THE ECONOMIC IMPACT OF WASTE DISPOSAL

AND DIVERSION IN CALIFORNIA

A REPORT TO THE CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

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ABBREVIATED TERMS

ADC	Alternative Daily Landfill Cover
CalMAX	CIWMB California Materials Exchange Database
CIWMB	California Integrated Waste Management Board
CRV	California Redemption Value
DOR/DOC	Division of Recycling, Department of Conservation
DRS	CIWMB Statewide Disposal Tonnage Reporting System
IMPLAN	Impact Analysis for Planning
MRF	Material Recovery Facility
SWIS	CIWMB Solid Waste Information System Database
TS	Transfer Station
WASTE BOARD	California Integrated Waste Management Board
WCD	CIWMB Waste Characterization Database
WTE	Waste to Energy Facility

ECONOMIC TERMS

Costs of production: all costs of materials and services used, and salaries and wages paid to employees, in the production of goods and services

Direct effects: initial changes in employment, income and output resulting in the regional economic sectors that supply the inputs for production.

Economic sectors: all economic activities are categorized and assigned to groups. Each economic activity is assigned to only one sector.

Indirect effects: subsequent changes in employment, income, and output in all economic sectors resulting from changes in the initial sectors.

Induced effects: subsequent changes in employment, income, and output in all economic sectors as the result of personal consumption after changes in the initial sectors.

Input-output models: models of a given geographic area's economy for a fixed period of time, usually a calendar year. The models define all economic activity into sectors and calculate the effect of spending to produce one dollar's worth of output in one economic sector, on all subsequent spending stimulated by the original dollar, and the total resulting production output by all sectors in the economy.

Inputs: things such as energy and labor that will be used in the production of goods and services.

Job impact: a measure of how the economic sectors of interest influence the total number of jobs created within a year throughout all economic sectors. A job is defined by the average number of hours worked by employees in each economic sector.

Multiplier effects: the total economic impacts resulting from the initial change in spending, on all sectors in the economy. They include all direct, indirect, and induced effects of the economic activities.

Outputs: the goods and services produced using the inputs.

Output impact: a measure of how the economic sectors of interest influence the total of all sales in all sectors of the economy.

Total income impact: a measure of how the economic sectors of interest influence the total income for all persons in the economy.

Value-added: value of goods and services minus the costs of inputs (excluding labor) used by the sectors in producing the goods or providing the services.

Value-added impact: a measure of how the economic sectors of interest influence the value-added in all sectors of the economy.

Total sales: all sales and revenues of an economic sector generated from all activities within the sector.

EXECUTIVE SUMMARY

This document is the first attempt to estimate the economic impacts of the waste disposal and diversion system in California. The study develops a general model of the flows of selected disposed and diverted materials in the state, and uses economic impact analysis to estimate xstatewide and regional economic impacts (in terms of total sales, value-added, total income, and jobs) for disposal and diversion activities.

Summary Findings

While additional work is needed to better define and refine the inputs used in this study, the results to date suggest that disposal and diversion activities have a significant impact on the California economy. The analysis estimates that the 1999 direct and indirect economic impacts of solid waste disposal and diversion were:

- Over $9 billion in sales
- Over $21 billion in total output impacts
- Almost $8 billion in total income impacts
- Almost $11 billion in value-added impacts, and
- Over 179,000 additional jobs impact

In addition, the results show that diverting solid waste has a significantly higher impact on the economy than disposing it. When material is diverted rather than disposed in California:

- Total sales and value-added impacts more than double,
- Output impacts and total income impacts nearly double, and

- The jobs impact nearly doubles.

As shown in the following table, the average impacts of choosing to divert rather than dispose waste are substantial.

1999 Average Impacts Statewide for Additional Disposal or Diversion

	Disposed	Diverted	Additional Gain from Diversion (Difference)
Total Sales ($/ton)	$119	$254	$135
Output Impact ($/ton)	$289	$564	$275
Total Income Impact ($/ton)	$108	$209	$101
Value-added Impact ($/ton)	$144	$290	$146
Jobs Impact (Jobs/1,000 tons)	2.46	4.73	2.27

While the relative impacts for individual jurisdictions vary because of differences in material flows and business and industrial infrastructures, generally, diversion in California generates larger economic impacts than disposal. The statewide economic impacts from disposal and diversion at 1999 rates were estimated to be 17 to 20 percent higher than the impacts if all the waste had been disposed. The California waste disposal sectors would have generated a total output impact (all sales in all sectors of the economy) of $18.08 billion to the economy if all waste generation were disposed. The disposal sectors would have also generated a value-added impact (the increase in the value of goods and services sold by all sectors of the economy minus the costs of inputs (excluding labor) of $8.99 billion and created 154,200 jobs. With both disposal and diversion sectors operating at the 1999 rate of diversion, the combined sectors would have generated a total output impact of $21.20 billion, produced a value-added impact of $10.74 billion, and created 179,300 jobs.

The study also looked at the economic impacts in the six regions of California. According to the analysis, in five out of the six regions waste diversion and disposal at 1999 rates would have a greater economic stimulation effect than if all the waste went to disposal. The one exception is the Eastern California region, which does not have much infrastructure that supports diversion-related business; so most recyclables are delivered out of the region for further processing.

The added positive impacts of diversion come from sales of the separated recyclable materials; their processing into feedstock, sales of energy for transformation and biomass products, and the value-added in manufacturing that uses recycled feedstock. Creating markets to accept more recyclable and compostable materials would be the key to stimulating more economic activities and higher impacts in the state.

Typically, for every average ton of waste disposed in 1999, the study estimated that $108 in total income impacts and $144 in value-added impacts would be generated in the state economy. Whereas, for every average ton of waste diverted, $209 in total income impacts and $290 in value-added impacts would be generated. Also, about 2.5 total jobs would be added in the economy for every additional 1,000 tons of waste disposed, while about 4.7 jobs would be added if the same volume of waste had been diverted as recyclables.

The highest average economic impacts from diversion are in the Central Valley, Southern California, and Bay Area regions. These regions have more agricultural, business, and industrial infrastructure relative to the other regions, and a high percentage of the output generated by the waste industries are re-spent in the same regions. Also, relatively more recycling manufacturers are located in these areas and they create more value-added and jobs within the regions. In all three regions, total average output impacts are over $200 per ton more if the waste is diverted rather than disposed.

Generally, the IMPLAN economic analysis software worked well as a tool to measure the economic impacts of waste disposal and diversion data. The waste flow model and impact results relied on “best estimates” from available sources for disposal and diversion volumes, cost allocations, and revenues. Some materials and practices could not be completely quantified. The lack of complete, reliable and up-to-date data is a major barrier to better analysis in the waste industry; with more accurate data, the precision of the results could be improved.

The economic impacts presented in this study understate economic impacts from diversion because we used a conservative estimation approach (particularly in relation to activity in the manufacturing sectors). The main trends, however, are clear and similar to those studies in other states. Compared with waste disposal, waste diversion activities result in a large increase in economic impacts and job creation.

1 Introduction

1.1 The Development of the Waste Diversion Industry and Waste Economics

Waste Diversion

In 1989, the California legislature passed the California Integrated Waste Management Act (AB 939), which required all jurisdictions in the state to reduce the amount of their solid waste disposed in landfills by 25 percent by the year 1995 and 50 percent by the year 2000. The total amount of waste generated in the state in 1990 was approximately 51 million tons, and the statewide waste diversion rate in 1990 was estimated to be 17 percent (CIWMB, 2000b). The California Integrated Waste Management Board (Waste Board) reports that the diversion rate has increased since the enactment of AB 939. The goal of 25 percent diversion rate was met on schedule by most jurisdictions in 1995 as required, and the statewide diversion rate in 1999 was 37 percent (CIWMB, 2000b).

The Waste Board has employed the conservation tenets of "reduce, reuse, and recycle" to reach the State's diversion goals. It has educated consumers and producers on waste reduction methods and helped businesses and governments develop markets for commonly discarded raw materials and biodegradable materials. Jurisdictions throughout California have increased the number and scope of their diversion programs to meet the waste reduction target. These activities not only have an environmental impact on the communities involved, but also have an important economic dimension.

Source reduction means redesigning products and processes so that less material is used to achieve the same function. Manufacturers can use less packaging around their products, office workers can conserve paper by making double-sided copies, and consumers can select products that last longer and produce less waste. Another major waste diversion activity is reuse. There are numerous resale and thrift shops, repair shops, classified newspaper ads, and garage sales that service and sell used clothes, electronics, automobiles, furniture, and other items. The emerging market for used items traded or auctioned on the Internet also falls in this category.

Recycling activities represent a large part of the state's diversion activity. Consumers can recycle cans and bottles, commercial firms can recycle shipping cardboard and unsold food, and manufacturers can recycle their own scrap materials. At the waste industry level, there are 42 active Waste Board-permitted material recovery facilities (MRFs) in California that sort and consolidate recyclable materials as of June 2000 (CIWMB, 2000e). There are also thousands of recycling brokers and processors that trade source-separated and consolidated materials, and treat materials to create feedstock for manufacturers to use as inputs for their products. Materials are exchanged widely within and across the state and even across national borders. There are also 114 active Waste-Board-permitted composting facilities in the state that develop agricultural and landscaping products as of June 2000 (CIWMB, 2000e).

Government sponsored activities include curbside collection of recyclables and yard wastes offered along with the waste collection services in most cities. Currently, the state has a recycling "deposit-refund" program on beverage containers, and the Division of Recycling;

Department of Conservation (DOR/DOC) estimates that the 75 percent of all beverage containers were returned for refund and marketed as recyclable materials in 1997. More than 650,000 tons of materials have been diverted from landfills and over $5.5 million have been saved since 1992 through CalMAX, the Waste Board sponsored service that promotes exchanges of recyclable materials (Waste Board, 2000i).

Economics

While some diversion activities were already incorporated as traditional parts of the economy, as shown by the 17 percent statewide diversion rate in 1990, the mandates of AB939 greatly expanded the number and scale of diversion opportunities offered by communities throughout the state. The Act has resulted in an increase in the amount of material shifted from disposal-based economic activities to new diversion-based activities and infrastructure, and the marketing of new sources of locally produced alternative feedstock for use by the state's manufacturers and agricultural producers.

In addition to the avoidance of the environmental costs of operation and long-term maintenance of bioactive landfill sites, there are real economic benefits to diverting materials from disposal. Landfills in California charged an average tipping fee of $35 per ton for disposal of waste in 1999 (CIWMB, 2000h). The diversion of waste from landfills saves communities from paying the tipping fees, and the additional diversion activities create jobs, add revenues, and help stimulate other economic sectors. Unfortunately, to date, there has been no tool available in California at the state or local level that would allow the examination or measurement of the economic impact of solid waste disposal or diversion.

This is the first time a study has been done that estimated economic impacts for California waste generation. Although we would need better data and further analysis before suggesting that the results be used as the basis for specific investment and policy-making, it can be regarded as support of the concept that waste diversion is not only good for the environment, but also good for the state and regional economies of California.

1.2 Study Objectives

This study divides California into 6 economic regions (with an additional out-of-state region) as shown in the map (see Figure 1-1), and estimates both the direct and indirect economic impacts of waste disposal and diversion activities for the year 1999.

The specific objectives of the study are to:

1) Develop a general model of solid waste and diverted materials flow in the state.
2) Select and test economic impact software for the analysis of waste disposal and diversion in California.
3) Estimate the economic impacts of disposal and diversion activities for the state and regions. That is to say, how much additional economic activity is stimulated for each average ton disposed, recycled, or composted?
4) Compare the economic impacts of disposal and diversion activities. That is, what would be the economic impacts of replacing a disposal-only scenario with disposal and diversion?

5) Discuss how economic impact study results can be used to support decision-making about waste management.
6) Suggest data improvement and further research in the area of waste economics.

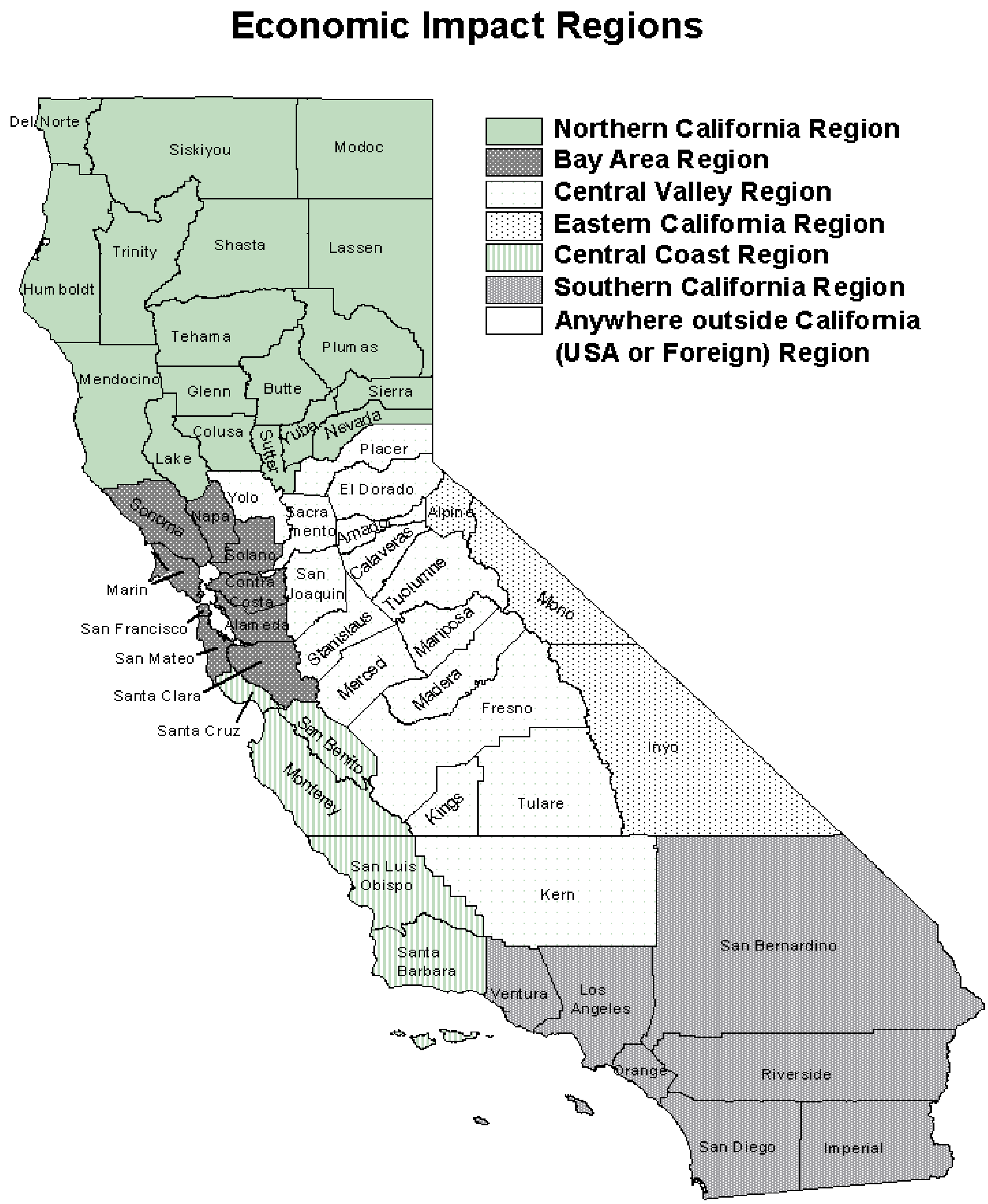

Figure 1-1 Map of Waste Regions in California

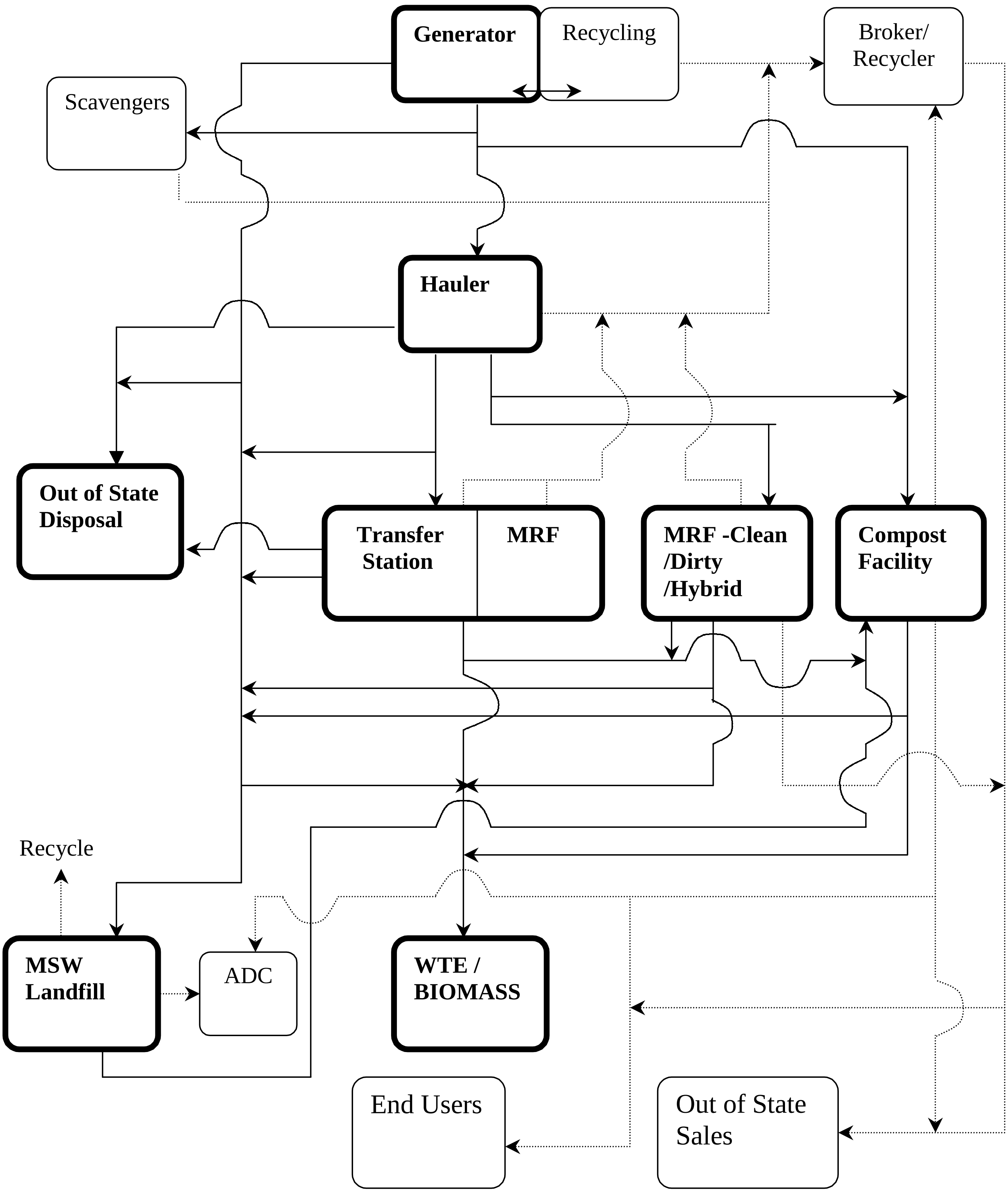

Figure 1-2 Generalized 1999 Waste and Recyclables Flow

LEGEND
.... Diversion
______ Disposal

1.3 Study Methods and Limitation

Waste generated at residences, businesses, and institutions passes through multiple economic sectors, such as collection, transportation, and processing, to reach its final destination. Figure 1-2 shows the general flows of materials for waste disposal and diversion; the solid arrows indicate the typical municipal solid waste (MSW) flow, and the dotted arrows indicate the flow for recovered materials. The economic sectors analyzed in this study are:

Waste/Recyclables Haulers
Transfer Stations/Material Recovery Facilities
Waste to Energy Facilities
Waste Disposal Facilities
Composting Facilities
Recycling Brokers/Processors
Recycling Manufacturers

This study concentrates on recycling activities for diversion because secondary data and production components have not yet been developed to quantify source reduction and reuse. Savings from implementing source reduction practices, such as using e-mail to distribute information rather than paper copies, are available for additional spending on new products and services. However, there are no accepted measurement standards or secondary data yet available to estimate the amount and value of economic activity in this area of behavior.

It is also difficult to specify which activities are considered 'reuse.' For example, repairing and reselling used cars are a normal part of the ownership cycle, but it can also be considered reuse in some sense, since the vehicles were not disassembled for parts and ground up for scrap. More work needs to be done in the area of life-cycle analysis of products before commonly accepted economic definitions can be developed to allow the collection of meaningful data. In addition, waste sent to inert material facilities and waste tire facilities were not included in this study. To this extent, the study underestimates the actual impact of all diversion. The model, however, could accommodate these activities if sufficient data could be obtained.

The tonnage volume and cost data was collected primarily from secondary data sources, such as the Department of Commerce, waste industry studies, and Waste Board databases. Data from our survey contributors and other industry studies were used to assign quantitative values to production components (labor, rent, and equipment, for example) for all the sectors.

1.4 Study Organization

Chapter 2 presents and summarizes previous studies done in other states on measuring economic impacts of waste disposal and waste diversion activities. It also presents studies done on waste issues in California. Chapter 3 identifies the sources for the secondary data used in this report and describes the survey data collection methods. Chapter 4 describes how the collected data are used and economic impacts are estimated. The results of analysis are presented in Chapter 5 and interpreted in Chapter 6. Chapter 6 also discusses how economic impact data could be used hypothetically to help a jurisdiction support a decision on local waste diversion. Chapter 7 makes suggestions for further research.

2 Literature Review

This chapter summarizes past studies that analyzed waste disposal and diversion activities and estimated their costs or impacts in California or elsewhere. This chapter also discusses studies that examined market development for diverted materials.

2.1 Costs of Disposal and Diversion

Most recent economic studies of waste disposal and diversion presented case studies and compared the costs of waste collection and disposal with the costs of collection and processing of recyclable materials in different communities.

Platt and Morris (1993), who studied 15 different communities throughout the United States, estimated that the collection and disposal costs of residential solid waste fell in the range of $40 and $170 per ton, while the net costs of source-separated curbside recycling and composting were between $35 and $120 per ton. Net recycling costs include costs of collection and processing minus revenues from the sales of recyclables. They found that the net recycling costs were lower than the collection and disposal costs in most communities, and argued that recycling could be relatively more expensive if the communities experienced high startup program costs, low level of initial material recovery, additional system design needs, and low costs of landfilling.

Deyle and Schade (1991) also compared the long-term cost of municipal enterprise curbside recycling of mixed residential and commercial materials to that of waste disposal in landfills for four large and small communities in Oklahoma. They found that net recycling cost less than landfill disposal when the landfill tipping fees were more than $35 per ton in the large cities and $60 per ton in the small ones. A nationwide survey by Folz in 1992 suggested that when the tipping fee was $33 per ton, the cost of recycling was the same as that of disposal, assuming an equal scale and efficiency of recycling and disposal collection programs. In cities where recycling is mandatory, which results in higher participation and recovery amounts, recycling was competitive at tipping fees as low as $14 per ton. Folz (1999) also reported that in 1996, the average net recycling costs for curbside programs in 158 cities were $30 less per ton than the average costs for collection and disposal of solid waste.

The State of North Carolina analyzed the full costs of solid waste management for 15 selected local governments by considering operating costs, costs of capital expenditures, revenues from sales of recyclables, and indicators of efficiency (North Carolina DEHNR, 1997). Of the 15 jurisdictions, 6 of the 8 that had household recycling rates of more than 12 percent found that the net recycling cost was less than that of solid waste collection and disposal. A similar study in Washington showed that in 1992, the net per-ton costs of residential recycling in three large study cities were lower than the costs of disposal by $25 to $65 per ton (Sound Resource Management Group, Inc., 1993). A fourth city had a mix of residential and commercial waste and the net savings advantage of recycling was $13 per ton over disposal. The comparative cost advantage of recycling would increase as the market demand for recyclables and landfill-tipping fees rise as expected in coming years.

2.2 Economic Impacts

Besides calculating the costs of recycling and other diversion activities and comparing them with the disposal costs, some studies also discussed the direct and indirect impacts of an increased level of waste diversion on the number of jobs created and sales of recyclable materials processed and manufactured. The States of Maine, Nebraska, Florida, North Carolina, Minnesota, Washington, and Arizona conducted state studies from 1993 to 1998 to examine direct economic activities and impacts associated with recycling. Similar studies covered larger areas such as southern or northeastern parts of the United States (Roy F. Weston 1994, 1996). All the studies found that recycling increased the net employment level and value-added in the study areas. Based on previous studies, Quigley (1988) reported that, with conservative estimates, one job would be created in the collection and processing sectors per 800 tons of materials recycled, while one job would be created per 600 tons with moderate estimates, and one job would be created per 400 tons with liberal estimates.

Platt and Morris (1993) estimated that just the processing alone of recycled materials directly created 9 jobs for every 15,000 tons of recovered materials (1 job for every 1667 tons), compared to 2 jobs created with incineration (1 job for every 7,500 tons) and 1 job created with landfilling (1 job for every 15,000 tons). Platt and Morris also indicated that recycling would attract new industries such as scrap-based manufacturing, further increasing the number of jobs created through recycling. Studies done in the Northeast (Roy F. Weston, Inc., 1994), South (Roy F. Weston, Inc., 1996), and Washington (Sound Resource Management Group, Inc., 1993) showed that most of the increase in recycling jobs was in the manufacturing sectors. Arizona also reported that the collection, processing, and end user sectors together generated $604 in value-added per ton of materials recycled and created 4.6 jobs for every 1,000 tons (1 job for every 217 tons) of recyclables (Arizona Department of Commerce, National Marketing Division, 1996).

Using their own Recycling Job Model, North Carolina showed that the direct jobs created due to recycling far outweighed the jobs lost through reduced tonnage landfilled (North Carolina DEHNR, 1995b). The model treated recycling as a part of the material flow in the entire North Carolina economy, and the increase in recycling flow resulted in the decrease in the material flow in solid waste and virgin material uses. By correlating the employment level and tons of materials managed in each sector, the model showed that for every 100 jobs created from processing and manufacturing of recycled materials in the state, the solid waste, timber harvesting, and industrial sand extraction sectors lost only 13 jobs. This result may overestimate the relative impacts of recycling since most virgin materials came from outside North Carolina, and most job losses occurred outside the state.

Some studies also evaluated total economic impacts, including the direct, indirect and induced impacts. A study in Maine estimated the total economic impacts including indirect economic impacts from recycling using the input-output IMPLAN software (Land & Water Associates and Market Decisions, Inc, 1993). They estimated that the total economic impacts per ton of recyclables were $1,539 in value-added, and 10.22 jobs created for every 1,000 tons of materials recycled (1 job for every 98 tons). Of the total impacts, the manufacturing sectors in Maine account for large economic impacts, generating $1,365 in value-added and 7.90 jobs per 1000 tons (1 job for every 127 tons). The Florida study used a similar input-out model, Regional Input-Output Modeling System II (RIMS II), and the Minnesota study used the REMI model software to estimate the scale of total economic impact. Florida estimated that 13,000 jobs existed in recycling industries and 28,558 jobs (including the 13,000) were created in the overall economy from recycling in 1995 (Florida Department of Commerce, Division of Economic Development. 1996). Minnesota estimated the economic impacts of recycling manufacturing were $1,197 per ton in value-added, with 16.14 new jobs created for every 1,000 tons of recyclables (1 job for every 62 tons) (Minnesota Office of Environmental Assistance, 1997). While there were differences in the assumptions used in each of the models, the overall trends from each study were similar. Recycling created additional jobs in the economy, and the indirect effects throughout the economy were 2 to 3 times the direct effects of the initial spending.

2.3 Infrastructure for Diversion Industries

Sell et al (1998), using data from 1984, 1993, and 1994, examined the total economic and fiscal impacts of waste developments in rural western states, including Colorado, Nebraska, Oklahoma, Texas, and Utah. They show that waste diversion operating and siting regions experienced larger gains in population, employment, and income, relative to the non-development sites. The studies in Washington and North Carolina also examined the potential growth of the recycling industry. The study in North Carolina examined the employment trend, capital demand, and need for technical and business assistance, associated with recycling business. It indicated that the recycling business has been growing rapidly in recent years and the implementation of waste reduction laws and recycling programs by local governments were the main factors for this growth. North Carolina also reported increased opportunities for its recycling firms to expand their businesses overseas, particularly to Asia, because of their rapidly growing economies

(North Carolina DEHNR, 1995a). The Washington study showed that the recycling industry, specifically manufacturers of recycled-content products, was providing opportunities for increased capital investment, employment, and growth (Sound Resource Management Group, Inc., 1993).

Remear (1991) listed several barriers to economic development from recycling, which included the under-valued public benefits of recycling facilities, under-investment in research and development, variable recycled-product demand, and regulatory uncertainties.

Previous California studies characterized the disposal and diversion status and examined diversion policy options in the state. A 1991 Disposal Cost Fee Study, done by a consultant for the Waste Board, reported diversion rates for the state for different materials, discussed the costs of disposal and diversion activities, and the environmental benefits. However, the results of subsequent CIWMB research were not consistent with those found in 1991. . California Futures (1993) discussed the costs and benefits of different market development options by considering the potential value of materials diverted, jobs created, and the costs of collection, recycling, manufacturing, and administration.

As seen in the studies discussed above, recycling was found to be cost-effective, to increase the net employment level and total value-added in the economy, and to have the potential for further growth. Scarlett (1993) showed that among various case studies there were large differences in recycling costs. She argued that it was necessary to estimate the total costs of recycling more accurately by including all related direct and indirect costs involved in all stages of recycling processes. Prior studies lack a comprehensive analysis of the total economic impact of recycling and did not consider economic impact of source reduction or other waste diversion activities because of limited model designs or the inability to find good data.

The current study focuses on disposal and diversion activities in California, but like previous studies it lacks data about some forms of diversion. The report updates the past California studies wherever possible, and examines how current diversion activities affect the regional economies.

3 Data Collection

This chapter discusses types of relevant data available. Chapter 4 then explains how and where these data were used in the study. A majority of the data that was useful for this study was found in documents and database published by and maintained at the California Integrated Waste Management Board (Waste Board), the Division of Recycling, Department of Conservation (DOR/DOC), Federal and local governments, and waste and recycling industry associations. Wherever possible, we obtained data from California sources for the study year, 1999, but some data came from other states that have a different waste and diversion infrastructure, and/or from other years than 1999. These data were used for estimation of 1999 California numbers only when the California sources were unable to supply the data. Some industry representatives in California were also surveyed to cross check data accuracy. Many of these data sources were combined or averaged and used as the inputs for the economic model.

3.1 Secondary Data Collection

3.1.1 Generators and Collection

In a study of disposal practices and materials in the waste stream, the Waste Board estimated the amounts of waste disposed from different sources in California in 1999 (CIWMB, 2000g). Of the total disposed, 48.8 percent of the waste stream was contract-hauled commercial waste, 38.1 percent was contract-hauled residential waste, 10.5 percent was self-hauled commercial waste such as small businesses roofers and landscape maintenance services, and 2.6 percent was self-hauled residential waste such as rural areas without curbside service (CIWMB, 2000g). Table 3.1 summarizes the waste characterization of businesses, residences and self-haulers for 1999 in California.

Table 3.1 Estimated Municipal Solid Waste Disposed in California by Material Type, 1999

Material Types	Residential Waste (in 1,000 tons)	Commercial Waste (in 1,000 tons)	Self-Haul Waste[3] (in 1,000 tons)	Total (in 1,000 tons)
Paper	3,918 (27%)	7,151 (39%)	268 (5%)	11,337 (30%)
Glass	576 (4%)	441 (2%)	50 (1%)	1,067 (3%)
Metal	660 (5%)	1,101 (6%)	522 (11%)	2,284 (6%)
Plastic	1,263 (9%)	1,801 (10%)	272 (6%)	3,337 (9%)
Organics[1]	6,423 (45%)	5,738 (31%)	1,020 (21%)	13,181 (35%)
Other[2]	1,434 (10%)	2,086 (11%)	2,776 (57%)	6,295 (17%)
Total	14,273 (100%)	18,318 (100%)	4,909 (100%)	37,500 (100%)

1. Includes food, yardwaste, agricultural waste, textile, and other composite organic
2. Includes construction and demolition, special waste, mixed residue, and other materials
3. Includes self-haul from residential and commercial sources

Source: CIWMB Waste Characterization Database (2000g)

The State government publishes annual reports on revenues and expenditures for the refuse enterprises in the state, counties, and cities. The 1995-1996 fiscal year Counties Annual Report (State of California, 1996a) specifies the amounts of revenue and expenditure for refuse enterprises operated by county governments. The report shows that county governments in California received combined revenues of over $438 million from their own refuse enterprises during the fiscal year of 1995-1996. The 1995-1996 fiscal year Cities Annual Report (State of California, 1996b) specifies revenue and expenditure information on refuse enterprises operated by city governments. The total solid waste operation revenues for all city governments in California were over $1 billion.

The Counties Annual Report and Cities Annual Report also show that many cities and counties contract refuse collection services to private companies. In fiscal year 1995-1996, about 60 percent of cities designated all or part of the services to the private sector, while larger cities tended to have their own operations. Less than 40 percent of cities with population under 10,000 had city operated solid waste collection, while more than 60 percent of cities with population over 50,000 had city operated waste collection.

Several reports showed that the typical residential service charge for collection was about $15 to $17 per month per household (Hilton Farnkoph & Hobson, LLC, Contra Costa County Website). Because the average number of persons per household in California was 2.94 (1999 California Statistical Abstract), we calculated that the annual service charge was about $61.2 to $69.4 per person. Annual volume per capita of residential disposal was 0.45 tons in 1998 (CIWMB, 2000j), and we estimated that the annual disposal fee per ton from residential collection was about $136 to $154. The 1997 California Waste Survey (Alder, et al, 1998) also calculated commercial and residential waste collection costs of waste hauling companies. It estimated that 22 percent of the total costs went to drivers' salaries and fringe benefits, and 25 percent was allocated to disposal tipping fees paid at the landfill gates. Since the average tipping fee in the state was $35 in 1999, the collection cost was estimated to be $140 per ton. These estimates on collection charges were cross-checked with an industry-related expert using multiple sources of information, who found that residential collection fees were about $100-140 and commercial waste collection fees were about $80-$100 per ton.

Miller (1993) estimated that the residential collection cost of recyclable materials on a typical suburban route were $96,122 for a 23 yard-capacity vehicle operated by one person in 1992, and the recycling cost ranged between $90 to $150 per ton. In Seattle, contract prices for recyclables collection and processing in 1993 were $81 per ton on average (Miller, 1993). According to our industry-related expert, recycling collection fees can be as high as $200 per ton, and greenwaste collection fees are about $130-140 per ton.

3.1.2 Waste Industry

The Waste Board maintains two databases regarding waste volumes and flows in California: the Disposal Reporting System (DRS) and the Solid Waste Information System (SWIS). The DRS database specifies jurisdictions of origin and final destinations of California waste (2000d). It includes disposal volumes of all waste at all California and out of state Board-permitted landfills, the volumes processed at all Board-permitted Waste To Energy (WTE) facilities, and volumes designated as Alternative Daily Cover (ADC) use at California landfills. The SWIS database also maintains information on facilities that are required to file operating permits with the Waste Board (2000f). As of June, 2000 it contained data on daily permitted capacity of materials handled at 176 active landfills, 42 Material Recovery Facilities (MRFs), 306 transfer stations, 3 Board-permitted transformation facilities, and 114 compost facilities (CIWMB, 2000e).

Table 3.2 presents estimated volumes of waste and recyclable materials handled at different Waste-Board permitted facilities. The SWIS database was used to estimate the volumes of waste handled at transfer stations, MRFs, and composting facilities, and the DRS database was used to obtain volumes of waste that were delivered to landfills and WTE facilities. The DRS disposal data do not exactly match the data in the Waste Characterization Database (WCD); the DRS reported that the total amount of waste disposed in 1999 was 38.3 million tons, while the WCD survey study estimated that it was 37.5 million tons as shown in Table 3.1. Because the DRS disposal data tracks all disposal volume flow from generation to final disposal, it was more suitable for regional analysis.

If all facilities in California operated 365 days at the average 45 percent capacity of SWIS-permitted throughput[1] in 1999, approximately 17.8 million tons were handled at the transfer stations, 7.5 million tons were handled at the MRFs, and 5.0 million tons were handled at compost facilities (CIWMB, 2000f). The DRS reports that 36.4 million tons were disposed at landfills in California, 2.2 million tons were recycled as ADC at the landfill sites, 0.9 million tons were transformed at Board-permitted WTE facilities, and 1 million tons were transported out of state for disposal in 1999 (CIWMB, 2000d).

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[1] We used the conversion factors of 1000 lbs. per cubic yard (or 2 cubic yards per ton) for compacted waste delivered to landfills, and 500 lbs. per cubic yard (or 4 cubic yards per ton) for uncompacted waste delivered to transfer stations, MRFs, transformation facilities, and compost facilities (CIWMB, 2000). A 45 percent capacity baseline was obtained by comparing the permitted capacity in the SWIS database with the landfill volumes reported by the Waste Board.

These two database do not contain all waste facilities. Those facilities with small-scale operations are not required to obtain permits and are not included in the SWIS databases. Some facilities also receive permits from other agencies. For example, most biomass WTE facilities obtain permits from the Air Board; some inert material sites have mining permits. There were 90 non-Board permitted waste-to-energy facilities listed as having active permits in February 2000 (California Energy Commission, 2000). The Waste Board estimated that 1.6 million tons of yardwaste were burned for energy in California at their facilities in 1999 (CIWMB, Organics Section 2000).

Table 3.2 Estimated Volume Handled at Waste-Board Permitted Facilities, 1999

Facility Types	Estimated Volume Handled (in Million Tons)
Landfills (Disposal) [2]	36.4
Landfills (ADC uses) [2]	2.2
WTEs [2]	0.9
Transfer Stations [1]	17.8
MRFs [1]	7.5
Compost Facilities [1]	5.0
Out of State Disposal [2]	1.0

Source: 1. CIWMB, SWIS Database (2000f); 2. DRS Database (2000d)

The Waste Board (2000h) also has information on tipping fees charged at different facilities in 1999 as specified in Table 3.3. The average landfill-tipping fee in the state for compacted waste was $35.6 per ton and for uncompacted waste was $34.6 per ton, but the fees varied by facility, ranging from $3.50 to $72.75. Facilities that collect construction and demolition materials charged relatively lower fees, while small facilities located in rural areas tended to charge higher fees.

Table 3.3 Average Tipping Fees by Facility Type, 1999

Facility Type	Compact rate($/ton)	Uncompacted Rate($/ton)
Landfills	$ 35.6	$ 34.6
Transfer Stations	$ 46.2	$ 45.4
MRFs	$ 41.6	$ 45.0
MRF/Transfer Stations	$ 45.7	$ 42.0
WTE Facilities	$ 34.8	$ 31.2
Compost Facilities	$ 37.6	-

Source: CIWMB (2000h)

Several past studies estimated the costs of operations at different facilities. Using data from Idaho, Bolton (1995) estimated that in 1994 about 36 percent of the total cost of landfill operations went to employment compensation, and insurance accounted for about 24 percent. Biocycle (1994) estimated that the average cost of composting waste materials was between $3.96 and $10.28 per ton using medium technology with a screener and shredder. The costs depended on the volume of the waste stream ranging from 10,000 to 100,000 tons per year. The facilities with higher volumes were more cost-efficient at processing the materials.

3.1.3 Recycling Brokers, Processors, and Manufacturers

The Waste Characterization Database, the Waste Board's market guides (1996a; 1996b), and other data were used to estimate the 1999 volumes of recyclable materials handled by recyclers (Waste Board, 2000a; Waste Board, 2000g). Table 3.6 summarizes these disposal and recovery volumes and recovery rates by material types. An estimated 19.0 million tons of waste generated in California was recovered in 1999. An estimated 8.8 million tons of organic waste were sent to compost facilities and WTE facilities or used as ADC, so that recyclers handled approximately 10.2 million tons of California generated material. Total waste generated in the state was estimated as approximately 56.4 million tons. This estimate is lower than the generation volume estimated by the Waste Board at 59.7 million tons, since source reduction, reuse, and recycling of material types included in the 'other' category in Table 3.6, were not counted in our estimation. Also, we used the 37.4 million ton figure from the DRS as the disposal tonnage.

The DOR/DOC runs the recycled beverage container program and keeps a record of volumes of materials collected in all counties. In this program, the Department collects redemption payments from beverage distributors and pays back recyclers the California Redemption Value (CRV) specified in Table 3.4 when the containers are returned. Redemption payments not claimed are used to help other recycling-related activities, such as paying increased handling fees to recyclers, funding local curbside programs for cities and counties, and providing recycling grants. Table 3.5 describes the volumes of redemption materials collected by material type in California.

Table 3.4 CRV Rate for Major Container Types

Container Type		CRV per container ($)
Aluminum	Less than 24 ounces	0.025
	24 ounces or more	0.050
Glass	Less than 24 ounces	0.025
	24 ounces or more	0.050
Plastic	Less than 24 ounces	0.025
	24 ounces or more	0.050

Source: DOR/DOC, Payment and Processing System (2000a)

Table 3.5 CRV Volumes Collected by Major Material Type, 1998

Material Type	Volumes (in Tons)
Aluminum	118,900
Glass	330,600
Plastic	30,700

Source: DOR/DOC, Payment and Processing System (1999a)

The DOR/DOC also has names of operators and their locations for 526 curbside programs, 1,118 drop-off centers, and 3,020 recycling centers in California as of September 2000. The DOR/DOC lists do not cover all recycling brokers, but only those who collect redemption materials; so some metals and paper and paperboard materials, that do not have redemption values, are excluded from being listed. The lists, however, contain valuable information tracking the economic activities of a large percentage of brokers and processors.

Table 3.6 Estimated Disposal Recovery Rates and Volumes by Material Types, 1999

Materials	Materials as Percent of Disposal [1]	Percent of Generation Disposed	Total Volumes Disposed in California[2] (in 1,000 tons)	Percent of Generation Recovered	Total Volumes Recovered (in 1,000 tons)
Paper	30	69	11,305	31[3]	5,079
Glass	3	57	1,064	43[3]	804
Metal	6	36	2,277	64[4]	4,048
Plastic	9	91	3,327	9[3]	337
Organic	35	62	13,143	38	8,750
Other	12	-	6,277	-	
Total	100		37,394		19,018

1. CIWMB WCD (2000g)
2. CIWMB DRS
3. Estimated from the Waste Board Market Guides (1996)
4. Steel Recycling Institute (2000); Aluminum Association (2000)
5. CIWMB Organics Section (2000)

It is difficult to estimate the volumes of materials handled by recycling manufacturers, as numerous manufacturers use virgin and recycled material feedstock alternately and recyclables flow in and out of regions quite frequently and erratically, depending on the prices for the materials. Recycling data came from previous reports, industry organization summaries and contacts, and the 1997 U.S. Census of Manufactures. The average scrap values of recyclable materials are specified in Table 3.7.

Table 3.7 Average Scrap Value per Ton by Material Type in Los Angeles (Between January 12, 1996 and June 9, 2000)

Material Type	Average $ Per Ton
Steel	28
Aluminum	614
Glass	30
Plastic	186
Paper	52

Source: Waste News (various years)

The Waste Board Market Guides (CIWMB, 1998a; CIWMB, 1998b) and various industry reports list the main end users of different recycled materials. For each manufacturing sector identified as an end user, the US Census lists material types used in the manufacturing of different products. This was used to estimate the percentage of recycled and virgin materials used in the manufacturing sectors. The Census data cover the whole United States and do not often provide data specific to California. The values of manufactured products using recycled materials were estimated based on the percentage of manufacturing operations located within the state, as listed in the IMPLAN input-output database.

According to the Aluminum Association (2000), 9.3 billion pounds of aluminum were recycled in 1999 in the United States, and 2.0 billion pounds came from used beverage cans. Secondary smelters consumed 43 percent of scrap aluminum, primary producers used 39 percent, and 18 percent went to other uses. In California, integrated aluminum smelters producing can sheet material and secondary smelters producing remelt secondary ingot (RSI) are the main end users of used aluminum cans (CIWMB, 1998b). Can sheet producers and die casters use RSI.

67 million tons of steel was recycled in 1999 in the United States (Steel Recycling Institute, 2000), and copper and steel producers, iron foundries, and exporters were main end users of the recycled steel. Most recycled steel was used in electric arc furnace and basic oxygen furnace facilities. The electric arc furnace (EAF) process uses almost 100 percent recycled steel to produce structural beams, steel plates, and reinforcement bars. The basic oxygen furnace (BOF) process uses 25 percent recycled steel to produce automotive fenders, encasements of refrigerators, and packaging like soup cans, five-gallon pails, and 55 gallon drums (Steel Recycling Institute, 2000).

Paper values differ by different types; computer printout and high-grade paper have the highest resale values, while mixed paper has little value. The amount of paper and paperboard recycled in 1998 in the United States was 45 million tons, and the American Forest and Paper Association (1999) estimated 68.5 percent of old newspapers, 75.2 percent of old corrugated materials, 35.1 percent of printing-writing papers, and 41.8 percent of office papers are recovered. Most recovered paper is used for newsprint, paperboard, containerboard, tissue, and printing-writing papers, or is exported out of country.

Nearly 2 million tons of glass waste was generated in California, and about 800,000 tons of the total was recovered in California in 1996. Of the all the glass waste recovered, more than 425,000 tons were estimated to be redemption value glass (CIWMB, 1998a). Most recovered glass cullet is used in the production of glass containers and fiberglass.

Of all plastic materials, only PET bottles had California redemption values until January of 2000, and the recycling rates for these materials were significantly higher than other types. The DOR/DOC estimated that 65 percent of redemption plastic bottles were recycled in 1999. The Container Recycling Institute estimated that in 1997, only 40 percent of PET plastic bottles in the Unites States were recycled; of these 46 percent were collected through curbside and drop-off programs, and 54 percent were collected through a deposit program. Recycled plastics were used in different manufacturing products, but the only large end users identified were plastic bottle manufacturers.

3.2 Survey Methods and Data Collection

A survey was prepared and mailed to a sample of waste haulers and operators of landfills, transfer stations, material recovery facilities (MRFs), and waste-to-energy and biomass facilities, as well as to some selected recyclers and brokers in California, for the purpose of estimating the regional volumes and flows of waste materials and cost and revenue allocation. An example of the survey is found in Appendix D. In many cases, the same company operates waste hauling services, transfer stations and MRFs, and waste disposal facilities, thus a survey package with five different surveys (Waste Collection, Transfer Station/MRF, Disposal Facility, Composting

Facility, and Recycling Broker/Processing surveys), was mailed to a sample of operators in the Waste Board's SWIS database between June and July 2000. A WTE/Biomass facility survey was then mailed separately to biomass and Board-permitted WTE facility operators, while a Recycling Broker/Processing survey was mailed to a sample of those who were identified as the collectors of CRV materials on DOR/DOC recycler list.

The main purpose of the survey was to collect information on regional material flows and cost allocations that were unavailable in previous studies and reports. As discussed earlier, the secondary data on the recycling brokers and processors sectors are particularly limited. Survey procedures ensured that all operators, regardless of size, had a chance to be included in the survey; however, large operators were sampled more heavily than small operators, as they were more likely to have detailed information. Survey data were reviewed for reasonableness, and representatives of the waste industries reviewed summaries of the data.

Since all operations involved in the waste and diversion industries were not included in the sample, survey estimates are subject to sampling variability. For example, as discussed in Section 3.1.3, the DOR/DOC recycler list includes only those who accept CRV materials, thus non-CRV brokers are underrepresented in the sample. Survey results are also subject to non-sampling errors such as failure to respond to a given question, mistakes in reporting, or processing the data. The effects of these errors cannot be measured directly. They were minimized through quality controls in the data collection process and through a careful review of all reported data for consistency and reasonableness.

The survey results were used mainly to cross check and adjust the secondary and IMPLAN data. The individual results were aggregated over operations and not used separately in the analysis.

4 Economic Impact Modeling

To analyze the economic impacts of the disposal and diversion sectors, the total impacts of all the revenue and spending of these sectors on all sectors in the economy must be captured. For example, whenever the disposal and diversion sectors expend money such as purchasing equipment, they rely on a whole network of other economic sectors. To support the initial purchase, the equipment retailer stocks models and parts from manufacturers, which are transported, warehoused, and then sold and maintained locally. The spending from the initial purchase is distributed to many other sectors, and subsequently re-spent by the receiving sectors for their own needs. Also, each of the businesses in the supply chain produces waste and recyclable materials, which are handled by the waste disposal and diversion sectors. Because these interconnected transactions are present in the economy, the sectors of initial concern eventually interact with all other sectors in the economy. The sum of all the indirect and induced effects of the economic activities is called a "multiplier effect."

This chapter discusses how the economic impact model was used. Because consistent state and regional data were limited, the state and regional outputs of each economic sector and costs of operations are calculated using various methods. The details of the model and data used are described in the following sections.

4.1 Input-Output Model: IMPLAN System

Regional and national input-output models are an established method in economics. They are used to describe different region's and country's economies, and to estimate the economic effects of policy changes and different resource uses. Input-output models are models of a given geographic area's economy for a fixed period of time, usually a calendar year. The inputs are things that will be used in the production of goods and services. The outputs are the goods and services produced using the inputs. An input-output model classifies all economic activity into sectors and calculates the effect of one dollar's worth of sales in any economic sector, on all subsequent spending stimulated by the original dollar, and the total resulting output by all sectors in the economy. The U. S. Department of Commerce develops a national input-output model every five years.

For any region, the IMPLAN software system creates an input-output model and estimates the total economic impacts of the sectors of interest by using the input-output relationships to derive multipliers for sales, employment, income, and value-added. The IMPLAN model for the United States has 522 economic sectors, and every economic activity is assigned to one sector and that sector only. In the IMPLAN system, multiplier effects are separated into three categories: direct, indirect, and induced effects. The direct effects refer to the changes in employment, income, and output in the sector that has the initial change. The indirect effects refer to the subsequent changes in all other sectors in the economy as the result of the change in the initial sectors. The induced effects include all impacts when personal consumption is added to the model.

For example, suppose a baseball team decides to construct a new stadium in Northern California that costs $100 million. If the indirect sales multiplier for the construction sector is 0.5 and the induced multiplier is 0.6, then we estimate that an additional $50 million is generated in sales in all other sectors in the region, and another $60 million is generated in sales from the additional spending by consumers.

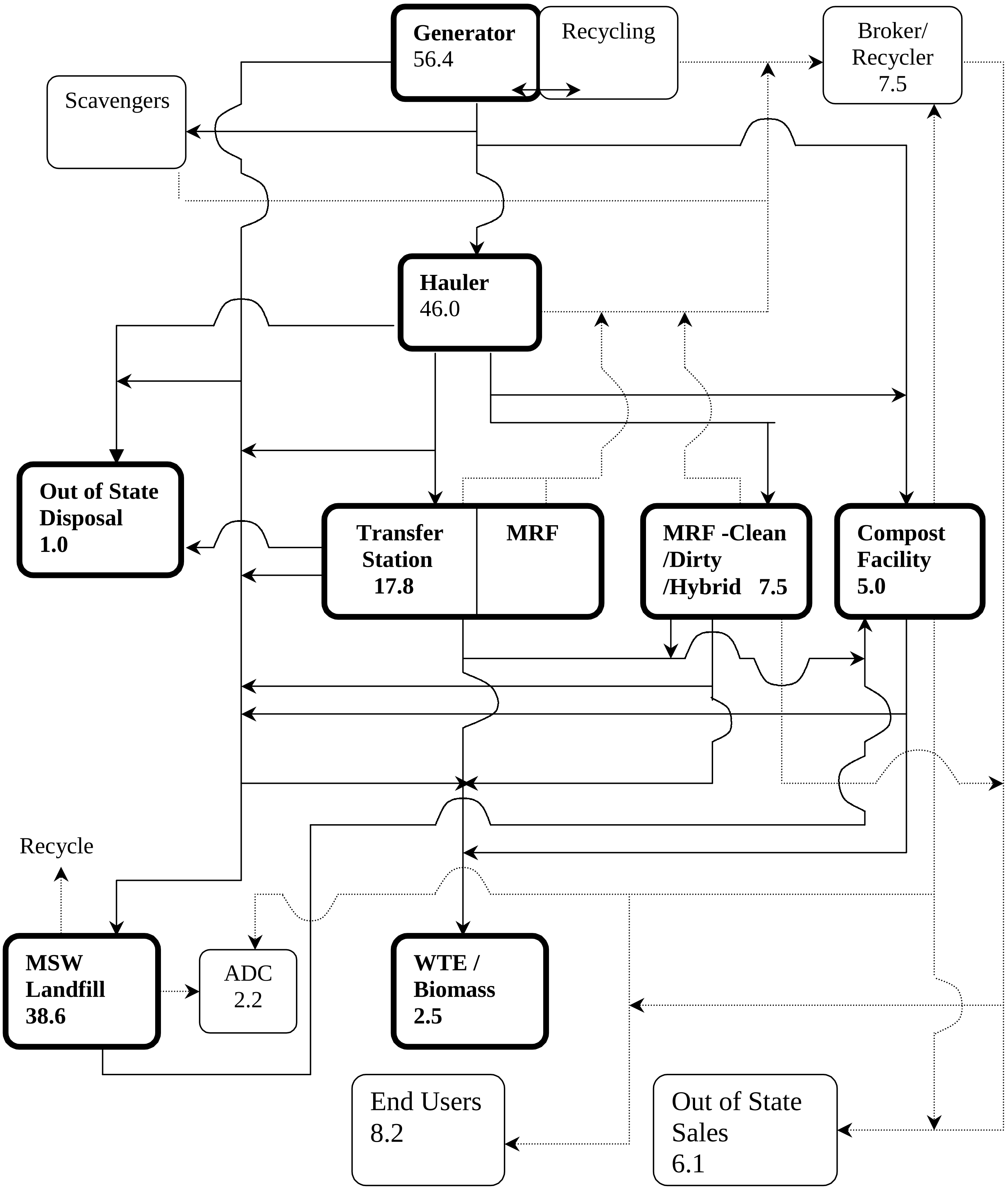

Figure 4-1 California 1999 Waste and Recyclables Volume Flow (in million tons)

LEGEND
………. Diversion
______ Disposal

4.2 Data

This section discusses how and where data described in Chapter 3 are used in the economic impact model. All secondary data described in Chapter 3 were included or referenced for the analysis. The survey results were used mainly to cross check and adjust the secondary and IMPLAN data. The individual results were aggregated over operations and not used separately in the analysis.

4.2.1 Material Flow

Figure 4-1 above and Figures 8-1 through 8-9 in Appendix E show our estimate of the disposal and recyclables flows from one sector to the next in California. The SWIS, DRS, and Waste Characterization Study data, as well as the survey results, which were discussed in Chapter 3, were used to estimate the percentages of the volume flows. The charts track material flows from their generation to their end uses, with procedures used to reduce double counting and estimation errors. Whenever regional flow data was not available, the state estimates of material flow were used as a proxy for all regions.

Waste haulers were assumed to collect all waste handled at the transfer stations, compost facilities, and MRFs, as well as the non-self-hauled waste brought directly to in-state and out-of-state disposal sites, and the amount of waste delivered to WTE/ biomass-to-energy facilities. The Waste Board (2000g; 2000f) estimates that approximately 13.1 percent of waste materials were delivered to the landfills by self-haulers and 30.2 million tons were delivered to in-state transfer stations, compost facilities, or MRFs in 1999, as discussed in Section 3.1. Some 86.9

percent of the total disposed waste was non-self hauled; of this, 13.8 million tons were estimated to have been delivered by haulers directly to in-state and out-of-state disposal sites, and 1.6 million tons to biomass-to-energy facilities. The total tonnage collected in California by haulers was thus estimated to be 46.0 million tons in 1999, as shown in Figure 8.1. Further detail is shown in Figures 8.2 to 8.4.

We also assumed that compost facilities sold 90 percent of their material as compost products within the region and delivered 10 percent outside the region. The statewide material flow from compost facilities is shown in Figure 8.7. The World Resource Foundation (1997) estimates that dirty (mixed waste) MRFs typically have recycling rates of 10 to 30 percent of the quantities processed, while clean (source-separated) MRFs typically have recycling rates of 85 to 97 percent. Based on this data and the survey results, we assumed that MRFs delivered half of the waste they received to landfills and sold the other half to recyclers; and of the amount sold to recyclers, 50 percent of the materials were sold inside the region and 50 percent outside. The statewide material flow from MRFs is shown in Figure 8.6.

Note that in statewide or regional analysis, when materials are transported out of the study area, they are regarded as "exports" from the study area. Only the values of goods produced and services occurring before exporting count as economic impacts. The "exports" category includes "out of state disposal" of disposed materials and "out of state sales" of diverted materials in Figure 4.1 and 8.1 to 8.9.

4.2.2 Output

State and regional output estimates were also calculated from the DRS, SWIS database, and Waste Characterization Study. Table 4.1 summarizes the state and regional outputs of different sectors in 1999. The volumes of waste collected in each region were multiplied by the estimated per-ton collection value of $140, based on the 1999 California Waste Survey and industry estimates. For recycling collection, we multiplied volumes handled at MRFs by the estimated recycling collection value of $178 per ton, and for yardwaste collection, we multiplied the total volumes handled at compost and biomass WTE facilities by the estimated collection value of $140 per ton. These collection value estimates were crosschecked with an industry expert as explained earlier in Chapter 3.

For the transfer stations and landfills, almost all income came from tipping fees. The volumes handled at these facilities were multiplied by their corresponding tipping fees to derive their total outputs. Tables 3.2 and 3.3 in the previous chapter presented the volumes and average tipping fees at different facilities in state. For WTE and biomass facilities, the Environmental Defense Fund (1990), and our survey results, were used to estimate that 37 percent of total sales came from tipping fees, 58 percent came from energy sales, and 5 percent came from the other sources.[2] MRFs received income from tipping fees and material sales; the survey results indicated that they sell the materials at an average of $30 per ton. Compost facilities received income from tipping fees and compost sales; based on the survey results, compost products were assumed to have been sold at $10 per ton. Compost was estimated to shrink in volume by 55

[2] We assumed that 500 lbs. of waste generates 1-kilowatt hour of energy, and the electricity value is $0.11 per k/hr. (EDF, 1990, and survey results).

percent during the compost process (Biocycle 1994), thus only the fraction of volumes processed at the facilities were sold as composts.

To calculate the state output of the recycling brokerage and processing sector, the market prices of recyclable materials were multiplied by their volumes. The prices were presented in Table 3.7, and volumes of materials recovered in the state were estimated in Table 3.6. Regional outputs of the sector were calculated from the state output and the waste disposal ratio in each region from the WCD.

Table 4.1 Regional Output by Sector, 1999

Sector	State (in $1,000)	Northern California Region (A) (in $1,000)	Bay Area Region (B) (in $1,000)	Central Coast Region (C) (in $1,000)	Central Valley Region (D) (in $1,000)	Southern California Region (E) (in $1,000)	Eastern California Region (F) (in $1,000)
Waste Collection	4,469,216	110,359	854,306	169,341	543,089	2,786,937	5,185
Recycling Collection	1,329,491	29,563	309,655	48,464	352,982	588,826	-
Yardwaste Collection	918,400	42,924	212,074	52,580	310,941	299,836	-
Transfer Station	821,167	38,958	197,592	10,857	127,035	445,910	815
MRFs	443,807	9,869	103,368	16,178	117,832	196,560	-
Compost Facility	221,392	10,352	51,123	12,675	74,956	72,826	-
ADC	153,287	4,420	60,707	5,636	5,002	77,344	178
Landfills	1,273,436	27,536	239,696	550,644	164,741	789,415	1,385
Incineration	234,429	7,055	34,841	8,638	77,726	106,161	-
Recycling Broker	619,910	23,386	147,352	20,763	120,475	307,366	568
Recycling Manufacturers	19,403,448	388,506	3,505,771	283,754	1,940,122	13,277,120	7,251

Source: CIWMB SWIS; DRS; DOR/DOC

This study considered only the manufacturers that use recyclable materials extensively in their production. Their recyclable material uses were estimated from the 1997 IMPLAN data and the 1997 Census of Manufactures. The IMPLAN model has county level sales data for all manufacturing sectors. The amounts of sales values that are attributed to recyclable materials were calculated using the Census' percentage of costs of recyclable materials used versus the costs of virgin materials for different sectors. Note that many manufacturers not included in the study use some recyclable materials, so the dollar volume and impacts of manufacturers in the study are underestimated.

4.2.3 Cost of Operations

Waste disposal and diversion sectors are not specified in the current IMPLAN system. Waste-related industries were assumed to have similar costs of production to those of existing sectors in the IMPLAN system, ant then were adjusted with cost information obtained from various data sources summarized in Table 4.2. Because the secondary cost data came from different years, all employment compensation data were adjusted to a common year using average hourly earnings for production workers and all other cost data using the Producer Price Index (PPI) for finished goods as in Table 4.3.

The survey served as a good tool to collect data on cross-regional material flows and detailed costs of operations information. The survey results on the flows also allowed us to assign input costs to sectors that were delivering waste or buying recyclables. The operations cost data were also used to modify the cost data in the IMPLAN system.

Table 4.2 Data Sources for Operation Costs

Study Sectors	Data Sources	Year of Data
Waste Collection	Alder et al (1998)	1997
Recyclables Collection	Miller (1993) EDF (1991)	-
Yardwaste Collection	Alder et al (1998), Waste Board (2000)	1997 2000
Transfer Stations	Survey	1999
MRFs	Tellus (1991)	1990
Composting Facilities	Biocycle (1994) Survey	 1999
Landfills	Bolton (1995); Survey	1994 1999
WTE Facilities	Tellus (1991) Survey	 1999
Recyclers	Survey	1999
Recycling Manufacturers	Census of Manufacturers IMPLAN data	1997 1997

Table 4.3 Producer Price Index and Earnings

Year	PPI	Earnings ($/Hour)
1989	113.6	9.66
1990	119.2	10.01
1991	121.7	10.32
1992	123.2	10.57
1993	124.7	10.83
1994	125.5	11.12
1995	127.9	11.43
1996	131.3	11.82
1997	131.8	12.28
1998	130.7	12.78

Sources: Bureau of Labor Statistics

4.3 Study limitations

Because of limited secondary data and survey participation, as well as variations in input uses from facility to facility, we were constrained to use the same input allocation factors for labor and other inputs for all regions. The volumes of recyclables used in the manufacturing sectors were estimated from the material uses described in the national Census of Manufacturers, and no direct survey of manufacturers was conducted. We assumed that same industries used the same percentage of recyclable materials (versus virgin materials) across the region, which best approximates real input uses. Some facilities were known to use more recyclable materials than others even in the same industries, but this was not captured in the study.

4.4 Estimation Procedures

Basic economic models were constructed for the State of California and for each of the regions, and then customized by introducing variables for each of two scenarios. The first scenario assumes that all the waste generated in the state and the regions in 1999 went to disposal and there was no diversion activity. The second scenario assumes that both disposal and diversion occurred at the estimated 1999 rates.

In the disposal-only model, output values for the sectors were calculated by multiplying the volumes of waste generated by per-ton collection costs, transfer costs, or average tipping fees. According to the DRS (CIWMB, 2000d), 97.5 percent of waste disposed in the state went to landfills and WTE facilities in the same region. Based on these assumptions, the total economic impacts of the disposal sectors were estimated for California and for each region.

The next set of models reduced the amount of waste going to disposal sectors and included diversion sectors. These models most resemble the current disposal and diversion situations in California. Combined impacts of the diversion and disposal sectors for California and each region were estimated, using data on output values, material flows, and costs of production, as specified in Chapters 3 and 4. Economic impacts of each diversion activity were also identified and estimated.

The combined disposal and diversion models were then compared with the disposal-only models to analyze the net impacts of having diversion sectors in the economy instead of having all the waste disposed at landfills.

5 IMPLAN Results

This chapter presents the estimates of the economic impacts of the waste disposal and diversion sectors in disposal-only models and disposal-diversion models. The results of models with all generation going to disposal sectors are presented first for all of California along with regional analysis. Total economic impacts from disposal-diversion models for all of California and all regions are then presented. These two models are then compared, and the impacts from selected diversion activities of the second sets of models are shown.

5.1 Economic Impact of Disposal Activities in the Disposal-Only Models

This section considers the economic impacts of having all waste generated in California and each region going only to disposal. The economic sectors included in these models are waste collection, transfer stations, landfills, and WTE facilities. Table 5.1 presents the result of the estimated economic impacts. The second column displays the total sales of the disposal sectors adjusted to remove any double counting, and the third to sixth columns display the multiplier effects of the sectors. One of the multiplier effects is output impact, which is a measure of how the disposal sectors influence total sector sales in the economy. The third column of Table 5.1 shows that the California waste disposal sectors add a total output impact of $18.08 billion to the economy if all generation is disposed.

The total income impact in column four measures the amount of total income for all persons in the economy attributed to the disposal-related economic sectors, which are estimated as $6.83 billion. This is also part of the value-added impact in column five which measures the increase in the value of goods and services sold by all sectors of the economy, minus the costs of inputs (excluding labor), used by the sectors in providing the services. Value added impacts from disposal models are shown at $8.99 billion. The last of the multiplier effects in the sixth column is the job impacts, which shows that 154,200 jobs are created in all sectors of the economy.

Regional multiplier effects are also presented in Table 5.1. Because most waste is disposed in the same regions as the points of waste generation, economic impacts of disposal sectors are closely correlated with the volumes of waste generated in each region. The Southern California region (E) has the most population and commercial sectors, and the largest volumes of waste generated within the region. The table shows that the region has the largest output from disposal sectors as well as largest multiplier effects. Total output of disposal sector is $4.14 billion, and the region generates $9.58 billion in sales impacts, $3.61 billion in total income impacts, $4.72 billion in value-added impacts, and creates 82,000 jobs in the economy.

Table 5.1 Economic Impacts Of All 1999 Waste Generation Going Only To Disposal

Region	Estimated Final Sales 1999 (in $1,000)	Impact on Economy			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (1,000)
All California	7,515,696	18,076,597	6,829,702	8,994,681	154.2
Northern California Region (A)	219,668	494,410	181,429	236,808	5.0
Bay Area Region (B)	1,564,876	3,641,847	1,409,767	1,851,560	29.4
Central Coast Region (C)	294,476	637,213	242,831	313,009	5.9
Central Valley Region (D)	1,290,260	2,916,988	1,082,145	1,421,334	27.2
Southern California Region (E)	4,137,992	9,580,721	3,608,171	4,722,769	82.0
Eastern California Region (F)	6,625	12,206	4,439	5,780	0.1

5.2 *Economic Impacts of Disposal and Diversion Activities in the Disposal-Diversion Models*

This section discusses the economic impacts of models when both disposal and diversion sectors are operating at the 1999 rate of diversion. As seen in Table 5.2, columns three, five and six, these combined sectors are generating a total output impact of $21.20 billion, producing value-added impacts of $10.74 billion and creating 179,300 jobs. The Southern California, Bay Area, and Central Valley regions specifically are experiencing large impacts, gaining $5.63 billion, $2.21 billion, and $1.76 billion in value-added, and creating 95,800, 33,900, and 32,200 jobs, respectively.

Table 5.2 Economic Impacts of All Waste Generation Going to Both Diversion and Disposal at 1999 Rates

Region	Estimated Final Sales 1999 (in $1,000)	Impact on Economy			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (1,000)
All California	9,179,872	21,202,264	7,899,570	10,739,242	179.3
Northern California Region (A)	238,636	517,463	188,817	257,180	5.2
Bay Area Region (B)	1,904,847	4,223,924	1,627,949	2,207,142	33.9
Central Coast Region (C)	315,926	666,276	255,873	337,601	6.2
Central Valley Region (D)	1,597,169	3,462,420	1,292,609	1,755,819	32.2
Southern California Region (E)	5,117,327	11,347,974	4,168,314	5,634,805	95.8
Eastern California Region (F)	5,944	10,726	3,890	5,223	0.1

5.3 Comparison of Economic Model Results

When comparing the two tables above, certain differences become apparent. Statewide, all the measures of impact are higher for the combined disposal and diversion models. Total output impacts are $3.13 billion or about 17 percent higher than the disposal-only model, value-added impacts are $1.74 billion or about 19 percent higher and job creation is 25,000 jobs or about 16 percent higher.

The Southern California, Bay Area, and Central Valley regions specifically are experiencing large differences, gaining $1.77 billion, $0.58 billion, and $0.55 billion in output impacts, $0.91 billion, $0.36 billion, and $0.33 billion in value-added impacts, and creating 13,800, 4,500, and 5,100 jobs, respectively. There will be more analysis of the results in Chapter 6.

5.4 Economic Impacts of Diversion Activities

In addition to estimating the total impacts of disposal and diversion, the economic impacts of each diversion activity used in the models were identified and individually estimated for the state and for all the regions using the estimated diversion rate for 1999. The statewide diversion rate was 37 percent, and this number varied by region based on material flows.

Because MRFs, composting facilities, and recycling manufacturers receive recyclable materials from other sectors, we considered only the additional output above the costs of recycling and yardwaste collection and recyclable feedstock in estimating their impacts on the economy. This approach was used to avoid double counting of the sales and impacts.

As seen in Table 5.3, having diversion sectors in the economy leads to large impacts on output, total income, value-added, and employment in the state. Total output impacts of the diversion sectors in California are estimated to be $10.15 billion, and diversion sectors are also generating $3.76 billion in total income impacts, $5.22 billion in value-added impacts, and creating 85,200 jobs. Recycling manufacturers, especially iron and steel related and nonferrous metals industries, are generating large economic impacts in California.

Tables 5.3 to 5.9 present regional total sales and multiplier effects from their different diversion activities. The Southern California region (E) has the largest output and multiplier effects from all diversion activities. The total output, income, and value-added impacts are $4.80 billion, $1.72 billion, and $2.40 billion, respectively, and 39,900 jobs are created in the region. The Central Valley region (D) has the most output and multiplier effects from yardwaste collection and composting facilities, since they are located in the area where agriculture is the main economic activity. The Northern California region (A) has relatively higher economic impacts from paper-related recycling manufacturing. There are little multiplier effects in the Eastern California region (F) since there are relatively few diversion activities.

Table 5.3 Economic Impacts of Diversion Sectors in California

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	1,353,202	3,189,964	1,363,288	1,768,215	27.5
Yardwaste Collection and Compost Facility	953,494	2,301,649	858,354	1,139,786	19.6
Recyclers	619,910	1,209,503	460,250	754,360	12.0
Collection and Transformation Facility	160,482	372,759	146,102	193,655	3.3
Recycling Manufacturers					
Paper, Cardboard-related	158,197	322,724	87,791	139,063	2.1
Plastics related	50,382	105,744	31,850	47,149	0.8
Glass related	287,200	594,162	201,004	296,177	4.9
Iron and Steel related	528,892	1,095,434	342,947	490,680	8.4
Nonferrous Metals	469,787	962,857	266,053	392,453	6.5
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.4 Economic Impacts of Diversion Sectors in the Northern California Region (A)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	30,090	65,603	27,689	35,525	0.7
Yardwaste Collection and Compost Facility	44,583	100,582	36,277	47,907	1.0
Recyclers	23,386	43,701	16,202	26,767	0.5
Collection and Transformation Facility	-	-	-	-	-
Recycling Manufacturers					
Paper, Cardboard-related	15,625	29,827	8,401	13,335	0.2
Plastics related	273	538	144	214	<0.1
Glass related	5,938	10,598	3,382	5,099	0.1
Iron and Steel related	982	1,891	593	825	<0.1
Nonferrous Metals	139	263	86	119	<0.1
Regional Total	121,017	253,003	92,773	129,791	2.5
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.5 Economic Impacts of Diversion Sectors in the Bay Area Region (B)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	315,178	713,326	312,608	403,921	5.8
Yardwaste Collection and Compost Facility	220,178	513,066	195,814	259,450	4.1
Recyclers	147,352	277,949	107,730	176,480	2.7
Collection and Transformation Facility	-	-	-	-	-
Recycling Manufacturers					
Paper, Cardboard-related	24,432	47,625	13,690	21,775	0.3
Plastics related	7,955	16,000	5,167	7,637	0.1
Glass related	82,865	164,162	57,255	83,918	1.3
Iron and Steel related	155,220	304,074	100,458	142,048	2.1
Nonferrous Metals	49,230	94,940	30,123	43,574	0.1
Regional Total	1,002,409	2,131,143	822,845	1,138,803	16.9
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.6 Economic Impacts of Diversion Sectors in the Central Coast Region (C)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	49,329	104,109	45,468	57,661	1.0
Yardwaste Collection and Compost Facility	54,589	118,043	44,336	57,660	1.1
Recyclers	20,764	36,825	14,098	23,178	0.4
Collection and Transformation Facility	-	-	-	-	-
Recycling Manufacturers					
Paper, Cardboard-related	63	109	31	47	<0.1
Plastics related	926	1,610	482	700	<0.1
Glass related	2,302	3,979	1,338	1,962	<0.1
Iron and Steel related	1,341	2,383	529	783	<0.1
Nonferrous Metals	5,923	9,646	2,281	3,290	0.1
Regional Total	135,237	276,703	108,563	145,282	2.6
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.7 Economic Impacts of Diversion Sectors in the Central Valley Region (D)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	359,278	799,068	338,660	438,208	7.5
Yardwaste Collection and Compost Facility	322,823	729,071	266,654	353,934	6.8
Recyclers	120,475	223,518	83,957	138,975	2.4
Collection and Transformation Facility	51,179	111,501	42,856	56,792	1.1
Recycling Manufacturers					
Paper, Cardboard-related	24,467	46,020	11,362	18,175	0.3
Plastics related	3,546	6,692	1,903	2,833	0.1
Glass related	87,033	166,059	56,680	82,816	1.5
Iron and Steel related	45,991	86,638	24,600	35,137	0.7
Nonferrous Metals	23,353	42,178	10,308	15,314	0.3
Regional Total	1,038,145	2,210,745	836,981	1,142,184	20.7
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.8 Economic Impacts of Diversion Sectors in the Southern California Region (E)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	599,328	1,357,186	581,606	748,818	11.7
Yardwaste Collection and Compost Facility	311,322	720,958	268,055	353,181	6.2
Recyclers	307,366	578,453	220,486	362,203	5.8
Collection and Transformation Facility	109,300	244,144	95,242	125,285	2.2
Recycling Manufacturers					
Paper, Cardboard-related	93,610	180,749	47,713	75,628	1.2
Plastics related	37,641	74,407	22,050	32,479	0.6
Glass related	109,063	215,169	70,673	104,549	1.8
Iron and Steel related	325,358	650,538	200,990	286,359	5.2
Nonferrous Metals	391,141	779,697	210,878	310,650	5.3
Regional Total	2,284,128	4,801,301	1,717,691	2,399,152	39.9
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

Table 5.9 Economic Impacts of Diversion Sectors in the Eastern California Region (F)

	Estimated Final Sales[1], 1999 (in $1,000)	Impact on			
		Output (in $1,000)	Total Income (in $1,000)	Value Added (in $1,000)	Number of Jobs (in 1,000)
Recycling Collection and MRFs	-	-	-	-	-
Yardwaste Collection and Compost Facility	-	-	-	-	-
Recyclers	568	891	325	563	<0.1
Collection and Transformation Facility	-	-	-	-	-
Recycling Manufacturers					
Paper, Cardboard-related	-	-	-	-	-
Plastics related	36	1	<1	<1	<0.1
Glass related	-	-	-	-	-
Iron and Steel related	-	-	-	-	-
Nonferrous Metals	-	-	-	-	-
Regional Total	604	945	383	583	0.1
California Total	4,581,547	10,154,797	3,757,638	5,221,667	85.2

1. Estimated final sales are calculated by adjusting for the costs of recycling and yardwaste collection and recyclable feedstock sales to avoid double counting.

6 Interpretation of Results

This chapter discusses the implications of the results obtained from two scenarios in Chapter 5, presents the economic impacts of an average ton of waste sent to disposal or diversion beyond the 1999 diversion rate, and discusses how the study findings can be hypothetically used in project decisions.

6.1. Study Implication from the Two Scenarios

The previous chapter estimated how much the disposal and diversion sectors affected the economy in California and each of six regions in 1999 for two different scenarios. When all waste is disposed, large impacts are created in the California economy because collection and landfill sectors require more labor and other inputs to operate. When waste is diverted, the economic impacts related to disposal are lost, due to the decreased amount of waste collection and disposal activities; however, additional large economic impacts are created from diversion activities. In all the regions except for the Eastern California region, when the impacts of limited disposal are combined together with those of diversion, the total surpasses the economic impacts produced by the disposal only model. There is a lack of recycling infrastructure and facilities in the Eastern California region which leads to the movement of waste and materials into other regions and out-of-state.

Because different regions have different economic activities and business and industrial infrastructures, the economic impacts from different diversion activities vary as seen in Tables

5.3 through 5.9. For example, the Northern California region has more forestry industries, and thus has relatively more paper-related manufacturing activities. The Central Valley region has more agricultural sectors that make more use of greenwaste as compost for crop production.

The findings in Chapter 5 suggest that diversion is good for the California economy, as it creates additional economic impacts compared to the disposal-only model. When waste was diverted at the 1999 rate, we found that at least 17 to20 percent higher economic impacts were created in output, value-added, and job creation. The actual impacts would be larger if all manufacturing sectors could be identified and captured in the study. The economic impacts would also increase when the diversion business and industrial infrastructures become more established, as seen in the Southern California and Bay Area regions. Creating markets to accept more recyclable and compostable materials would be the key to stimulating more economic activities and higher impacts in the state.

6.2. Average Economic Impacts per Ton for Changes in Disposal verses Diversion

Table 6.1 summarizes the average economic impacts of each additional ton of waste disposed or diverted beyond the present diversion rate for the state and each region. We divided the total output, income, value-added, and jobs generated in the disposal and diversion sectors by the tons of waste disposed and diverted to derive the average impacts. ‘Average’ impacts were used in the study instead of ‘marginal’ because marginal impact function could not be estimated from IMPLAN system.

In California as a whole, the total economic impacts per ton from diversion are close to twice as much as the impacts from disposal. Typically, a change of one additional ton of waste disposed in California would generate $289 of total output in the state economy from all the multiplier effects, while a change in one additional ton of waste diverted as recyclables would generate as much as $564 in the economy. For every ton of waste disposed, $108 in total income and $144 in value-added would be created in the state economy, while for every ton of waste diverted, $209 in total income and $290 in value-added would be created. As defined in the previous chapter, "value-added" is the output minus all material costs (except labor) used in production. Table 6.1 also shows that only 2.46 jobs would be created for every 1,000 tons of waste disposed (1 job for every 400 tons), while 4.73 jobs would be created if the same volume of waste is diverted as recyclables (1 job for every 213 tons).

The main findings of this study are similar to those of the past studies presented in Chapter 2. The waste diversion activities result in a large increase in economic impacts and job creation. Some past studies, however, resulted in higher indirect economic impacts and jobs created, mainly in the manufacturing industries. The differences between our work and those of other studies resulted from our conservative estimation methods of impacts in the manufacturing sectors. Other studies examined a sample of manufacturers and applied the rates of their recycled materials uses across the state, while this study used Census results to estimate the rates and volumes of recycled material uses for manufacturers. As the result, this study covers the entire state and is more consistent across regions in estimating impacts, but it may not capture some manufacturers' impacts, compared to other survey-oriented studies.

Table 6.1 Average Economic Impacts of Additional Waste Disposal and Diversion in 1999

Region		Total Sales 1999 ($/ton)	Impacts on Regional Economy			
			Output ($/ton)	Total Income ($/ton)	Value Added ($/ton)	Number of Jobs (Per 1,000 tons)
All California	*Disposed*	119	289	108	144	2.46
	Diverted	254	564	209	290	4.73
Northern Region (A)	*Disposed*	115	260	94	125	2.62
	Diverted	186	388	143	199	3.90
Bay Area Region (B)	*Disposed*	118	275	106	140	2.22
	Diverted	224	476	184	254	3.78
Central Coast Region (C)	*Disposed*	115	250	94	123	2.30
	Diverted	189	387	152	203	3.61
Central Valley Region (D)	*Disposed*	105	241	88	118	2.23
	Diverted	276	587	222	303	5.49
Southern Region (E)	*Disposed*	123	287	108	142	2.46
	Diverted	265	557	200	278	4.62
Eastern Region (F)	*Disposed*	131	241	87	114	2.42
	Diverted	55	85	31	51	0.92

The study also found that the economic impacts varied by region. Average waste diversion would stimulate the regional economies more than disposal in all regions but the Eastern California region. As discussed earlier, the Eastern California region does not have much infrastructure that supports recycling business, and most recyclables are delivered out of the region for further processing and use in manufacturing. Economic impacts from diversion are the highest in the Central Valley, Southern California, and Bay Area regions. These regions have more business and industrial and/or agricultural infrastructure relative to other regions, and a high percentage of the outputs generated by the diversion activity are re-spent in the same regions. Relatively more recycled material users and/or recycling manufacturers are located in these areas, and they create more value-added and jobs within the regions. As seen in Table 6.1, the Central Valley region’s total output impacts are close to $350 per ton more when the waste is diverted than when disposed. In the Southern region the difference is $270 per ton, and in the Bay Area it is $200 per ton.

6.3 Important Notes on Using the Economic Impact Results

In making the use of the study findings above, one must realize that the study results are based on the reliability of secondary data sources and survey answers as well as various assumptions that were made along the way as explained earlier in the report. In addition, not all economic factors were or could be quantified, and some that were are only our best estimates. When given a choice of data or method, we used the more conservative estimate. To this extent, this study is not a precision tool, and it has likely resulted in the underestimation of actual economic impacts. Although the trends are clear, decision-makers must use the study findings carefully.

The study assumed the same cost functions for all regions for all disposal and diversion sectors as explained in Chapter 4. But there are some variations in input costs such as land and transportation costs, and some facility designs are more labor intensive and others feature unique processes, locally fabricated machinery, and special relationships between companies. This is especially true of the waste industry, which is currently in a period of rapid change featuring much experimentation and consolidation.

The study also did not evaluate economic impacts for each local jurisdiction separately within the region nor included all manufacturing sectors that existed in the region. Different communities even in the same region would benefit differently from any spending depending on their share of the regional business and industrial infrastructure. Generally, the more commercial and industrial business infrastructure in a community, the bigger the share of the original expenditure will be captured, and the more likely that portions of subsequent rounds of re-spending will be spent there or stay in the community. It was also not possible to track the flow of all recyclable materials with the scope of this study, and some recycling manufacturers were left out of the study that might generate large local economic impacts in a particular community.

An economic impact estimate is only an advisory tool for general planning purposes, and should not be used alone to make critical monetary decisions. But it can provide insight into the relative merits of different paths of development.

6.4 Hypothetical Example Using the Study Findings

This section describes in hypothetical terms how economic impact data could be used as an advisory tool at the local government level. Suppose a jurisdiction located in the Bay Area region (B) is faced with the problem of determining whether to fund a recycling program that costs $50,000, but can divert 1,000 tons of waste from landfills.

We recommend that you do not use the data in Table 6.1 for an actual analysis. But, if one had more precise local data showing that, for example, one ton of waste disposed in a landfill in the Bay Area region (B) generates $118 in total output in the disposal sectors (which include waste collection, transfer stations, landfills, and WTE biomass), and it also generates $275 in total sales in the regional economy after all multiplier effects are accounted for. Total income impacts, and value-added impacts in the region are $106, $140 respectively per ton, and 2.22 jobs would be created region-wide per 1,000 tons of waste disposed.

When the same waste is diverted as recyclables in the region, $224 per ton would be generated in the combined disposal and diversion sectors, $476 per ton would be added to the total output of the regional economy after the multiplier effects, and $184 per ton in total income impacts and $254 per ton in value-added impacts would be stimulated in the regional economy. In addition, for every 1,000 tons of waste diverted, 3.78 jobs would be created in the region.

Since the new recycling program is estimated to divert 1,000 tons of waste as recyclables from landfills, the net increase in the economic impacts, when comparing diversion to disposal would be calculated as follows:

	Average for each 1,000 tons	
Total Income Impacts =	(184 – 106) x 1,000	= $78,000
Value-Added Impacts =	(254 – 140) x 1,000	= $114,000
Jobs Creation Impacts =	(3.78 – 2.22) x 1	= 1.56 jobs

The increase in total income and value-added impacts are larger than the recycling program cost; therefore, the program would provide a positive benefit for the region. This is one method of benefit-cost analysis. To examine the full range of benefits and costs (including environmental and social) and their distribution would require more data and analysis. It should be noted that the program cost may be a public expenditure, but the total income will be a private benefit. In addition, the job creation and resulting taxes will be spread throughout the region but the costs of the program may accrue to a single jurisdiction. It is important to examine and quantify the distribution and value of the impacts. No one would ever fund a program based on a single piece of evidence, but economic impacts are one indicator that may provide insight in an overall analysis of the question by decision makers.

7 Suggestions for Further Research

Although this is the first input-output analysis of the solid waste industry done in California there are many areas where standardized definitions and improved accuracy of data inputs could improve the economic analysis of the waste disposal and diversion sectors.

The regional geographic areas defined in this study are "best guesses" based on general economic experience and the opinion of Waste Board staff and members of the waste industry. Hard data is needed about the size, shape and number of waste disposal and diversion regions in California. Waste geography is sensitive to demand factors and transportation costs, but periodic consistent tracking of the origins and flows of waste and recyclable materials would reveal valuable information about the basic behavior of material volumes under differing economic conditions.

The tonnage and cost data in this study have been collected primarily from secondary data sources, such as the Waste Board databases, the U.S. Department of Commerce, and waste industry studies and estimates. The Waste Board databases were very helpful, but their scope was limited to Board-permitted sites and many of the smaller facilities are not required to submit data. Much of the permit data was also in poorly identified amounts (tons/pounds/cubic yards), was not up to date, or lacked a standard conversion factor. Additional data about the total amount of diverted materials in California, especially non-CRV materials, would be especially helpful.

As explained in Chapter 4, not all manufacturers using recycled materials were included in the study, as there is only limited census data on the use of recycled materials and only in certain industries. A survey of recycled material volume and use by manufacturers during local waste audits could be valuable in determining the flow and end uses of materials.

In discussing the draft survey with potential participants, the authors were struck with how frequently both disposal and diversion related businesses, big and small, did not have good knowledge of their revenue and cost allocations and had to rely on traditional "rules of thumb" or rough experience to determine outlay percentages for such things as labor, equipment, or insurance costs. Fortunately, some firms did have the data or were willing to do research. This lack of fundamental business data may be evidence of how recently the diversion industry has emerged and/or the rapid changes taking place in the industry. Many of those contacted expressed a sincere desire for better estimates on operations data. The development of better and more standardized accounting methods would be helpful to the waste industry, especially small operators.

The Waste Board's hierarchy starts with source reduction, but this form of diversion was not included in the study because it is very difficult to assign economic values and obtain volume data in this area of behavior.   There is no secondary data yet available from the government or the waste industry to measure the amount and value of the economic activities.. A survey of waste generators would be necessary to gain a sample of practices by industry type and an estimate of the average dollar savings. It may be difficult to determine where the savings are applied without a longitudinal study, as the saved expenditures may not be distinct, or the alternate spending may not occur in the same time period.

The economic impacts from reuse industries were also not captured in the study. It was not possible to specify which activities are considered ‘reuse’, as it is vaguely defined in State statutes and regulations, and there are no secondary estimates for many types of reuse. More work needs to be done in the area of economic life-cycle analysis of products before commonly accepted economic-based definitions can be developed to allow the collection of meaningful data.

In addition, overall environmental benefits and costs from waste diversion have not been discussed in this study. Much work needs to be done to develop standard measurement methods, and the volume and economic value of environmental protection in California.

Case studies are also not included because it was not possible to gain sufficient cooperation from local governments and waste and diversion industries. At least one county has, however, expressed interest in further research.

8 Appendixes

8.1 Appendix A: Data Contributors

Public agencies and private firms in California provided survey response data, document review comments, or other information to assist in the development of this study. The authors are very grateful for their support. For reasons of business confidentiality, not all the firms that cooperated with the study wished to be publicly recognized.

Please note that no support data or economic estimates listed should be construed to represent the data submitted by any one of these contributors for their regions. Confidential business revenue and expenditure production factors used in this study were masked and are presented as summary averages only. Any data errors or misstatements in the study reflect the Authors' opinions only.

The following firms were among those that assisted in the study.

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8.4 Appendix D Copy of a Typical Survey Instrument

Each respondent in the survey sample was provided with an appropriate survey form for collection, MRF/transfer station, disposal, brokerage, composting and/or waste to energy. They were also given general directions, a map of the regions, a glossary of terms, an addressed return envelope, and a contact phone number for questions. Each respondent also received a follow up phone call.

Please fill out this questionnaire if you collect refuse, recyclables, green wastes, and/or other materials from residences, businesses, and any other establishments. If you also operate transfer stations, material recovery facilities (MRF), landfills, recycling buyback centers, and/or drop-off centers, please report information regarding these activities separately from your collection activities by filling out other questionnaires in your survey package in addition to this questionnaire.

Waste Collection Survey

In this questionnaire, please provide us with information regarding your collection services of refuse, recyclable, and green waste materials for the most recent year of operations in California for which you have complete data. If you do not have a complete year, please estimate the average or typical tonnage volumes you collect or dollars you expend in a year. ***All the information you provide us will be handled in a strictly confidential manner.***

Please provide us with information about you and your employer.

Respondent's Name: ____
Respondent's Title: ____
Company Name: ____
Address: ____
Contact Phone Number ____

If you would like your company name to appear on our acknowledgment page, please specify how you would like it to read. If you do not fill in this line, your company's participation will remain anonymous.

Name: ____

If you would like to receive a copy of our completed report, please indicate where we should send the report:

Address: ____
City/Zip ____

Please see the state map included in the survey package and note all regions in which you operate (*Please circle all letters that apply*):

Regions: A B C D E F

Please complete a questionnaire for all California regions that you circled above, but report data from each region separately. If you have operations in more than one region, please copy this questionnaire as needed. Please note that terms in **boldface** are defined in the glossary in your survey package.

Data in this questionnaire comes from:

Region: ________________________ (*Please specify one region only)*

Year: ________________________ (Fiscal or Calendar year

Collection Services

Q1. Please estimate the percent of your total annual tonnage volume that comes from each of the following collection services you provide in the region you specified *(Please include volumes of all **refuse**, **recyclables**, and **green waste** materials; Please do not include volumes collected from **drop-off centers** or **buyback centers**).*

`

Residential Waste Collection ___________________ %

Commercial Waste Collection ___________________ %

Industrial Waste Collection ___________________ %

Institutional Waste Collection ___________________ %

Q2. Please provide following information relative to materials that you collected from all your **residential** service areas in the region:

Materials Collected	Annual Volume Collected (tons)	Names of All Counties You Serve in Region Specified	Number of Homes and Multi-units Housing Complexes You Serve
Refuse			___________________ homes ___________________ multi-units complexes
Recyclables			___________________ homes ___________________ multi-units complexes
Green Waste			___________________ homes ___________________ multi-units complexes
Other *(Please Specify)* __________			___________________ homes ___________________ multi-units complexes

Q3. Please provide following information relative to materials that you collected from all your **commercial/ industrial/ institutional** service areas in the region:

	Annual Volume Collected (tons)	Names of All Counties You Serve in Region Specified	Number of Accounts Served	Market Share of Your Business in the Region (%)
Refuse				
Recyclables				
Green Waste				
Tires				
Other *(Please Specify)* ___________				

Q4. Please provide following information about the next destination of materials that you collected from all your collection services in the region *(The example below shows that 2,000 tons of materials you handled were sent to* ***landfills****, 30% of the materials was shipped to Region A and C, and 15% was shipped outside California)*:

Destination of Materials You Handled	Annual Tonnage	Percent Shipped Outside the Region but in California	Region(s) beside Your Own that You Send Waste to	Percent Shipped Outside California
(Example) ***Landfills***	*2,000 tons*	*30%*	*A, C*	*15%*
Transfer Station/ MRF				
Landfills				
Waste-to-Energy Facility (Waste Board Permitted)				
Waste-to-Energy Facility (Not Waste Board Permitted)				
Recycling Brokers/ Processors				
Composting Facilities				
Other *(Please Specify)* ____________________				

Operating Revenues

Q5. What was the total annual amount of **gross receipts** received from all accounts in the region, including **tipping fees**, sales of **recyclable** materials, and other payments?
_________________________dollars

Q6. Please estimate the percent of total **gross receipts** that came from each of the following sources *(The example below shows that 10% of annual **gross receipts** came from **service fee** charged for **residential refuse** collection.)*:

Revenue Source		Revenues (%)
*(Example)** *Service Fee Charged for **Residential Refuse** Collection*		*10%*
Service Fee	**Residential Refuse** Collection	
	Commercial/ Industrial/ Institutional Refuse Collection	
	All **Recyclables** Collection	
	All **Green Waste** Collection	
	All **Special Waste** Collection	
Sales of All **Recyclable** Materials		
CRV Payments Received		
Sales of All **Green Waste**		
Interests, Rents, Royalties, and Dividends Received		
Other Sources *(Please Specify)* ________________ ________________ ________________		________________ ________________ ________________

Operating Expenses for Year

Q7. Please estimate your total annual expenditures in the region for all items in the following table *(If you do not know the exact amounts, please make a best estimate)*:

Expenditure Items	Expenditure for Year (Dollars)
Tipping Fees Paid to Landfills or Other Facilities	
CRV Paid to Customers	
Labor Costs for All Employees	
Fringe Benefits for All Employees	
Operating Equipment and **Operating Materials** Purchased or Leased for Use for Your Operations	
Trucks, Loaders, etc	______________ dollars
Handling and Processing Equipment	______________ dollars
Office Equipment	______________ dollars
Containers/ Bins	______________ dollars
Other Materials	______________ dollars
Equipment Maintenance and Repair **Outside Contracted Services** (Including labor and parts):	______________ dollars
In-house Maintenance and Repair, Material Costs (Not including labor costs)	______________ dollars
Fuel and Oil Expenses	
Land Purchased during the Survey Year	
Ongoing **Construction Expenditures** for Facilities (Not Include Routine Maintenance Costs)	

Q7 (cont'd)

Expenditure Items	Expenditure for Year (Dollars)
Facility Maintenance and Repair **Outside Contracted Services** (Including labor and parts): **In-house Maintenance and Repair, Material Costs** (Not including labor costs)	 ________________________ dollars ________________________ dollars
Rental or Lease Costs for Land and Facility Uses	
Insurance Costs	
Water Uses	
Utilities besides Water	
Property Taxes	
Indirect Business Taxes	
Contracted Transportation Costs	
Loan and Interest Payments	
Office Supplies	
Franchise Fees, Business Licenses and Operating Permits	
Consulting and Professional Services	
Others *(Please Specify)* __________________________________ __________________________________	 __________________________ __________________________

Thank you very much for your time and cooperation. Please remember to fill out additional questionnaires for other regions and other activities

8.5 Appendix E Waste Flow Charts

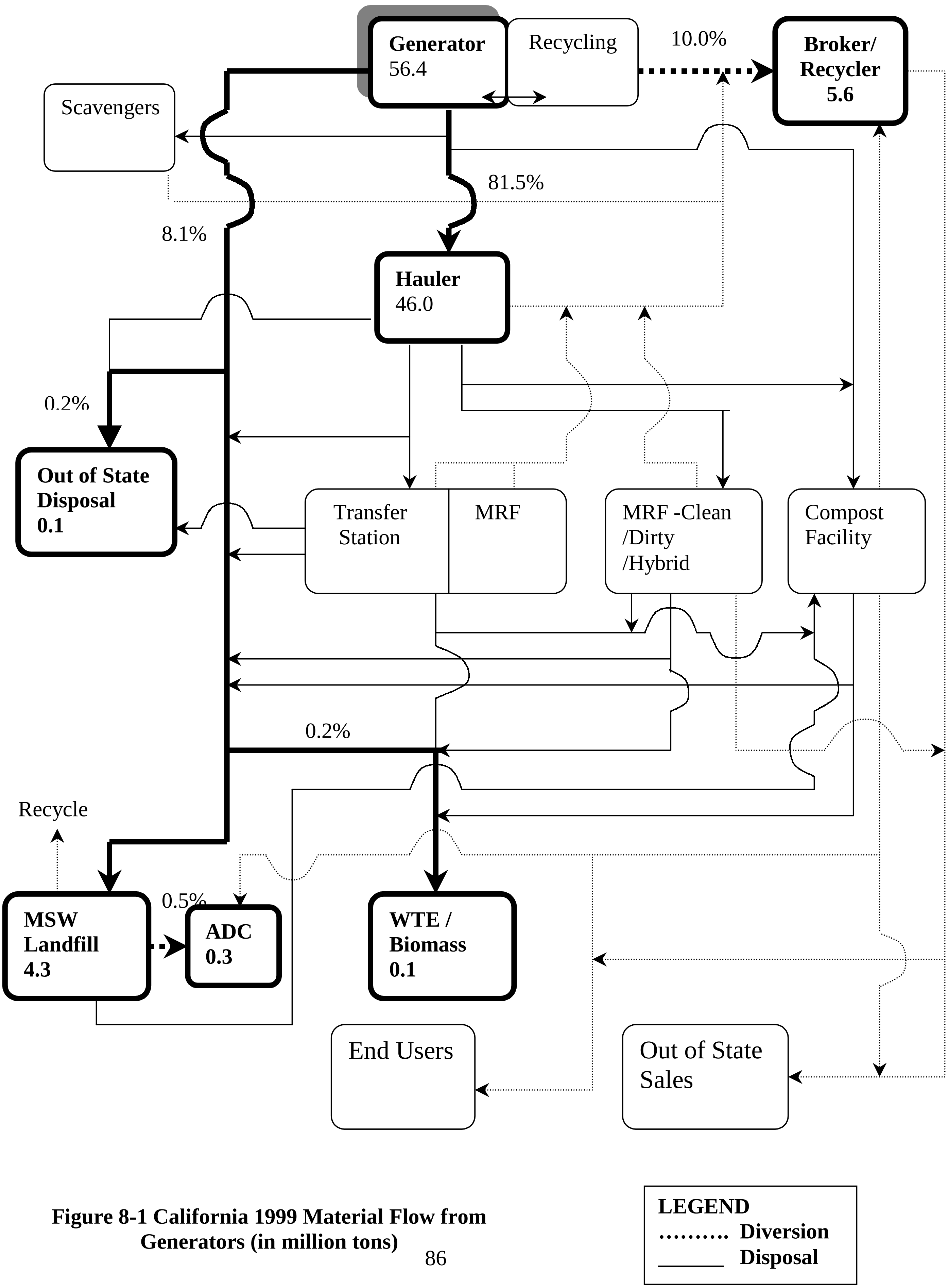

Figure 8-1 California 1999 Material Flow from Generators (in million tons)

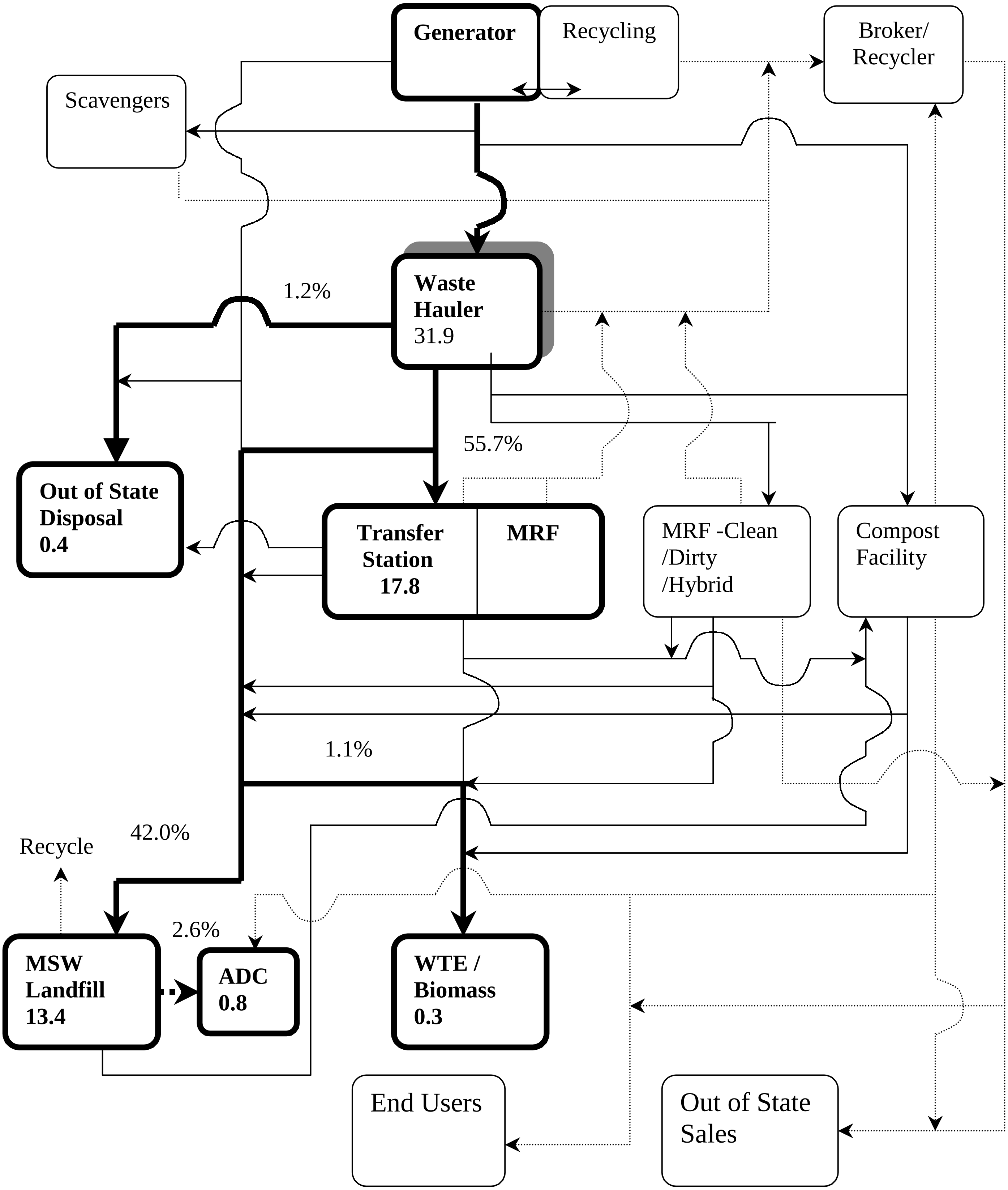

Figure 8-2 California 1999 Material Flow from Waste Haulers (in million tons)

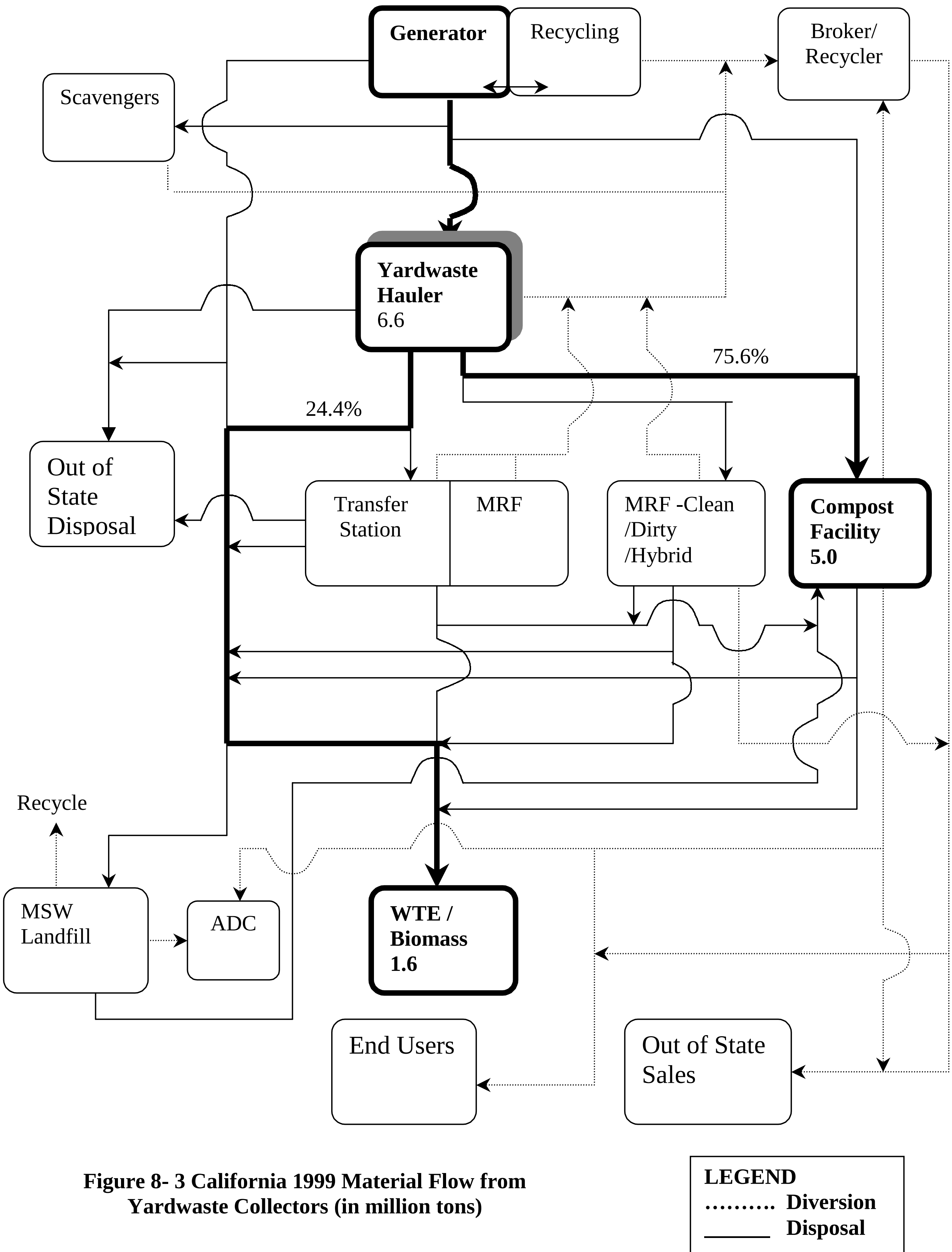

Figure 8- 3 California 1999 Material Flow from Yardwaste Collectors (in million tons)

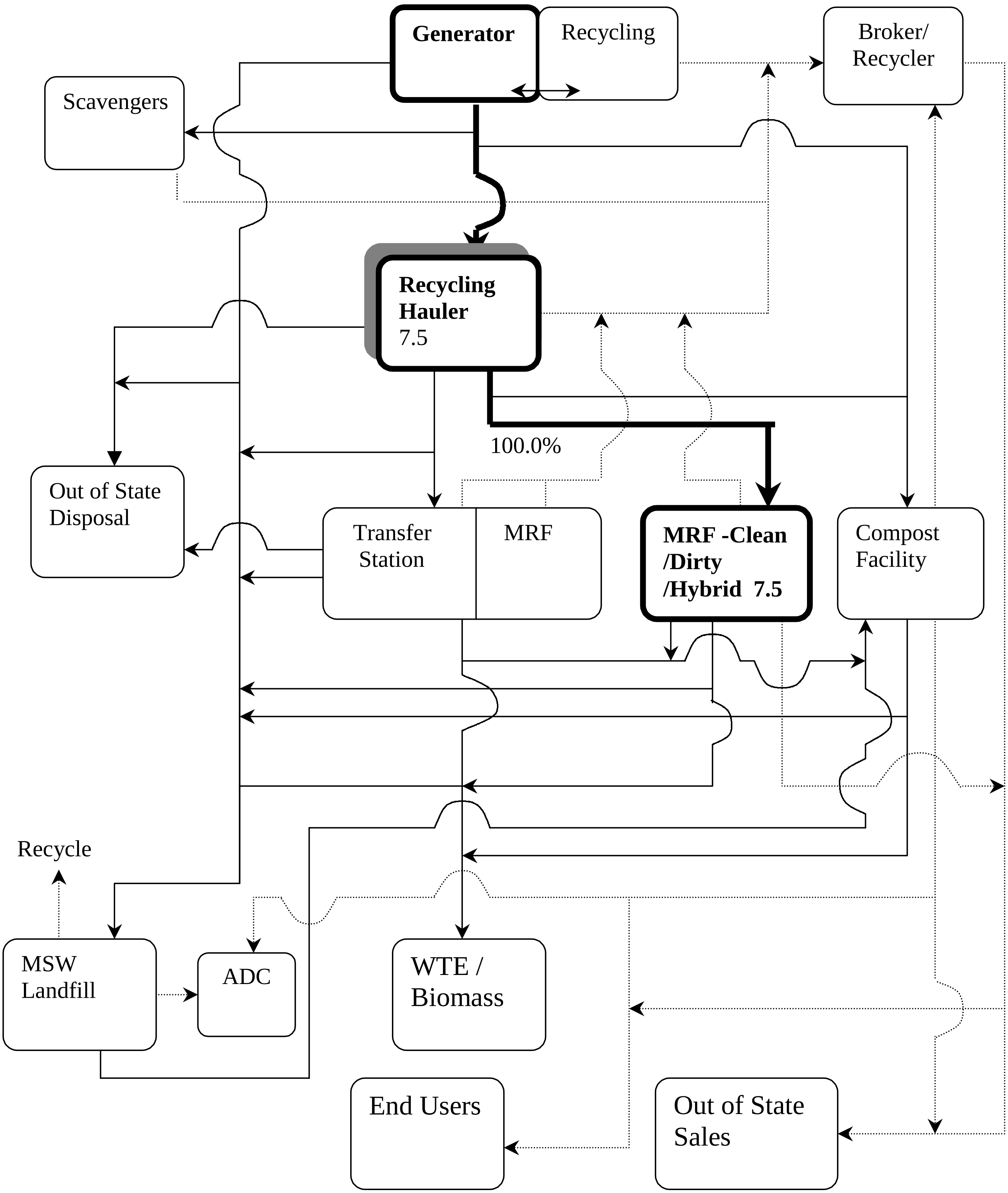

Figure 8-4 California 1999 Material Flow from Recycling Collectors (in million tons)

LEGEND	
....	Diversion
______	Disposal

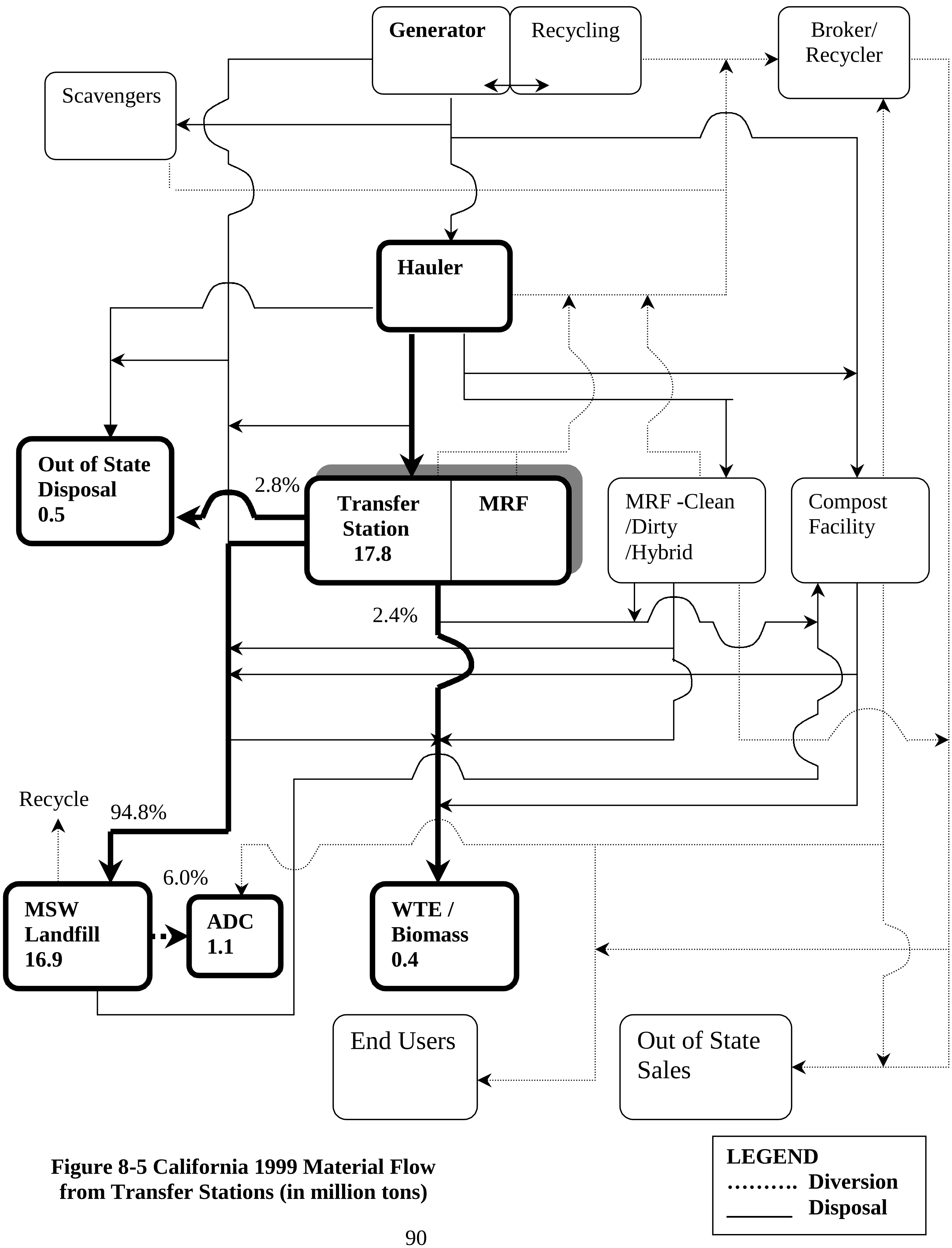

Figure 8-5 California 1999 Material Flow from Transfer Stations (in million tons)

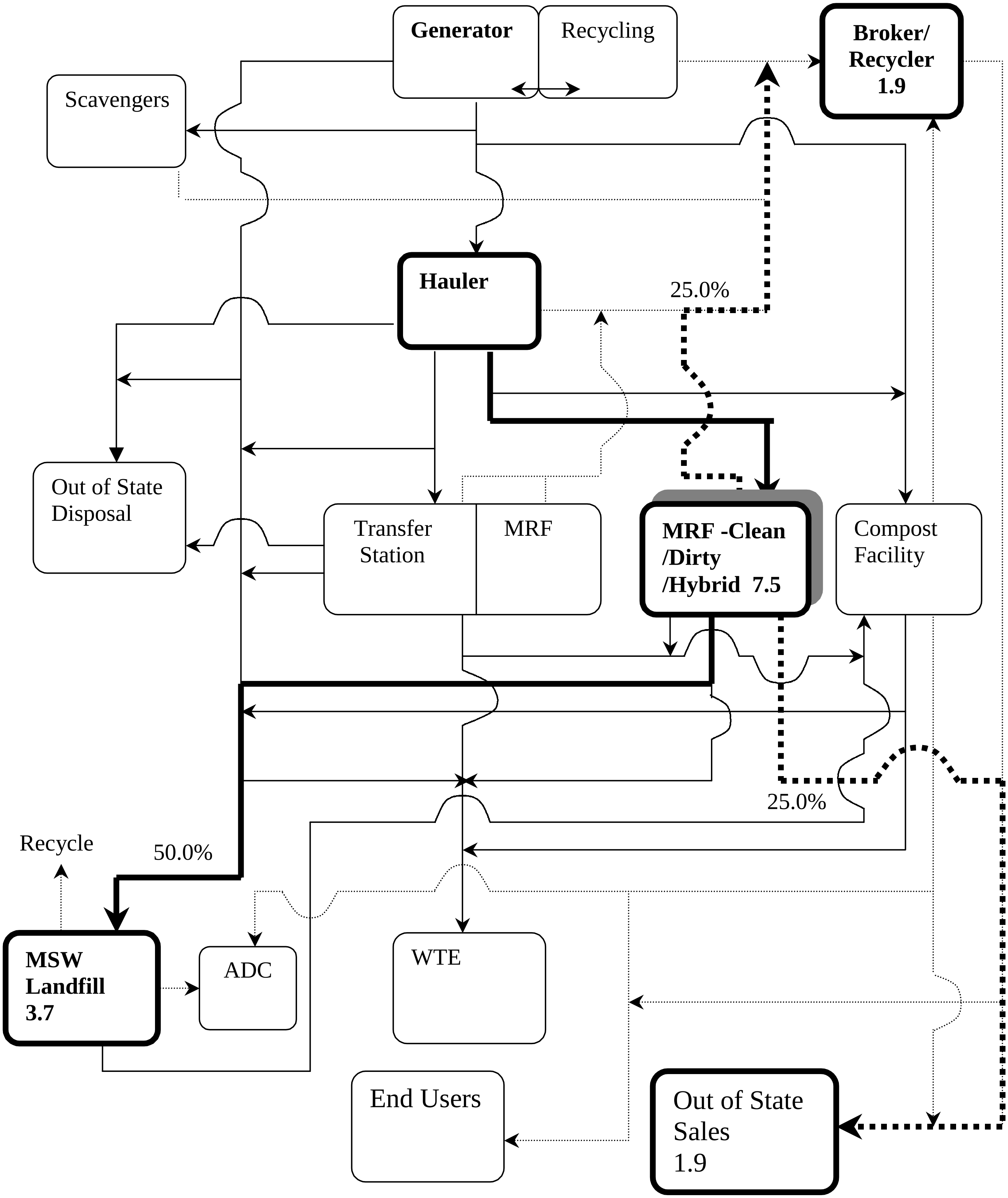

Figure 8-6 California 1999 Material Flow from Material Recovery Facilities (in million tons)

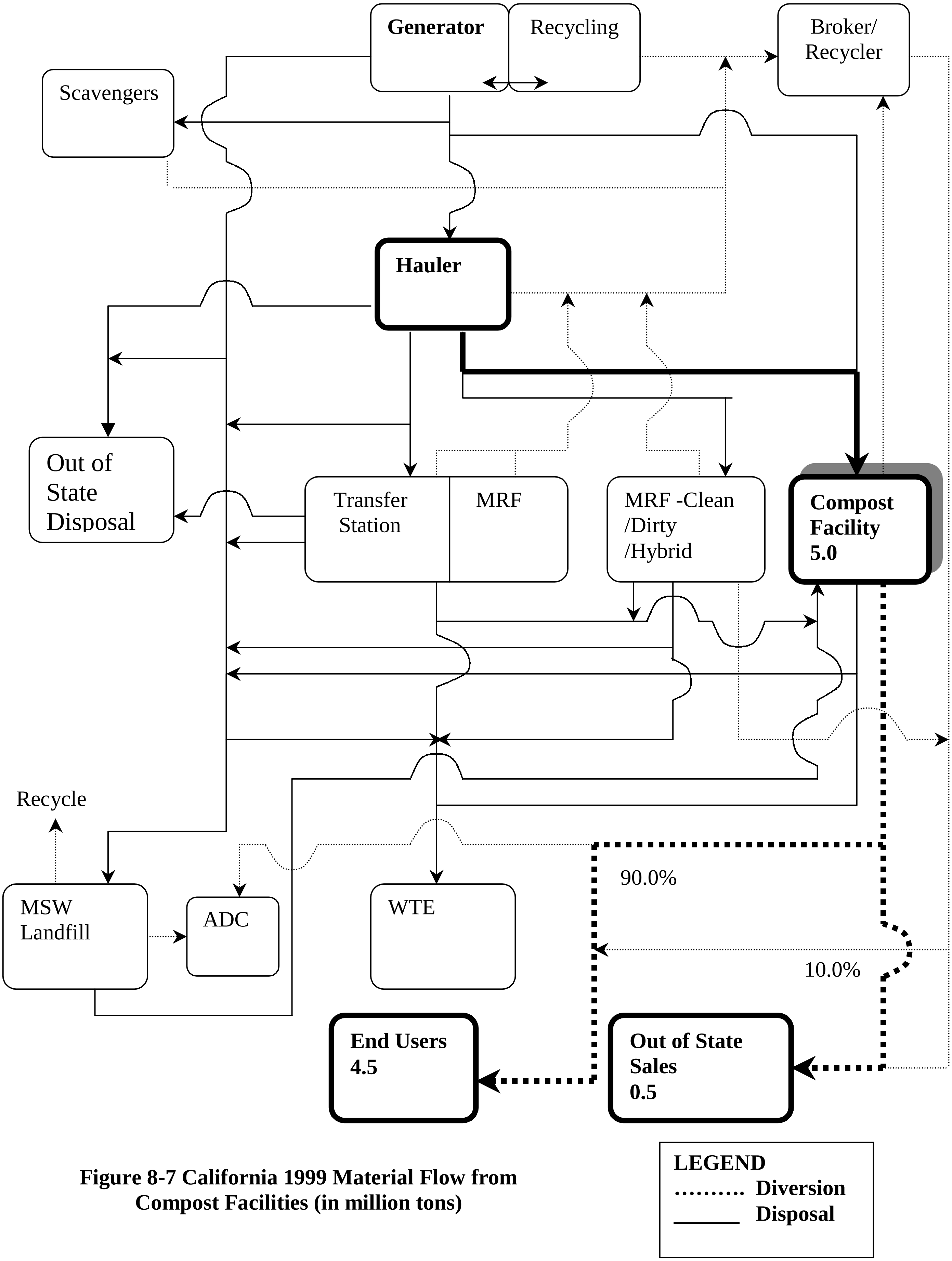

Figure 8-7 California 1999 Material Flow from Compost Facilities (in million tons)

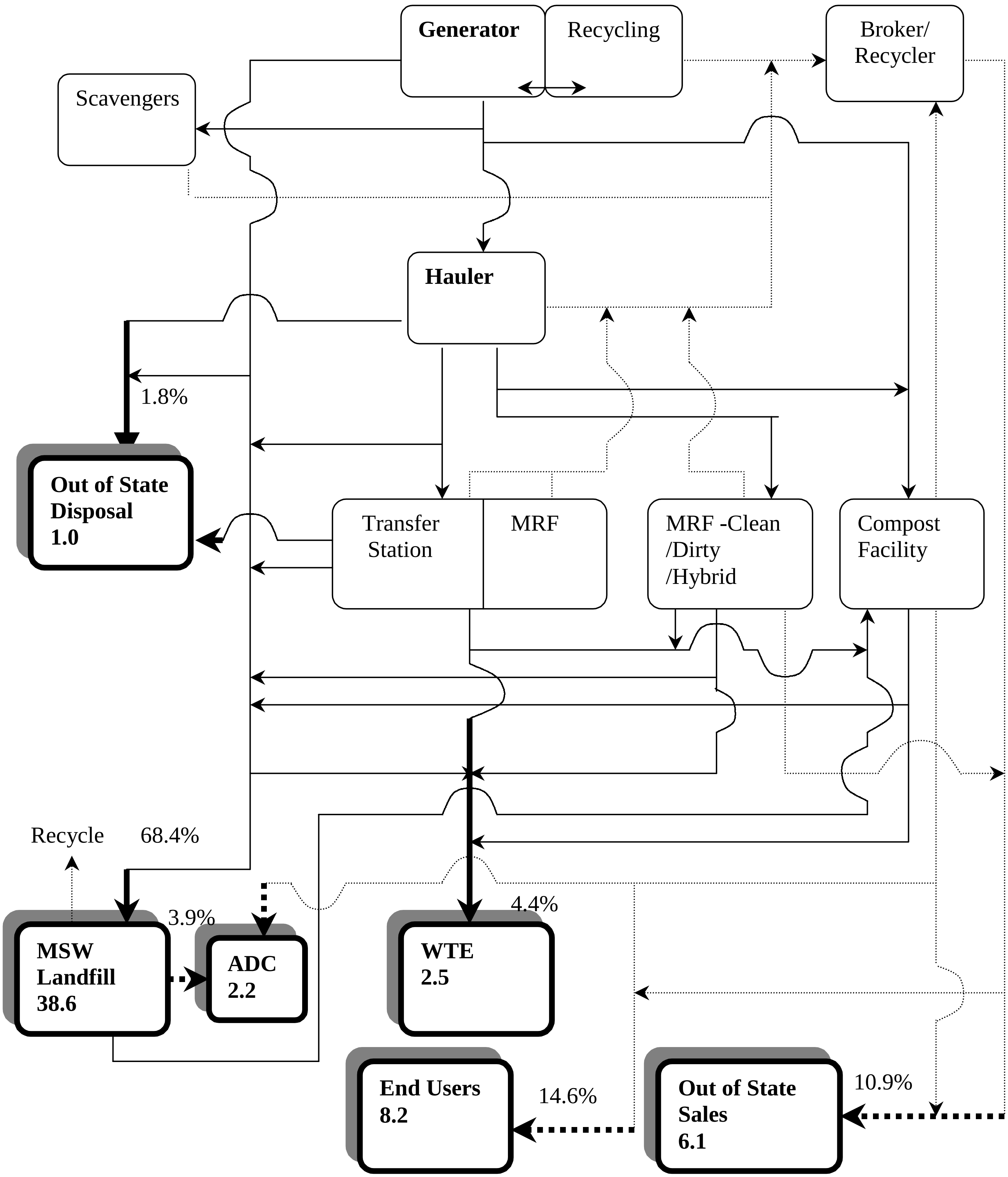

Figure 8-8 California 1999 Material Flow to End Use (in million tons)

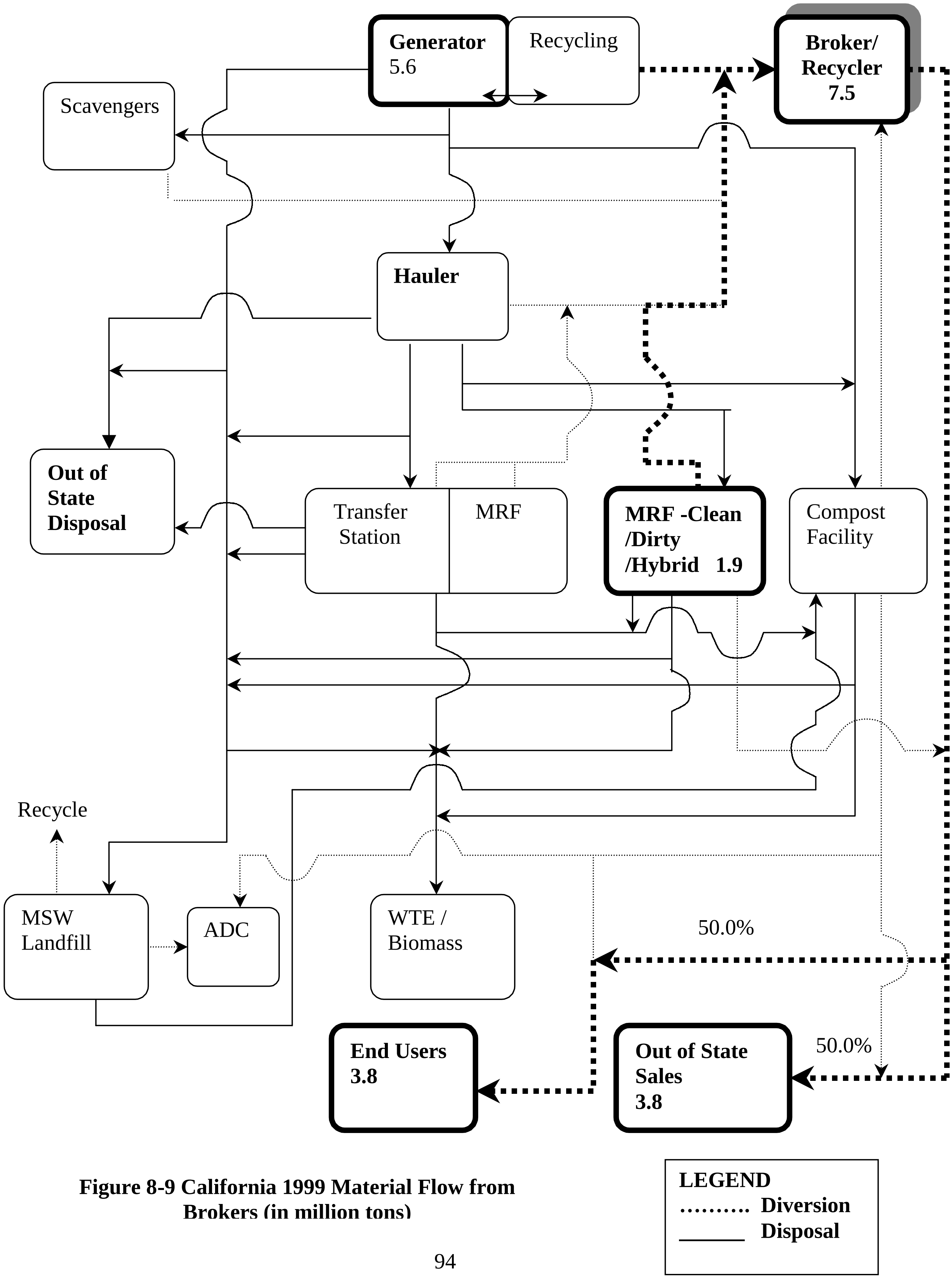

Figure 8-9 California 1999 Material Flow from Brokers (in million tons)