
**AB 341's 75 Percent Goal
and Potential New
Recycling Jobs
in California by 2020**



California Department of Resources Recycling and Recovery

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S T A T E O F C A L I F O R N I A

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Summary

1. To achieve the AB 341 goal of 75 percent recycling, Californians will need to recycle, compost, or source-reduce more than 23 million tons of material that is currently being disposed. If this additional material can be handled and manufactured into new products in California facilities, it could result in more than 100,000 new recycling jobs in the state. This is based primarily on the 2011 Tellus/SRM study,¹ which provides a forecast for future years using material-specific ratios of jobs per 1,000 tons recycled by 2020 (with an overall average of 5.7 jobs per 1,000 tons).

The largest job gains would be in the paper, plastics, and inert materials sectors, with more than 25,000 new jobs in each. The major source of potential new jobs would be in processing and manufacturing activities. While organic materials comprise one-third of the total material types, they do not require as much secondary processing or remanufacturing to make a final product. Still, this sector could account for more than 14,000 new jobs.

For each new job created, at least one additional job would also be created or induced indirectly. For example, the collection of recyclables creates secondary jobs because a new collection route requires a driver and often times a specialized truck that must be manufactured, sold and serviced.

2. Recycling jobs created within California are affected greatly by exports and other issues such as the difficulty of siting and financing new manufacturing and composting or anaerobic digestion facilities in California.

In 2012, California ports exported nearly 20 million tons of waste and scrap material (with a value of more than \$8 billion, that went to China and other East Asian countries. An estimated 60 to 80 percent originated within California, and of that, more than half of the total tonnage was paper.

3. Currently, processing and manufacturing sectors support 3 to 11 times more jobs than collection and landfilling (inerts and paper at the lower end, plastics and metals at the higher end).² The average for current recycled materials collection and secondary processes is 5.3 jobs per 1,000 tons (note that this is slightly less than the figure of 5.7 jobs per 1,000 tons used to estimate future job growth; the increased rate for future years is due to a projected shift in materials mix from what is currently being collected).

For 2020, it is estimated that collection and landfill disposal will account for a median value of 1.45 jobs per 1,000 tons.³ Curbside recycling, materials recovery facility (MRF) operations, and transfer entail about 2.9 jobs per 1,000 tons of recycled materials, more than twice that of landfill disposal. Source-separated recycling generates about 7.8 jobs per 1,000 tons, about five times that of landfill disposal operations. Reprocessing and remanufacturing per 1,000 tons of material accounts for 2.8 jobs for wood, 4.2 jobs for paper, 10.3 jobs for plastics, and 4.1 jobs for ferrous metals.

¹ See Table 1, page 8, in this report. Tellus/SRM, Tellus Institute, *More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.*, 2011, page 34.

² See Table 3, page 13, “Jobs per 1,000 Tons Throughput.”

³ For 2020, this report uses median values, and consolidated materials categories, derived from the Tellus/SRM report. The values for collection are estimated for 2008 and for 2030, and a median was selected as appropriate for 2020.

4. The statewide capacity for recycled material processing, and in particular manufacturing, is far from sufficient to handle the additional 23.5 million tons anticipated to be available if we meet AB 341's 75 percent statewide goal in addition to the 20 million tons currently being exported.

Section 1: Reports Reviewed

CalRecycle reviewed 16 reports on jobs and recycling that have been published since 2000 as shown in Table 1. An overview of each of those published reports is provided in the annotated bibliography. The reports in Table 1 are divided into two categories: Twelve primary sources and four supplemental sources. The primary sources provide California-specific employment data, or fundamental metrics for recycling job potentials, while the supplemental sources provide additional information used to validate estimates and metrics.

Recent studies have increasingly focused on the positive economic impacts of increasing waste diversion, the increasing employment created in the past decade, and the number of jobs that are projected to be created by future expansions of waste diversion activities and reprocessing industries. Some of the sources reprised or reassessed data from existing reports rather than original estimates, and some utilized less selective methodologies for determining job categories by using broader definitions of materials or recycling activities. Each successive report built upon findings from earlier reports and modified the definitions and materials categories. Employment was assessed in different ways, generally with a trend toward broader definitional categories. These differences make a normalized comparison of data difficult.

Of the 12 primary sources, this CalRecycle report relies heavily on information provided in four reports for the current status of California recycling jobs because of similar methods of analysis, and then on five other reports for "jobs per 1,000 tons" metrics to estimate future job potentials.

Note that this CalRecycle report is an analysis of potential job creation and does not include a benefit/cost analysis of the recycling industry and related employment. A benefit/cost study would involve estimates of the "raw price" of the recycled materials, the "end value" of the remanufactured commodities, and the cost of labor and transportation in the manufacturing steps in between. Such an effort is beyond the scope of the current study.

Table 1: Sixteen Reports on Jobs and Recycling

| TITLE | Date | Author(s) | Prepared for: | Jobs per 1,000 Tons | | | | Total Jobs | | | |
|--|-------------|----------------------------|-------------------------------------|---------------------|--------------|------------|------|-------------|--------------|------------|------|
| | | | | CA-specific | Other States | U.S. Total | U.K. | CA-specific | Other States | U.S. Total | U.K. |
| Primary Sources | | | | | | | | | | | |
| California Recycling Economic Information Study | Jul., 2001 | R.W. Beck / NRC | CIWMB | ✓ | | | | ✓ | | | |
| The Economic Impact of Waste Disposal and Diversion in California | Apr., 2001 | U.C. Berkeley | CIWMB | | | | | ✓ | | | |
| U.S. Recycling Economic Information Study | Jul., 2001 | R.W. Beck | National Recycling Coalition | | | | | ✓ | ✓ | ✓ | |
| Recycling and Economic Development: Review of Literature | Apr., 2009 | Cascadia | King County, Washington | | ✓ | | | | ✓ | | |
| Recycling Economic Information Study Update: DE ME MA NY PA | Apr., 2009 | DSM/MSW | Northeast Recycling Coalition, Inc. | | ✓ | ✓ | | | ✓ | ✓ | |
| More Jobs, Less Waste: Potential for Job Creation in the UK and EU | Sept., 2010 | URSUS Consulting | Friends of the Earth | | | | ✓ | | | | ✓ |
| California's Green Economy: Summary of Survey Results | Oct., 2010 | LMID / Empmt. Dvpt. Dept | California State | | | | | ✓ | | | |
| Cost Study on Commercial Recycling | Jan., 2011 | HF&H / Cascadia | CalRecycle | ✓ | | | | ✓ | | | |
| More Jobs, Less Pollution: Growing the Recycling Economy in the U.S. | Nov., 2011 | Tellus / SRM Group | Tellus Institute | | | ✓ | | | | ✓ | |
| Returning to Work: Domestic Jobs Impacts from Recycling Beverage Containers | Dec., 2011 | Morris/Morawski | Container Recycling Institute | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| Many Shades of Green: Regional Distribution and Trends in California's Green Economy | Jan., 2012 | Collaborative Econ. | NEXT10 | | | | | ✓ | | | |
| The West Coast Clean Economy: Opportunities for Investment and Job Creation | Mar., 2012 | GLOBE / CCS | Pacific Coast Collaborative | | | | | ✓ | ✓ | | |
| Supplemental Sources | | | | | | | | | | | |
| The Scrap Recycling Industry 2011 Economic Impact Study | Jul., 2011 | Dunham & Assoc. | Inst. Of Scrap Recycling Industries | | | | | | | ✓ | |
| Sizing the Clean Economy: A National and Regional Green Jobs Assessment | Jul., 2011 | Brookings / Batelle | Metropolitan Policy Program | | | | | ✓ | ✓ | ✓ | |
| Employment in Green Goods and Services - 2010 | Mar., 2012 | Bureau of Labor Statistics | U.S. Dept. of Labor | | | | | ✓ | ✓ | ✓ | |
| Impact Analysis of a Beverage Container Deposit Program in Maryland | Dec., 2011 | U.Md. / ECONorthwest | Waterfront P'tnership/Abell Found'n | | | | | | ✓ | | |

CalRecycle used current California recycling job information in these four sources and metrics in these five sources to estimate future recycling job potential.

Section 2: Estimates of Current California Recycling Jobs

For the purposes of this report, CalRecycle relied on four studies with California-specific numbers for existing recycling jobs estimates that were similarly derived, although even these are not readily comparable. These four studies, along with job estimates, are shown in Table 2, below. The year for the source data is shown. The earliest year of data is 1997, with the other three studies estimating the numbers of jobs for 2009 and 2010.

Table 2: California Recycling Jobs Estimates

| Study | Source (Author / Publisher) | Year Pub. (Data Yr.) | Estimated No. of CA Recycling Jobs and Category Definitions | |
|--|---|-------------------------|---|---|
| California’s Green Economy: Summary of Survey Results | LMID / California EDD California State | 2010 (2009) | 115,400 | Recycling existing materials excluding manufacturing |
| U.S. Recycling Economic Information Study | R.W.Beck / National Recycling Coalition | 2001 (1997) | 62,700 | Recycling and reuse, excluding virgin material preparation and downstream conversion |
| Many Shades of Green: Trends in California’s Green Economy | Collaborative Economics / NEXT10 | 2012 (2009) | 26,500 | Waste management and remediation services |
| The West Coast Clean Economy | Globe – CCS / Pacific Coast Collaborative | 2012 (2010) | 15,700 | Recycling and reuse |

Although three of the reports state in their title to be “clean” or “green,” the estimates reflect jobs from a narrower definition that pertains to direct employment from recycling as a range of activities related to collection, sorting/brokering, and processing; the numbers do not include jobs associated with remanufacturing. Even given this narrower range, there is still a wide range of disparate activities covered in these four reports. The wide range in job estimates is largely explained by the varying definitions of the categories, summarized in the far right column. Furthermore, the latter two reports appear to address a much smaller portion of the collection and recycling activities. For example, the “West Coast Clean Economy” study defined 37 separate categories of “clean economy” jobs, which resulted in a relatively narrow definition of recycling when compared to the other three studies. This subsequently translated to a relatively low number of recycling jobs.

The studies clearly demonstrate the problems inherent in calculating precise estimates of “core” recycling jobs. Adjusting the 2001 study, which used 1997 data, for population and consumption growth over the last 15 years would result in an estimated employment of approximately 75,000 in recycling and reuse activities. Thus, two of the studies suggest a “core” recycling number – 75,000 and 115,000 – that is much greater than the smaller numbers in the two other studies.

These higher estimates are somewhat consistent with two earlier studies prepared for the California Integrated Waste Management Board that presented estimates of “current” California jobs related to recycling. The board, and its successor CalRecycle, relied on two reports for nearly a decade: 1) “The Economic Impact of Waste Disposal and Diversion in California” (April 2001) by UC Berkeley; and 2) “California Recycling Economic Information Study” (July 2001) by R.W.Beck.

These studies estimated recycling-related job numbers in the range of 84,000 (direct employees, R.W.Beck) to 179,000 (direct plus indirect employees, UC Berkeley). However, neither was used as a primary source for this report. In the case of the UC Berkeley study, the methodology used could not be readily correlated with the methodologies used in more recent studies because the definitions of waste types and data sources varied significantly. In the case of the Beck study, the same researchers included identical California data in a broader national study for the National Recycling Coalition. Therefore, CalRecycle used the national study as a primary source.

A third recent study prepared for CalRecycle, “Cost Study on Commercial Recycling” (June 2010), evaluated economic impacts associated with CalRecycle’s regulation requiring mandatory commercial recycling. It was prepared by HF&H Consultants in conjunction with Cascadia Consulting Group. The focus of the study was on cost impacts of the regulation, but it also indirectly provided rough estimates of job creation under future alternative scenarios of recycling in California. Because the methodology and definitional categories were not consistent with other studies considered in this report, the HF&H study was not used.

Despite the inability to readily compare estimates across similar studies, they support the conclusion that efforts in the past two decades to support recycling and reuse have increased California employment in the recycling and reuse sectors. Furthermore, as CalRecycle and California businesses respond to the 75 percent reuse and recycling goal, these reports support the conclusion that enhanced recycling infrastructure can be leveraged into regional economic growth initiatives and additional employment gains in the recycling sector.

Section 3: 2020 Projections of Additional Recycling and Associated Jobs

California’s new statewide 75 percent source reduction, recycling, and composting goal represents a new paradigm in materials management. In order to reach that goal, CalRecycle estimates that by 2020 it will be necessary to redirect an additional 23.5 million tons of material annually from disposal in landfills (or sent to other disposal-related activities) to recycling or composting, or to not generate these tons in the first place by reducing waste at the source. To the extent that this can be accomplished in-state, CalRecycle expects to see a commensurate increase in workforce, implementation of new technologies and/or construction of new facilities such as anaerobic digestion, accompanying changes in infrastructure, and significant reductions in greenhouse gas emissions.

This section will explore the number of new California recycling-related jobs that could potentially be created by attaining the 75 percent recycling goal, in order to assess the contribution to the state’s economy of reusing or recycling these materials within California.

The general methodology for estimating potential future jobs in recycling is based on studies that develop commodity-specific or activity-specific ratios of jobs to tons of materials handled. Data from surveys and census reports are used to develop these ratios. In Table 3 below, the results from five studies with compatible parsing of jobs categories are aggregated according to different activities and different recycled commodities. Some studies developed the ratios of jobs per 1,000 tons of specific recycled commodities, while others developed similar ratios by type of activity. Only one of the studies provided a complete breakdown of jobs by type of activity, though all developed at least some factors for specific commodities. One study examined the jobs per 1,000 tons factor for the United Kingdom (the factors in this study were adjusted to reflect the different quantities involved, i.e., tons vs. tonnes).

Table 3: Jobs per 1,000 tons Throughput, Summaries from Five Studies

| Source / Study | Average FTE* jobs per 1,000 tons throughput | | | | | | |
|--|---|-------------------------------|----------|----------------------|----------------------|-------------------------|----------------------|
| | CMConsulting / CRI Impacts Parameters | | | URSUS/ FOE | Cascadia/ Wash. | SRM/ Tellus | DSM Inc/ NERC |
| Waste Management or Manufacturing Stage | Container Deposit Return | Curbside & other Recyc. | Disposal | Data Year 2004 | Data Year 2009 | Data Year 2008*** | Data Year 2008 |
| <i>Collection **</i> | 7.34 | 2.30 | 1.17 | | | 1.67 | 2.01 |
| <i>Res. & Commercial Collection</i> | | | | | | | 1.00 |
| <i>Compost and Misc. Organics</i> | | | | | | 0.50 | 1.18 |
| <i>Transfer to landfill</i> | | | 0.22 | | | 0.10 | (no tons) |
| <i>MRF / landfill operations</i> | 0.56 | 0.64 | 0.04 | | | 0.56 | 0.62 |
| <i>Secondary processing</i> | | | | | | | |
| Glass | 0.37 | 0.37 | | 0.67 | 2.60 | 7.85 | 1.40 |
| Glass Product Producers | | | | | | | 3.82 |
| Paper | | | | 3.13 | 1.80 | 4.16 | 4.24 |
| Paper & Paperboard Mills / De-Inked Pulp | | | | | | | 2.35 |
| Plastics Reclaimers | | | | | | | 2.05 |
| Plastic Product Manufacturers | 2.00 | 1.00 | | 13.93 | 9.30 | 10.30 | 8.24 |
| Iron and Steel | | | | 4.82 | | 4.12 | 3.35 |
| Aluminium | 0.00 | 0.58 | | 9.82 | | 17.63 | (no tons) |
| Wood | | | | 0.67 | | 2.80 | (no tons) |
| Textiles | | | | 4.46 | 8.50 | 2.50 | (no tons) |
| Rubber Product Manufacturers | | | | | | 9.24 | 7.71 |
| Biowaste | | | | 1.16 | 0.40 | | 0.92 |
| Average all recycling | | | | 5.54 | 5.00 | | |

* FTE: Full-time-equivalent.

** Collection includes administration, management & maintenance.

*** Tellus Data Year 2030 Collection is estimated to be 1.23 jobs per 1,000 tons throughput.

CMConsulting/CRI: “Returning to Work: Domestic Jobs Impacts from Recycling Beverage Containers,” December 2011; Job metrics from associated economic model “MIRJCalc: Measuring the Impact of Recycling on Jobs Calculator” by Morawski and Wilcox.

URSUS/FOE: “More Jobs, Less Waste: Potential for Job Creation in the UK and EU,” September 2010; URSUS Consulting, for Friends of the Earth.

Cascadia/Wash.: “Recycling and Economic Development: Review of Literature,” April 2009; Cascadia, for King County, Washington.

SRM/Tellus: “More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.,” November 2011; SRM Group, for Tellus Institute.

NRC/DSM: “Recycling Economic Information Study Update: DE, ME, MA, NY, PA,” April 2009; DSM/MSW, for Northeast Recycling Coalition, Inc.

Estimates of Additional Jobs

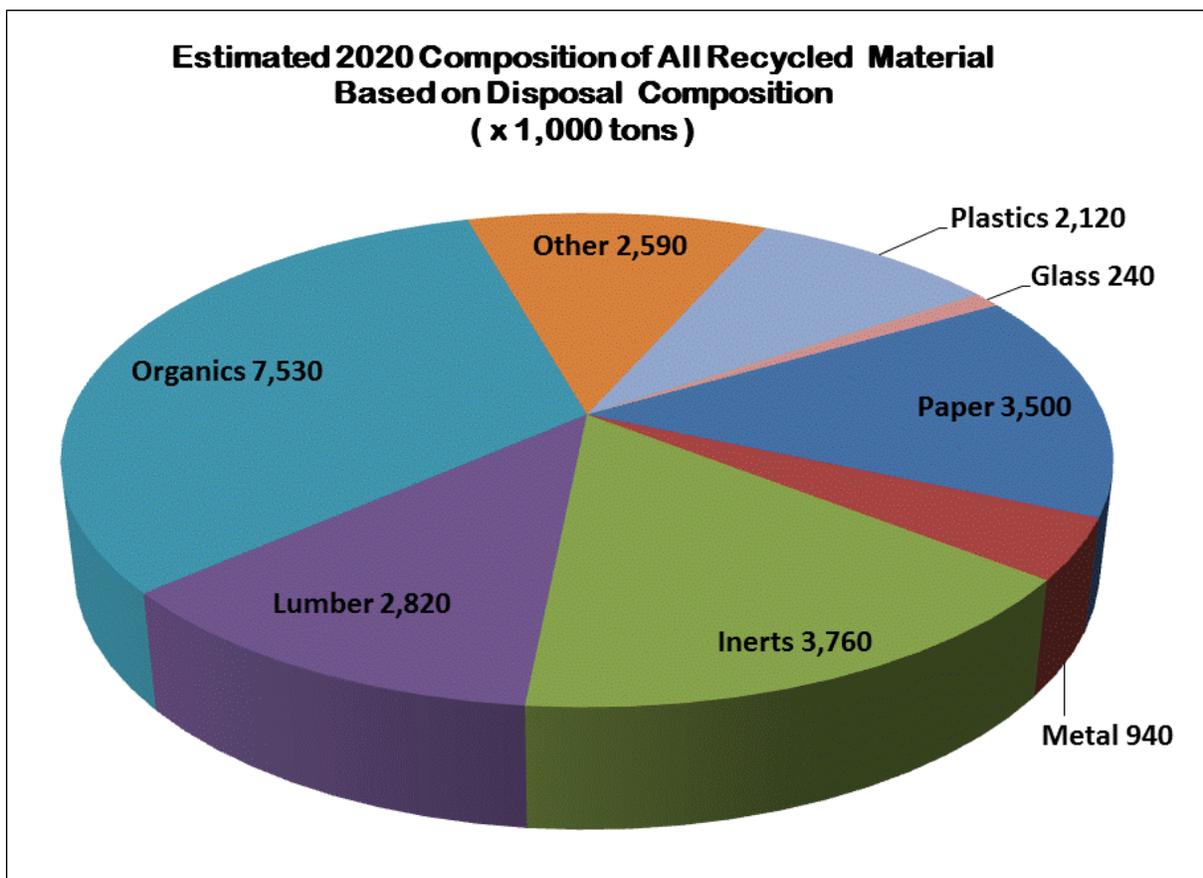
A reasonable estimate of the number of additional recycling jobs expected by achieving the AB 341 goal can be determined by taking the material-specific ratios of expected jobs per 1,000 tons and applying those data to the tonnage of materials anticipated to be diverted from landfills. CalRecycle used a set of “jobs-per-1,000 ton” ratios from the Tellus/SRM study, shown in Table 3 above, in order to derive the

expected number of jobs created. Although the specific values differ from those provided in other studies, the Tellus/SRM study was selected due to its superior level of detail and analysis, i.e., the breakout of data for specific materials and activities.

These material-specific job ratios then need to be applied to the anticipated tonnages of these materials. As noted earlier, CalRecycle estimates that an additional 23.5 million tons of material must be source-reduced, recycled, or composted annually in order to reach the new 75 percent statewide goal. To establish a reasonable estimate of the amounts of different materials expected to be diverted, CalRecycle used the composition of the waste stream as determined in its 2008 waste characterization study⁴ and assumed that the percentage composition of the additional 23.5 million tons redirected from landfills will be the same.

The resulting distribution is shown in Chart 1 below and illustrates the expected composition of collected materials in 2020 available for recycling and composting.

Chart 1: 2020 Additional Tons Recycled, by Material Category



The “jobs-per-on” factor, from the Tellus/SRM study (Table 3), can be applied to the expected tons recycled, by material category, for the additional 23.5 million tons that will be redirected in order to meet

⁴ California 2008 Statewide Waste Characterization Study, Nov. 10, 2009. CIWMB. This is found at: <http://www.calrecycle.ca.gov/WasteChar/WasteStudies.htm#2008>

the 75 percent recycling goal.⁵ The Tellus/SRM report was chosen as a guide for the job metrics because it was the most uniform in methodology, and complete in material types, for the purposes of this California report.

This report uses job factors for waste diversion derived from the Tessus/SRM Report in order to calculate 2020 estimates shown in Table 4. The table shows the material composition and tonnages, the per-ton jobs estimates, and the estimated number of additional jobs for each material category, as well as by category of work activity.

Table 4: Estimated Jobs by 2020, by Types of Materials and Processes

| 23.5 Million Tons Recyclables | | | Employment Associated with Recycling Activities | | | | |
|-------------------------------|----------------------------|-----------------------|---|---------------|--------------------------------|---------------|------------------|
| Material Type | Material Composition Share | Material Tons x 1,000 | Job Factors (Jobs/1,000 ton) | | Number of Jobs | | |
| | | | Collection & Processing (2020) | Manufacturing | Collection & Processing (2020) | Manufacturing | TOTAL Added Jobs |
| Paper | 15% | 3,500 | 3.45 | 4.16 | 12,075 | 14,560 | 26,635 |
| Glass | 1% | 240 | 3.45 | 7.85 | 828 | 1,884 | 2,712 |
| Metal | 4% | 940 | 3.45 | 4.12 | 3,243 | 3,873 | 7,116 |
| Plastics | 9% | 2,120 | 3.45 | 10.30 | 7,314 | 21,836 | 29,150 |
| Green | 10% | 2,350 | 1.95 | na | 4,583 | na | 4,583 |
| Food | 13% | 3,060 | 1.95 | na | 5,967 | na | 5,967 |
| Other Organics | 9% | 2,120 | 1.95 | na | 4,134 | na | 4,134 |
| Lumber | 12% | 2,820 | 3.45 | 2.80 | 9,729 | 7,896 | 17,625 |
| Other Inert | 16% | 3,760 | 1.95 | na | 7,332 | na | 7,332 |
| Other | 11% | 2,590 | 1.45 | na | 3,756 | na | 3,756 |
| Total | 100% | 23,500 | | | 58,960 | 50,049 | 109,009 |

Data Source:

Material composition: "California's New Goal, 75% Recycling"

Jobs factors for waste diversion from: "More Jobs, Less Pollution..." Tellus/SRM Report, Table 5 (p. 34).

The “jobs-per-1,000 tons” estimates developed in the SRM/Tellus Report were modified somewhat in this table. Some modifications were for improved simplicity in calculations and display. The specific numbers developed by SRM/Tellus were for 2010 and 2030 collections, and included the assumption of increased operational efficiencies over the two decades. As this report is targeting the year 2020, the end points were averaged, where this was appropriate.

Using these modified metrics, the “Collection and Processing” category is expected to generate about 59,000 jobs, and the “Manufacturing” category is expected to generate about 50,000 jobs, for a total of approximately 109,000 jobs. It must be emphasized that these figures include part-time jobs, and also include the relatively small number of current operator jobs located at landfills and incinerators. Some of

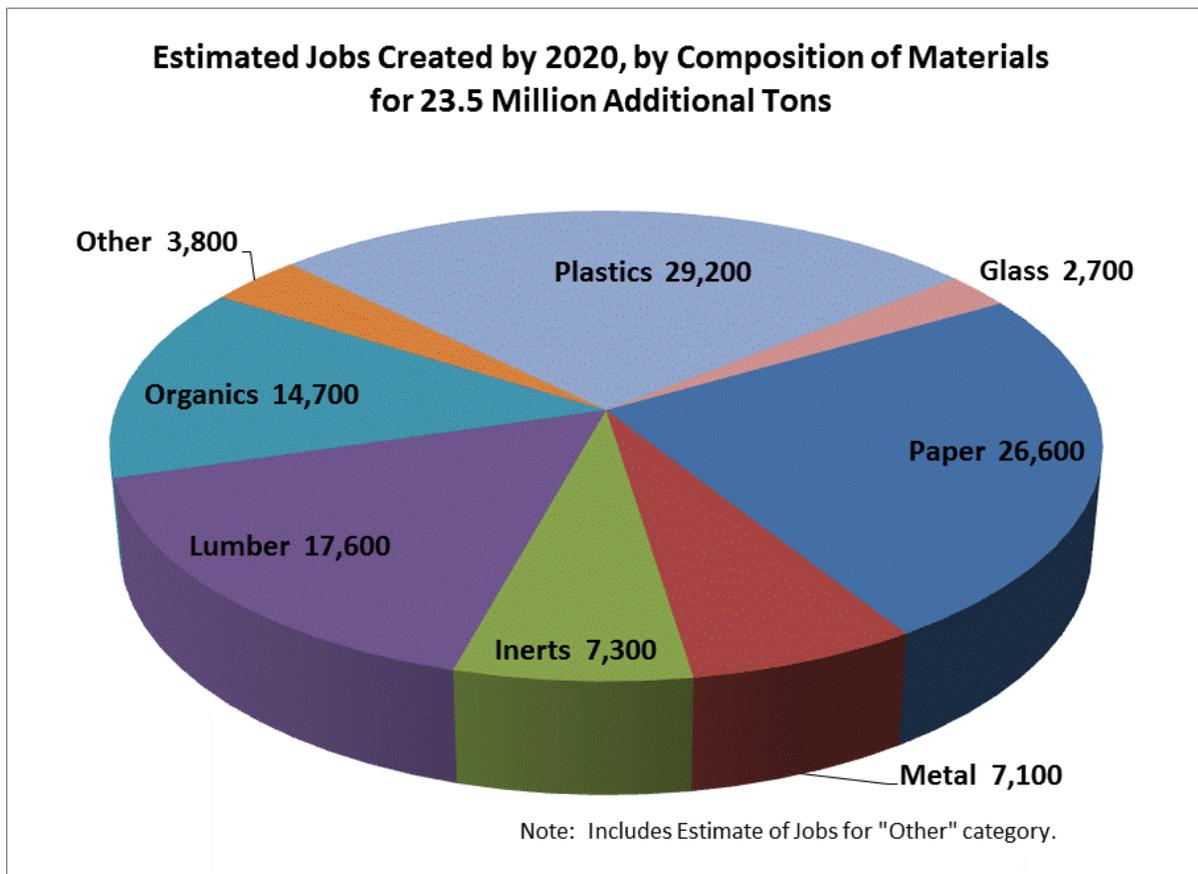
⁵ Note that this study revises data published in the 2001 “U.S. Recycling Economic Information Study” by R.W.Beck for the National Recycling Coalition. The Tellus/SRM data distinguishes the “Manufacturing” from the “Reuse/Remanufacture” processes that largely involve refurbishing and reuse processes.

these jobs will be eliminated as a result of the reduced tonnage, but the reduction will not substantially reduce the estimated jobs gained.

The Tellus/SRM Report also provides “Jobs per 1,000 Tons” estimates for processes that are called “Reuse and Remanufacturing,” which are not included in the above analysis. As a result of not including “Reuse and Remanufacturing” in the above analysis, the current calculations may result in a slight underestimate of the potential jobs created. However, this is a significantly smaller category than “Manufacturing” (about one-tenth the size) and is characterized by enterprises such as computer and electronic remanufacture, motor vehicle parts, and tire retreaders. Furthermore, there are no tonnage estimates for these types of materials, and it is assumed that most of the tonnage associated with the “Collection and Processing” category feeds directly into the “Manufacturing” sector.

Chart 2 illustrates the expected composition of the jobs that could be created as a result of the enhanced recycling strategies.

Chart 2: Forecast of California New Job Estimates by Material Type for Additional Tons



As a cross-check on the earlier studies referenced above, there are currently roughly 50 million tons of materials diverted from landfills, of which about 20 million tons are exported (see below). This means that roughly 30 million tons remain in California and are being recycled, supported by existing jobs. Applying the same Tellus job factors to this data (average of 5.7 jobs per 1,000 tons material recycled)

results in current jobs on the order of 170,000. This is higher than the estimates shown in Table 2 but confirms that recycling already is a major component of the California economy.

Additional conclusions of the studies indicate that, regardless of the methodology used or how recycling may be defined in these studies, it is clear that the trends of increasing recycling and recycling jobs are bright spots in an otherwise tepid economic recovery. Several of the studies show that, on a national level, the number of recycling-related jobs is increasing at a rate roughly three times faster than total jobs. Despite the definition and methodology inconsistencies among these studies, several findings appear consistently throughout these reports:

1. Recycling generates more jobs than landfilling;
 - *Collection and landfill disposal account for a median value of 1.35 jobs per 1,000 tons (0.5 to 2.6 jobs per 1,000 tons, depending on the region and population density).*
2. Recycling jobs thus far have been mainly in collection and processing, but manufacturing products from recycled materials generates more jobs per ton of material than collection and processing combined;
 - *The average for current recycled materials collection and secondary processes is 5.3 jobs per 1,000 tons.*
 - *Curbside recycling, MRF operations, and transfer entail about 2.9 jobs per 1,000 tons of recycled materials, more than twice that of landfill disposal.*
 - *Source-separated recycling generates about 7.8 jobs per 1,000 tons, about five times that of landfill disposal operations.*
3. Manufacturing from other recycled materials generates 50 percent more jobs than the first two activities. Processing and manufacturing sectors make up from 3 to 11 times more jobs than collection and landfilling (inerts and paper at the lower end, plastics and metals at the higher end).⁶
 - *Reprocessing and manufacturing accounts for 2.8 jobs per 1,000 tons for lumber , 4.1 jobs for metals, 4.2 jobs for paper, and 10.3 jobs for plastics.*

Section 4: Infrastructure Needs

Infrastructure will play a critical role in achieving the 75 percent recycling goal and realizing the full potential job growth in California. In order to collect, sort, and process the additional 23.5 million tons of recyclable materials and then to remanufacture them into beneficial products, it is important to examine infrastructure needs. Since the enactment of AB 939 in 1989, California has developed a fairly mature infrastructure for collection, sorting, and preliminary processing of recyclable materials in order to meet the diversion mandates of AB 939. However, as evidenced by the significant amounts of recyclables being exported, California has a limited remanufacturing infrastructure.

Exports

During the past two decades, higher-level processing of bulk or baled plastics, papers, and metals has been occurring at an increasing rate in other countries. As a result, the jobs created through these processes have largely been developed in destination countries to which the recyclable materials have been shipped.

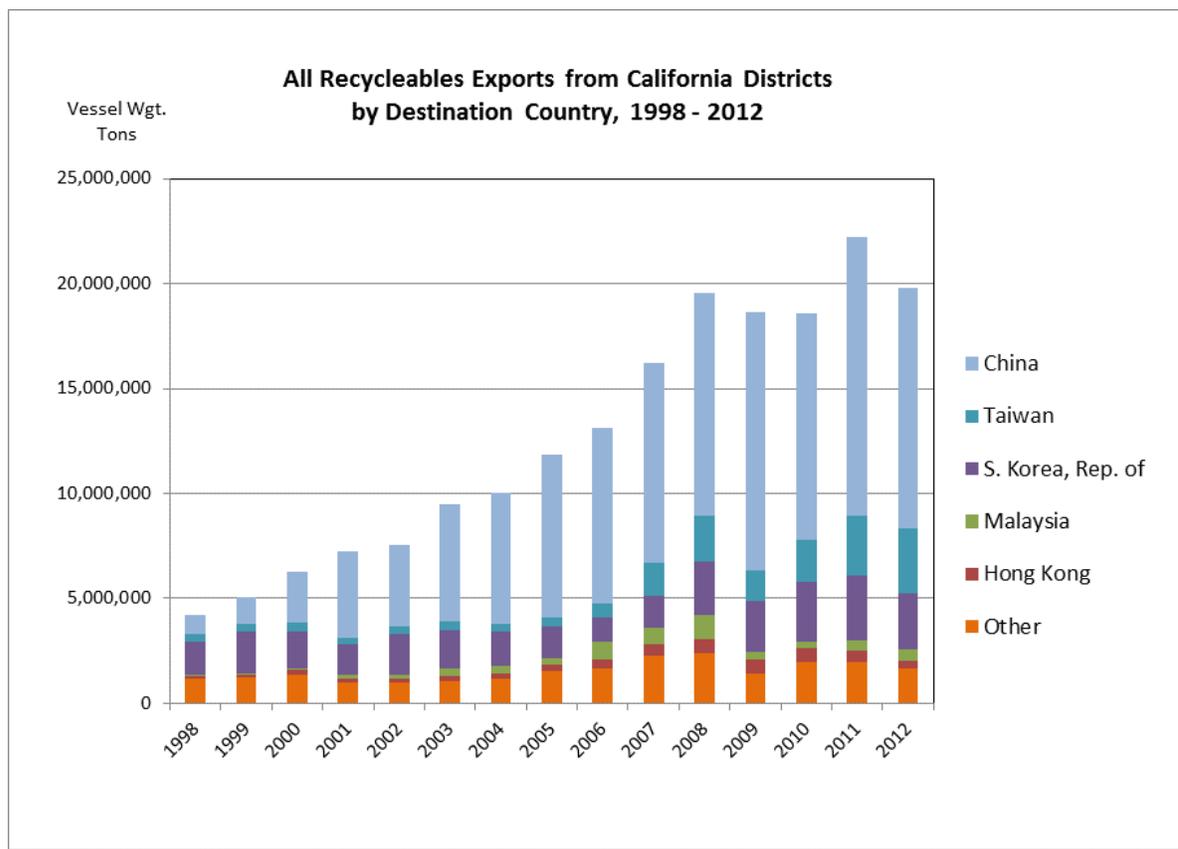
⁶ See Table 3, page 13, “Jobs per 1,000 Tons Throughput.”

The export markets for recyclable materials are primarily in Asia, with China providing the largest destination markets for nearly all recyclable materials (see Chart 3). An analysis of the WISERTrade database of exported recycled materials shows that in 2012, California ports exported more than \$8.1 billion in waste and scrap material to China and other East Asian countries⁷. Those countries receive the majority of recyclable plastic and metals exported from California as well. Scrap and recyclables accounted for almost 20 million tons, or 28 percent, of the total export market from California ports in 2012. Of this, an estimated 60 to 80 percent of recyclable tons (approximately 12 to 16 million tons) exported from California originated from within California.

All paper grades combined make up more than 50 percent of the recyclables market in terms of tons but less than 15 percent of the dollar value in the recyclables market. The various grades of metals make up 43 percent of the recyclables market by weight but 75 percent by dollar value.

The exported recyclable commodities are currently collected and processed, but if the manufacturing were done domestically, it would create 58,000 new jobs that would boost local and regional economies. Additional cost savings would occur with the reduced transport distances of recycled raw and reprocessed materials, both in reduced energy use and in reduced greenhouse gas emissions. Jobs would be added, fewer virgin resources would be needed, and the carbon footprint would be reduced.

Chart 3: Exports of Recycled Materials by Destination Countries



An estimate of the potential number of processing and manufacturing jobs represented by the recycled materials currently exported from California ports is greatly dependent upon the specific type of materials

⁷ WISERTrade © is the proprietary database of trade statistics accessed by CalRecycle under an annual license from Massachusetts-based WISER, LLC.

but can be derived by using a calculation process similar to that used to obtain the estimate of jobs created by additional recycling of currently disposed materials.

The export tonnage for 2012 was 20 million tons, but the mix of materials was significantly different from the mix of materials available for domestic recycling. It is estimated that about 70 percent of the recycled exports originated in California. Furthermore, the jobs related to collection and processing for these exported materials already occur domestically, whether in California or in other states, so the additional jobs created by not exporting these materials would be limited to the manufacturing sector.

The metric of manufacturing jobs per 1,000 tons is applied to the exported tonnages for four principal material groups: paper, glass, metal, and plastics. If all of these materials that are currently exported were handled in California, the maximum number of manufacturing jobs that would result in California for these four material groups would be 83,000. However, that number assumes that the manufacturing of recycled materials imported from other states would also occur in California. Considering that only 70 percent of the materials are estimated to originate in California, the number of jobs would be roughly 58,000.

Infrastructure

California disposes roughly 30 million tons of discarded material each year in landfills.⁸ But more material—perhaps as high as 60 million tons annually—is diverted through recycling, composting or otherwise flowing through California’s recovered materials infrastructure.⁹ Currently, more than 1,500 known facilities in the state process or use the recovered materials in some way (not counting used oil, e-waste or beverage container collectors). These include 139 materials recovery facilities, 376 transfer stations, 245 construction and demolition processing facilities, 107 scrap metal processors, and 67 paper stock processors.¹⁰

California processors currently have the capacity to handle most of the recovered commodities. However, manufacturers in the state may have little excess capacity at present to turn additional materials – such as the 23.5 million tons that would be captured to achieve the 75 percent goal -- into new products.

CalRecycle does not have complete data on all recycled-content manufacturers statewide – most are not required to report feedstock volume or sales data to CalRecycle – but the department does gather some voluntary manufacturing data. Despite some gaps, the collected data do provide insight into manufacturing products with recovered materials in California and the relatively low ability of industries to take in large amounts of additional material. For example:

- Glass Product Manufacturing—15 facilities use about 700,000 tons of cullet per year, leaving about 100,000 tons of unused capacity annually. The vast majority of the cullet is melted in furnaces operated by glass container and fiberglass producers (five plants and four plants, respectively) for use in new products.

⁸ California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System: <http://www.calrecycle.ca.gov/lgcentral/drs/>.

⁹ This is a rough estimate derived from CalRecycle’s Facility Information Toolbox (FacIT), a statewide inventory of disposal, diversion and recovered material market statistics gathered from a variety of sources. The estimate was calculated from FacIT’s “Estimated Facility Capacity & Throughput” page, by adding total throughput for all activities not disposal-related, and subtracting out manufacturing activities that likely purchased the processed materials (to avoid double-counting). <http://www.calrecycle.ca.gov/FacIT/Facility/CountybyActivity.aspx>. Some of the FacIT data are reported voluntarily, so companies not tracked by CalRecycle would not appear. Most data in the summary tables are from 2010; they are expected to become more comprehensive and accurate as source facilities add or update their information.

¹⁰ FacIT, “Facility Counts by Activity”, <http://www.calrecycle.ca.gov/FacIT/Facility/CountybyActivity.aspx>.

- **Plastics Manufacturing**—21 facilities use about 400,000 tons of recycled resins per year, leaving only about 70,000 tons per year of excess capacity.
- **Paper and Paperboard Manufacturing**—14 facilities use more than 1.1 million tons of recovered fiber per year, operating essentially at full capacity.

California's organics processing infrastructure also faces constraints. Currently it includes 130 composting facilities, 160 chip and grind facilities, and a handful of anaerobic digestion facilities that are just entering the commercial market and still ramping up throughput. Existing composting facilities provide an overall available excess capacity of roughly 2 million tons per year.

The state is also home to 25 biomass conversion facilities that handle mostly forest and agricultural wastes but also process about 1.5 million tons of urban wood wastes annually. Yet like recycled-content manufacturing, the overall capacity for handling organic materials will be insufficient, especially since organics comprise the largest component of the waste stream and cannot easily be exported.

It is unlikely California would be able to absorb much of the 20 million tons of recycled materials exported each year, or the additional 23.5 million tons that would be diverted from landfills to meet the 75 percent goal, without substantial investment in new or expanded manufacturing plants and composting and anaerobic digestion facilities. For the near term, this means California will continue to rely on export markets to consume many of the state's recovered materials, particularly fibers and resins.

Bibliography (with selected annotations)

California Integrated Waste Management Board (CIWMB) (now Department of Resources Recycling and Recovery, or CalRecycle), *Diversion is Good for the Economy: Highlights from Two Independent Studies on the Economic Impacts of Diversion in California, 2003.*

This report was prepared by staff of the CIWMB to compare the two earlier reports by R.W.Beck Inc., and the study commissioned by the CIWMB, written by Goldman and Oshigi from UC Berkeley. Both studies reviewed the economic impact and jobs creation in California and were released in 2001. This report compared the methodology and contrasted the findings of the two earlier reports.

Cascadia Consulting Group, *Recycling and Economic Development: A Review of Existing Literature on Job Creation, Capital Investment, and Tax Revenues, King County, Solid Waste Division, 2009.*

This literature review summarized key findings from more than 50 existing studies, reports, Internet sites, journal articles, media releases, and presentations addressing the impacts of recycling on job creation, capital investment, and tax revenues. This report defined “recycling” to include collection, processing, remanufacturing, and “end markets.” Key findings were that employment per ton of material recycled varies among states, but can be as much as 10 times higher than employment per ton of material disposed. In California and six other states, incomes in the recycling industry were above the statewide average and higher than the average for the disposal industry. It also found that in the U.S., paper mills, steel mills, plastics converters, and iron and steel foundries accounted for 50 percent of recycling jobs, 62 percent of recycling wages, and 59 percent of total recycling industry receipts.

DSM Environmental Services, Inc., *Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania, prepared for Northeast Recycling Council, 2009.*

This report featured significant modifications from the 2001 U.S. Recycling Economic Information Study, in response to critiques of the scope and methodology of that work. For this project, the authors 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. The 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 addressed concerns about the previous methodology and may yield more accurate results, they also limit the ability to make direct comparisons between the 2000 and 2010 reports.

Edgar & Associates, Inc., *Beyond Waste, 2012.*

This short report cited results from other reports, and reviews California’s recent legislation directed at increasing the tonnage redirected from landfills. Using metrics developed in other reports, estimates are made regarding the potential creation of jobs and the potential reduction of GHG emissions in California.

Employment Development Department, Labor Market Information Division, *California’s Green Economy: Summary of Survey Results, 2010.*

In this study, California’s EDD defines “GREEN” employment as jobs that produce goods or services that result in 1) **Generating and storing renewable energy**, 2) **Recycling existing materials**, 3) **Energy-efficient product manufacturing, distribution, construction, installation, and maintenance**, 4) **Education, compliance, and awareness**, and 5) **Natural and sustainable product**

manufacturing. The EDD surveyed California employers, divided them into 20 business sectors (plus one unclassified), and measured the impact of these five activities on the state's economy as a whole and on those 20 categories. Out of 15,200 employers responding to the inquiry, 7.9 percent reported employees working on green products and services (433,000 jobs). About 61 percent of green workers spend more than half their time on green activities (263,000 jobs). The job statistics were further broken down by region and industry.

Friends of the Earth, *More jobs, less waste: Potential for job creation through higher rates of recycling in the UK and EU, 2010.*

This report evaluates potential job impacts in the United Kingdom and the European Union if those entities adopt a target of 70 percent recycling by 2025. Using available employment data in waste and recycling sectors, the report estimates that recycling an additional 115 million metric tons of readily recyclable materials could create 322,000 direct jobs, 161,000 indirect jobs (suppliers, other support services), and 80,000 induced jobs (employee personal spending) in the EU. In the UK, this target could create 29,000 direct jobs, 15,000 indirect jobs, and 7,000 induced jobs.

Globe Advisors and The Center for Climate Strategies, *The West Coast Clean Economy: Opportunities for Investment & Accelerated Job Creation, prepared for Pacific Coast Collaborative, 2012.*

This report—covering California, Oregon, Washington, and British Columbia—contends that the “Clean Economy” is the single most important global opportunity in the coming years, worth about \$2.3 trillion by 2020. The report evaluates policy drivers, employment numbers, and potential growth in five sectors: energy efficiency and green building; environmental protection and resource management; clean energy supply; clean transportation; and knowledge and support. The report also found that the clean economy is growing faster than the economy as a whole and is more resilient to market volatilities. Waste diversion, recycling, and green consumer products are part of the Environmental Protection and Resource Management sector. The authors base their job calculations on the Brookings-Batelle database, updated for 2011, and get a slightly smaller number: 308,792 total clean economy jobs for California, including 52,225 jobs in Waste Management and Treatment, as well as 15,692 jobs in “Recycling and Re-use.”

Goldman, George and Aya Ogishi, *The Economic Impact of Waste Disposal and Diversion in California, prepared for CIWMB (now CalRecycle), 2001.*

This report estimates the economic impacts of waste disposal and diversion by tracking the flows of disposed and diverted materials in California. It estimates the statewide and regional economic impacts in terms of total sales, value added, and total income and jobs for 1999 using IMPLAN, an economic impact assessment software system. The report finds that recycling creates 2.27 times more jobs per ton than disposal.

HF&H Consultants and Cascadia Consulting group, *Cost Study on Commercial Recycling, prepared for CalRecycle, 2010.*

CalRecycle commissioned this study to better understand the costs, potential savings, and net costs associated with the expansion of commercial recycling in California, in response to the Mandatory Commercial Recycling Measure of the AB 32 Scoping Plan. This study evaluates costs associated with recovering varying amounts of readily recyclable materials that are high in GHG emissions. It also explores regional cost differences and the overall cost effectiveness of California's recycling system, which includes collecting, processing, and transporting, and disposal costs and revenues from the sales of the recyclables. Based on this study, CalRecycle staff estimates that managing 3.6 million tons of commercial waste would generate about 2,500 direct jobs.

John Dunham and Associates, Inc., *The Scrap Recycling Industry 2011 Economic Impact Study: Methodology and Documentation*, prepared for Institute of Scrap Recycling Industries, Inc., 2011.

This study estimates economic activities generated by firms involved in processing and brokerage/sale of scrap plastics and rubber, paper, textiles, glass, metals, electronics and related products. It measures the number of jobs in the sector, the wages paid to employees, and the value added to the economy using the IMPLAN model. According to this study, the scrap recycling industry accounted for about \$90 billion in output, and scrap processors and brokers directly and indirectly employed 459,000 people in 2011.

Morris, Jeffrey and Clarissa Morawski, *Returning to Work: Understanding the Domestic Job Impacts from Different Methods of Recycling Beverage Containers*, prepared for Container Recycling Institute, 2011.

This study examines impacts of beverage container recycling on domestic employment. It found that a direct relationship exists between material recovery tonnage and jobs, and that jobs gained from recycling exceed jobs lost in virgin extraction or landfilling. It looks at export of materials and estimates that 800 U.S. jobs are lost every year with the export of PET. The authors report that for beverage containers, deposit programs create 11 to 38 times more jobs than curbside recycling. The authors also state that due to contamination and other quality issues, much of the glass collected from single-stream recycling systems is unusable in manufacturing.

NEXT 10, *Many Shades of Green: Regional Distribution and Trends in California's Green Economy*, 2010.

This study complements EDD's 2010 California Green Economy report by tracking California's green jobs by 11 regions and by 15 segments of the green economy from 1995 to 2010. The report found green employment grew faster than statewide employment, especially in the energy generation, energy storage, and clean transportation segments.

R. W. Beck, Inc., *U.S. Recycling Economic Information Study*, prepared for the National Recycling Coalition, 2001.

This landmark report assesses the size of the entire U.S. recycling and reuse industry. It examines direct economic activities for 26 categories of recycling and re-use establishments, and indirect economic impacts for four additional categories supporting recycling and reuse businesses. This report also uses the IMPLAN model to estimate induced effect of personal spending by employees of direct and indirect establishments and generates a multiplier to measure total economic values and tax revenue attributed to the recycling and re-use industry. Furthermore, this report presents employment trends by materials and by industry.

National Recycling Coalition, Inc. and R. W. Beck, Inc., *California Recycling Economic Information Study*, prepared for CIWMB (now CalRecycle), 2001.

This report reprises the California data from the larger "U.S. Recycling Economic Information Study," and includes some additional interpretation not specifically included in the national report. It also examines direct economic activities for 26 categories of recycling and reuse establishments, and indirect economic impacts for four additional categories supporting recycling and reuse businesses. This report also uses the IMPLAN model to estimate induced effect of personal spending by employees of direct and indirect establishments and generates a multiplier to measure total economic values and tax revenue attributed to the recycling and re-use industry.

The Brookings Institution, Metropolitan Policy Program, *Sizing the Clean Economy: A National and Regional Green Jobs Assessment*, 2011.

According to this report, the national "clean economy" employs some 2.7 million workers spread across a diverse group of industries. The authors subdivide five "Clean Economy Categories" into

39 “Clean Economy Segments.” Of these segments, two are directly related to recycling: “Recycled-Content Products” and “Recycling and Reuse.” The Brookings-Battelle Clean Economy database underpins the report and may be accessed online. Based on that data, in 2010 California had 318,156 “clean economy” jobs, about 12 percent of the nation’s total. In the two recycling-related segments, California had 19,844, or about 10.5 percent, of the nation’s 189,000 jobs. There are an unknown number of additional California jobs in other “Clean Economy Segments” that could be considered to be related to recycling. Those are likely focused in six additional segments: Biofuels/Biomass, Pollution Reduction, Professional Environmental Services, Regulation and Compliance, Waste Management and Treatment, and Waste-to-Energy.

Tellus Institute, *More Jobs, Less Pollution: Growing the Recycling Economy in the U.S., 2011.*

This report assesses job and environmental impacts of a Green Economy Scenario in which the U.S. diverts and recycles 75 percent of municipal solid waste and construction and demolition debris by 2030. The Green Economy Scenario is estimated to generate 2.3 million direct jobs, an increase of 1.1 million jobs above a year 2030 business-as-usual approach, and nearly 1.5 million more jobs than these sectors provided in 2008. In the 2030 Green Economy Scenario, some 98 percent of total waste management sector jobs are associated with diversion, and only 2 percent with disposal. Indirect and induced jobs are not quantified for this study; however, a series of environmental benefits are calculated.

University of Maryland Environmental Finance Center, *2011 Impact Analysis of a Beverage Container Deposit Program in Maryland, prepared for the Waterfront Partnership of Baltimore, Inc. and the Abell Foundation, 2011.*

This report evaluates the feasibility of a beverage container deposit program in Maryland. It does not calculate job creation. The report focuses on energy savings calculations from the recycling of five categories of materials: aluminum, steel, PET, HDPE, and glass. The authors develop an equation that predicts progressive recycling rates over time for the five material types.

U.S. Department of Labor, Bureau of Labor Statistics, *Employment in Green Goods and Services--2010, March 22, 2012 news release.*

This study estimates that in 2010 there were 3.1 million jobs associated with producing goods or services that benefit the environment or conserve natural resources: 96 percent in the private sector and 4 percent in the public sector. California had 338,445 green jobs, including 230,758 jobs in the private sector (68 percent) and 107,687 jobs in government (32 percent). Among California private-sector jobs, construction, professional, scientific and technical services, and administrative and waste services were the largest employment types.