a variable disposal rate, residents can either pay higher solid waste disposal costs or they can: (1) reduce their garbage generation by purchasing more carefully; (2) recycle to divert their waste from the expensive disposal into less expensive (or free) recycling programs; or (3) they can illegally dump or burn their waste.

The EPA summarizes by saying:

There are several keys to developing a successful solid waste management system. These key ingredients include: providing incentives to customers, providing a convenient system with choices and a variety of legal alternatives for waste management; providing extensive information on the system; doing high-

quality planning and integrated system analysis; and providing an integrated system that works together to reinforce solid waste management goals and objectives (EPA 1990, p.7).

Within this discussion, of course, the bottom line requirements of a waste system must also be satisfied. A system must generate revenues sufficient for its purposes, but by providing convenient and inexpensive choices to households and by increasing the cost of disposal, legal diversion of solid waste will increase.

The Problem of Illegal Dumping

The main argument for the adoption of variable disposal rates is that as disposal rates increase, residents will seek alternative ways of managing their waste. If curbside recycling is available, residents will recycle some of their solid waste, thereby reducing the amount that is disposed, and they will be rewarded for their behavior by a lower garbage bill. This assumes that residents will seek legal avenues of recycling as an alternative to disposal. Instead of recycling, however, some residents may illegally dump their solid waste to avoid paying the higher disposal fees. The following section discusses aspects of illegal dumping and how it might be impacted by the adoption of variable disposal rates in Hollister. Illegal dumping here refers to spot dumping of rubbish. Littering of roadways by the public is considered as a separate matter, although this too, may be impacted by higher disposal fees.

The relationship between the cost of disposal and the amount of solid waste that is illegally dumped seems to be straightforward. At least some illegal dumping is conducted by people who wish to avoid the costs associated with proper disposal of their materials. If the cost of disposal increases, illegal dumping may increase as more and more people consider it as an alternative. Richard J. Mauck, deputy director of Public Works for the City of Santa Clara, in a recent paper prepared for the County of Santa Clara Solid Waste Commission, says:

Cities nationwide have reported that when landfill rates increase in a significant manner, illegal dumping frequently occurs... [I]llegal dumping has increased so dramatically in some cases, additional staff has been added for enforcement, public information, prosecution, and clean-up activities. Many cities have used a portion of the increased landfill tipping fees to fund these increased costs (Mauck June 24, 1992, paper prepared for County of Santa Clara Solid Waste Commission).

Others contend that although there are some transitional effects of increased disposal fees, levels of illegal dumping do settle down (Skumatz 1990) and some residents will dump regardless of the cost of disposal. A community must include an assessment of the effect that an increased or variable disposal rate will have on illegal dumping and take precautions before adopting a variable disposal rate.

Historically, the problem of illegal dumping has been partially addressed through the implementation of low single-fees for curbside solid waste collection. Because a flat fee distributes costs to the largest group, it is typically low. A flat fee structure allows households to dispose large amounts of waste conveniently for a single fee, and thus much of the financial incentive for illegal dumping is eliminated. But flat fees have not completely solved the problem of illegal dumping, as witnessed by the continuation of illegal dumping activities. The same motives that will encourage residents (especially low-income residents) to find alternatives to disposal under a variable disposal rate scheme, may also drive some to illegally dump, and the transition to variable disposal rates may involve a short-term increase in these activities. To minimize the adverse effect of variable disposal rates, established, available, legal alternatives to curbside disposal (curbside recycling, composting etc.) and functioning public education programs must exist before variable disposal rates are implemented. Without them, variable disposal rates could simply anger residents who have no alternatives and exacerbate the existing illegal dumping problem.

Illegal dumping occurs when several components are present: perception of high disposal fees, low chances of getting caught (and/or low penalties), and the availability of suitable land. Dumping usually occurs in areas where a vehicle can pass away from the

view of neighbors or residents. Typically, a low lying area, a creek bed or a gully is chosen because of the ease of unloading rubbish down from the vehicle and because of their typically remote locations. Items that are discovered in illegal dump sites include general household rubbish and items that are difficult and/or expensive to dispose of, such as white goods and furniture. Hollister's waste officials have expressed concern about a rise in illegal dumping if a variable disposal rate is implemented. This is a valid concern because collection of dumped materials will drain monies away from other public programs, anger local residents, and present another environmental problem that must be addressed. The discussion that follows summarizes aspects of illegal dumping that should be addressed by Hollister before a variable disposal rate is implemented.

Fee Structure

If legal avenues of solid waste disposal are perceived as expensive or troublesome, some residents may consider illegal dumping as an alternative to higher disposal fees. While not all illegal dumpers seek cost-savings, many would use this as a justification for their activities. If landfill and curbside collection fees are perceived as fair, or at least commensurate with the level of service provided, dumping may occur less frequently. In the case of variable disposal rates, the public must be explicitly informed how the new rates are fair, and how they can use the new rates to save themselves money. Variable disposal rates give residents a choice about how they want to spend their waste collection dollars. If they do not want to recycle and reduce, they can still dispose of unsorted materials at the curb, but it will cost more. If they wish to save money, they are able to do this in the new fee system, and this should be stressed.

Although Santa Clara Public Works Director Richard Mauck has suggested that illegal dumping usually increases with higher disposal fees, some studies suggest that a rise in flat fees has more effect on illegal dumping levels than implementation of variable rates.

According to a study by the New Jersey Board of Public Utilities, illegal dumping increased in the state in 1987 after dramatic increases (in flat fees) inflated rates. The BPU claims that some citizens were angry because they 'lacked control' over disposal costs (Goldberg 1990, p. 98).

If variable disposal rates are implemented after legal avenues of disposal such as curbside recycling and clean-sweep days are implemented, residents may feel there is an alternative to garbage disposal and may consequently dump less. Illegal dumping, however, may continue with a variable disposal rate until there is a strong disincentive for dumpers to stop their activities and instead use available legal disposal and diversion methods. A strong disincentive to dump is also needed to persuade those who are already dumping that they will be caught and penalized for their actions. They must be persuaded that financially, it is not worth the risk. Efforts to curtail illegal dumping have in the past primarily focused on enforcement. These efforts are discussed below.

Financial Penalties for Illegal Dumping

The actual fine or penalty an illegal dumper might receive for his activities also has bearing on the level of illegal dumping. Laws have been enacted to allow local governments to assess moderately large fines to those caught dumping. These are rarely used, however, except in flagrant violations or when evidence is available that positively links the perpetrator to the crime. For the most part, few illegal dumpers are caught, and when they are caught, their fines are small.

If an illegal dumper perceives the risk of being caught, convicted, and the resulting penalty as being small, or at least outweighing the cost and hassle of legal disposal methods, illegal dumping will continue. In economic terms, the dumper decides that the benefits of illegal dumping are greater than the potential costs of illegal dumping. A community must change this situation before a variable disposal rate is begun, otherwise the incentive is still present and illegal dumping may increase as a result of increased disposal costs. Some efforts have focused on increasing the penalty for illegal dumping so

it is no longer worth the risk, while others have sought to prevent access to obvious dumping sites. Both of these methods can help minimize illegal dumping activity.

Judge Larry E. Potter of Memphis, Tennessee, writes in Waste Age Journal of his opinion about how to handle illegal dumping. As a member of the judicial system, his focus is on increasing enforcement efforts and prosecuting violators. Because of the ineffective and inconsistent prosecution of violators in Memphis and in Shelby County, Tennessee, enforcement officials were low in morale and made little effort to enforce illegal dumping laws. A single court that was established for the adjudication of cases relating to health, fire, housing and zoning code violations reversed this tendency. It was here that all illegal dumpers were tried.

With this single unified court, cases could be heard in a consistent manner, the morale of enforcement agencies was renewed and greater prosecution of violators has resulted (Waste Age Nov. 1989).

This example may suggest to Hollister, which has had very limited success in abating illegal dumping, ways in which to effectively enforce existing laws. Waste Age also writes of the property owners responsibility in keeping their property free of illegally dumped material. In Dougherty County, Georgia, the local enforcement agencies have been fining properties owners who do nothing to curtail illegal dumping on their lands. Georgia law holds the property owner responsible for illegal dumps if the dumper is not caught (Waste Age Nov. 1989). Landowners must share responsibility for their property by limiting access to their land and making sure it is not a nuisance.

Hard-to-Dispose Items

Large and bulky items are frequently found at illegal dump sites because these items are not typically accepted by curbside collection services. When residents move and these items become inconvenient or costly to dispose of, they may be illegally dumped. In response, some communities collect household rubbish, including large and bulky items,

once or twice per year at special events hosted by the garbage collector. These events may help control illegal dumping as witnessed by the typically large participation rates for the events. Some materials can go to institutions that accept used goods and sell or redistribute them to the needy and indigent. However, these organizations would be hard pressed if residents were to donate broken and useless items to these outlets instead of properly disposing of them.

Theft of Disposal Capacity

One phenomenon that may occur when garbage rates increase dramatically is illegal use of other people's disposal services. Industrial dumpsters that are being used at a building site are usually placed curbside and are accessible to local residents who may use some portion of these dumpsters to dispose of their large and bulky waste. Dumpsters are priced according to their size, and not according to how much waste is actually contained in the dumpsters. If some unused portion of the dumpster is filled by neighboring residents, there is no problem. The resident is consuming otherwise unused space to dispose of their large and bulky waste, thereby keeping these materials off the street, without costing the builder anything. However, if the curbside dumpster will become full, the illegal dumper is actually robbing the building site of some of its disposal capacity. The use of variable disposal rates without some sort of "clean-sweep" days to collect large and bulky items may increase illegal dumping and theft of disposal capacity.

Burning Solid Waste

Burning solid waste is another garbage disposal method that is undesired, if not illegal. In the unincorporated areas of San Benito County, many residents now regularly burn their waste then self-haul the residual ashes to the landfill. San Benito County is part of the Monterey Bay Air Pollution Control District, where burning of field stubble and household rubbish is allowed (conversation with Monterey Bay Air Pollution Control

District, 2/26/93). This activity may increase as a result of increased disposal costs, and illegal burns may begin to occur in the incorporated parts of the city.

Conclusion

The preceding discussion has summarized some aspects of illegal dumping that might be impacted by variable disposal rates. If appropriate measures are not taken by Hollister before a variable disposal rate is implemented, illegal dumping may increase with new and higher disposal rates. The next section discusses the development and implementation of San Jose's Recycling Plus! disposal rate. This system will be examined in detail because it is a variable disposal scheme that was developed in a considered fashion by a progressive regional city. Illegal dumping and the reaction of residents to the new fees was anticipated by the city of San Jose, and although there are large differences between Hollister and San Jose, some of the discussion may offer insight for Hollister's waste planners.

San Jose's New Variable Rate Scheme

In July of 1993, the city of San Jose will begin a new system of solid waste disposal pricing. The new "Recycling Plus!" system will change the existing flat residential garbage fee to a volume-based fee where households pay their garbage bills based on the level of service to which they subscribe. Three sizes of containers will be available to residents: 32 gallon, 64 gallon, 96 gallon, and after 1994, a smaller 20 to 32 gallon container (Summary of Draft Recycling Plus! RFP, 8/21/91, p. 5). Customers will specify the number and size of the containers placed at the curb, subscribe to this weekly service, and will be billed accordingly. Unlimited curbside recycling will be available to residents for collection of newspaper, glass, metals, mixed paper, and plastics in the stackable bins that are already in use by city residents, and yardwaste collection will eventually be

available to most residents for a fee. All of these services will be performed by private contractors who will be responsible to the San Jose's Environmental Services Department (ESD). The terms and requirements for all of these services were outlined when the city put the contract up to bid and issued a Request For Proposal (RFP) for the job. In its RFP for this new waste system, San Jose described the services required of the chosen contractor. The city's goal was to obtain a contract with a large private company, specifying the solid waste services system the city wanted. The incentives and structure of the system would be spelled out in a contract, and the contractor would be responsible for supplying these services. Should the contractor fail to provide service detailed in the RFP, the city specified penalties that would be assessed. The two largest waste collectors, Browning Ferris Industries and Waste Management Incorporated, as well as other smaller waste hauling firms, competitively bid for a contract that rewarded them:

with a base rate per household served, with a double incentive of 1) a rate for tonnages recycled, and 2) revenues from the sale of recyclables (OEM Environmental Committee Memorandum of 8/28/91, p. 1).

These components of the contract serve the city's purposes by giving the contractors an incentive to perform. The base-rate for each household served by the garbage company provides a very secure revenue base for the garbage company. If this base rate were the sole reward for the contract, there would be no incentive to recycle, but the contract also provides compensation for the contractor that is dependent upon the amount of recyclables that are recovered and sold. Since the incentive only applies to tonnage that is actually sold, the contract encourages clean materials that the private company can sell at premium prices in the local commodities market.

San Jose will give the chosen contractor a yearly disposal capacity at the city's Newly Island landfill. This Contractor Disposal Allocation (CDA) is determined by multiplying the number of households served by a declining per capita disposal allocation. Free disposal space decreases each year, thereby encouraging diversion and recycling by

the private contractor. By 1994 the per capita allocation will be 1,601 pounds per household, a decrease from the 1990 level of 2,948 pounds per household. The city requested that responses to the RFP detail specific charges for each service rendered: a monthly dollar cost for each level of curbside garbage services, a per ton cost for collection, transportation, processing, and marketing of qualifying recyclables, and a single dollar cost for the collection of annual free bulky goods collection (OEM Environment Committee Memorandum of 8/28/91, p. 25).

Materials flow control is also maintained by the city of San Jose. The city is interested in using flow control as a tool to develop local recycling industries. Guaranteed amounts of recyclables are often demanded by industries before investing in costly new manufacturing processes that use recycled materials. If the city of San Jose can assure manufacturers that it has a steady flow of recyclable materials, manufacturers may be attracted to the area. The contractor must also maintain computer records of the amount and types of recyclables and garbage that is collected from residents. The contractor will maintain an information database that is compatible with the San Jose's Intergraph mapping system. The maintenance of a geographic information system (GIS) with all route information will be enormously helpful to future planners who can use this data to analyze the system's performance, and help meet information requirements of AB 939.

San Jose's new rates are as follows: \$13.95 per month for a single 32-gallon (can size) container, \$24.95 per month for a larger 64-gallon container, and \$37.50 per month for a 96-gallon container. These variable rates represent sizable increases from the old flat rate of \$12.50 per month for unlimited service. As of early February, 1993, when the new rates had been advanced to the city council for approval, the Environmental Services Department (ESD) [the new name for the Office of Environmental Management], received a number of vocal residents who expressed concerns about the rates. Some residents see variable disposal rates as an example of governmental interference in private business, and

they philosophically oppose the new rates. One resident speaking at the first council meeting on February 16, stated " It's probably too late in American history to ask you guys how you got this power. But its not too late to ask you, with some courtesy, to explain what you are doing" (San Jose Mercury News, 2/17/93). Another resident stated " We should get a break if we recycle. Instead our rates are going up!" (San Jose Mercury News, 2/17/93). The ESD claims that in the previous month, they received 16,983 calls about the new system and only 5% were complaining about the new rates, the vast majority were non-fee related questions about the new system. ESD claims that the residents who are flooding the council members are those who are angry, the vast majority of San Jose's residents are willing to put up with the new rates and will in response recycle more. Lindsey Wolf, spokesperson for the Environmental Services Department stated that "The [council] is getting the folks that are steamed. They know the system, they're acquainted with their council members, and they're unhappy. The customer service people are dealing with what I would call the general public" (San Jose Mercury News, 2/17/93).

Additionally, more residents are choosing smaller service levels at a higher than expected rate and thus revenues from the system may be less than projected. The city of San Jose may face a reduction in the revenue stream from garbage collection. In January of 1993, the ESD sent out a flyer asking residents to specify what level of service they wanted. Residents chose the 32-gallon collection service in higher numbers than ESD had anticipated when they drew up the finances for this waste system. The result could be inexact forecasts of revenues from the system. As a result of their constituents' concerns, several councilmembers floated alternative price schemes that weren't so steep. However, by end of February, 1993, the City Council adopted without change the new rates.

San Jose's new Recycling Plus! system offers insight into what sort of billing and service arrangements are possible if a large city requests these services from their private waste contractor. The issues that were discussed by San Jose's City Council reflect typical

responses to the increased rates. When any city fee increases, there are many residents who naturally oppose it. Increases in something that has for so long been thought of as a free good will spark resistance. There are other cities in Santa Clara County that already rely upon variable disposal rates, and San Jose's new rates are within the range of these other city's garbage fees. There are many differences between Hollister and San Jose, and Hollister's waste system must reflect local conditions. However, the preceding discussion illustrates the process of designing and adopting a variable disposal rate. Hollister must investigate what will motivate local residents to participate in diversion programs before a new rate system is implemented. One way to determine the attitudes and motivations of Hollister's residents is through a survey. The next section discusses prior surveys about economic incentives for recycling that can offer background insight for Hollister.

Attitudes About Solid Waste And Recycling

The attitude of the general public toward solid waste collection and recycling is vitally important to the success of any incentive scheme. No incentive scheme will work without the participation of residents. One way to anticipate the impact of a new scheme is through survey methods that characterize a population's motives and attitudes towards recycling and garbage disposal. Surveys attempt to estimate how a new rate system will fare by the responses of those sampled. Only after a survey is performed can one attempt to design an incentive scheme that works within the existing value system of the populace. The following surveys may offer some insight for Hollister policymakers before a new rate system is implemented. As was shown by San Jose's new rate system, some residents may be vocally opposed to any new rate system, but if it can be shown that they are a minority, the city council might muster the strength to adopt a new rate system unchanged. The first survey presents results of a general survey of the general public towards economic incentives for solid waste disposal. This survey used data from all over the United States

and attitudes in Hollister may be significantly different than those discovered in this study. A second survey is described that offers additional information regarding waste fee structures and the opinion of San Jose's Hispanic residents.

The National Solid Wastes Management Association (NSWMA) conducts yearly opinion polls of Americans regarding solid waste and incineration issues. Its 1989 survey polled 3,500 Americans. Although the questions asked in this poll are often centered on garbage incineration issues, thereby revealing the real reasons for the survey, one question in the 1989 survey concerned variable disposal rates and is relevant to Hollister's study. When selected adults were asked "Would you favor or oppose rewarding people who generate less garbage by charging them less than other people for trash collection?" 61% favored this action, 28% opposed this action, and 11% did not know (NSWMA 1989, p. 10). A 3% margin of error is expected with the size of the sample. A majority favored rewarding smaller disposers with smaller fees.

In a survey conducted by the city of San Jose, the Office of Environmental Management (OEM) circulated a questionnaire regarding how to improve garbage, recycling, and billing services. By March of 1991, 7,228 of these surveys had been tabulated. The survey was conducted primarily because the city was considering a new volume-based fee structure and little data existed about how some aspects of the change would be received by local residents. Survey participants were asked to read a description of different aspects of solid waste collection and billing, then answer the survey's questions. One question concerning variable disposal rates is presented below:

As described in the previous article, 'Should Garbage or Recycling Be Unlimited?' which of the rate structures, in your opinion, would be most effective in meeting state mandated goals?

- a) Continued fixed rate for unlimited quantity of garbage collection
- b) Fixed rate for garbage collection of up to 3 cans or wheeled cart
- c) Variable rate for garbage collection (fewer cans, lower rate)
- d) Other

By March of 1991, 6,990 persons returned meaningful responses to the city. Of these, 59% selected a fixed rate for garbage collection, 20% selected a fixed rate for up to three cans, and 21% selected the variable rate scheme. A majority of the public was in favor of keeping the billing system the same (initial tabulated results of survey made available to the author by OEM personnel). In spite of these results, San Jose moved forward with the new variable disposal rate scheme previously described. The city of San Jose also sampled Hispanic residents in another survey that is described below.

Hispanic Opinions About Solid Waste and Recycling

A large number of Hispanics live in San Benito County and Hollister. No exact percentage is available because it depends on the definition of Hispanic, but 36% of Hollister's households were listed as "of Hispanic origin" in the 1980 census (Hornor 1991, p. 172), and the San Benito Unified School Board estimated that 20% of the school district's children are not fluent in English (verbal estimation on March 25, 1992). Hollister must consider how this large minority group views recycling and garbage collection before considering changing to variable disposal rates. San Jose also has a large population of Hispanic residents. A survey of San Jose's Hispanic residents was performed by Phase III Market Research in anticipation of the new Recycling Plus! waste system. The city of San Jose wished to determine Hispanic residents' opinions regarding the city's curbside recycling programs, assess their satisfaction with the program, and identify major sources of information typically used by the Hispanic community. Group focus sessions were employed in the survey. Selected participants were Hispanic in origin, Spanish-speaking, in charge of taking out the garbage for their household, and over 18 years of age. Phase III Marketing Research conducted two focus group sessions of 12 participants each at their San Jose facilities during the summer of 1991. All participants reported that they recycled in some manner or another, and the majority of participants in the survey recycled for cash

at buy-back centers. A summary of the results of these focus sessions regarding Hispanics are presented below.

1. Most recycled for the value of the beverage containers they collected at recycling centers.
2. For those residents who did use the curbside program, aluminum was still withheld from the curbside program and redeemed for cash at recycling centers.
3. Reasons for participation were not to help the city or the environment, but rather to help oneself.
4. In questions pertaining to rate changes, all participants were hostile to the idea of rates being linked to garbage collection volume. They cited that people would litter more, and the new rates would penalize large families.

(Phase III Research September, 1991, 1-5)

Although Hispanics in this survey appear hostile to variable disposal rates, they also appear to be motivated in their recycling habits by financial reward. If the new rates were explained as a way to save money, Hispanics might respond more positively to them. Two areas of special concern were also noted: (1) Hispanics appear to be very concerned about the possibility that variable disposal rates could penalize large families; and (2) they believe illegal dumping and littering might increase as a result of the new rates. Both of these concerns must be addressed by the rate scheme and an education and public information program must be developed before Hispanics can be expected to be comfortable with variable disposal rates.

The results of the surveys discussed above suggest that some of Hollister's population (maybe a majority) would approve of a rate system that rewards residents who minimize their waste, while others are concerned with the effect on their own waste fees. These previous surveys were very general, and depending upon how surveys ask similar questions, and what discussion precedes the question, very different results may follow.

Hollister and San Jose are very different cities: Hollister is a small rural town, while San Jose is a large urban city. These differences may yield large discrepancies in how their respective residents view variable disposal rates and the use of economic incentives. But the preceding discussion does point to areas that should be investigated before a variable disposal rate is implemented. The next chapter describes a survey of Hollister that was performed in hopes of obtaining a clear picture of what would appeal to Hollister's residents, and how a variable rate system should be implemented.

Summary of Related Studies

This chapter has provided some background to issues surrounding variable disposal rates and the use of economic incentives to encourage recycling. It has examined factors that influence the generation of solid waste, it has described differing incentive schemes, and it has looked at how illegal dumping might be affected by a change to variable disposal rates. An example of how a city can develop its own variable rate scheme through its contractor has been given by describing the San Jose's new Recycling Plus! scheme.

Few previous studies have been able to show that economic incentives will cause a decrease in the total amount of solid waste that is produced by a household, where the total produced waste refers to the total amount of materials that are generated from a household, including materials are to be diverted to recycling, composting, and for unsorted garbage disposal. Conversely there are studies that find little or no change in the amount of solid waste produced because of increases in disposal costs. While the amount that is presented for curbside collection may decrease with economic incentives, the amount that is generated will remain constant, being more reflective of family size and the income of residents than of disposal costs. Because the cost of disposal is insignificant in relation to the purchase price of most goods, there does not seem to be any decrease in the total amount of solid waste that is generated by residents when incentive schemes are introduced. Some

communities note, however, a shift occurs in the disposition of solid waste when economic incentives are implemented and curbside recycling is available (Seattle). Residents shift from unsorted curbside disposal of solid waste to recycling, composting, and self-hauling rather than paying higher disposal fees.

Some researchers (De Young, Katzev & Pardini, Stern), believe it misguided to exclusively focus on extrinsic rewards for residents who perform resource-conserving behavior. Extrinsic rewards are financial gains that are obtained by residents who recycle and divert their solid waste. Variable disposal rates, in which disposal fees are linked to the amount of solid waste that is disposed, are an example of extrinsic reward structures. More investigation of intrinsic rewards is needed, where intrinsic rewards are the good feelings that accompany resource conserving behavior. These good feelings and sense of community spirit seem to encourage resource conserving behavior such as recycling and composting. Scarce funding might be best spent encouraging civic-minded individuals to divert their solid waste rather than financially encouraging other society members to recycle.

The problem of illegal dumping must also be addressed by any community seeking to encourage diversion through economic incentives. Illegal dumping will continue to be a headache for waste planners as long as there is an incentive for the activity. This incentive must be removed by prosecuting illegal dumpers and providing local residents one or two free clean-sweep days each year, where residents can rid themselves of large and bulky goods for free. When the incentives for illegal dumping are removed and residents are aware of free and legal disposal alternatives, illegal dumping will be curbed.

Because Hollister has such a large Hispanic population [36% in 1980] (Honor 1991, p. 172), the opinions expressed by Hispanics regarding incentives for recycling are important. Studies conducted by the city of San Jose found that Hispanics recycled for financial gain and were concerned that economic incentives would penalize large families

and encourage illegal dumping. If Hispanics are shown how economic incentives can save money, and how they can continue to recycle beverage containers for cash under the new system, many Hispanics would probably be more enthusiastic about variable disposal rate schemes.

The next chapter describes a survey of Hollister regarding diversion incentives and waste management systems in general. Ideas that have been expressed in this chapter were incorporated into Hollister's survey. The questionnaire was developed and conducted over the summer of 1992.

CHAPTER 4

A SURVEY OF HOLLISTER HOUSEHOLDS

Introduction

The following section describes a survey about ways to encourage Hollister's residents to reduce their solid waste and to increase the amount they recycle. Residents were asked questions about their garbage and recycling practices and about a variety of economic incentives that might induce them to recycle. Hollister was chosen as the study area for two reasons. First the author was previously a consultant for this city and had developed Source Reduction and Recycling Elements for Hollister. Second, as part of graduate coursework, the author had developed a dynamic computer model of the local waste-shed.

The survey presented residents with possible future waste pricing schemes and service structures. They were asked how they would respond to alternative systems. The goal of the survey was to identify incentives that would encourage residents to use curbside recycling and composting as alternatives to unsorted disposal. In the survey, several different types of incentive structures were presented: reduced garbage bills for recycling households, increased curbside recycling opportunities, mandatory recycling requirements, and per-can garbage rates for unsorted waste disposal. Residents were asked to identify their preferences among these alternatives and quantify the financial incentive that would induce them to participate in diversion programs.

The underlying socio-economic model for the study is the rational economic model of human behavior. It provides a framework for analyzing residents' choices and current

practices and planning recycling programs that appeal to these motives. In the rational economic model of behavior, humans are believed to be rational, calculating beings who work to maximize their welfare through economic decisions and behavior. In this survey, it was assumed that garbage collection and recycling fall under these behavior rules, and residents make solid waste decisions that maximize their economic welfare.

The assumptions that underlie this survey are:

1. There exists a set of values for most members of the public that govern their garbage generating and recycling behavior. These values are encompassed in the rational economic model of human behavior.
2. A statistically based survey method (with all its faults and limitations) can determine these values through a system of questions about current behavior and anticipated behavior in response to differing economic incentives.
3. Knowing this value system, predictions can be made regarding residential response to future economic incentive structures. Furthermore, future incentive structures that will increase the recycling rate for Hollister residents without inducing greater illegal dumping can be designed.

Background To Study

Hollister Background

Hollister is located in San Benito County. Despite the county's size of 1,397 square miles (Hornor 1991, p. 493), the total population is less than 40,000 residents. There are only two incorporated cities in San Benito County, Hollister and San Juan Bautista. Both are located in the northern end of the county. San Juan Bautista has fewer than 2,000 residents and is eight miles northwest of Hollister, the county seat. Hollister's residents live in an agricultural region and they identify with rural communities and with the

Monterey Bay Area rather than the San Francisco Bay Area.

Hollister's estimated population of 18,700 residents (Hornor 1991, p. 172) consists primarily of whites and Hispanics, with whites comprising about 40% of the population and Hispanics comprising about 36%. In 1990, there were 5,888 total households, with 3,300 (56%) of these being owner-occupied residences (1990 Census). Per capita yearly income in 1987 was \$8,882, with median household income at \$15,500 per year (Hornor 1991, p. 172).

San Benito County occupies ten different census tracts, 6 of which enclose parts of Hollister (Fig. 4). The following information about Hollister was obtained primarily through 1990 census tract data.* An initial demographic characterization of Hollister can be done by using two attributes of Hollister's census tracts, the median value of homes and the ethnic background of residents. Because Hispanics are such a large minority in Hollister, the percent of Hispanics in a census tract can be used as an ethnic indicator, while the median value of homes can serve as an economic indicator. The following are summaries of these traits for the six census tracts that enclose Hollister.

<u>Tract #</u>	<u># of Households</u>	<u>% Hispanic Homes</u>	<u>Mean Value of Home (\$)</u>
1.98;	41	34.1 %	\$325,000.
3;	623	74.6 %	\$228,000.
4;	1,795	52 .0%	\$146,000.
5;	1,178	48.8 %	\$162,000.
6;	1,209	31.2 %	\$198,000.
7;	1,042	30.3 %	\$220,000.

* General summary information was gleaned from 1990 census tract data that was published in CD-ROM format and was available at San Jose State University's Clark Library. Tract boundaries were obtained from a private map company, Western Economic Research Inc.

Census Tracts in Hollister, California

Figure 4

Prior Studies of the Hollister Wasteshed

The California Integrated Waste Management Board (CIWMB) has jurisdiction over solid waste in California. The John Smith Road Landfill in San Benito County, which accepts Hollister's solid waste, must comply with different CIWMB laws pertaining to its operation. Several recent studies about the landfill have been performed by the San Benito County and the landfill's operators. John Smith Road Landfill is owned by the San Benito County and operated by a private firm, Hollister Disposal Company. It accepts waste from Hollister and the unincorporated parts of San Benito County. Solid waste is measured in cubic yards of solid waste that is brought in by Hollister Disposal Company packer trucks, commercial trucks and vehicles, and industrial trucks. There is no scale at the landfill, so the received volume must be converted to weight for reporting purposes. Historically, John Smith Road has used a conversion factor of six cubic yards of solid waste per ton of weight. Figure 5 shows the intake of solid waste at the John Smith Road Landfill from 1988 to 1993. Several important points are shown on this figure. There is a seasonal factor in the amount of solid waste accepted at the landfill, and operators report that in the winter months, smaller amounts of solid waste are received. Initially, the amount of solid waste seems to be growing from 1988 to 1990. After the 1989 Loma Prieta earthquake, intake at the landfill increased significantly during 1990 as a result of building materials and rubbish and rubble being cleared away. The economic recession that followed in California from 1991-1993 resulted in a reduction in the amount of solid waste accepted at the landfill. The amount of solid waste accepted at John Smith Road Landfill during 1990 was used to generate ten year quantity projections used in Hollister's SRRE. As is apparent in Figure 5, 1990 was a statistically aberrant year, and ten-year projections based on this year may be significantly greater than that which will occur.

Prior to 1989, California counties were required to prepare County Solid Waste Management Plans (CoSWMPs) that described the county's solid waste system and

Figure 5

projected future disposal needs. CoSWMPs were made obsolete by the passage of AB939, the Integrated Waste Management Act of 1989. Integrated waste management is a significant departure from past waste management practices in California. Instead of regulating solid waste disposal, it encourages diversion and reduction of solid waste from California's landfills. The act reorganized the California Waste Management Board into the California Integrated Waste Management Board (CIWMB) and established a hierarchy of waste management practices with waste reduction as primary, followed by recycling, followed by disposal. In 1991, a Source Reduction and Recycling Element (SRRE) was drafted for Hollister as part of the requirements of AB939. California's cities and counties are required to show how they will achieve a 25% reduction in landfilled waste by the year 1995 and a 50% reduction by the year 2000. The Elements contained detailed plans for future diversion programs, including reduction, recycling, composting, and public education programs. Hollister performed a careful analysis of its diverted and disposed wastestream (Table 1), described how its waste was being managed (Table 2), made predictions about types and quantities of wastes expected to be generated over a 15-year planning period, and proposed diversions in specific wastestreams to meet overall diversion goals (Table 3).

AB 939 required jurisdictions to develop new methods of waste management that focused on diversion and recycling rather than disposal as the primary methods of managing solid waste. Instead of disposal-based systems, communities were required to develop integrated waste management schemes, where disposal was replaced by reduction and diversion methods such as composting and recycling. In the course of researching and developing these Elements, Wahler Associates used surveys, field studies, and interviews to gather substantial information about Hollister's wasteshed, and a Waste Generation Study characterizing Hollister's wastestream was conducted. The Waste Generation Study extensively characterized the types and quantities of Hollister's solid waste and projected

Hollister's Diverted and Disposed Materials
Year 1991

	Disposed Weights (tons)	Diverted Weights (tons)
Paper Total	7079.7	7137.2
Corrugated	1836.0	3168.1
Mixed paper	4024.0	3009.6
Newspaper	1143.8	934.4
White paper	76.0	25.1
Plastics Total	2787.9	18.7
HDPE	555.8	15.0
PET	44.2	3.7
Film plastics	695.9	0.0
Other	1492.1	0.0
Glass Total	837.1	458.5
AB 2020	313.3	252.9
Other	523.8	205.7
Metals Total	1676.6	277.8
Aluminum cans	256.9	148.4
Other aluminum	115.4	69.7
Bi-metal containers	606.4	0.0
Ferrous	582.6	0.0
Other metals	115.4	59.7
Yard Wastes Total	5696.2	6.3
Other Organics Total	6016.7	0.0
Food wastes	3641.7	0.0
Rubber	8.2	0.0
Wood wastes	2137.8	0.0
Other organic	229.1	0.0
Other Wastes Total	4187.5	0.0
Cement, etc.	659.2	0.0
Cannery waste	0.0	0.0
Diapers	613.5	0.0
Asphalt	577.7	0.0
Tar paper	1413.2	0.0
Roofing tile	391.6	0.0
Other wastes	532.3	0.0
Special Wastes Total	2735.0	52.6
White Goods	0.0	45.2
Industrial sludge	561.4	0.0
Asbestos	0.0	0.0
Scrap tires	0.0	7.3
Street sweepings	2173.6	0.0
Other special waste	0.0	0.0
TOTALS	31016.6	7951.1

Table 1

How Hollister's Solid Waste Is Managed

Year 1990

(percentages listed are percentages of total generated wastestream)

	Landfilled	Recycled	Total
Paper Total	18.2	18.3	36.5
Corrugated	4.7	8.1	12.8
Mixed paper	10.3	7.7	18.0
Newspaper	2.9	2.4	5.3
White paper	0.2	0.1	0.3
Plastics Total	7.2	0.0	7.2
HDPE	1.4	0.0	1.5
PET	0.1	0.0	0.1
Film plastics	1.8	0.0	1.8
Other	3.8	0.0	3.8
Glass Total	2.1	1.2	3.3
AB 2020	0.8	0.6	1.5
Other	1.3	0.5	1.9
Metals Total	4.3	0.7	5.0
Aluminum cans	0.7	0.4	1.0
Other aluminum	0.3	0.2	0.5
Bi-metal containers	1.6	0.0	1.6
Ferrous	1.5	0.0	1.5
Other metals	0.3	0.2	0.4
Yard Wastes Total	14.6	0.0	14.6
Other Organics Total	15.4	0.0	15.4
Food wastes	9.3	0.0	9.3
Rubber	0.0	0.0	0.0
Wood wastes	5.5	0.0	5.5
Other organic	0.6	0.0	0.6
Other Wastes Total	10.7	0.0	10.7
Cement, etc.	1.7	0.0	1.7
Cannery waste	0.0	0.0	0.0
Diapers	1.6	0.0	1.6
Asphalt	1.5	0.0	1.5
Tar paper	3.6	0.0	3.6
Roofing tile	1.0	0.0	1.0
Other wastes	1.4	0.0	1.4
Special Wastes Total	7.0	0.1	7.2
White Goods	0.0	0.1	0.1
Industrial sludge	1.4	0.0	1.4
Asbestos	0.0	0.0	0.0
Scrap tires	0.0	0.0	0.0
Street sweepings	5.6	0.0	5.6
Other special waste	0.0	0.0	0.0
TOTALS	79.6	20.4	100.0

Table 2

Where Recycled Materials Went 1990

	Residential (tons)	Commercial (tons)	Industrial (tons)	Totals (tons)
John Smith Landfill				
Recycling				
Total	95.2	2.6	0.0	97.8
Newspaper	8.6	0.0	0.0	8.6
White Goods	43.3	0.0	0.0	43.3
Metal	43.3	0.0	0.0	43.3
Cardboard	0.0	2.6	0.0	2.6
Angulo Recycling Co.				
Total	159.3	0.0	0.0	159.3
Glass	113.0	0.0	0.0	113.0
Aluminum Cans	41.5	0.0	0.0	41.5
Plastic	4.8	0.0	0.0	4.8
San Benito Recycling Co.				
Total	276.5	416.5	0.0	693.0
Aluminum Cans	100.5	0.0	0.0	100.5
Glass	162.9	162.9	0.0	325.8
Plastics	13.1	0.0	0.0	13.1
Cardboard	0.0	149.1	0.0	149.1
Computer Paper	0.0	24.0	0.0	24.0
Copper	0.0	8.9	0.0	8.9
Aluminum Scrap	0.0	66.7	0.0	66.7
Brass	0.0	4.9	0.0	4.9
Leatherback Industries				
Total	0.0	0.0	5760.0	5760.0
Cardboard	0.0	0.0	2880.0	2880.0
Mixed Paper	0.0	0.0	2880.0	2880.0
The Free Lance				
Newspaper	774.0	0.0	0.0	774.0
The Pinnacle				
Newspaper	0.0	0.0	111.6	111.6
Hollister City Parks				
Yard waste	6.0	0.0	0.0	6.0
Auto Scrap Yards				
Diverted Scrap Tires	7.0	0.0	0.0	7.0
Total Weight	1318.0	419.1	5871.6	7608.7

Notes:

1. 78% of residential diverted waste processed at John Smith Landfill was apportioned to Hollister, the remaining 22% was apportioned to unincorporated areas of San Benito County. Some data was from June through January and some data was from October through January. It is assumed that all cardboard is of commercial origin.
2. Angulo Recycling Co. receives only residential diverted waste. It was apportioned according to population.
3. Cardboard, copper, aluminum scrap and brass processed by San Benito Recycling Co. are of commercial origin. 90% of these wastes were apportioned to Hollister and 10% to unincorporated areas of San Benito County. It is assumed that 50% of the glass received is of commercial origin and 50% is of residential origin. Plastics are assumed to be of residential origin only.

Table 3

the amount of these materials in future solid waste. A quantitative field study was performed by a Wahler field crew in January, 1991, at the John Smith Road Landfill. The crew sorted, categorized and recorded nearly two tons of Hollister and San Benito County garbage over the week of January 13-18, 1991. The waste study provided detailed information about the composition and management of Hollister's current solid waste (Table 2). AB 939 also required the quantification of material diverted from landfill disposal facilities to recycling facilities. All local recycling companies were interviewed and asked to estimate the amount, type, and origin of material they recycled (Table 3). Their estimates formed the basis of Hollister and San Benito County solid waste diversion rates that were published in the Elements and were used by Wahler Associates to develop plans that allow Hollister and San Benito County to divert 50% of their solid waste from the landfill by the year 2000 (Table 4). These SRREs were finalized in 1992, and programs are being implemented by Hollister. A survey of Hollister's residents can show how economic incentives can assist diversion programs in meeting the goals of AB 939.

Survey Development

Reasons for Survey

As part of Hollister's efforts to reach the goals set by AB 939, some sort of new disposal pricing scheme will be needed to induce residents to separate and reduce their waste. Although Hollister's current overall diversion rate of approximately 20% is very good, it is only because a mixed-paper recycling facility in the city uses large quantities of newspaper for the underlayer in its production of roofing paper. If Hollister implements some sort of pricing scheme that encourages residential diversion, it can easily reach a 50% diversion rate in its residential stream by the year 2000. Like many waste management systems, Hollister Disposal Company currently offers Hollister households unlimited curbside disposal of solid waste for a fixed monthly fee. Under this fee scheme, there is

How Hollister Will Meet AB 939 Requirements

Component	1991 Diverted		Year 1995 Diverted		2000 Diverted	
	Weight tons	Percent	Weight tons	Percent	Weight tons	Percent
Source Reduction	0.0	0.0	929.4	2.0	3474.6	6.0
Home Composting	0.0	0.0	464.7	1.0	1158.2	2.0
Variable Disposal Rates	0.0	0.0	232.3	0.5	1737.3	3.0
Diaper Service	0.0	0.0	232.3	0.5	579.1	1.0
Recycling	7892.3	20.3	12500.4	26.9	21310.8	36.8
City Government Program	0.0	0.0	232.3	0.5	579.1	1.0
Residential Curbside	0.0	0.0	1161.7	2.5	2779.7	4.8
Commercial Drop-off	438.0	1.1	1022.3	2.2	2663.8	4.6
Landfill Recovery	45.2	0.1	325.3	0.7	1911.0	3.3
Residential Buy-back	1273.2	3.3	2091.1	4.5	2548.0	4.4
Industrial	6135.8	15.7	7667.5	16.5	10829.1	18.7
Composting	6.3	0.0	464.7	1.0	4053.7	7.0
Landfill/Self-Haul	6.3	0.0	232.3	0.5	2026.8	3.5
Curbside (Yardwaste)	0.0	0.0	232.3	0.5	2026.8	3.5
Special Waste Programs	52.6	0.1	54.8	0.1	68.3	0.1
White Goods Recovery	45.2	0.1	46.5	0.1	57.9	0.1
Landfill Tire Recovery	7.3	0.0	8.4	0.0	10.4	0.0
Total	7951.1	20.40%	13949.3	30.018%	28907.4	49.92%

Note : all diversion percentages are expressed as portion of total generated waste for that particular year.
Quantities shown are from 1990 data multiplied by growth factor.

Table 4

little economic incentive for residents to recycle materials for which they receive no compensation (i.e., materials other than beverage containers), or to reduce their disposal volume, since these efforts will not result in a lower garbage bill.

The pricing scheme of a rural jurisdiction is vitally important to the success of any recycling or source reduction program. For a rural jurisdiction faced with achieving the goals mandated under AB 939 and having little money or staff to implement programs, the pricing of waste collection and disposal is a very useful tool. Unlike urban communities, rural communities have large amounts of open space and are far less dependent upon landfills for garbage disposal. If curbside garbage collection service or self-haul tipping fees are perceived as exorbitant, rural residents can easily resort to illegal dumping in order to dispose of their unwanted garbage. A survey of Hollister residents was conducted because of the need for a new pricing scheme that would not increase illegal dumping. It was thought that a survey might be able to pinpoint incentives that would encourage recycling without increasing illegal dumping. Statistical sampling methods were used to produce a picture of the city's residents accurate enough to design a successful incentive scheme.

Target Population

The people who will be most affected by city-sponsored diversion programs are those who currently subscribe to curbside garbage collection service. These residents will be offered city-sponsored curbside recycling service when Hollister implements plans that are described in the SRRE, including curbside recycling services. By asking sampled residents questions about their current behavior and about their anticipated behavior in response to various recycling and garbage scenarios, predictions can be made regarding Hollister's overall response to new waste disposal pricing schemes.

The household was chosen as the basic unit for the survey because it is the basic

unit of waste generation and collection. Apartment dwellers and county unincorporated area residents who self-hauled their waste to the landfill were not targeted in the survey. Garbage collection for residents living outside the cities of Hollister and San Juan Bautista is optional, and county dwellers were surveyed only if they subscribed to garbage service. Adult respondents were sought in the survey because they would be responsible for running the household, would pay the bill, and would initiate curbside service and ask for collection bins.

Sampling Methods

Mailouts were initially considered be the best survey method to reach a wide audience in Hollister. However, the low response rate associated with mailouts persuaded the author that it might be more cost effective to perform a phone survey or go door-to-door to gather responses. In live interviews, more time can be devoted to explaining questions to residents and better information may be generated. Statistical error in a survey is equal to the difference between the sample's results and results that would be obtained if the whole population was surveyed. Responses from three hundred randomly selected residents were needed to reduce statistical error to within 6%, which was the goal for the survey.

Telephone survey data were gathered by random sampling methods where all elements in the sampling frame had an equal chance of being polled. All households with a phone had an equal chance of being called because random number tables (CRC Standard Mathematical Tables, 1987) were used to generate telephone numbers. Although this population is not necessarily the same group as those who subscribe to garbage service, for the survey's purposes these sets are similar enough. In the subsequent door-to-door survey, proportional sampling was used to obtain a sample frame that would be proportionally similar to the town's actual census tract distribution. In all of the surveys, the adult household member who was actually interviewed was dictated by chance. As it

turned out, far more women were contacted than men. When Spanish-speakers were encountered during the door-to-door survey, a household member was usually able to translate the questions into Spanish. If residents were not able to interpret the questions for the household, their telephone number was recorded and they were re-contacted in the subsequent Spanish-speakers survey.

Expected Data Quality

Survey data quality is dependent both upon the clarity of questions asked and the accuracy of the responses. Residents were asked about their current practices and about their hypothetical responses to differing economic incentive schemes. The survey characterized residents current behavior and their anticipated behavior in response to possible waste systems. The data suggested appropriate incentive structures that exploit residents' values and that could form the core of future waste pricing schemes. Although it was hoped that the data obtained in the survey would provide insight regarding Hollister's residents, several points were kept in mind in designing and executing this survey. They were as follows:

1. Without previous studies of Hollister's target population, it was difficult to design questions that revealed past and future anticipated behaviors.
2. People may say one thing, but actually do something else. Residents may be lazy, or not care enough to actually recycle although they would answer honestly in a questionnaire that they would.
3. The best results that a survey of this scale could achieve would be to reveal the motivating factors behind residents' behavior. By analyzing residents' responses to hypothetical schemes, waste pricing schemes may be designed that subscribe to these motivations.

Questionnaire Development

Survey questions were developed over a period of two months. Draft questions were used in a pre-survey of a dozen Hollister residents who were called at random and polled several weeks before the full-scale phone survey. The pre-test revealed several survey questions that were confusing to residents, and some questions were reworded. Second generation questions are presented in Figure 6. The 14 questions that were finally asked in the survey took almost nine minutes to answer.* This second survey questionnaire was used in the full telephone survey, the subsequent Spanish-speakers survey, and the following door-to-door survey.

The thrust of this study was to determine incentives that would induce Hollister residents to recycle. Instead of straightforwardly asking this and risking responses that were attempts to please researchers, the survey sought multiple answers to these questions in a roundabout fashion. Residents were first asked questions about their household solid waste and recycling practices in general. These questions were followed by more specific questions concerning economic incentives that comprised the core of the survey. These subsequent questions illuminated the motivation behind residents' current behavior and were as important as the quantification questions in characterizing residents' value systems.

Some survey questions asked residents to quantify and describe their behavior in response to hypothetical economic incentive schemes. The survey asked these kinds of questions in several different ways throughout the interview. Residents were asked for their opinions on economic incentives first in a general manner. They were then asked other questions less relevant to economic issues, followed by more specific economic questions. This purposeful dancing-around-the-issue was to prevent residents from feeling compelled

* Had the questionnaire been longer, it would have been too time consuming and costly.

Survey Questionnaire

Rap Sheet

Hi my name is ---, I'm surveying Hollister residents about garbage collection and recycling and I'd like to ask you a few questions. Have you got a few minutes to answer a few questions for a survey on how to improve garbage collection? Fine, I'll read you an introduction then ask you the questions.

If they do not understand English, thank-them in Spanish, note the time and a Spanish speaker will call them at a later date.

A) Phone number called

637-_____

636-_____

B) Spanish speaker?

C) Male or female ?

D) Time called?

Survey Questions

1) Current unlimited garbage collection service is \$15.40/mo., do you write the check, or otherwise pay the utility/garbage bill for your household?

y

n

Other _____

2) How many cans or bags does your household put out each week?

1

2

3

4

Other (unknown, shared apartment, etc.)

3) Do you or other household members recycle? Aluminum, glass, newspaper, cardboard, plastic, other?

y

n

Circumstances of recycling (buy-back, drop-off, curbside-pilot, etc.) _____

4) Do you think the garbage fee should be based on the number of cans set out at the curb?

y

n

5) If curbside recycling service was offered for newspaper, glass, aluminum, cardboard, or yard waste, would you participate?

y

n

6) Do you feel that recycling should be:

—mandatory, or
voluntary?

7) Does your household have a compost pile?

y

n

Figure 6

- 8) Do you want a curbside yard waste (leaves and grass) collection service? (assume there will be extra costs)
- y
n
- 9) Would you be more likely to recycle if it reduced your garbage bill?
- y
n
- 10) If your household recycled, how much should your garbage bill be reduced?
- 5%
10%
20%
30%
Other (value of materials, \$ amount, etc.) _____
- 11) If the present system of unlimited garbage service was replaced with a different system which promoted recycling, which of the following systems would you prefer?
- A) Per can garbage rate? i.e. you only pay for what you throw away
B) Same as present system? a flat rate for unlimited service
C) Discount for recycling households?
D) Base rate of 2 or 3 cans with extra fees for more cans?
Other _____
- 12) Consider recycling as an alternative to the present system, which costs \$15.40 per month. If you were given a \$1.00 discount on your present monthly bill, would you recycle ?
- How about \$2.00?
How about \$3.00?
How about \$4.00 or more?
Other _____
- 13) How can illegal dumping be avoided?
- A) Free dumping for income qualifying families?
B) Clean sweep days once or twice per year?
C) Discount for self hauling to designated garbage receptacles?
- That's it. Now I'll just ask a few questions for statistical purposes.
- 14) You do not have to answer this question if you do not want to. For statistical purposes, could you please estimate your household's income to nearest \$10,000.
- \$10k-\$20k
\$30k-\$40k
\$50k-\$60k
over \$60k
- 15) What is the nearest intersection near where you live ?

Figure 6 (continued)

to answer subsequent economic questions in a way that was consistent with previous answers. Respondents were asked to describe the monetary incentives that would encourage them to recycle both in an absolute dollar amount and as a percent reduction in current garbage collection fees. Residents were also asked to choose a waste disposal system that they favored. Among the alternatives presented was one with economic incentives, and one that resembled the current single-fee system.

Demographic information was also gathered. Questions were asked about the respondents' sex, household income, and household location. The location and income questions were prefaced by a statement saying these responses were for statistical purposes only, and respondents were not required to answer them. Other questions were informational in nature and not essential to the survey, but were asked because they were important questions requiring little extra effort. One such question regarded curbside yardwaste collection, and another asked residents if they had a compost pile.

Survey and Results

Initial Telephone Survey

The initial telephone survey was conducted the weekend of May 2-3, 1992. It took three people two days, from 10 a.m. to 4 p.m. each day, to get the initial 178 responses. Four-digit random numbers were taken from a random number table (CRC Standard Math Table, 1987) and affixed to the primary telephone prefix (637). This telephone prefix is used for 70% of local telephone subscribers in Hollister. Hollister has a second telephone prefix that is used for the remaining 30% of its telephone numbers. However, no attempt was made to contact these remaining numbers. A phone session randomly targeting households in this additional telephone prefix area would have been too time consuming since far fewer random numbers would have produced actual phone numbers of

residences.* In the telephone survey, randomly generated telephone numbers were dialed until an qualified adult respondent was reached. If an adult was not home, or if the household indicated they did not subscribe to garbage service, i.e., they lived outside city limits or were apartment dwellers, they were thanked and the survey of that particular home ended. A rap sheet and questionnaire (Fig. 6), developed through initial interviews, were used in the survey. Hollister's City Hall phones were used for the telephone sessions. Telephone interviews of Spanish-speakers were originally to be made at the same time other calls were being made. However, after securing the phones, the Spanish translator was unavailable on that day, and Spanish-speakers were called back two weeks later on May 16, 1992.

Spanish-speakers

In performing both the initial telephone surveys and the subsequent large phone survey, whenever Spanish-speaking residents were encountered, they were noted and recontacted by a Spanish-speaking surveyor. Callbacks to those identified as Spanish-speakers were performed on Saturday, May 16. A single Spanish translator made all of these calls. Prior to the phone session, she translated the survey questions into Spanish and was able to use the translation in making the calls, rather than relying on her interpretive skills.** Seventeen out of twenty-three Spanish speaking residents identified in the telephone survey were subsequently recontacted by a Spanish-speaking interviewer. A separate analysis was performed for this group of respondents.

* Even with the 637 telephone prefix, several random numbers were usually dialed before an actual residence was reached.

** Spanish-speaking residents were very eager to be polled in Spanish, and most were very responsive.

Subsequent Door-to-Door Survey

The large telephone survey conducted on May 2-3, 1992 netted only 178 responses, so a second survey was required as an additional 122 responses were needed to reach the goal of 300 responses. The second survey was conducted on June 20, 1992. The city's telephones used in the initial survey were no longer available for use, so a door-to-door method was chosen for the second survey. As described earlier, Hollister occupies six census tracts. Five of these census tracts contain over 1,000 homes and were targeted in the survey. Census tracts were used as the sampling frames in designing the door-to-door survey. The actual number of responses sought for each census tract was determined by multiplying each census tract's percent share of total homes in Hollister, by the remaining goal of 122 responses. One census tract (1.98) was eliminated from further study because of its small size (41 households), while the other five census tracts in Hollister (3, 4, 5, 6, 7) were selected for the study. Maps outlining these census tracts were drawn and neighborhoods that appeared representative of each tract were selected. The author traveled to each of these neighborhoods and looked for streets that contained the tract's average-sized dwellings. Individual streets from these neighborhoods were included as turf for the canvassers.

Three surveyors went to Hollister on June 20th to conduct the door-to-door survey. Two other surveyors were unavailable on the day of surveying, so only three census tracts (4, 5, and 6) were sampled. Surveyors went door-to-door along the selected routes speaking to adult residents who were at home. If residents had already been contacted in the telephone survey, they were thanked and surveyors went to the next home. The responses from this second survey were placed in a computer database and analyzed.*

* The results for each sampling event are graphically presented in Figure 7 through Figure 14, as a separate group, and included with all other data in a combined group.

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Data Input and Analysis

Surveyors recorded residents' responses on pre-copied rap sheets. These sheets consisted of a brief introductory statement followed by survey questions. Surveyors were asked to record the respondent's answers to survey questions by circling the appropriate answer or by writing a short explanatory note.*

Analysis of the data was done using Excel. Two types of data were entered into the database: numerical data and circled alphabetic responses to questions (a, b, c, etc.). Limitations within Excel produced some problems with numeric data. When residents responded within a range (for example, 2 to 3 cans of garbage per week), data was entered as an average of 2.5 cans per week instead of the actual response of 2-3 cans per week. Similar averaging techniques were used with other responses, such as income. When respondents indicated two selections in the multiple choice questions, both were entered, so some data was double counted. This did not occur very often, and it was not expected to alter data quality. Many respondents made additional comments or responses to surveyors that were not transcribed into the database. Once a database had been established, Excel offered a method to analyze and cross reference the large amount of data quickly and easily. Total counts of responses, and percentage response rates for each selected answer for the combined survey are shown on Table 5. Response rates (in percent) for the telephone, spanish-speakers, and door-to-door surveys, are shown separately and combined on Table 6. The average response rate for each question was 85%. The highest response rate was for question question number three (99%), while the lowest response rate was for question number 14 (57%).

* Data from circled and written responses were later transcribed into a database. Only circled responses were entered into the computer database; long answers and comments were excluded. In transcribing the data, one researcher read the data aloud to another researcher, who entered it into the computer database. This method of data entry produced fewer errors than one person transcribing it alone.

Combined Survey Response Counts and Percentages

Surveyer's Initial?	Number of Responses	
p	86	
j	62	
t	42	
r	57	
	247	
Male Female? Sex	Number of Responses	Total Question Response Rate
		58%
		%
m	56	36
f	98	64
Total Responses	154	
<i>Note, the sex of respondents were not recorded for 42% of the surveyed population.</i>		
Question # 1 Pays Garbage Bill? y/n	Number of Responses	Total Question Response Rate
		97%
		%
y	164	64
n	94	36
Total Responses	258	
Question # 2 Weekly Household Disposal Volume? Number of cans per week	Number of Responses	Total Question Response Rate
		96%
		%
0.5	1	0
1.0	33	13
1.5	16	6
2.0	93	37
2.5	20	8
3.0	42	17
3.5	12	5
4.0	31	12
4.5	1	0
5.0	3	1
>5.0	3	1
Total Responses	254	

Table 5

Combined Survey Response Counts and Percentages

Question # 3	Recyclers ? y/n	Number of Responses	Total Question Response Rate 99%
			%
	y	228	87
	n	34	13
	Total Responses	262	
Question # 4	Should garbage fee be based on volume? y/n	Number of Responses	Total Question Response Rate 84%
			%
	y	113	51
	n	109	49
	Total Responses	222	
Question # 5	Would Respondent Participate in Curbside? y/n	Number of Responses	Total Question Response Rate 94%
			%
	y	207	83
	n	43	17
	Total Responses	250	
Question # 6	Mandatory or Voluntary Recycling? V/M	Number of Responses	Total Question Response Rate 95%
			%
	V	124	49
	M	127	51
	Total Responses	251	
Question # 7	Composters? y/n	Number of Responses	Total Question Response Rate 94%
			%
	y	50	20
	n	200	80
	Total Responses	250	

Table 5 (continued)

Combined Survey Response Counts and Percentages

Question # 8	Want Curbside Yardwaste Collection?	Number of Responses	Total Question Response Rate
	y/n		91%
			%
	y	128	53
	n	112	47
	Total Responses	240	
Question # 9	Recycle For Reduction In Bill?	Number of Responses	Total Question Response Rate
	y/n		98%
			%
	y	199	77
	n	49	19
	no difference	11	4
	Total Responses	259	
Question # 10	Reduction Needed?	Number of Responses	Total Question Response Rate
	Percent		72%
			%
	5	21	11
	10	73	38
	15	9	5
	20	39	20
	25	8	4
	30	25	13
	35	0	0
	other	16	8
	Total Responses	191	0
Question # 11	System Preference?	Number of Responses	Total Question Response Rate
	a,b,c,d		89%
			%
	a	43	18
	b	46	19
	c	112	47
	d	35	15
	Total Responses	236	

Table 5 (continued)

Combined Survey Response Counts and Percentages

Question # 12 Amount Needed to Induce Recycling? Dollar amount	Number of Responses	Total Question Response Rate 73%
		%
1	99	51
2	25	13
3	22	11
4	30	15
>4	18	9
other (value of materials etc.)	7	4
Total Responses	194	0

Question # 13 Ways To Avoid Illegal Dumping? a,b,c	Number of Responses	Total Question Response Rate 83%
		%
a	38	17
b	117	53
c	62	28
e	2	1
Total Responses	219	

Question # 14 Income level? In tens of thousands of dollars	Number of Responses	Total Question Response Rate 57%
		%
5	6	4
10	15	10
15	24	16
20	13	9
25	9	6
30	14	9
35	15	10
40	7	5
45	5	3
50	10	7
>50	33	22
Total Responses	151	

Table 5 (continued)

Combined Survey Response Counts and Percentages

Question # 15	Census Tract Number Tract Number	Number of Responses	Total Question Response Rate 79%
	1.98	0	%
	3	30	0
	4	60	14
	5	46	29
	6	49	22
	7	14	23
	County Residents	10	7
	Total Responses	209	5

Table 5 (continued)

Survey Response Percentages By Sampling Event

<i>Total Number of Responses</i>	<i>Telephone Data</i> 178	<i>Spanish Data</i> 25	<i>Door-To-Door Data</i> 70	<i>All Databases Combined</i> 265
Question (C)				
Sex	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
Male	37	17	44	36
Female	63	83	56	64
% who answered question	66	71	36	58
Question (2)				
Weekly Household Disposal Volume?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
0.5	1	0	0	0
1.0	14	0	13	13
1.5	7	13	3	6
2.0	36	19	42	37
2.5	9	6	4	8
3.0	15	25	18	17
3.5	5	13	1	5
4.0	9	25	16	12
4.5	1	0	0	0
5.0	2	0	0	1
>5.0	1	0	1	1
% who answered question	96	94	96	96
Question (4)				
Should Garbage Fee Be Based On Volume?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
Yes	46	71	57	51
No	54	29	43	49
% who answered question	83	82	87	84
Question (6)				
Mandatory or Voluntary Recycling?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
Voluntary	53	44	42	49
Mandatory	47	56	58	51
% who answered question	94	94	96	95
Question (9)				
Recycle for Reduction in Garbage Bill?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
Yes	77	71	90	77
No	23	29	10	19
% who answered question	93	82	97	98

Table 6

Survey Response Percentages By Sampling Event

Question (10)				
Percent Reduction Needed?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
5.0	10	0	17	11
10.0	42	8	35	38
15.0	5	0	6	5
20.0	22	46	11	20
25.0	2	0	11	4
30.0	10	46	13	13
other	10	0	7	8
% who answered question	69	76	77	72

Question (11)				
System preference?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
a	23	0	10	18
b	19	46	15	19
c	44	54	57	47
d	15	0	18	15
% who answered question	92	76	86	89

Question (12)				
Dollar Amount Needed to Induce Recycling?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
1.0	61	0	41	51
2.0	14	7	11	13
3.0	9	21	15	11
4.0	6	57	26	15
>4	10	14	7	9
Other Responses	2	0	7	4
% who answered question	71	82	77	73

Question (14)				
Income level In Tens of Thousands?	<i>Telephone Data</i>	<i>Spanish Data</i>	<i>Door-To-Door Data</i>	<i>All Databases Combined</i>
5.0	2	17	6	4
10.0	9	50	8	10
15.0	17	0	16	16
20.0	6	33	10	9
25.0	3	0	12	6
30.0	9	0	12	9
35.0	15	0	2	10
40.0	3	0	6	5
45.0	4	0	2	3
50.0	5	0	10	7
>50	27	0	16	22
% who answered question	53	35	71	57

Table 6 (continued)

Data Quality

The quality of data that were finally counted and analyzed by the computer can be thought of as the total of inaccuracies and errors that were introduced throughout the process of sampling and reporting. Sampling, by its nature, is the reduction of large, complex systems that are difficult to understand into smaller models that can be sampled and analyzed and from which conclusions can be drawn. According to random sampling theory, if data are drawn from a randomly distributed set, and if statistical sampling is done correctly, one can draw conclusions from a smaller sample frame that apply to the real world. However, in the process of gathering original data and transcribing and analyzing this data, errors are introduced, biases emerge, and mistakes are made, all of which blur interpretation and hide relevant information. This survey is no exception, and the following is a list of its inaccuracies and biases:

Surveyor bias: this is bias that is introduced through the actions of the researcher. Four individuals were responsible for gathering the data, three males and one female. The individual personal biases of each surveyor may have influenced responses, or recordings of responses, from residents. Individual researchers were trained to explain the meaning of each question, but in the process of explaining questions, some bias may have been introduced by the surveyor's personal preferences.

Statistical skew: this is error that may have been introduced through sampling. In choosing to survey on weekends, to use phone survey methods, or to survey selected neighborhoods, some statistical skew may have been introduced into the survey. One indication of statistical skew in the telephone survey data was the high percentage of female respondents.

Question interpretation bias: although efforts were made to ask clear and precise questions and to help interviewees understand the questions, some confusion may have

been introduced by an unclear understanding of the questions and their meaning. Respondents were asked to make spontaneous judgments about their anticipated behavior. Some respondents may have been hesitant to admit ignorance or confusion with questions, and they may have chosen answers without fully understanding how the questions pertain to themselves.

Interpretation error: as results were summarized and transferred to computer media for analysis, some error may have been introduced in the interpretation and transcription of survey form results. Answers that were unclear, or were obviously useless, were purposely left out of the data that were entered into Excel. Other answers required some interpretation and, at the discretion of the researchers, these results were included in the statistical database. Other questions may also have been interpreted differently than the surveyor or respondent meant them to be.

Accuracy: the external validity of the results is directly dependent upon the absolute number of responses. The actual number of responses obtained in the survey was a compromise between needed accuracy and cost. With 265 respondents, the sampling error is expected to be less than six percent ($\pm 6\%$).

Survey Findings

During initial result compilation, responses for each question were counted and initial statistical analyses were performed. Over the course of the survey, 178 telephone interviews were conducted, followed by 17 Spanish interviews, followed by 70 door-to-door interviews. Although only 265 respondents were finally contacted in the survey instead of the goal of 300 responses, this sample size yielded information of sufficient reliability for the thesis. Table 5 shows the total count and response rate for the combined survey, while Table 6 presents the response distribution for each different sampling event.

The data was analyzed both in its entirety and by each sampling event. Figures 7 through 14 graphically present the results of six economic-incentive questions and two sociological-information questions.*

A discussion of the questions asked of residents follows:

Question Number 1: "Current unlimited garbage collection service is \$15.40/month. Do you write the check, or otherwise pay the utility/garbage bill for your household?" This question sought to distinguish residents who paid the garbage bill and thus were aware of garbage service cost from those who did not. Nearly two thirds (64%) of respondents indicated they were responsible for paying the garbage bill. This is a higher-than-expected result.

Question Number 2: "How many cans or bags does your household put out each week?" This question was asked because very little information existed that showed, volumetrically, how much garbage was generated by the average Hollister household. The mean volume of waste reported each week by Hollister households was 2.4 cans, and 37% of households disposed of 2.0 cans per week. Most respondents (81%) used three or fewer, cans for garbage disposal each week.

Question Number 3: "Do you or other household members recycle?" This question was asked to determine the overall recycling participation rate for Hollister households. Eighty-seven of respondents answered that they recycled. Most respondents recycled for profit at local buy-back centers. The very large percentage of residents who already recycle for cash could form the basis for some sort of drop off/buy back recycling program geared toward those who recycled for economic gain.

Question Number 4: "Do you think the garbage fee should be based on the number of cans set out at the curb?" This question was the first question regarding economic incentives.

* Overall, 64% of respondents were female, while 36% were male.

Most residents treated this as a general question and answered it in the hypothetical sense—that, in general, garbage fees should be based on volume. No clear mandate emerged from this, however. Overall, 51% indicated that fees should be based on volume of garbage. However, 49% said garbage fees should not be based on the volume. Given the error margin of the survey, no conclusion can be drawn, except that opinion is split on whether volume-based fees are desirable.

Question Number 5: "If curbside recycling service was offered, would you participate?" This question helped determine how many residents would participate if curbside recycling programs were offered by the city. A majority (83%) of residents who answered indicated they would participate in curbside programs if they were offered. It is unknown how many "yes" respondents had previously participated in curbside programs prior to living in Hollister and thus knew how much extra effort was involved in separating recyclable materials, or how many respondents would become lazy and eventually cease separating and recycling their materials.

Question Number 6: "Do you feel that recycling should be mandatory, or voluntary?" Slightly more than half (51%) indicated that recycling should be mandatory. Some residents indicated recycling should be mandatory, yet also stated in previous questions that they would not participate in a curbside program if it was offered. This is consistent with previous studies in which respondents have shown an inclination to vote for laws that force them to do things that they would not ordinarily do. Enforcement of such a mandatory recycling law would be very difficult.

Question Number 7: "Does your household have a compost pile?" This question asked residents whether they composted yardwaste at home. Only 20% of respondents said they composted at home. This low participation rate may be interpreted as meaning home composters, by themselves, will not significantly reduce yardwaste. It also shows there is a large potential for increasing the number of homes that have compost piles.

Question Number 8: "Do you want a curbside yard waste collection service? Survey researchers instructed residents to assume service costs would be in addition to existing garbage disposal fees." This question was asked because the Hollister Disposal Company has initiated a pilot curbside yard waste program, and information about residents' desire for curbside yard waste collection may be useful to it. About half (53%) of respondents said they would be interested in some sort of curbside yard waste service, even if there was an extra fee for the service. Yard waste diversions will only make an important contribution to meeting Hollister diversion goals if residents use the service and are willing to pay for it. A separate yard waste program is, in some sense, superfluous to residents because they can dispose of yard waste as part of currently offered garbage collection services, although materials collected this way would probably not be composted or mulched.

Question Number 9: "Would you be more likely to recycle if it reduced your garbage bill?" This was another question regarding motivating factors behind residents' behavior. Residents were asked if they would recycle if given an economic incentive. More than three-quarters (77%) of respondents stated that they would recycle for a reduction in their garbage bill. Many other residents did not need an economic incentive to recycle; they indicated it would make no difference in their current recycling behavior.*

Question Number 10: "If your household recycled, how much should your garbage bill be reduced? 5%, 10%, 20%, 30%, value of materials, dollar amount, etc?" This question was a follow-up question to the previous question. It asked residents to consider what percent discount they would need on their garbage bill to induce them to participate in

* Many of the respondents who indicated they would be more likely to recycle if it reduced their garbage bill, failed to report a dollar figure on the follow-up incentive question or failed to indicate a discount on the garbage bill that would induce them to participate in recycling programs. Respondents may have answered this question in the hypothetical sense rather than relative to their actual behavior. Respondents may have also had difficulty giving considered responses to follow-up questions during the "live" interview.

city-sponsored recycling programs. Nearly half (49%) of respondents sought 10% or less reduction in their garbage bill, while 74% of respondents sought a 20% or less reduction in their bill. Only 25% of respondents sought more than a 20% reduction in their garbage bill for recycling.

Question Number 11: "If the present system of unlimited garbage service was replaced with a different system which promoted recycling, which of the following systems would you prefer?

- A) Per can garbage rate;
- B) Same as present system, a flat rate for unlimited service;
- C) Discount for recycling households;
- D) A base rate of two or three cans with extra fees for more cans?"

This question asked residents to choose their preferred waste management system from several different solid waste systems. The current system of unlimited waste collection for a fixed fee was among the waste systems presented in this question. Almost half (47%) of respondents chose answer (c), discounts for households that recycle; 18% chose system (a), a per-can garbage rate; 19% chose system (b), the present unlimited service system; and 15% chose system (d), a system with a smaller base rate.

Question Number 12: "Consider recycling as an alternative to the present system, which costs \$15.40 per month. If you were given a one dollar discount on your present monthly bill, would you recycle?" If this amount was insufficient, residents were asked if two dollars would induce them to recycle, and so on until residents were presented with a five dollar incentive to recycle. Just over half (51%) of respondents indicated that a discount of one-dollar per month would be sufficient incentive for them to recycle. Nearly two-thirds (64%) of respondents indicated that two dollars or less would be sufficient incentive. Slightly over one-third (35%) needed three or more dollars to recycle, and many indicated the value of the recyclable materials themselves. The actual value of the materials

collected from a residence is highly dependent upon the number of beverage containers that are present in solid waste. It is unlikely that any household could generate greater than several dollars worth of redemption containers each week, and if they did, they would probably withhold them from the program.

Question Number 13: "How can illegal dumping be avoided? Free dumping for qualifying residents, clean-sweep days once or twice per year, or a discount for those who self-haul their rubbish to a designated garbage receptacles?" This question asked residents about ways to alleviate illegal dumping. More than two-thirds (70%) of respondents indicated their desire for some sort of method of disposing large amounts of household rubbish once or twice per year. Residents could self-haul waste to the landfill, or they could be provided curbside pickup of materials in what are called "Clean Sweep Days."

The following questions were demographic in nature and were prefaced by a statement indicating these were optional questions for statistical purposes only.

Question Number 14: "What is your present household income?" Only 57% of those queried answered this question. Almost half (45%) indicated their households earned \$25,000 per year or less. This is consistent with economic data indicating that the median income of Hollister households is about \$15,500 per year.

Question Number 15: "What is the nearest intersection where you live?" This question asked residents for the name of the nearest street intersection near their residence. This information determined their census tract.

A comparison of survey results with census tract information showed that survey respondents were fairly representative of Hollister's actual population. Only census tract number 7 was significantly under-represented in the data. The census tracts that were originally to be sampled in the door-to-door interviews included tracts 4, 5, 6, and 7. Only three canvassers actually conducted interviews that day, however, and census tract 7 was not specifically targeted. The following table shows the survey's distribution of

respondents, versus the actual census tract distribution of Hollister's residents.*

<u>Tract Number</u>	<u>Survey Percentage</u>	<u>Census Tract Percentage</u>
3	14%	10%
4	29%	30%
5	22%	20%
6	23%	20%
7	7%	18%

Additional Analysis of Hollister's Data

Measures of Association

In addition to counting the number of different responses to survey questions, other statistical methods attempted to explain responses. These further methods sought answers to the following questions:

1. Is there any relationship between those respondents who actually pay the garbage bill and those who might favor a variable disposal rate system with opportunities for savings ? Are residents who are more aware of garbage costs (those who pay the garbage bills), more prone to favoring variable garbage rates?
2. Are residents who dispose of large amounts of garbage less likely to favor a change to variable disposal rate, since presumably they would pay more for their garbage service?
3. Are residents consistent in their responses to questions about economic

* Round-off error accounts for percentages not summing to 100%. Census tract 1.98 is in Hollister, but its size is so small (41 households) that it was not specifically targeted in the door-to-door survey.

incentives? Was the percentage reduction needed to induce them to recycle similar to the dollar amount cited in the follow up question?

4. Do households with larger incomes generate more garbage as suggested by previous studies?

The chi-square method was used to determine association between survey questions. The chi-square statistic is a test for independence between sets of responses. Is a respondent who answered a certain way to a particular question more likely to answer a certain way to subsequent questions, or are the responses statistically independent? The statistical attribute chi-square, represented by X^2 , signifies the association between response sets.* The significance level in the analysis of Hollister's survey data was set at $p \leq 0.05$.** Table 7 shows the percent of responses to selected question sets as well as the summed chi-square statistic and the resultant probability level. Interpretations of the results follow.

No significant association was found between answers to Question 1 (those who pay the garbage bill), and answers to Question 4 (those who think the bill should be based on volume). There was an approximately 80% probability that the results were due to random chance. In other words, there is no significant association between those who pay the garbage fee and those desiring a variable disposal rate system.

No significant association was found between answers to Question 2 (the amount of garbage a household produces) and answers to Question 4 (those who think the bill should be based on volume). There was an approximately 30% probability that the results

* $X^2 = \sum (f_a - f_e)^2 / f_e$, where f_e is the expected frequency of answers, and f_a is the actual frequency of differing answers.

** Table 7 shows matrices that were constructed of the response distribution (in percent) to question sets and the summed chi-square statistic that represents the total association between questions. The chi-square statistic was compared to a chi-square table. The standard that was used for determining non-independence was the 5% level of probability.

**Response Distribution (in percent)
To Selected Question Sets**

Pays Garbage Bill vs Should Garbage Fee Based on Volume

		Should Garbage Fee Based on Volume		
		y	n	SUM
Pays Garbage Bill ?	y	35%	37%	72%
	n	15%	14%	28%
	SUM	50%	50%	131

$$X^2(1, n=131) = .06, \\ p = .80$$

Weekly HH Disposal Volume (in cans/week) vs Should Garbage Fee Based on Volume

		y	n	SUM
Less Than 2.0	y	15%	11%	26%
Between 2.0 and 3.5	y	28%	35%	62%
Greater than 3.5	y	7%	5%	12%
	SUM	50%	50%	133

$$X^2(2, n=133) = 2.28, p = .30$$

% Reduction Needed To Recycle vs Dollar Amount Needed

		\$\$\$s Needed				
% Reduction Needed To Recycle		1	2	3	4	>4
5%	y	8%	0%	1%	0%	1%
10%	y	21%	8%	5%	2%	3%
15%	y	5%	0%	1%	0%	0%
20%	y	10%	2%	1%	2%	2%
25%	y	0%	0%	1%	5%	0%
30%	y	9%	2%	2%	3%	3%
	SUM	53%	13%	11%	13%	10%

$$X^2(20, n=87) = 30.5, p = .06$$

Weekly HH disposal volume (in cans/week) vs Income Level (in \$1,000/year)

		5	10	15	20	25	30	35	40	45	50	>50	SUM
Less Than 2.0	y	2%	5%	4%	3%	1%	2%	3%	1%	0%	1%	1%	24%
Between 2.0 and 3.5	y	2%	3%	9%	3%	4%	5%	5%	3%	3%	5%	20%	63%
Greater than 3.5	y	0%	1%	3%	3%	1%	1%	2%	1%	0%	1%	1%	14%
	SUM	4%	9%	16%	9%	6%	8%	10%	5%	3%	7%	22%	148

**Total Number
of Respondents**

$$X^2(18, n=148) = 21.7, \\ p = .25$$

Table 7

were due to chance. Hence, it is difficult to hypothesize that persons who do not want a variable or per-can rate are mostly the ones who are disposing larger volumes of waste.

Association was approached between Question 10 (the percent reduction needed) and Question 12 (the dollar amount cited as a sufficient incentive to recycle). There was an approximately 6% probability that the results were due to chance. People were consistent in their financial analysis. If residents said they wanted a large discount on their garbage bill for recycling, they also said they would want more money for recycling.

No significant association was found between Question 2 (the weekly disposal volume) and Question 14 (the reported household income). This translates into a 25% probability that the results are due to chance. Although previous studies (EPA, Wertz, Skumatz) found association between the household income and the amount of solid waste generated, in this study, at the .05 significance level, households that report higher incomes were not significantly associated with households that dispose more solid waste.

Survey Conclusions

The objectives of this survey were to characterize Hollister residents in ways that would help solid waste planners design recycling and waste reduction incentives. Of Hollister's residents, 265 were interviewed in three sampling events over the summer of 1992. The percentage sample results acquired are accurate to within $\pm 6\%$. Respondents' distribution across census tracts were similar to Hollister's actual census tract apportionment, and were fairly representative of Hollister's whole population. Whenever Spanish-only speakers were encountered, they were surveyed in Spanish. They were encountered approximately 6% of the time. Interviewees were asked about their current garbage and recycling practices and about economic incentives that would induce them to recycle. The average response rate for survey questions was 85%, and many questions were answered by over 95% of respondents. The following major conclusions can be

drawn from the survey's results:

1. A majority of Hollister's residents can be encouraged to recycle by economic incentives. The size of the incentive need not be large: 51% of respondents indicated they would recycle for a single dollar's reduction in their garbage bill, while 4% indicated they needed no financial incentive at all. Almost three-quarters (74%) of residents indicated that a garbage bill reduction of 20% or less would induce them to recycle. Given that Hollister households are currently paying \$15.40 per month for current service, a 20% reduction works out to approximately \$3 less per household per month. More than three-quarters (77%) of respondents stated that they would recycle for a reduction in their garbage bill. In related questions, 47% chose the waste system entitled "discount-for-households-that-recycle," while 18% chose the per-can fee system. Both of these systems offer an economic advantage to residents who recycle and reduce their garbage.
2. Hollister may not need to implement an expensive curbside recycling and collection system if residents can be encouraged to recycle through private vendors who will pay residents for the materials. Most of Hollister's residents (87%) reported they already recycle; most recycle beverage containers at buy-back centers where residents sell their recyclable goods for cash. These residents already make trips to the recycling center to be paid for beverage containers, and they might be persuaded to also take other materials such as newspaper, cardboard, mixed glass, and plastic. Centralized curbside collection of recyclable materials would probably cost each household approximately \$2 to \$3 per month. If residents who are already recycling their beverage containers for cash could be encouraged to also recycle newspaper, cardboard, and glass at buy-back centers, Hollister could significantly increase

the amount of material that is diverted from the wastestream without implementing a centralized curbside program. In addition to not being charged for the monthly costs of curbside collection, residents would have the added benefit of continuing to be paid for their material.

3. If economic incentives can induce Hollister residents to recycle, increases in disposal fees may induce some to dump their solid waste illegally. A large number of Hollister's residents are at or near the poverty level. The relative cost of disposal fees increases for those with smaller earnings, and these residents must be accommodated when planning economic incentives, especially if the price of unsorted waste collection increases for the average residence. Additionally, these residents must be given some means to cheaply and legally rid themselves of large and bulky goods. In the survey, residents were very enthusiastic about some sort of free clean sweep days in which they could dispose of large volumes of unwanted materials and rubbish. Curbside collection of these materials once or twice per year was preferred to any other alternative; 53% of respondents indicated this choice. Another alternative that would eliminate labor costs associated with curbside collection would be allowing residents to self-haul free to the landfill once or twice per year. Less than one-third (28%) thought this was the best way to avoid illegal dumping.
4. At the .05 significance level no question sets that were tested exhibited association with each other, although one set did approach significant association. The percent discount needed for participation in recycling programs was found to be almost associated (6%) with the dollar discount cited as a sufficient inducement to recycle. Residents seemed to act as rational, calculating beings in their estimation of needed inducement. If they stated they wanted a large garbage discount to participate in recycling programs, they also

stated a higher dollar figure in the subsequent question. There was no association between the amount of garbage that a household reported and the income of that family. This failure to find association contradicted previous studies that found association between a family's income and its garbage production. Nor was there association between those who produce large amounts of garbage and those who believe the rate should be based on their garbage production. Perhaps a variable rate system will not alienate those who produce large amounts of waste since some of these larger garbage producing families believe that waste fees should be based on the amount of garbage produced. Neither was there association between those who pay the garbage bill and those who think the bill should be based on volume.

CHAPTER 5

CONCLUSIONS

General Conclusions

This thesis describes the use of economic incentives in an integrated waste management system where garbage fees are used to persuade residents to reduce and divert solid waste from curbside disposal. It has summarized the history of economics so as to place the discussion of economic incentives into the larger picture of changing economic models of the world and the environment. Environmental economics attempts to include environmental damage in decision-making by better assessing the costs to the environment of human activities. Most solid waste disposal fees currently do not reflect the impact to the environment, or the waste of resources resulting from solid waste disposal methods and the present system of garbage fees needs to be changed. Disposal fees that are based on the amount of solid waste presented for disposal deliver a strong message about the environmental impact of solid waste disposal and the need for diversion. These fees will probably become more common as cities seek ways to encourage residents to reduce and recycle their solid waste.

It seems inevitable that communities will begin to use pricing mechanisms to encourage residents to reduce curbside disposal amounts and to increase their diversions. This transition to a user fee system goes along with passing the increasing cost of landfill environmental compliance on to consumers and the requirements of new laws such as AB 939. Pricing mechanisms also fit within a free market solution to environmental impact management. Solid waste pricing mechanisms that address multiple goals for a community

must be designed. These goals include the diversion of waste materials, the minimization of illegal dumping, and the funding of any waste services that the community provides to residents. These goals may conflict. If any one of these goals is not addressed, the pricing mechanism may not induce the desired behavior from residents. On the contrary, a poorly conceived pricing mechanism could anger residents and lead to increased dumping. One of the primary needs for any pricing scheme is that it covers the cost of services that are provided to residents. If recycling and diversion programs are provided to residents, the fee structure, whatever it might be, must cover the expenses of these services. However, a fee structure can encourage recycling and diversion as well. When pricing mechanisms are implemented that are sensitive to the local needs of residents, and if convenient alternative waste management methods are available to residents, it appears that residents will respond by diverting materials from unsorted disposal and into diversion programs. A very important point is that convenient diversion programs must already exist before pricing mechanisms that play to these programs can be expected to succeed. From the high participation of residents in existing drop-off and buy-back centers it appears that residents will use these centers for recycling activities and a curbside program may not be necessary.* An additional goal of any fee scheduling must also be that illegal dumping, long a problem in many communities, does not increase as a result of the new rates. These multiple goals can be achieved if a careful analysis of the local population is made and an assessment of the financial needs of a waste system are weighed against the need to provide visible diversion incentives to residents.

The second section of this thesis was devoted to investigating what factors influence the generation of solid waste and what factors might reduce the amount of materials that are presented for disposal. Most recycling schemes, except for Materials

* From the results of the survey, 87% of residents reported that they already recycle. Most recycled for cash at local buy-back centers or used drop-off facilities.

Recovery Facility (MRF) systems, rely upon residents to pre-sort recyclable materials from disposed materials, and either place them separately at the curb for curbside acceptance, or return them to a drop-off site. The success of any of these systems is dependent on the participation of residents. It is very important to the success of recycling programs that the motivation behind participation is characterized and encouraged. Because the cost of disposal of consumer goods is small compared to their purchase price, this thesis concludes that residents will not reduce the amount of goods they purchase. Even in a variable disposal rate system, cost-of-disposal will continue to be a small fraction of the total cost of goods and materials. However, economic incentive schemes can significantly increase diversion of waste materials into recycling programs if these programs are convenient and inexpensive. The central premise of this thesis is that if recycling is convenient and cheap, and if the fee system penalizes unsorted disposal, residents will divert more of their waste to recycling programs.

Several factors such as illegal dumping and equality of the rate scheme should be investigated before a community decides to adopt a variable rate structure. Mechanisms to alleviate some of the inequality that economic incentives impart to poorer residents should be developed before a new rate fee is adopted. Variable disposal rates that do not have a very steep incentive structure (i.e., price jumps between differing service levels are small), may allow larger families to feel less affected by new rates and thereby, hopefully, alleviate illegal dumping. When a community considers a move to economic incentives, it should also consider the penalties given illegal dumpers and investigate whether legal disposal options for large and bulky items are provided to residents. A community cannot expect to eliminate illegal dumping unless expected fines for illegal dumping far outweigh possible financial gain. A community should offer each household some sort of large and bulky disposal services once or twice a year where large or hard-to-dispose items are collected by the garbage service. The cost for these services should be assessed each resident and

should be mandatory, although hidden, in their garbage fee statement. When residents know that they will pay for and receive these services whether they use them or not, fewer will illegally dump their large and bulky items.

All of these related issues were discussed in preparation for an actual survey of Hollister, California that was conducted over the summer of 1992. The survey asked residents about economic incentives and how they would react to possible disposal pricing schemes. A set of 15 questions was posed to 265 residents who were contacted in three separate polls. Residents expressed their preferences among waste systems and services and explained their rationale behind their expected behavior. Although residents, in general, thought the idea of rewarding residents who diverted materials was good, there was no mandate for such a fee structure. A majority said they would divert if they could obtain some financial reward for recycling and reducing their solid waste. However, 87% of respondents stated that their households already recycled, most for profit at buy-back centers where aluminum cans and beverage bottles are returned because of their California redemption value. If a variable disposal rate was implemented in Hollister and if curbside recycling was available to residents, they would probably continue to recycle beverage containers for cash at the buy-back centers. For those who stated interest in economic incentives, incentives need not be large, 51% of those polled indicated they would recycle for a single dollar's incentive. A large number of residents also indicated their desire for some sort of clean-sweep days or other mechanism to discard hard-to-dispose items. This could be implemented by the local waste hauler at curbside, or residents could take their materials to the dump themselves. This single act could also relieve some of the pressure that tempts some residents to illegally dump.

Unresolved Questions and Future Studies

Several questions can still be asked about Hollister that reflect the sampling

methods and the survey. There is still much uncertainty whether residents will actually do what they said they would do in the survey. Follow-up studies should compare the responses that were indicated in the survey with their actual behavior. Recycling requires extra effort from residents, and there may exist a sizable "credibility-gap" between what residents say they will do and what they actually do.

There are also questions about how a community's economic incentive structure can allow for those members of society that are poor or are otherwise unable to bear the increased cost of garbage services. Several economists have stated that economic incentive schemes necessarily are a trade-off between efficiency and equality. In pursuing economic incentives that have some financial incentive, are poorer residents penalized? If they are, how can the incentive scheme be modified to allow more equitable distribution of burden without losing the incentives?

Although this thesis investigated economic incentives, a preponderance of pertinent literature suggests that intrinsic incentive schemes can also encourage residents to recycle and divert without financial reward. It seems that the rational economic model of human behavior is too narrow. Not all residents seek economic gain, so other reasons must exist to explain human behavior. Successful recycling programs often point to these other encouragements and public awareness campaigns for their success. An aggressive publicity campaign would succeed in letting residents know about recycling and diversion programs, while also serving as a feedback mechanism for public concerns. Future studies of Hollister should investigate residents who would recycle no matter their reward. This segment of the population would be very helpful to a municipality that was attempting to maximize their recycling benefit.

If Hollister's population can be broken down into several subgroups, each acting for its own reasons, perhaps Hollister can gain an understanding of its population and how to motivate these different groups. Some of the population is motivated by financial reward

and may currently recycle or may begin recycling if they can save money. Other residents recycle because they feel it is the right and civic thing to do; these residents may recycle no matter the reward. It may be far more cost effective for Hollister to encourage these residents who are intrinsically motivated to recycle than attempting to offer sufficient external incentive to those residents who require financial rewards.

Specific Recommendations to Hollister

The following recommendations are presented for Hollister's solid waste planners. These recommendations reflect the results of the literature search, findings from Hollister's survey, and plans that are contained in Hollister's Source Reduction and Recycling Element. Hollister has recently begun a pilot curbside recycling program that collects newspaper, aluminum cans, plastic, glass, and yard waste. These programs will probably become the core of Hollister's future diversion programs. However, in planning future diversion strategies, Hollister should not overlook the residents that already recycle materials at drop-off and buy-back centers. These residents recycle at no cost to the city, and do not need city sponsored incentives. Specific recommendations follow:

1. Hollister should not enact a very steep incentive scheme where incremental cost increases between the number of cans serviced are large. Small increases in price will provide a signal to residents about the future direction of solid waste disposal without overly penalizing larger families. In later years, as residents become familiar with variable disposal rates and Hollister Disposal Company more confident about its revenues, changes can be made in the pricing scheme. Residents have indicated that they would be willing to reduce and recycle more for a decrease in their disposal costs of approximately two dollars per month. As long as residents were also provided "free" curbside recycling, so there was an outlet for the materials, many would begin recycling more and the city would

reap the benefits. Based on data from this survey, the average household produces 2.4 cans of garbage per week. Hollister should price garbage service so that the cost for the average household does not increase, yet still provide rewards for those who dispose less and penalties for those who dispose more than the average amount. Accordingly, the cost for those households that dispose of three cans per week of garbage should remain at \$15.40 per month. For four cans, the charge should be \$17.40 per month. Those who dispose of only one can per week should be rewarded with a cost of \$11.40 per month; similarly those who dispose of two cans per week should only be charged \$13.40 per month. Because the cost for the average household will not increase under this scheme, and because both incentives and penalties are present, Hollister can expect more solid waste to be diverted from the solid waste stream without undue outcry from large families.

2. In the future, Hollister needs to compare the revenues it can expect from residents against the cost that is required to provide the programs. As residents become familiar with variable disposal rates, many will switch to recycling and home composting and then decide a smaller service level is required. The smaller service level will mean smaller revenues under a variable disposal rate. The change in revenues from this transition must be anticipated by Hollister, and any programs that are funded from user fees must be covered by the cost for these services. As more residents reduce their disposal needs through recycling and seek lower service levels, those residents that produce greater amounts of solid waste must pay higher and higher rates to maintain the same overall revenue base. That is why a steep variable disposal rate is less desirable, the cost differential between average, above-average, and below-average garbage production creates uncertainty in the revenue stream. A

criticism of a system is that less steep is that those who conserve resources are subsidizing those who dispose more garbage. This may be inevitable, if only because the marginal cost of providing larger household collection service is not directly related to the number of cans placed at curbside.

3. Hollister should provide annual, or semi-annual, curbside collection of large and bulky goods through "Clean Sweep" days. Many residents indicated they needed some method of disposing of large and bulky items that all households generate. This should be negotiated as part of the next contract that is awarded to Hollister Disposal Company. The cost for this service should be assessed on every household, and it should be mandatory. If residents do not have a choice about whether they can be charged for this service, there would be much less incentive for them to illegally dump large and bulky goods. In addition to the curbside pick-up of these materials, some sort of free drop-off for these materials should be implemented where residents could also leave materials once or twice per year. If the John Smith Road Landfill were to offer one free dumping to residents each year, where everyone received free service, there would be much less incentive to dispose of these materials through illegal dumping.
4. Hollister should examine the penalties and enforcement mechanisms that are used to dissuade illegal dumpers. Illegal dumping will not be eliminated unless Hollister plays an active part in the process. Stiff fines need to be levied by a local enforcement agency, access to dumping spots needs to be controlled, and residential garbage service must be made mandatory for all residents in the outlying areas of San Benito County. In addition, Hollister residents must be provided with some sort of "Clean Sweep" days described above. If they are paying a mandatory fee and receiving clean sweep days, fewer residents will

look towards illegal dumping for their large and bulky items. By enacting a shallow variable disposal rate, by providing curbside recycling and free large and bulky goods disposal, and by enforcing dumping laws, Hollister will minimize the incentive for illegal dumping.

5. Hollister should fund public awareness programs that encourage self hauling to the existing private recycling companies. Many of Hollister's residents already self-haul to buy-back centers and sell their aluminum cans and beverage bottles for their redemption value. These residents may be motivated by a public awareness campaign to recycle and divert other materials without relying on any city-provided services. Residents might be persuaded to also return newspaper and cardboard, even though they received no money for these materials. These materials comprise a sizable portion of solid waste and voluntary diversions would help the city reach its diversion goals.
6. Few residents currently compost. This fact may signal a large potential for home composting to alleviate the amount of solid waste that is disposed through the regular solid waste service. In addition to implementing a curbside yard waste service for residents, Hollister should encourage residents to home-compost. In the survey, 53% of respondents wanted yard waste service, even if it cost extra. Hollister may consider encouraging home composting of seasonal leaves and grass, or implementing a seasonal yard waste service.

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