

Recycling and Economic Development

A Review of Existing Literature on Job Creation, Capital Investment, and Tax Revenues

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Prepared by



for



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Recycling and Economic Development Literature Review

This review of literature on recycling and economic development was commissioned by the King County LinkUp program and conducted by Cascadia Consulting Group, an environmental consulting firm based in Seattle, Washington. Since directing Washington's Best Management Practices for Solid Waste Study in 1988, Cascadia has played an integral role in helping communities throughout the United States analyze waste issues and develop effective waste reduction, diversion, and recycling programs. Cascadia's staff brings deep knowledge of the recycling industry and extensive experience collecting and analyzing information about solid waste, recyclables, and markets for recycled materials. The Acknowledgments section identifies the team members that contributed to this literature review.

Introduction and Overview

Background

Cities and counties across the United States are working hard to address their waste streams in a cost-effective way that safeguards public health and the environment. Having already designed and implemented some of the most successful waste prevention and recycling programs in the nation, King County, Seattle, and other Puget Sound communities are better positioned than most to reap local benefits from improved resource recovery through materials exchange programs, reuse industries, and manufacturing from recycled feedstock. To understand more fully the impacts that increased recycling has on local and regional economic development, King County—together with its program partners, Seattle Public Utilities and enterpriseSeattle—commissioned a literature review examining studies that have been conducted on recycling and economic development around the country.

Since 1994, when the Washington State Department of Ecology started issuing annual reports on the state's disposal stream, waste generation per person in Washington has increased at an average rate of 6 percent per year—higher than the 2 percent annual population growth rate. In this time, Washington citizens have generated well over 145 million tons of solid waste—"roughly equivalent to the amount of solid waste discarded in the United States in one year" (Washington 2007). Many Washington cities and counties, including the City of Seattle and communities in at least a dozen other counties, send their waste out of state for disposal. Increasing recycling can reduce this waste while offering local economic opportunities.

Scope of Literature Review

This document presents key findings summarized from more than 50 existing studies, reports, Web sites, journal articles, media releases, and presentations addressing the impacts of recycling on **job creation**, **capital investment**, and **tax revenues**. In this review, "recycling" is defined to include collection, processing, remanufacturing, and end markets, though not all studies use the same definitions. Because findings from the literature review are intended to inform regional planning efforts, special consideration has been paid to reports addressing regional recycling programs and economies or comparable efforts elsewhere.

While this review provides a broad perspective on the economic impacts and benefits that result from recycling as whole, it does not delve deeply into the economic impacts associated with specific waste streams or materials, such as electronic waste, building deconstruction, or organics and composting. Further, it does not explicitly address other related "material recovery" activities, such as salvage and reuse, which may feed into similar end use markets but are separate from recycling programs. Where appropriate, we recommend literature that addresses these more specific areas of inquiry.

Overview of Literature and Gaps

In general, the field of “recycling and economic development” appears to be an incomplete area of study, particularly in terms of formal published literature. This section provides a brief summary of the body of literature itself (rather than the findings), including research sponsors, gaps in the literature, and relevant examples that could be applied locally.

Most studies are government-sponsored. Much of the available research was conducted by waste research and engineering consulting firms funded by state and federal agencies or nonprofits, such as R.W. Beck’s landmark *U.S. Recycling Economic Information Study* commissioned by the National Recycling Coalition and funded in part by the U.S. Environmental Protection Agency (R.W. Beck/NRC 2001). The public agencies supporting these studies more often have solid waste or environmental mandates, rather than an economic development focus. Additional relevant Web sites, articles, and outreach materials released by public and private organizations and individuals were based largely on data resulting from these same national, regional, and statewide studies. Academic researchers from the University of California–Berkeley and University of Missouri conducted studies for their respective states, but these studies have not been broadly referenced or cited. Additional reports for Michigan and Montana were developed internally by state agency staff, but these studies provided less comprehensive information, and their methodologies were not clearly specified. Most information on this subject is found in the “gray” literature, including government publications and industry periodicals, rather than peer-reviewed academic journals.

Many studies lack comparable definitions and methods. Study methodologies and research definitions varied significantly from study to study. While the *Recycling Economic Information Study* commissioned by the Northeast Recycling Council (NERC) in 2000 and the *U.S. Recycling Economic Information Study* commissioned by the National Recycling Coalition and funded in part by the U.S. Environmental Protection Agency in 2001, both conducted by the same firm, R.W. Beck, used the same methodology to measure and report the economic impacts of recycling, other relevant studies were not readily comparable to analyses in other states or regions. For instance, there has been no standard method for defining industries and impacts that *directly result from recycling*, as opposed to industries and impacts that *correspond with recycling but are not dependent* on the success or existence of recycling programs. For this reason, figures related to “job creation” or “tax revenues” may seem inflated in some reports compared to others. The most recent regional *Recycling Economic Information Study Update*, conducted for NERC in 2009 by DSM Environmental Services, featured significant modifications from the original study (R.W. Beck/NERC 2000) in response to these issues as well as other critiques of the scope and methodology of the previous study. The new study addressed many of the issues that arose during the first study, such as more clearly distinguishing “activities associated with the collection and processing of recyclables” from “reuse and remanufacturing” and “recycling reliant” activities. The 2009 analysis also limited the reported economic contributions of manufacturing activities to a percentage intended to reflect more accurately the portion of recycled materials used. Though these modifications address concerns about the previous methodology and may yield more accurate results, they also limit the ability to make direct comparisons between the 2000 and 2009 data (DSM/NERC 2009).

Depth of information varies by topic. Information on recycling and “job creation” was most readily available, as the topic was highlighted or at least mentioned in nearly every available report. Information on “recycling and capital investment” was missing or absent from most of the available literature. Data on “tax revenues” were typically included, but they were calculated differently from state to state, making them difficult to compare.

Several studies provide relevant examples for potential local adaptation. Washington State and the Pacific Northwest region have their own demographics, infrastructure, and attitudes toward waste reduction, diversion, and recycling. However, the region could adapt one or more existing research methodology to prepare a customized, updated “Economic Impacts of Recycling” study for the region or a geographic subset. Several efforts elsewhere offer relevant examples for conducting such a study in the Puget Sound region or a different local geography. These studies include:

- **Recycling Economic Information Study and Recycling Economic Information Study Update, commissioned by the Northeast Recycling Coalition (NERC), 2000 and 2009.** These two reports, produced for NERC by R. W. Beck and DSM Environmental Services, respectively, offer a well-rounded view of the progress that has been made in the study of recycling and economic development. Just as the 2000 study—the first of its kind in the U.S.—formed the basis for many subsequent studies across the country, NERC’s thoughtfully modified 2009 study appears likely to influence nationwide research efforts on this topic over the next decade.

2000. The Northeast Recycling Coalition hired R.W. Beck to conduct this multi-state study to inform its efforts to support recycling in its member states. The methodology developed for this study was also used to conduct the *U.S. Recycling Economic Information Study (2001)* and a number of subsequent statewide studies conducted by R.W. Beck. NERC’s member states have used the results of the study to plan, promote, and monitor a range of recycling programs at both state and regional levels.

2009. NERC recently hired DSM Environmental Services and MidAtlantic Solid Waste Consultants (MSW) to conduct another multi-state study to update its 2000 report. The methodology developed for this analysis differed significantly from the 2000 study, in part to resolve issues that emerged during industry critiques of the scope and methodology. While the modifications make it difficult to draw direct comparisons between the 2000 and 2009, the changes are expected to provide a more accurate estimation of the economic contribution of recycling. In addition, the report offers “Recommendations for Future Studies” (page 35), which could prove useful during the development of future research efforts.

- **Economic Impacts of Recycling in Iowa, commissioned by the Iowa Department of Natural Resources, Recycle Iowa Office, 2007.** R.W. Beck, in conjunction with David Swenson Consulting, conducted this single-state study to provide an overview of the economic impacts of recycling on Iowa’s economy. The study had four objectives: 1) measure the current economic impacts of recycling activities (collectors, processors, end-users, remanufacturers and reuse establishments, and recycling equipment manufacturers) on Iowa employment, income, and tax revenue; 2) compare the results of the study to the *U.S. Economic Impacts of Recycling Study* (R.W. Beck/NRC 2001); 3) identify market development opportunities for specific recyclable materials that maximize beneficial economic impacts on the state of Iowa’s economy; and 4) characterize the greenhouse gas savings associated with Iowa’s recycling activities. The results provide a comprehensive overview of statewide economic and climate change impacts and opportunities.
- **The Economic Impact of Waste Disposal and Diversion in California, California Integrated Waste Management Board (CIWMB), 2001.** This California statewide study was conducted for CIWMB by George Goldman and Aya Ogishi of the University of California–Berkeley’s Department of Agricultural and Resource Economics. This smaller-scale study does not provide a comprehensive assessment of the measurable economic aspects of waste reduction and recycling programs in the state, but it instead develops a general model of the flows of selected materials disposed and diverted in the state. It uses economic impact analysis to estimate statewide and regional economic impacts (in terms of total sales, value added, total income, and jobs) for disposal and diversion activities. This model-based methodology could provide useful results at a lower cost than a more extensive statewide or regional study.

Research Approach and Economic Update

Existing literature on solid waste and recycling runs the gamut from reports, studies, and conference proceedings to Web sites, magazine articles, and more. Each source identified for inclusion in this literature review demonstrated an apparent link to economic development in one or more of the three focus areas: job creation, capital investment, or tax revenues. Sources that were developed more than ten years ago, relied on old data, or presented findings from international studies were generally not included. Where possible, data and examples for this review have been obtained from primary sources,

such as commissioned studies and reports. These and other recommended “go-to” sources are noted at the end of each section, based on their relevance to the topic of job creation, capital investment, or tax revenues. Secondary sources such as articles, report summaries, and outreach materials were included in this review but with less emphasis.

While the data collected during this literature review are expected to be relevant and reliable, their utility has some limitations. A majority of the studies conducted on recycling and economic development rely on data that are more than five years old. In addition, many of the statewide reports on “recycling economic impact” present findings that were obtained using markedly different research methodologies and definitions. For instance, some studies (such as the 2001 *U.S. Recycling Economic Information Study* conducted by R.W. Beck for the National Recycling Coalition and funded by the U.S. Environmental Protection Agency) counted job creation and revenues associated with such supporting industries as recycled product retailers, glass and rubber manufacturers who rely only partially on recycled materials, and recycling equipment manufacturers and retailers, while others (such as the 2001 statewide *Survey of Washington State’s Recycling Industry* conducted by Cascadia Consulting Group for King County) counted only those jobs that were directly dependent on the existence of waste diversion and recycling programs, such as recycled materials collectors, haulers, final-stage processors, and (re)manufacturers who rely solely upon recycled feedstock. Note that the most recent available study, released in February 2009 by the Northeast Recycling Council as an update to its 2000 *Recycling Economic Impact Study*, provides separate measurements for three distinct categories: Recycling Industries (collectors and processors—the “supply side” of the equation); Recycling Reliant Industries (which depend exclusively on recycling and recycled materials); and Reuse and Remanufacturing Industries (with reported revenues correlating to the amounts of recycled material utilized). A breakdown of these categories appears below (DSM/NERC 2009).

Recycling Industries

- Government Staffed Residential Collection
- Private Staffed Recycling Collection
- Compost/Organics Processor
- Materials Recovery Facilities
- Recyclables Material Wholesalers

Recycling Reliant Industries

- Glass Container Manufacturing Plants
- Glass Product Producers
- Nonferrous Secondary Smelting and Refining Mills
- Nonferrous Product Producers
- Nonferrous Foundries
- Paper and Paperboard Mills/Deinked Market Pulp Producers
- Paper-based Product Manufacturers

Recycling Reliant Industries *(continued)*

- Pavement Mix Producers (asphalt and aggregate)
- Plastics Product Manufacturers
- Rubber Product Manufacturers
- Steel Mills
- Iron and Steel Foundries
- Other Recycling Processors/Manufacturers

Reuse and Remanufacturing Industries

- Computer and Electronic Appliance Manufacturers
- Motor Vehicle Parts (used)
- Retail Used Merchandise Sales
- Tire Retreaders
- Wood Reuse
- Materials Exchange Services
- Other Reuse

Notably, the current economic picture for recycling, like most industries and the economy as a whole, is turbulent. Prices for recycled feedstocks are subject to the same economic forces as virgin feedstocks, falling during times of recession. As a result, some communities are scaling back their recycling programs or stockpiling materials. The long-term economic consequences and timeline for recovery for recycling and remanufacturing industries, like the rest of the economy, remain unclear.

Summary of Key Findings

This section highlights key findings from the literature review. The subsequent sections of the document discuss these findings in greater detail and include citations from the literature.

Job Creation

Recycling creates jobs and income.

Information on recycling and “job creation” was most readily available in the literature, as the topic was highlighted or at least mentioned in most reports reviewed.

- A-1. Most of the studies reviewed suggest that, on a national scale, **the recycling industry has been creating jobs and increasing its overall share of the labor market.** In fact, recycling has consistently been shown to create more jobs—at higher income levels—than landfilling or incineration of waste.
- A-2. In some states, recycling currently employs fewer people than the waste disposal industry; however, **employment per ton of material recycled has been reported to be almost ten times greater than employment per ton of material disposed.**
- A-3. **Individuals employed in the recycling industry showed higher average income figures** than statewide average income levels for a majority of reporting states, including California, Iowa, Minnesota, Michigan, Indiana, North Carolina, and Washington. In these states, recycling incomes also were higher than average disposal industry incomes.
- A-4. In the United States, **paper mills, steel mills, plastics converters, and iron and steel foundries account for 50 percent of all recycling industry employees;** 62 percent of recycling industry wages; and 59 percent of total recycling industry receipts.
- A-5. One state’s study found that **job creation in the recycling sector outweighed job losses in waste disposal and virgin materials mining and manufacture** that directly result from recycling program success.
- A-6. Despite significant capital investment in the recycling industry **in Washington State, employment levels have remained constant or decreased slightly**—a variation from the results presented in most statewide economic evaluations across the country and nationwide.

Capital Investment and Economic Potential

Recycling programs usually provide a reliable and attractive return on capital investment.

Information on “recycling and capital investment” was limited or largely absent from the available literature. The summary presents the limited findings available on capital investment and also addresses related economic factors associated with the recycling industry, such as revenue generation, commodity values, stocks, and public investments in supportive policies and programs.

- B-1. As of 2007, **the recycling industry accounted for about 2 percent of the \$12.36 trillion U.S. gross domestic product.**
- B-2. In recent years, **the recycling industry has begun to attract significant capital investment from the private sector,** a trend which is expected to continue as the quality of recycled materials improves and virgin resources become more costly.

- B-3. Non-ferrous metals and plastics have the highest economic value per ton of material; glass and yard waste have the lowest sales value. No single recycled materials market dominates the industry, but **investment opportunities are concentrated in five major material categories: steel, non-ferrous metals, paper and paperboard, plastics, and electronics.**
- B-4. By promoting public recycling programs early on, Washington State positioned itself as a reliable source of recycled materials, inviting investment from a range of private firms. According to a survey of the industry, by 2001, **companies in Washington had invested more than \$850 million in facilities, equipment, and vehicles to support recycling.**
- B-5. Though public-sector investment in collection and processing is not the sole force behind job creation and recycling revenues, **public recycling programs provide the material flows that underpin private industry success and resulting economic benefits.** As more public recycling programs increase their collection, the private sector will have access to a larger supply of materials, fostering growth and expansion.
- B-6. According to an industry survey, **more than 1.2 million tons of recyclables materials were remanufactured in King County in 2001**, about one-quarter of the Washington's total. Significant additional potential may exist to expand the recycled products manufacturing industry locally, creating additional jobs and revenues in Washington and in the Puget Sound region.

Tax Revenues and Other Public Benefits

Recycling boosts public revenues in a number of ways—not just taxes.

Data on “tax revenues” resulting from recycling were not widely available in the literature. Some were reported, but they were calculated differently from study to study, making them difficult to compare.

- C-1. Nationally, **the recycling and reuse industries are reported to generate approximately \$12.9 billion in federal, state, and local tax revenues**, with 80 percent going to federal and state governments. Reported actual state and local tax revenue amounts varied significantly or were not available in the literature.
- C-2. **Reported taxable revenues and wages that recycling contributes to national, state, and local economies are significant.** These contributions are not always translated into tax dollars in the literature, but the benefits are clearly implied.
- C-3. In addition to earned tax revenues, **cities, counties, and states realize real, quantifiable cost savings in environmental protection and public health** that are directly or indirectly tied to the success and growth of the recycling industry. Cost savings and benefits include reductions in landfill and disposal costs, energy consumption, greenhouse gas emissions, and pollution.

Literature Review by Topic Area

Part A. Job Creation

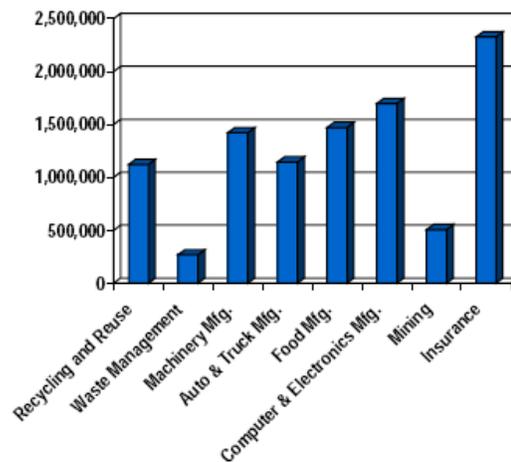
Virtually all of the studies reviewed addressed job creation and employment related to recycling. However, the methodologies used to measure actual employment varied from study to study. The most significant consideration involved differences in methodology for determining which industries and job types should be counted as “recycling” jobs and which should not. While some studies included all industries and job types occupying a place along the “supply” or “demand” sides of the recycled materials chain, including consulting services and remanufactured product retailers, other studies included only those industries and job types that were directly linked to the collection, processing, and remanufacture of recycled materials. The different approaches have resulted in figures that are difficult to compare directly. More recent studies—particularly the Northeast Recycling Council’s 2009 *Recycling Economic Impact Study Update*—have taken steps toward more clearly defining and distinguishing the categories of industries and job types contributing to recycling’s overall economic impact.

While current employment figures for recycling and related industries vary significantly across states and regions, some trends remain consistent. The following section presents key findings and trends in the area of job creation and includes more detailed discussion along with literature citations.

Discussion of Key Findings on Job Creation

A-1. While many traditional industries (such as textiles and manufacturing) have lost significant numbers of jobs over the past several years due to advances in technology, globalization, and corporate consolidation, **recycling has continued to create jobs and increase its share of the labor market** (Alvarado 2004; DSM/NERC 2009).

From 1967 to 2000, the recycling industry experienced an annual employment growth rate of 8.3 percent, outperforming the fast food and health care industries as well as growth in total U.S. employment, which averaged only 2.1 percent during the same period (Seldman 2002). In 2001, the United States was found to have 56,000 recycling and reuse establishments, employing approximately 1.1 million people with an annual payroll of \$37 billion (R.W. Beck/NRC 2001). Employment in the recycling sector is on par with auto and truck manufacturing and far outranks the waste management and mining industries.



Figures gleaned from more recent statewide studies suggest that this number has continued to rise, as public and private investments in recycling programs and infrastructure have combined to build stronger technologies and broader public support. Though critics may note the 2001 report’s broad definition of the recycling industry, other studies have reached similar conclusions, including the estimates of jobs per ton of materials recycled, as discussed further below. The Northeast Recycling Council’s 2009 *Recycling Economic Impact Study Update* created three distinct categories (Recycling Industries, Recycling Reliant Industries, and Reuse/Remanufacturing Industries) to track and quantify the different sources of recycling-related jobs and revenues contributing to state and regional economic development (DSM/NERC 2009).

Reported total salaries and wages devoted to the recycling sector varied greatly, from mostly rural Montana, reporting approximately \$9 million dollars in recycling wages and benefits in 2003, to California, reporting approximately \$4 billion that same year (Blend/Montana DEQ 2004; CIWMB 2003). Even states located in the same region and researched during the same year using the same methodology showed notable differences in salaries and wages. In NERC's 2009 *Recycling Economic Impact Study Update*, New York reported approximately \$1.4 billion in annual payroll, with nearly 4,000 recycling-related establishments and 32,240 total employees. Pennsylvania reported a significantly higher payroll of \$2.2 billion, with nearly 4,000 recycling-related establishments and 52,316 total employees (DSM/NERC 2009).

In Washington State, the recycling industry workforce is comparable to other resource-producing industries; in 2001, it was greater than in the mining industry and ranked just behind employment in primary aluminum production (Cascadia/King County 2002).

Labor market shares for recycling also vary widely from state to state. On the low end, North Carolina reported in 2003 that recycling accounted for approximately 0.35 percent of the state's total workforce. Though low, this represented an increase of 40 percent in ten years, a greater percentage than the biotech and agricultural livestock industries (Ewadinger 2005). A more recent survey of North Carolina's recycling sector businesses claimed a "continued upward trend" in employment, though no new statewide percentage was provided. In this 2008 study, businesses involved in the collection, processing, manufacturing, reuse, or composting of post-consumer or post-industrial materials were asked if they "planned on creating new jobs" in 2009, 2010, or both. Of those interviewed, 84 businesses, or 45 percent, estimated that 339 new jobs would be created during the next two years. This figure is less than the 834 new jobs created between 2003 and 2008 but more than twice the number of jobs terminated during the same time frame (North Carolina 2008).

Other states—including Iowa, Pennsylvania, and Massachusetts—reported labor market shares ranging from 1 percent to 3 percent. In Massachusetts, the recycling industry was reported to employ 3 percent of the workforce, or, "as many people as child care services, the accounting and bookkeeping sector, or the electric utilities industry." In fact, employment in the Massachusetts recycling industry ranked higher per capita than California, New York, and Florida (R.W. Beck/NRC 2001). On the higher end, Indiana reported a 7.9 percent labor market share for the recycling sector, including 2.5 percent through direct employment, and 5.4 percent by industry and employee spending in the economy (Indiana 2001).

Because these figures have been reported at different times using different survey methodologies, and because some of these studies are the first of their kind, it is difficult to make direct comparisons among states or over time. Where these comparisons are possible, however, historical trends reveal a marked increase in labor market shares directly or indirectly tied to the recycling industry.



A-2. While overall employment figures for the recycling industry are generally lower than for the solid waste disposal industry, research suggests that **employment rates are higher for recycling on a per-ton basis**. Studies found increasing the tonnage of recycled materials, or diverting additional tons of waste from landfills, would result in ten times more jobs than increasing the tonnage of disposed waste (Alvarado 2004; Seldman 2006). In Massachusetts, some recycling-based paper mills and plastic product manufacturers have been reported to employ 60 times more workers than do landfills on a per-ton basis (Massachusetts DEP 2004).

Below is a table showing average annual job distribution in the United States per 10,000 tons of material recycled or disposed per year (TPY) (Seldman 2006).

Type of Employment	U.S. Jobs per 10,000 TPY
Plastic Product Manufacturers	93
Glass Product Manufacturers	26
Recycling-based Manufacturing (Miscellaneous)	25
Paper Mills	18
Conventional Materials Recovery Facilities (MRFs)	10
Composting	4
Landfills and Incineration	1

The above figures do not provide information on collection or hauling of recyclable materials. Nationwide, these activities combined to account for less than 20 percent of the total recycling employment and receipts.

As reported by a 2003 California study, recycling a ton of “waste” materials has approximately twice the economic impact of burying it in the ground. On average, recycling one additional ton of waste will pay \$101 more in salaries and wages; produce \$275 more in goods and services; and generate \$135 more in sales than disposing of it in a landfill (CIWMB 2003).

The higher level of jobs per ton of materials recycled, rather than disposed, was consistent across the studies reviewed, though actual numbers may vary based on the study methodology used and which jobs are counted. Results for King County were somewhat different, as the 2001 *Survey of Washington State’s Recycling Industry* reveals. Following is a table showing the distribution of employment in King County’s recycling workforce—more than half of which is devoted to the collection and hauling of recyclable materials (Cascadia/King County 2002).

Type of Employment	King County Jobs in 2001
Collecting and Hauling	803 (55%)
Recycled Products Manufacturing	374 (25%)
Final Stage Processing	268 (18%)
Transporting	25 (2%)
TOTAL	1,470



A-3. Individuals employed in the recycling industry have higher reported average income figures than average disposal industry incomes and statewide average incomes, according to nearly all statewide studies of recycling economic impact reviewed (Alvarado 2004; Blend/Montana DEQ 2004; CIWMB 2003; Indiana 2001; Goldman/CIWMB 2001; Krieger/Michigan Recycling Coalition 2001; North Carolina 2008; R.W. Beck/NERC 2000; R.W. Beck/NRC 2001; Reardon/Illinois DCCA 2002; DSM/NERC 2009).

Average income figures reported for individuals employed in the recycling industry were higher than statewide average income levels for a majority of reporting states, including California, Iowa, Minnesota, Michigan, Indiana, North Carolina, and Washington. In these states, recycling incomes also were higher than average disposal industry incomes (Alvarado 2004; Blend/Montana DEQ 2004; CIWMB 2003; Indiana 2001; Goldman/CIWMB 2001; Krieger/Michigan Recycling Coalition 2001; North Carolina 2008; R.W. Beck/NERC 2000; R.W. Beck/NRC 2001; Reardon/Illinois DCCA 2002; DSM/NERC 2009).

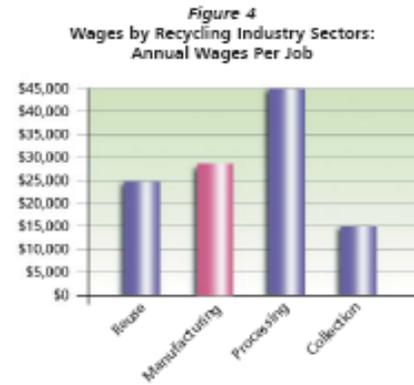
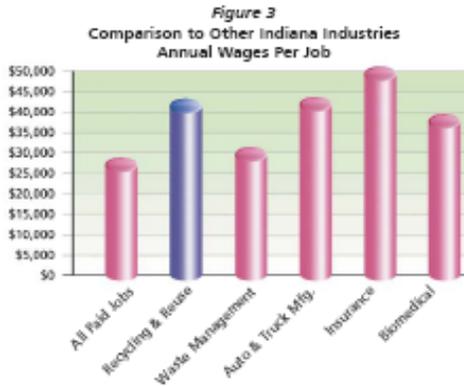
Because various methodologies were used to define “the recycling industry,” the salary ranges presented in each report correspond to different sets of labor categories. For instance, in studies modeled after the NERC methodology, the recycling industry was specifically defined as relating to:

- Collecting materials or used products for the purposes of intermediate processing, manufacturing, and/or distribution by reuse sales establishments;
- Intermediate processing of recovered materials or used products including sorting, cleaning, consolidating, treating, disassembling, densifying, and/or transferring ownership for use in processing, product manufacturing, and/or for distribution by reuse sales establishments;
- Reclaiming of recovered materials or used products to produce refined raw materials and/or reusable products meeting the specifications of manufacturers, reuse sales, or other end-users;
- Manufacturing “first-stage” products containing recycled materials or used products;
- Operating wholesale or retail sales establishments that offer, largely or exclusively, used products prepared for reuse; and
- Activities intimately supporting the above activities through research, equipment development and sales, consulting, engineering, brokering, and exchange services.

NERC’s 2009 *Recycling Economic Impact Study Update*, which significantly modified the definitions presented above, organized recycling-related industries into three distinct categories: Recycling Industries; Recycling Reliant Industries; and Reuse/Remanufacturing Industries (DSM/NERC 2009).

Other studies, like that conducted by North Carolina, defined recycling-related employees more broadly as individuals who “dedicate any time to recycling-related activities or whose position would not exist without the recycling component of the business” (North Carolina 2008).

Thus, reported salary ranges are dependent on the types of jobs included in—and excluded from—calculations and often are not comparable across studies. For instance, Indiana, a state with a relatively large recycling workforce, reported an average industry wage for recycling and reuse jobs of \$41,200—approximately \$14,000, or 52 percent, higher than Indiana’s average wage at the time of the 2001 study. Jobs in the processing sector paid the highest wages, followed by manufacturing. Collection jobs for recycling, on the other hand, generally paid less than corresponding waste management jobs (which may more often be unionized) and less than average paid jobs overall; see excerpted figures below (Indiana 2001).



Excerpted from *Recycling Is Working in Indiana*, Indiana Department of Environmental Protection, 2001



A-4. Where, specifically, are the recycling industry’s “higher paying” jobs being created? While not all of the studies reviewed were able to provide exact numbers correlating to specific industry sectors, the 2001 R.W. Beck study provided overall figures for the United States. That study estimated the following **allocation of recycling jobs across industry sectors**:

Paper, paperboard, and deinked market pulp mills (grossing nearly \$49 billion in estimated annual receipts)	139,375 people employed
Steel mills (grossing \$46 billion in estimated annual receipts)	118,544 people employed
Plastics converters (grossing nearly \$28 billion in estimated annual receipts)	178,700 people employed
Iron and steel foundries (grossing over \$16 billion in annual estimated receipts)	126,313 people employed

In the United States, these four categories alone were reported to account for 50 percent of all recycling industry employees; 62 percent of recycling industry wages; and 59 percent of total recycling industry receipts. The study also suggested that the recycling and reuse industry “indirectly” supports nearly 1.4 million additional jobs in related industries, such as accounting firms and office supply companies. Based on economic modeling, these jobs were estimated to provide an annual payroll of \$52 billion and produce \$173 billion in receipts (R.W. Beck/NRC 2001).

The 2009 NERC study offered a more localized view of the allocation of jobs and economic impacts. Across the Northeast region, “Recycling Reliant Industries” provided 53% of the total jobs, 64% of the total payroll, and 61% of total receipts. While no single industry was dominant across states, the four categories listed above consistently ranked near the top within the “Recycling Reliant Industries” category. In some states, however, Recycling Industries (such as Private Residential and Commercial Collection) significantly outperformed the other industries in terms of employment, payroll, and receipts (DSM/NERC 2009).



A-5. Offsetting the direct increases in recycling sector employment would be job and income losses in garbage collection and disposal, as well as in virgin materials manufacturing. However, while successful recycling programs are shown to displace some jobs in sectors ranging from solid waste to timber harvesting and industrial sand extraction, a study commissioned by North Carolina suggested that **for every 100 jobs created from the processing and manufacture of recycled materials, only 13 jobs in corresponding industries were lost** (Goldman/CIWMB 2001).

Job losses in waste disposal and virgin materials mining and manufacture that directly result from recycling program success were shown, in North Carolina, to be balanced or outweighed by job creation in the recycling sector (Goldman/CIWMB 2001, North Carolina 2008).

Another study suggests that for every job created as a result of recovering additional previously wasted materials, another job is created in the non-recycling-related portion of the economy. This study for the ReCycle Iowa Program—a joint venture of the Iowa Department of Natural Resources and the Iowa Department of Economic Development—attempted to measure the jobs and income impact of recycling activities in Iowa. Although that study did not estimate job losses in virgin material acquisition and manufacturing, it did estimate a jobs multiplier, or the “indirect effect” on jobs in other intermediate commodities industries and the “induced effect” on jobs in consumption products industries from increased jobs in recycling industries. The study found that for every job created as a result of recovering additional materials that were previously disposed, another job is created in the non-recycling-related portion of Iowa’s economy. A similar multiplier effect was estimated for income flows (Morris/MassPIRG 1998).

Other studies comparing jobs created to jobs displaced are largely absent from the literature.

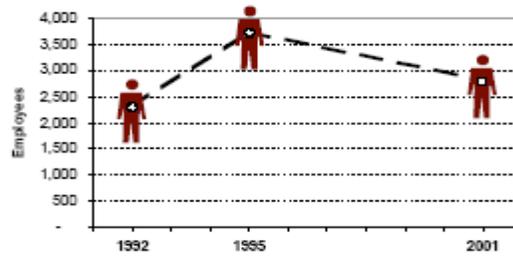


A-6. In recent years, **Washington State has seemed to miss out on the trend of rapidly increasing employment opportunities in recycling.** Despite significant capital investment in the recycling industry in Washington State, employment levels have remained constant or decreased slightly—a variation from the results presented in the bulk of statewide economic evaluations across the country and nationwide.

In 1996, the Washington State Future of Recycling Task Force and the Clean Washington Center, supported by Cascadia Consulting Group, reported that recycling had become an “economic and environmental success story” for the state. In the previous ten years, recycling tonnages had jumped 127 percent (compared to a 5 percent rise in disposal rates) to reach levels 40 percent above the national average. Employment had risen to 16,700 jobs statewide, with almost half created in the “high-wage” manufacturing sector (Cascadia/Future of Recycling Task Force 1996). Successes were attributed to the “sound policy basis” established by the Waste Not Washington Act, strong public support for recycling goals, and the intentional formation of partnerships among local and state governments and private-sector representatives (Cascadia/Future of Recycling Task Force 1996).

Between 1996 and 2001, recycling employment actually declined slightly, though changes in definitions of covered jobs may have contributed to this apparent decrease. The 2001 report on a statewide survey of the recycling industry speculated that the decline could result from increased mechanization (consistent with reported large increases in capital assets), as collecting vehicles and sorting machinery became more automated. Another explanation is that with increased exports of recyclable commodities (especially plastic and tires), jobs related to sorting, processing, and transporting the materials were outsourced to other states and overseas. The study estimated that Washington’s recycling industry employs more than 3,600 people and has invested over \$850 million in capital assets (Cascadia/King County 2002).

Figure 6: Trends in Recycling Employment (Excluding Manufacturing) – Washington State²⁵



Excerpted from Summary Report of the 2001 Survey of Washington State's Recycling Industry, *Cascadia Consulting Group, 2002*

Though more recent employment data are not readily available, the state has made some important strides toward developing recycling markets and infrastructure statewide, which could impact employment across the region. Since the 1996 *Future of Recycling* study, recycling infrastructure and employment have grown and become more widespread around Washington State, as noted below:

- **1996.** Recycling was “not equally developed in all parts of the state, because of varied economic, geographical, political, and social circumstances” (Cascadia/Future of Recycling Task Force 1996).
- **2001.** Over 50 percent of Washington’s recycling-related employment and related infrastructure was located within King County (Cascadia/King County 2002).
- **2007.** King County was home to 44 of the state’s 302 recycling facilities, less than 15% of the statewide total (Washington 2007).



Key Recommended Resources on Job Creation

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Part B. Capital Investment and Economic Potential

Quantitative information on capital investment was largely absent from the literature. Relevant sources of information included Cascadia Consulting Group's *Summary Report of the 2001 Survey of Washington State's Recycling Industry* developed for the King County Solid Waste Division, and Dr. Rona Fried's 2008 *Special Report: Investing in Recycling*, a secondary source that summarizes information from other reports and adds its own analysis of investments. Also, a 2008 report by Jeff Morris of Sound Resource Management provided an overview of recycling markets that could be useful for understanding recycling as an investment opportunity. The discussion below presents the limited findings available on capital investment and also addresses related economic factors associated with the recycling industry, such as revenue generation, commodity values, stocks, and public investments in supportive policies and programs.

Discussion of Key Findings on Capital Investment and Economic Potential

B-1. As of 2007, the recycling industry accounted for about 2 percent of the \$12.36 trillion U.S. gross domestic product.

In 1968, the U.S. recycling industry garnered \$4.6 billion in annual sales. In 2007, revenues reached approximately \$236 billion—more than twice the revenue brought in by the \$100 billion waste management industry, even though disposal rates continue to exceed recycling rates. Recycled materials have the potential to generate real economic value, while disposed waste raises environmental concerns (Fried 2008).

Remanufacturers, which recycle old materials into new products—from sheet metal to plastic composite, rubber, paper products, organic compost, and more—represented the largest segment (75 percent) of the recycling industry. The collection side of the industry—businesses that pick up curbside consumer recyclables, materials recovery facilities, and material wholesalers—represented the smallest segment, generating 1 percent of revenue, about \$2 billion annually (R.W. Beck/NRC 2001; Fried 2008).



B-2. In the past, landfills and other disposal methods have often provided more attractive incentives to investors than recycling programs. In recent years, the recycling industry has begun to attract significant capital investment from the private sector, a trend which is expected to continue as the quality of recycled materials improves and virgin resources become more costly. As recycling rates have increased and public investments in recycling infrastructure have led to more streamlined collection and processing (and, ultimately, higher-quality recycled feedstocks), the recycling industry's financial promise is closer to realization.

Studies indicate that although recycling costs more at the outset due to investments in technology, infrastructure, and behavior change, the long-term economic payoff far exceeds that of waste disposal (Alvarado 2004; Blend/Montana DEQ 2004; CIWMB 2003; Cascadia/Future of Recycling Task Force 1996; Cascadia/King County 2002; Dubester 2000; Ewadinger 2005; R.W. Beck/NRC 2001; Seldman 2002; Seldman 2008; USEPA 2008; Washington 2008; Young/Pennsylvania DEP 2005).

As the industry has grown in value, new recycling investment opportunities have entered the global economic scene. Though the entire economy has shifted since this publication, according to economic research firm Canaccord Adams, the recycling industry is “one of the few areas where investors can find protection during a recession” (Fried 2008). In 2007, the Canaccord Adams Recycling Index (CARI) rose 7.3 percent, easily beating the 3.7 percent gain in the S&P 500 Index, although it trailed NASDAQ. The top five stocks in the index averaged a 148 percent return in 2007; the bottom five stocks had a 71

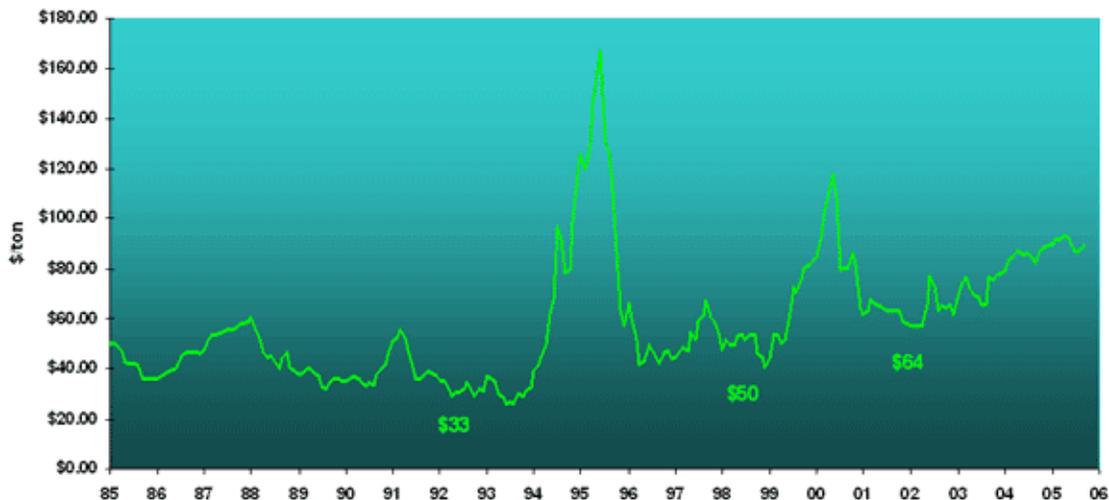
percent loss. A number of top recycling stocks earn consistent “buy” ratings, including Portland-based Schnitzer Steel.

Dr. Jeff Morris of Sound Resource Management offers the following on recycling market fluctuations:

Prices for all recycled materials tend to follow expansions and contractions in overall demand for manufactured goods. Recycling programs that collect many different materials may experience less revenue volatility over the course of an economic cycle, though revenue swings can still be pronounced, as seen in the chart below....

Price volatility in recycling markets is a given. Managing revenue fluctuations can make or break a recycling program. Negotiating long-term contracts that feature price floors or other revenue/risk-sharing agreements, and broadening markets by developing local manufacturing demand for recycled feedstocks, can moderate revenue peaks and valleys (Morris 2008).

Average Value for Curbside Recycled Materials Pacific Northwest, 1985-2005



Excerpted from *Recycling Markets*, Sound Resource Management (www.zerowaste.com/RecyclingMarkets.htm), 2008



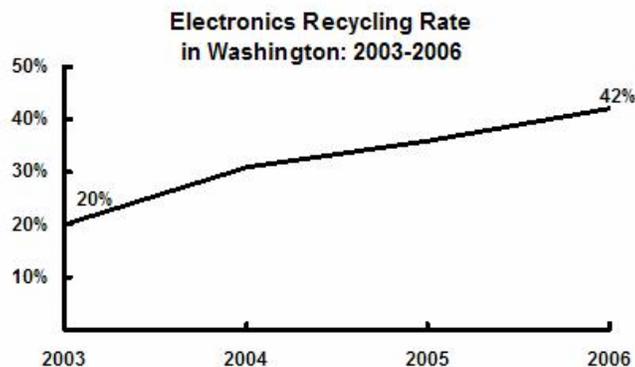
B-3. Non-ferrous metals and plastics have the highest economic value per ton of material; glass and yard waste have the lowest sales value. Iron, steel, paper/paperboard and tires have the highest recycling rates. No single recycled materials market dominates the industry, but investment opportunities are concentrated in five major material categories: steel, non-ferrous metals, paper and paperboard, plastics, and electronics.

- **Steel.** The steel industry recycles approximately 76 million tons of ferrous metals (steel and iron) annually, generating \$62 billion in sales and saving enough energy to power about 18 million homes. Recovering one metric ton of steel from scrap saves 2,500 pounds of iron ore; 1,400 pounds of coal; and 120 pounds of limestone (Fried 2008). For example, the Nucor Steel bar mill in Seattle handles large quantities of local ferrous scrap and bills itself as “Washington’s largest recycler.”
- **Non-ferrous Metals.** Composed of materials ranging from aluminum and copper to lead, zinc, nickel, titanium, cobalt, chromium, and precious metals, this group generates about \$28 billion in annual

sales. Aluminum is by far the most valuable material regularly recycled by the residential sector. For many communities, aluminum sales are enough to subsidize the cost of recycling less valuable materials. Using recycled aluminum eliminates almost 96 percent of the energy consumption and emissions associated with its manufacture, including greenhouse gases (Fried 2008).

- **Paper and Paperboard.** With \$50.5 billion in annual sales, recycling paper and paperboard is the second largest recycling sector, after metals. Of the raw material used to make all paper products, 37 percent now comes from recycled paper (Fried 2008).
- **Plastic.** Plastic is the next largest sector with \$28 billion in sales. Despite demand from plastic recyclers, plastics have a low recycling rate of 20 percent, down from 40 percent in 1994. This number can be significantly higher in states that have implemented “bottle bills.” Massachusetts, for instance, achieved an estimated 85 percent recycling rate as early as 1998, recovering around 90,000 tons annually. Its bottle bill, implemented in 1983, targets beer and carbonated beverage containers with a 5-cent refundable deposit (Fried 2008; Morris/MassPIRG 1998).
- **Electronics.** Electronics represent the fastest growing waste stream worldwide—and potentially, one of the greatest recycling investment opportunities (R.W. Beck/NRC 2001; Fried 2008). About 70 percent of the heavy metals and 40 percent of the lead in U.S. landfills come from disposed electronics, according to the USEPA. In addition, about 80 percent of electronic waste is shipped to Asia and Africa, where it is often dumped after the metals are salvaged. With metal values as an incentive—along with pressure from government agencies and nongovernmental organizations—manufacturers are starting to adopt product take-back policies. In the U.S., 35 states have banned electronics from landfills, setting the stage for the emerging electronics recycling, or “e-cycling,” industry. Several large recyclers and about 400 small recyclers in the U.S. generate \$700 million in annual sales from processing 1.5 billion pounds of electronics. From these quantities processed, about 900 million pounds of materials are recovered for a 60 percent recycling rate. The International Association of Electronic Recyclers (IAER) predicts the industry will process 3 billion pounds a year by 2010, making the development of an efficient infrastructure the key issue for the industry (Fried 2008).

In Washington State, recycling of electronics is on the rise, particularly due to the recent implementation of the E-cycle Washington program. Starting January 1, 2009, the statewide program accepts computers, monitors, laptops, and televisions at no charge to residents and selected other users. It is estimated that about 50 million pounds of electronic waste entered the disposal stream in 2006, with approximately 42% recycled or remanufactured. However, the actual generation of electronic waste could be much higher, since some is stockpiled or “stored indefinitely” before being disposed (Washington 2008). Current figures are not yet available, though they are expected to be significantly higher since the advent of “free” collection in 2009. Some of the new E-cycle collection sites have been overwhelmed by the quantities of materials delivered since the program began in January.



Excerpted from the 2008 Beyond Waste Progress Report (Washington 2008)



B-4. With one of the oldest and most progressive waste management programs in the country, Washington State is ahead of the curve in terms of recycling program success and industry infrastructure. By promoting public recycling programs early on, the state positioned itself as a reliable source of recycled materials, inviting investment from a range of private firms. According to a survey of the industry, by 2001, **companies in Washington had invested more than \$850 million in facilities, equipment, and vehicles to support recycling.**

Private Investment in Capital Facilities and Equipment

As of December 31, 2001, firms in Washington State had invested over \$850 million in the facilities, equipment, and vehicles necessary to carry out recycling activities. These funds have been invested primarily in structures and land for recycling facilities, equipment and machinery for handling recyclable materials, and vehicles to conduct recycling activities. These investments were allocated as follows:

- **\$190 million** (22%) was invested by firms that collect or haul recyclable materials.
- **\$7 million** (1%) was invested by firms that transport recycled materials, such as to a port, final-stage processor, or manufacturer.
- **\$189 million** (22%) was invested by firms that are final-stage processors of recyclable materials that process recyclable materials into different feedstocks used in manufacturing.
- **\$468 million** (55%) was invested by firms that remanufacture products using recycled feedstock; many manufacturers also process their own feedstock (Cascadia/King County 2002).

Public Investment in Policies and Programs

Washington State has committed to a broad range of policies and programs aimed at supporting waste reduction, diversion, and recycling throughout the state. The state's "Beyond Waste" plan, initially developed in 2003, has played an important role in shaping the planning and development of waste reduction, diversion, and recycling programs throughout Washington. As part of the plan, the Department of Ecology regularly monitors recycling activity and issues progress reports identifying areas of success and opportunities for further improvement. In 2008, the Washington State Department of Ecology invested \$25.5 million in city and county recycling programs as part of the Beyond Waste plan (Washington 2002, 2008).

In addition, the Washington Climate Action Team (CAT) identified several key programs and policies that would help drive recycling improvements in the region. Among these programs and policies are RCW 70.95, requiring all local governments to have a solid waste plan; the Washington State *Beyond Waste* plan and its initiatives on solid waste, hazardous and industrial waste, and organics; and the Electronic Product Recycling program. These policies and programs support capital investments and rely on partnerships among government agencies, nonprofits, and businesses (Washington CAT 2008).



B-5. In some states, such as North Carolina, the private sector supports several times the number of recycling employees—and brings in several times the amount of revenues—as the public sector. Public recycling programs, however, do currently provide the bulk of recycled material to the private sector. Though public-sector investment in collection and processing is not the sole force behind job creation and recycling revenues, **public recycling programs provide the material flows that underpin private industry success and resulting economic benefits.** As more public recycling programs increase their collection, the private sector will have access to a larger supply of materials, fostering growth and expansion (Alvarado 2004).

In Washington State, capital investment in recycling originates in both the public and private sectors. City, county, and state agencies are investing in a broad range of programs and financing options to increase recycling locally, regionally, and statewide (Washington 2008).

In states like Washington, where public recycling programs (collection and processing) *do* provide the bulk of local employment opportunities and revenues, opportunities may exist for expanding private-sector opportunities locally instead of shipping material resources to more remote manufacturing locations, particularly overseas. King County LinkUp, for example, works actively to expand markets for selected recyclable and reusable materials by facilitating an interactive community of businesses, public agencies and other organizations. LinkUp serves as a model for efforts to build local partnerships among materials suppliers, processors, and manufacturers to promote local autonomy and economic sustainability.

Material exchanges are another type of local government effort to help connect potential industrial users with recycled materials and feedstocks, though economic data on material exchanges was not identified in the reviewed literature. Information and links to other programs underway around the nation are provided on the Industrial Materials Exchange Web site (LHWMP 2008), www.govlink.org/hazwaste/business/imex.



B-6. According to an industry survey, **more than 1.2 million tons of recyclables materials were remanufactured in King County in 2001**, about one-quarter of the Washington's total. With more than two-thirds of the state's population, King County generates the most recyclables, though the majority of materials are remanufactured outside the county. Availability of materials and infrastructure can help create opportunities for increased local investment. Significant additional potential may exist to expand the recycled products manufacturing industry locally, creating additional jobs and revenues in the state and the Puget Sound region.

Although 71 percent of Washington State's residents lived outside King County in 2001, about half of Washington's recyclables collection infrastructure and employees was located in King County. The combination of dense population and increased opportunities for material collection created a viable network of recycling businesses.

However, most remanufacturing of recyclable materials that occurred in Washington happened outside of King County. About two-thirds of remanufacturing employees and nearly three-quarters of materials remanufactured in Washington (by weight) are located outside King County (Cascadia/King County 2002). Additional remanufacturing that relies on materials recovered from the King County waste stream occurred outside of Washington State entirely, but related figures are largely absent from the literature.

Following is a table excerpted from the *2001 Survey of Washington State's Recycling Industry* conducted by Cascadia Consulting Group. These figures illustrate the areas of greatest economic success—and potential—in the county at that time. (More current figures for remanufacturing were not available in the literature reviewed.)

Table 6: Quantities of Materials Re-manufactured – King County²⁶

Material Group	Quantity (tons) Re-manufactured in King County in 2001	Significant Products Made in King County
Paper	138	Compost
Plastic	471	Packaging (containers and bags), insulation
Glass	28,827	Containers, abrasive grit, water filtration medium
Metal	455,000	New metal
Wood	32,937	Mulch, compost
Concrete/Asphalt	453,005	Roadbed, new concrete
Yard Waste	215,563	Compost
Food Waste	13,274	Compost
Tires/Rubber	1,050	Boat bumpers, flooring, outdoor surfaces
Other materials	35,152	Gypsum, compost
Total	1,235,417	

While more current data on local remanufacturing were not available, the Department of Ecology reports annually on the amounts of materials diverted and recycled in its *Solid Waste in Washington State Annual Status Report*. Tracking trends in material diversion and recycling can help identify emerging market development opportunities for remanufacture and use of recycled feedstocks in the region.



Key Recommended Resources on Capital Investment and Economic Potential

Cascadia Consulting Group, for King County Solid Waste Division. 2002. *Summary Report of the 2001 Survey of Washington State's Recycling Industry.*

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Part C. Tax Revenues and Other Public Benefits

Local, state, and federal tax revenues resulting from recycling were not widely available in the literature. Revenues associated with recycling programs vary across regions and over time, and published information on city and/or county tax revenues from recycling is virtually nonexistent. The most relevant available study for comparing tax revenues across states using the same methodology is the 2001 *U.S. Recycling Economic Information Study* conducted by R.W. Beck for the National Recycling Coalition and U.S. Environmental Protection Agency, which provides estimated tax revenues based on economic modeling. Where available, non-estimated and more recent results from other studies, including information on additional public benefits, are also provided in the following section.

Discussion of Key Findings on Tax Revenues and Other Public Benefits

C-1. Nationally, the recycling and reuse industries are reported to generate approximately \$12.9 billion in federal, state, and local tax revenues, with 80 percent going to federal and state governments (R.W. Beck/NRC 2001). The brief, more specific mentions of tax revenues that we located revealed that tax revenues and reporting vary widely from state to state; published annual figures include \$40 million in Minnesota and \$14.2 billion in California (2000) at the state level.

Actual calculations of local, state, and federal tax revenues resulting from recycling were not widely available in the literature. The most relevant available study for comparing tax revenues across states using the same methodology is the 2001 *U.S. Recycling Economic Information Study* conducted by R.W. Beck, which provides national estimated amounts based on economic modeling. This study estimated government tax revenues arising from the recycling and reuse industry based on income levels and tax rates. The excerpted table below shows the estimated taxes paid directly by recycling and reuse industry establishments and their employees to various levels of government (direct revenues), along with total revenues, which includes estimated taxes from “additional economic activity.”

Industry Sector	Direct Effects Revenues				Total Effects Revenues			
	Federal	State	Local	Total	Federal	State	Local	Total
Recycling Collection	200	100	100	400	300	200	100	600
Recycling Processing	700	400	300	1,400	1,700	800	600	3,200
Recycling Manufacturing	5,400	2,600	2,100	10,000	20,500	9,900	7,800	38,200
Reuse/Remanufacturing	600	300	200	1,200	2,100	1,000	800	3,900
Total	6,900	3,400	2,600	12,900	24,600	11,900	9,400	45,800



C-2. Reported taxable revenues and wages that recycling contributes to national, state, and local economies are significant. These contributions are not always translated into tax dollars in the literature, but the benefits are clearly implied. Where tax revenues were not established or reported, many statewide studies provided estimates or calculated totals for annual sales, gross receipts, and payrolls, which could provide insight into potential tax earnings. Below is a list of reported figures for sales, receipts, and/or payroll for a range of states and years from 2000 to 2007. Note that the data are from different sources and are not directly comparable (Blend/Montana DEQ, 2004; CIWMB 2003; Gjerde/AWMA 1997; Goldman/CIWMB 2001; Indiana 2001; Massachusetts 2004; Minnesota 2002; R.W. Beck/NRC 2001; R.W. Beck/Iowa 2007; Reardon/Illinois DCCA 2002; Rustem/Michigan Recycling Partnership 2006; Valentine/Missouri 2005; Young/Pennsylvania DEP 2005; DSM/NERC 2009).

Delaware (2009)	Receipts of \$346 million*
Maine (2009)	Receipts of \$805 million*
Massachusetts (2009)	Receipts of \$3.2 billion*
New York (2009)	Receipts of \$10.1 billion*
Pennsylvania (2009)	Receipts of \$20.6 billion*
North Carolina (2008)	Annual payroll of \$376.8 million
Iowa (2007)	More than \$159 million in commodity gross receipts
Michigan (2006)	\$11.6 billion in gross receipts and payroll of \$2.06 billion
Missouri (2005)	Annual sales of \$5.12 billion and payroll of \$707.3 million
Montana (2004)	\$200 billion in total wages and sales
California (2003)	Annual sales of \$10 billion and payroll of \$4 billion
Illinois (2002)	Recycling and reuse as a \$12.2 billion industry
Minnesota (2002)	Payroll of \$1.19 billion
Ohio (2001)	Annual sales of \$22.5 billion

*Calculated using NERC's updated (2009) study methodology, which was designed to minimize double-counting and inflation.



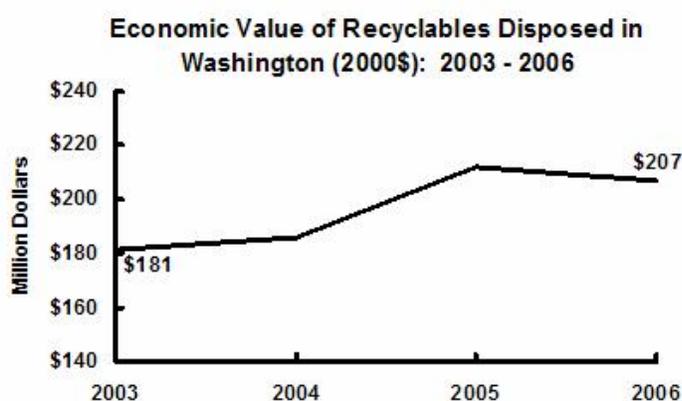
C-3. In addition to earned tax revenues, **cities, counties, and states realize real, quantifiable cost savings in environmental protection and public health** that are directly or indirectly tied to the success and growth of the recycling industry. Cost savings and benefits include landfill diversion and disposal cost savings, reduced energy consumption, greenhouse gas reductions, and reduced pollution. Additional benefits to the environment and public health increase the economic impacts of recycling when quantified (Fried 2008; Minnesota 2006; Washington CAT 2008). The broad range of public economic benefits of recycling includes higher income levels, revenues gained by selling recycled materials to manufacturers, dollars diverted from landfill and disposal fees, reduced need for subsidies to cover the costs of virgin materials extraction, carbon offsets, and energy savings (Morris 2001).

Landfill Diversion and Disposal Cost Savings

In a 2002 study of recycling economic impacts, the Ohio Department of Natural Resources estimated that the state's total avoided landfill costs as a result of recycling amounted to approximately \$4.6 million—about 128,000 tons diverted from landfills, at a fee of \$36 per ton.

A 1999 report issued by Green Solutions and Sound Resource Management estimated that capturing all recyclables remaining in Washington State waste streams would reduce garbage collection and disposal costs by \$113 million. (However, they cautioned that these savings with additional revenues obtained from the sale of the recycled materials may not be enough to cover the investment that would make this enhanced collection possible.)

Even during economic slumps—when commodity prices tend to drop—recycling remains more economically viable than disposal. When recyclable materials are disposed, their value is lost forever, and states like Washington are beginning to measure the gaps between waste generation and recycling as real economic losses. In its 2008 *Beyond Waste* progress report, Washington State reported an increase in “lost value of recyclables” between 2003 and 2006, even though the overall quantity of recyclables increased during that time. This “increase in lost value” was attributed not only to the increased volume of disposed recyclables, but to their increased market value. Between 2003 and 2006, the overall economic loss was valued at \$800 million.



Excerpted from the 2008 Beyond Waste Progress Report (Washington 2008).

Reduced Energy Consumption

Besides conserving natural resources, reducing waste, and preventing pollution associated with landfills, mining, and petroleum-based production, recycling also saves significant amounts of energy compared to virgin materials. The steel industry, for example, which recycles approximately 76 million tons of steel and iron annually, saves enough energy per year to power about 18 million homes (Fried 2008).

Even with the cost of collecting and transporting recyclables, energy prices have tended to favor increased recycling. It takes much less energy to make a product from recycled materials than from virgin materials; in the case of metals such as aluminum and zinc, energy accounts for 20 to 30 percent of the total manufacturing cost (Fried 2008).

By recycling 975,000 tons of scrap steel in 2005, Washington's recycling efforts reduced the need for virgin materials by twice that amount. For every ton of scrap steel recycled, the state avoided mining and processing two tons of raw materials such as iron ore, coal, and limestone. In addition, the 7,400,000 tons of materials recycled in Washington that year saved about 116,000 billion BTUs of energy, and saved about 925 million gallons of gasoline. This was equivalent to about half of the energy used in homes, and one quarter of the oil used in Washington annually (Washington 2005).

Greenhouse Gas Reductions

Washington State's measured recycling efforts for 2005 were calculated to reduce greenhouse gas emissions by almost 3.2 million tons or over 1,000 pounds per person—equivalent to the annual emissions of over 2.5 million passenger cars, more than half of the passenger cars in Washington (Washington 2005). Calculating savings using a conservative control cost estimate of \$8 per ton (with current estimates ranging from \$5 to \$30 nationwide), the state saved more than \$25 million in carbon offsets in 2005.

In light of figures like these, the Washington Climate Action Team (CAT) included “waste prevention and diversion from landfill disposal (or recycling)” as recommended “potent” strategies for reducing greenhouse gas emissions and conserving energy. The CAT noted that materials entering the waste stream have energy impacts and associated greenhouse gas emissions at every stage of their life cycle, from extraction and manufacturing through use and disposal. In its 2008 interim report, the CAT presented its case for increased waste prevention and recycling to reduce and prevent greenhouse gas emissions (Washington CAT 2008).

Below is an excerpted table showing the estimated greenhouse gas reductions and energy savings that resulted from recycling in Washington State in 2005.

Energy Savings and Greenhouse Gas Impacts from Recycling in Washington – 2005
(Relative to energy required for virgin production – list of selected materials)

Material Recovered/Recycled (limited list)	Tons Recovered	BTUs Saved by Recycling (in millions)	Tons Greenhouse Gases Reduced by Recycling (MTCE)
Aluminum Cans	15,441	3,173,034	56,863
Tin Cans	12,133	210,722	5,317
Glass	82,773	61,281	4,019
HDPE	9,319	457,178	3,200
LDPE	16,209	767,430	4,730
PET	8,534	436,537	3,298
Corrugated Cardboard	565,698	8,651,560	451,080
Mixed Paper	322,732	7,187,770	255,964
Newspaper	259,157	4,207,237	230,744
High-Grade Paper	58,661	587,863	5,361
Dimensional Lumber	351,855	161,523	291,700
Yard Trimmings	674,235	N/A	50,716
Mixed Metals	1,144,327	85,432,513	1,637,446
Mixed Plastics	7,247	219,347	N/A
Mixed Organics	596,177	N/A	17,207
Computers/Electronics	8,534	362,091	5,088
Concrete/Asphalt	1,783,418	173,312	3,442
Fly Ash	14,588	55,205	3,176
Tires	9,256	257,030	2,346
Total	5,940,294	112,401,633	3,031,697

Excerpted from Focus on the Benefits of Recycling (Washington 2005).

Between 2000 and 2005, Washington State had an approximate **17 percent increase in greenhouse gas emissions**, or 18.3 million tons of carbon dioxide equivalent emissions. The increase was reported to result primarily from the manufacturing of products purchased. While these reported emissions were generated both in Washington state and elsewhere, they were “**connected to purchases of goods and services made in Washington**” (Washington 2008).

To this end, increased material recovery and processing could go a long way toward mitigating climate concerns in Washington State, as locally manufacturing new products using recycled materials instead of virgin materials—such as metals and plastics—reduces greenhouse gases otherwise released from virgin materials acquisition, and processing. With a national recycling rate of 30.6 percent, the United States saved about 256 billion barrels of crude oil in 2007, the equivalent of taking about 22 million cars off the road (Fried 2008; White House Task Force on Recycling 1998).



*Excerpted from Recycling... for the Future
(White House Task Force on Recycling 1998).*

In particular, green building represents one promising avenue for reducing greenhouse gas emissions and increasing recycling and remanufacture in Washington State, including increasing demand for products made from recycled materials and encourages environmentally sound deconstruction.

Reduced Pollution

Making products from recovered materials reduces ten major categories of air pollutants and eight categories of water pollutants (Fried 2008). An earlier report issued by Green Solutions and Sound Resource Management provided the following estimates for pollution prevention per material type, as compared to virgin feedstocks:

	Air Pollution	Water Pollution	Mining Wastes
Steel	85% less	76% less	97% less
Aluminum	95% less	97% less	NA
Paper	74% less	35% less	NA
Glass	20% less	NA	80% less



Key Recommended Resources on Tax Revenues and Other Public Benefits

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International Experience

Though international experience on economic impacts associated with recycling was defined as outside the scope of this literature review, we did identify several resources that may warrant further investigation.

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Appendices (provided separately)

- **Summary Sheets.** Brief summaries of major studies reviewed, presenting key findings in job creation, capital investment, and tax revenues as well as links to electronic documents, where available.
- **Linked Bibliography.** A separate electronic bibliography, with links to all documents in the literature review library.
- **Source Materials.** Electronic copies (PDFs) of documents included in the literature review.