

From Waste to Jobs:

What Achieving 75 Percent Recycling Means for California

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EXECUTIVE SUMMARY

In October 2011, Governor Jerry Brown signed Assembly Bill 341 (Chesbro, Chapter 476, Statutes of 2011), modifying the California Integrated Waste Management Act and establishing a policy goal that “75 percent of solid waste generated be source reduced, recycled, or composted by the year 2020.” Recognizing the significant benefits that an effectively implemented AB 341 holds for waste diversion, ecosystem protection, materials management practices, and economic growth in California, NRDC commissioned Tellus Institute to assess the job creation potential of meeting the 75 percent recycling goal by 2020.

CalRecycle has estimated that currently half the waste generated in the state is source reduced, recycled, or composted. To increase California’s recycling rate from about 50 percent in 2012 to 75 percent by 2020, CalRecycle estimates that about 23 million tons of material that is currently being disposed must be recycled or composted. Using an approach developed by Tellus for an earlier national study of the job creation potential of recycling, we estimate that achieving a 75 percent recycling rate in California by 2020 has the potential to create at least 110,000 additional recycling jobs. (This estimate is very similar to one developed in 2013 by CalRecycle, which also used the earlier Tellus approach as the basis for its analysis).¹ Over 34,000 jobs would be in materials collection, 26,000 in materials processing, and 50,000 jobs in manufacturing using the recovered materials; though not all these jobs will necessarily be in California.

The job creation potential is driven by the larger number of jobs created per ton of material recycled as compared with material landfilled/disposed. For example, while waste collection and landfill disposal creates less than one job per 1,000 tons managed, the collection, processing, and manufacturing of products with recycled materials as feedstock creates 6-13 or more jobs per 1,000 tons, depending on the material.

The largest number of potential jobs are associated with recycling plastics (over 29,000), followed by paper (26,600 jobs) and lumber (17,600). The bulk of these jobs would come from manufacturing, which is more labor-intensive per ton of material than collection or processing. The composting of the large volume of organic materials that will need to be diverted from disposal would also create a large number of jobs (14,700). The environmental co-benefits of recycling and composting this material are substantial.

These estimates of potential job creation do not include the indirect jobs that may be created in other sectors that provide equipment and services to the recycling-related businesses or the manufacturers using the recycled material as inputs, nor do they include the induced jobs created by the spending of those holding the additional direct and indirect jobs. The specific location of these potential jobs will vary depending on material type and processing needs.

Given existing recycled commodity market conditions and export practices, as well as limited existing domestic processing and manufacturing capacity, not all of the estimated job creation would take place within California or even the United States. Retaining more of these jobs in California or the U.S. will be an incremental process, and will require a variety of policies, regulations and incentives to stimulate domestic investments to build or expand the required processing and manufacturing capacity to handle and use the materials.

Achieving a 75 percent recycling rate in California by 2020 has the potential to create at least 110,000 additional recycling jobs.

I. BACKGROUND

In October 2011, Governor Jerry Brown signed Assembly Bill 341 (Chesbro, Chapter 476, Statutes of 2011), modifying the California Integrated Waste Management Act and establishing a policy goal that “75 percent of solid waste generated be source reduced, recycled, or composted by the year 2020” (collectively referred to as “recycling”). AB 341 directs the California Department of Resources Recycling and Recovery (CalRecycle) to prepare a report for the Legislature by January 1, 2014 describing “concepts for legislative change and a vision of how CalRecycle programs will evolve within existing authority to achieve” this goal.²

AB 341 calls for an expansion of recycling services to every California business and over 70 percent of multi-family dwellings.³ Local diversion efforts over the last twenty years have largely focused on residential recycling. There is still a large untapped recycling opportunity in the commercial sector, which comprises almost three-fourths of the state’s current solid waste stream.⁴

As a first step in developing a statewide strategy to achieve AB 341’s goals, CalRecycle produced a discussion document in May 2012⁵ and held workshops for stakeholder input. The report and workshops summarize programs that are currently being implemented as well as potential new ways to tackle problematic waste streams. In this report, CalRecycle identified approximately 55 program concepts in 10 “focus areas” that are likely to be most effective in helping the state reach the 75 percent goal. While some programs relate to extensions of existing programs, others may require new investments, legislation or regulatory changes.

CalRecycle published an Update on AB 341 Legislative Report in October 2013 that presents draft priority policy recommendations.⁶ Importantly, the Update Report aligns strategies for achieving the 75 percent recycling goal with other societal objectives, including bringing green jobs to California and expanding manufacturing infrastructure. In fact, as described more fully below in the Results section, the Update includes an estimate of the job creation potential of meeting the 75 percent goal.

Recognizing the significant benefits that an effectively implemented AB 341 holds for waste diversion, materials management practices, and economic activity in California, NRDC commissioned Tellus Institute to assess the job creation potential related to California meeting the 75 percent recycling goal by 2020. Previously, Tellus had conducted a similar study—*More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.*⁷—that considered the job creation potential of a “Green Economy Scenario” that achieved a 75 percent solid waste diversion rate at the national level. As described below, the current analysis for California uses the methodology developed for the 2011 report and applies it to the California context. CalRecycle employed a similar analysis in developing its own estimate of job creation potential associated with achievement of the 75 percent goal.⁸

II. APPROACH

To estimate the job creation potential of achieving a 75 percent diversion rate, Tellus employed a life-cycle perspective, meaning the analysis covers the various stages of materials management including collection, hauling and processing (if any), as well as the ultimate disposition of the collected materials through reuse/remanufacturing, new product manufacturing, composting, or disposal via landfilling or waste to energy facilities.⁹

Our approach for estimating incremental job creation comprises three primary steps:

1. collecting current waste generation and composition data and making informed assumptions about the size and character of the waste stream in 2020;
2. identifying the incremental tonnage of waste by material type that needs to be recycled to achieve the 75 percent goal; and
3. applying appropriate job production factors (i.e. job estimates per ton of material handled for each material) to each phase of the materials management process.

Tellus' objective was to use existing data sources to the greatest extent possible and to adapt national or other jurisdictions' data where California-specific data were not readily available.

It is important to note that the job creation potential identified does not include the additional indirect jobs that may be created in other sectors that provide equipment and services to the recycling-related businesses or the manufacturers using the recycled material as inputs, nor does it include the induced jobs created by the spending of those holding the additional direct and indirect jobs (see further discussion on p.10).

On the other hand, given existing recycled commodity market conditions and export practices, as well as limited existing processing and manufacturing capacity, not all of the estimated job production would take place within the United States.¹⁰ As discussed more fully below, a variety of policies, regulations and/or incentives could help stimulate domestic

investments to build or expand the required processing and manufacturing capacity needed to handle and use the materials in the U.S., thereby retaining more of these jobs in this country.

CALIFORNIA WASTE GENERATION AND COMPOSITION

CalRecycle collects and maintains various waste generation and composition data on a statewide basis and is the best single source for this study. CalRecycle's Statewide Diversion and Per Capita Disposal Rate Statistics as well as its California 2008 Statewide Waste Characterization Study¹¹ are the most recent comprehensive data available and were used as the basis for the waste generation and composition assumptions in the current analysis.¹² It is important to note that CalRecycle reports aggregate solid waste data and does not distinguish between municipal solid waste (MSW) and construction and demolition debris (C&D).¹³ The impact of reporting MSW and C&D together is primarily a larger overall and per capita waste stream, and a lower fraction of items more prevalent in MSW (e.g., plastics) in the combined waste stream than in the MSW-only stream. Also, C&D waste is often recycled at higher rates than MSW, so the aggregation of MSW and C&D data results in an overall recycling rate that is higher than it would be for MSW alone.

Based on the 2008 Characterization Study, Table 1 below summarizes the composition of California's overall disposed waste stream¹⁴ by material type. Organic materials (food, paper, corrugated cardboard, composite organics, leaves and grass) account for about 50 percent (measured by weight) of the overall disposed waste stream. It is not surprising, therefore, that one of the key focus areas in CalRecycle's 75 Percent Initiative is on organic materials. The "Inerts and Other" waste category,¹⁵ mostly from the C&D type materials, comprises 29 percent of the disposed waste stream, and various plastics account for almost 10 percent of disposed waste.

Table 1: Composition of California's Overall Disposed Waste Stream by Material Type (2008)

Material	Est. Percent (by Weight)	+ / -*	Est. Tons	Material	Est. Percent (by Weight)	+ / -*	Est. Tons
Paper	17.3%		6,859,121	Plastic (continued)			
Uncoated Corrugated Cardboard	4.8%	0.9%	1,905,897	Film Products	0.3%	0.2%	113,566
Paper Bags	0.4%	0.1%	155,848	Other Film	1.4%	0.3%	554,002
Newspaper	1.3%	0.3%	499,960	Durable Plastic Items	2.1%	0.4%	834,970
White Ledger Paper	0.7%	0.3%	259,151	Remainder/Composite Plastic	2.8%	0.7%	1,104,719
Other Office Paper	1.2%	0.6%	472,147	Other Organic	32.4%		12,888,039
Magazines and Catalogs	0.7%	0.2%	283,069	Food	15.5%	1.9%	6,158,120
Phone Books and Directories	0.1%	0.0%	24,149	Leaves and Grass	3.8%	0.7%	1,512,832
Other Miscellaneous Paper	3.0%	0.4%	1,202,354	Prunings and Trimmings	2.7%	1.5%	1,058,854
Remainder/Composite Paper	5.2%	0.7%	2,056,546	Branches and Stumps	0.6%	0.4%	245,830
Glass	1.4%		565,844	Manures	0.1%	0.1%	20,373
Clear Glass Bottles and Containers	0.5%	0.1%	196,093	Textiles	2.2%	0.3%	886,814
Green Glass Bottles and Containers	0.2%	0.1%	79,491	Carpet	3.2%	2.0%	1,285,473
Brown Glass Bottles and Containers	0.3%	0.1%	108,953	Remainder/Composite Organic	4.3%	0.5%	1,719,743
Other Colored Glass Bottles and Containers	0.1%	0.0%	40,570	Inerts and Other	29.1%		11,577,768
Flat Glass	0.1%	0.1%	33,899	Concrete	1.2%	0.4%	483,367
Remainder/Composite Glass	0.3%	0.1%	106,838	Asphalt Paving	0.3%	0.4%	129,834
Metal	4.6%		1,809,684	Asphalt Roofing	2.8%	1.5%	1,121,945
Tin/Steel Cans	0.6%	0.1%	236,405	Lumber	14.5%	2.2%	5,765,482
Major Appliances	0.0%	0.1%	17,120	Gypsum Board	1.6%	0.7%	642,511
Used Oil Filters	0.0%	0.0%	3,610	Rock, Soil and Fines	3.2%	1.1%	1,259,308
Other Ferrous	2.0%	0.4%	801,704	Remainder/Composite Inerts and Other	5.5%	1.3%	2,175,322
Aluminum Cans	0.1%	0.0%	47,829	Household Hazardous Waste (HHW)	0.3%		120,752
Other Non-Ferrous	0.2%	0.1%	84,268	Paint	0.1%	0.1%	48,025
Remainder/Composite Metal	1.6%	0.5%	648,747	Vehicle and Equipment Fluids	0.0%	0.0%	6,424
Electronics	0.5%		216,297	Used Oil	0.0%	0.0%	3,348
Brown Goods	0.2%	0.1%	76,725	Batteries	0.0%	0.0%	19,082
Computer-related Electronics	0.1%	0.1%	32,932	Remainder/Composite Household Hazardous	0.1%	0.1%	43,873
Other Small Consumer Electronics	0.1%	0.0%	34,588	Special Waste	3.9%		1,546,470
Video Display Devices	0.2%	0.1%	72,053	Ash	0.1%	0.1%	40,736
Plastic	9.6%		3,807,952	Treated Medical Waste	0.0%	0.0%	0
PETE Containers	0.5%	0.1%	199,644	Bulky Items	3.5%	1.2%	1,393,091
HDPE Containers	0.4%	0.1%	157,779	Tires	0.2%	0.1%	60,180
Miscellaneous Plastic Containers	0.4%	0.1%	163,008	Remainder/Composite Special Waste	0.1%	0.1%	52,463
Plastic Trash Bags	0.9%	0.1%	361,997	Mixed Residue	0.8%		330,891
Plastic Grocery and Other Merchandise Bags	0.3%	0.0%	123,405	Mixed Residue	0.8%	0.2%	330,891
Non-Bag Commercial and Industrial Packaging Film	0.5%	0.2%	194,863				
				Totals	100.0%		39,722,818
				Sample Count	751		

* +/- refers to confidence interval. Confidence intervals calculated at the 90% confidence level.

Source: California 2008 Statewide Waste Characterization Study, Cascadia Consulting Group for the California Integrated Waste Management Board, August 2009, p. 6.
<http://www.calrecycle.ca.gov/publications/Documents/General/2009023.pdf>.

Note: Percentages for material types may not total 100% due to rounding

INCREMENTAL WASTE TONNAGE TO ACHIEVE 75 PERCENT RECYCLING

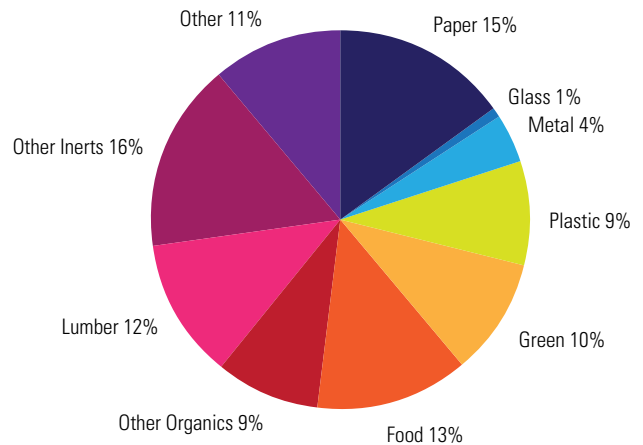
To estimate the additional waste tonnage that must be source reduced, recycled, or composted in 2020 to achieve the 75 percent recycling goal, we first need an estimate of waste generation in 2020. CalRecycle projects statewide waste generation by applying the per resident waste generation rate from recent years (averaged 10.7 pounds per resident per day from 1990 to 2010)¹⁶ to the state’s projected population (CA Department of Finance projects statewide population to grow from 37.3 million in 2010 to 40.6 million in 2020).¹⁷ Using these assumptions, the statewide waste stream is projected to grow by almost ten percent, from about 72.8 million tons in 2010 to almost 80 million tons in 2020.

CalRecycle has estimated that in 2020, absent relevant policy or other changes, more than half of this material, approximately 43 million tons, will be managed through traditional disposal (i.e. landfilling) or “disposal-related activities,” (i.e. alternative daily cover, alternative intermediate cover, exported for disposal, transformation in the state’s three waste-to-energy facilities, beneficial reuse, or waste derived fuel).^{18,19} However, with the 75 percent recycling goal, only 25 percent of the waste stream, or about 20 million tons (80 million tons in 2020 x .25), can be disposed. So, in order to reach the 75 percent recycling goal, roughly an additional 23 million tons must be recycled in 2020 (43 minus 20 = 23).

It is important to note that materials in the waste stream have different potential diversion rates depending on their specific characteristics and how they are used in various products. For example, metals are generally more effectively recovered and recyclable than composite packaging, which is much more difficult to recycle. Similarly, much of the organic waste stream (e.g., yard waste and food waste) is readily compostable, but the infrastructure to process and market compostable materials is limited and underdeveloped.

For the current study of employment impacts in California, Tellus relied on CalRecycle’s estimates of the additional tonnages by material type required to achieve the 75 percent diversion rate.²⁰ CalRecycle provided estimates of the composition by adjusting the 2008 Waste Characterization study results of waste disposed in landfills by including the additional materials managed by the “disposal-related activities” described above. These calculations resulted in the composition for disposed material presented in Chart 1.

Chart 1: Estimated 2020 Composition of Disposed Waste*



Source: The “Why” and “How” of Measurement for a 75 Percent Statewide Recycling Goal, CalRecycle, September 19, 2012 <http://www.calrecycle.ca.gov/75percent/Sept2012Wksp/WhyHowMeasur.pdf>.

*Includes traditional disposal and what is currently “disposal-related” material.

CalRecycle then applied this estimated composition to the additional 23 million tons of disposed waste in 2020 to project the tonnages for each material type that must be recycled in order to reach the 75 percent goal as presented in Table 3.

Table 3: Additional Tons to be Recycled in Order to Achieve 75 Percent Overall Recycling by 2020, by Material Category

Materials	2020 Additional Tons Recycled (1,000 tons)
Paper	3,500
Glass	240
Metal	940
Plastics	2,120
Green	2,350
Food	3,060
Other Organics	2,120
Lumber	2,820
Other Inert	3,760
Other	2,590
Total	23,500

As described below, Tellus used CalRecycle's 2020 waste composition estimates and its estimate of the additional tons by material type that will need to be recycled in order to meet the 75 percent recycling goal as key inputs for estimating incremental job creation.

It should be noted that CalRecycle's approach for estimating additional tons recycled by material type does not necessarily reflect the different diversion potentials of recyclable materials. Rather, it simply estimates additional tons recycled for each material based on its share of the disposed waste stream. For example, with paper estimated to account for about 15 percent of the 2020 disposed waste stream (see Chart 1, above), CalRecycle's approach assumes 15 percent of the more than 23 million additional tons that must be recycled in order to reach the 75 percent recycling rate will be paper. The same assumption (share of disposed waste stream = share of total additional tons recycled) is made for all the other material categories in the 2020 waste stream.

This approach, however, does not utilize the findings of the "Divertibility Analysis" in CalRecycle's 2008 Statewide Waste Characterization Study, which suggests that it may be easier to recover some materials from the existing disposal stream than others. If, as the Divertibility Analysis implies, materials with a higher associated job production factor end up being recovered at greater rates than those with a lower job production factor, then the number of overall jobs created will be greater than our estimate. The Divertibility Analysis estimates the extent and source of contamination for commonly recoverable paper, plastic, and metal materials that are in waste loads disposed at solid waste facilities. Based on the results of its sampling approach, CalRecycle estimated that about 63 percent of these recyclable materials were "clean" or uncontaminated at the time they arrived at disposal facilities.²¹

Various types of paper, including uncoated corrugated cardboard, account for an estimated 89 percent of the total tonnage of recyclable materials that is disposed. The Divertibility Analysis found that approximately 61 percent of all paper found in the disposal stream was clean and recyclable and that 39 percent was too contaminated to recycle.

By contrast, 78 percent of metals (tin/steel cans and aluminum cans) and 73 percent of plastics in the waste stream were found to be "clean" (i.e. recyclable). In

other words, the analysis shows that, due to different contamination levels, paper in the disposal stream has a lower potential for recycling than metals or plastics. As discussed below in the Results section, though metals represent only 4 percent of the disposed waste stream and plastics about 9 percent, if the estimates of 2020 incremental tons recycled reflected these higher potential recycling rates for metals and plastics, overall estimates of job creation potential of meeting the 75 percent recycling goal would also increase. This is due to the higher job production factors (explained below) associated with use of recycled metals or plastics in manufacturing relative to the use of recycled paper in manufacturing.

JOB PRODUCTION FACTORS

To estimate potential job creation associated with achieving the 75 percent recycling goal in California, Tellus used an approach we developed in a recent national study, *More Jobs, Less Pollution, Growing the Recycling Economy in the U.S.*²² For that study Tellus reviewed numerous reports and data sources (e.g., from state and federal agencies, non-governmental organizations, and consulting firms) on economic activity and jobs created through recycling and composting. Based on this review, we derived estimates of jobs produced per 1,000 tons of each material managed (paper, glass, metals, plastics, rubber, textiles, wood, food scraps, yard trimmings, miscellaneous organic wastes and other wastes) for each diversion and disposal activity (collection, processing, manufacturing, reuse/remanufacturing, landfilling and incineration). These "job production factors" were then applied to the tonnages of each material in the waste stream for each phase in the waste management system.

For the current study we first researched whether there were state-specific data regarding job creation and the various processes involved in solid waste management for each material in the waste stream. Unfortunately, we found no such data set for California, and this was confirmed by CalRecycle staff.

Thus, we used the national job production factors developed in our national study²³ and applied them to the incremental tons recycled by material in Table 3, above. These job production factors are presented in Table 4.

Table 4: Job Production Factors by Material and Management Activity (Jobs per 1000 tons)

	DIVERTED WASTE (Jobs per 1,000 tons)					DISPOSED WASTE (Jobs per 1,000 tons)		
	Collection 2008	Collection 2030	Processing	Manufacturing	Reuse/ Remanufacture	Collection	Landfill	Incineration
MATERIALS								
Paper & Paperboard	1.67	1.23	2.00	4.16	N/A	0.56	0.10	0.10
Glass	1.67	1.23	2.00	7.85	7.35	0.56	0.10	0.10
Metals								
Ferrous	1.67	1.23	2.00	4.12	20.00	0.56	0.10	0.10
Aluminum	1.67	1.23	2.00	17.63	20.00	0.56	0.10	0.10
Other Nonferrous	1.67	1.23	2.00	17.63	20.00	0.56	0.10	0.10
Plastics	1.67	1.23	2.00	10.30	20.00	0.56	0.10	0.10
Rubber & Leather	1.67	1.23	2.00	9.24	7.35	0.56	0.10	0.10
Textiles	1.67	1.23	2.00	2.50	7.35	0.56	0.10	0.10
Wood	1.67	1.23	2.00	2.80	2.80	0.56	0.10	0.10
Other	1.67	1.23	2.00	2.50	N/A	0.56	0.10	0.10
Other Wastes								
Food Scraps	1.67	1.23	0.50	N/A	N/A	0.56	0.10	0.10
Yard Trimmings	1.67	1.23	0.50	N/A	N/A	0.56	0.10	0.10
Misc. Inorganic Wastes	1.67	1.23	0.50	N/A	N/A	0.56	0.10	0.10

Source: More Jobs, Less Pollution: Growing the Recycling Economy in the U.S., Tellus Institute and Sound Resource Management, 2011.

As indicated in Table 4 above, treating materials as waste and paying to send these materials for landfill disposal or incineration is not labor intensive. Indeed, landfilling and incineration generate the fewest jobs per ton of waste managed (0.1 jobs per 1,000 tons). This is not surprising given that landfills and combustors can bury or burn large tonnages of undifferentiated waste with few employees.

Materials collection also generates relatively few jobs. Based on detailed data collected in 2010 by CM Consulting on behalf of the Container Recycling Institute, we have assumed that 1.67 jobs are created per 1,000 tons of material collected for recycling or composting and 0.56 jobs per ton for disposal. The difference in job production factors for recyclables versus trash collection reflects the fact that job creation related to materials collection varies by material type (mixed waste versus mixed recyclables versus source-separated recyclables) and that less labor per ton collected is required for mixed waste loads (slated for disposal) than for recyclables/compostables collection.²⁴ Note that the collection job production estimate for recyclables is expected to decline to 1.23 jobs per 1,000 tons by 2030 as single-stream recyclables collection (accompanied by increased automation) continues to grow.²⁵ For this analysis of job creation potential in California in 2020, we used the midpoint of 1.45 jobs per 1,000 tons recyclables collected.

Our assumption for processing of recyclables (2.0 jobs per 1,000 tons) and organics (0.5 jobs per 1,000 tons) may be somewhat conservative given the findings of the 2009 Recycling Economic Information Study Update for five northeastern states, which estimated 2.73 jobs per 1,000 tons processed.²⁶

Job estimates derived from several sources for the various manufacturing sectors that use recyclable materials demonstrate the labor intensity of manufacturing.²⁷ These job production estimates vary greatly by material/sector: from less than 3 jobs per 1,000 tons for wood and textiles, to about 4 jobs per 1,000 tons for paper as well as iron and steel manufacturing, to about 10 jobs per 1,000 tons for plastics and over 17 jobs per 1,000 tons for nonferrous metals.

Reuse and remanufacturing²⁸ are particularly labor intensive with job production estimates of over 7 jobs per 1,000 tons for several material/product categories and around 20 jobs per 1,000 tons for metal products.²⁹ Such high job production estimates for reuse and remanufacturing reflect the significant labor required for disassembly, inspection, repair/refurbishment, reassembly and testing. For the purpose of estimating jobs related directly to recycling and manufacturing products using recycled materials as feedstock, the jobs related to remanufacturing were not counted in the CalRecycle study, and have not been counted in this study.

III. RESULTS

To estimate the job creation potential of reaching California’s 75 percent recycling goal in 2020, we applied the job production factors by material and management activity from Table 4 (excluding reuse/remanufacturing) to the 2020 additional tons to be recycled by material in Table 3. The results are presented below in Table 5.

We estimate that recycling an additional 23 million tons of discarded materials per year by 2020, which would mean going from a 50 percent recycling rate in 2012³⁰ to a 75 percent recycling rate in 2020, has the potential to create at least 110,000 additional recycling jobs. Over 34,000 of the incremental jobs (31 percent of the total) are related to materials collection, 26,000 jobs (24 percent) are in materials processing, and over 50,000 jobs (45 percent) are in manufacturing in which the recovered materials are used. As noted in the Job Production Factors section, above, the recyclables processing assumption of 2.0 jobs per 1,000 tons handled is conservative. The Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania for the Northeast Recycling Council (2009) estimated that recyclables processing generates about 2.73 jobs per 1,000 tons. If we were to use this higher job production factor for processing of recyclables, it would add approximately 7,000 jobs for a total of 33,200 processing jobs and a grand total of 117,330 jobs associated with achieving the 75 percent recycling rate.

The approach described above was adopted by CalRecycle in its own study of potential job creation that would result from achieving the 75 percent recycling goal of AB 341.^{31,32}

As shown in Table 5, the largest number of jobs projected to be produced is in the plastics, paper, and lumber sectors. Recycling of an additional 2.12 million tons of plastics (including use in manufacturing) accounts for over 29,000 additional jobs, while recycling 3.5 million tons of paper produces almost 27,000 additional jobs, and the recovery and repurposing of 2.82 million tons of lumber produces almost 18,000 jobs. Note that while the 2020 additional tonnage of recycled plastics (2.12 million tons) accounts for about 9 percent of total incremental recycled tonnage, job creation associated with additional plastics recycling accounts for over 26 percent of the total estimated incremental jobs associated with a 75 percent overall recycling rate in California. This is due largely to the relatively high job production factor for plastics manufacturing (10.3 jobs per 1,000 tons).

While green waste, food, and other organics comprise about a third of the total projected additional tons to be recycled to meet the 75 percent goal in 2020 (7.53 million of 23 million total tons), organics create only about 13 percent of incremental jobs (14,684 out of 110,000). This is due to the fact that processing organics has a relatively low job production factor (0.5 jobs per 1,000 tons), and organics are not used as inputs in traditional manufacturing processes. Compost is an important input for agricultural production, but we are not aware of any studies that have analyzed the additional jobs created in the agricultural sector from compost application. As a result, we chose to be conservative and not attribute any job creation benefits to the use of compost. Nonetheless, processing organics for composting and diverting this material from landfills or combustors creates a valuable soil amendment product and has significant greenhouse gas benefits.

Table 5: Estimated Incremental Recycling Jobs in 2020, by Material Type and Process

Materials	Additional Tons Recycled (1,000 tons)	Tellus Job Production Factors				Employment Associated with Recycling Activities			
		Collection	Processing	Manuf	Total	Collection	Processing	Manuf	Totals
Paper	3,500	1.45	2.0	4.16	7.6	5,075	7,000	14,560	26,635
Glass	240	1.45	2.0	7.85	11.3	348	480	1,884	2,712
Metal	940	1.45	2.0	4.12	7.6	1,363	1,880	3,873	7,116
Plastics	2,120	1.45	2.0	10.30	13.8	3,074	4,240	21,836	29,150
Green	2,350	1.45	0.5	N/A	2.0	3,408	1,175	--	4,583
Food	3,060	1.45	0.5	N/A	2.0	4,437	1,530	--	5,967
Other Organics	2,120	1.45	0.5	N/A	2.0	3,074	1,060	--	4,134
Lumber	2,820	1.45	2.0	2.80	6.3	4,089	5,640	7,896	17,625
Other Inert	3,760	1.45	0.5	N/A	2.0	5,452	1,880	--	7,332
Other	2,590	1.45	0.5	N/A	2.0	3,756	1,295	--	5,051
Total	23,500					34,076	26,180	50,049	110,305

Note that while the job production factors for reuse and remanufacturing are by far the highest for any phase of materials management (even higher than manufacturing; see Table 4 above), and remanufacturing in the U.S. was valued at \$43 billion in 2011,³³ specific data on California remanufacturing by material type are not available. The job creation estimates in the current report, therefore, do not include potential jobs associated with reuse/remanufacturing. In part because of our conservative approach to methodological limits, this report is clearly offering a lower-range estimate of total California job creation potential associated with achieving the 75 percent recycling rate.

Moreover, these estimates relate to direct job creation. They do not include the indirect jobs that may be created in other sectors that provide equipment and services to the recycling-related businesses or the manufacturers using the recycled material as inputs; nor do they include the induced jobs created by the spending of those holding the additional direct and indirect jobs. While sufficient data are not available to estimate the potential indirect and induced jobs that reaching the 75 percent recycling goal would achieve, a recent study for the Environmental Standards Branch of the British Columbia Ministry of Environment estimated that direct jobs created from materials management activities represent about two-thirds of total job creation, with indirect jobs accounting for about 25 percent and induced jobs 10 percent of total jobs.³⁴ If this finding were applied to the 110,000 direct jobs estimate for California, it would result in an additional 38,600 jobs.

On the other hand, the estimate of 110,000 incremental recycling jobs does not account for the loss of jobs associated with the tonnage diverted from collection and disposal at landfills. Applying the job production factors for collection and disposal at landfills (0.56 and 0.10 jobs per 1,000 tons, respectively) to the more than 23 million incremental tons recycled in 2020 would result in 15,510 disposal-related jobs lost.

Also, realizing the job creation potential described above is dependent on the ability of the state's recycling infrastructure to process the collected recyclable materials within California and use those materials at in-state manufacturing facilities. Retaining more of these jobs in California or the U.S. will

be an incremental process, and will require a variety of policies, regulations and incentives to stimulate domestic investments to build or expand the required processing and manufacturing capacity to handle and use the materials. While jobs related to materials collection and a significant fraction of jobs related to materials processing are and will continue to be located in California, according to CalRecycle, in 2012 almost 20 million tons of recycled materials were exported by sea from California ports. Over half of this tonnage was mixed paper, cardboard and paperboard, and about 5 percent (over 1.1 million tons) was plastics. China and Hong Kong received about 95 percent of recycled plastics exports.³⁵ China received 58 percent of the total weight of all recyclables shipped, with Taiwan and Korea also significant importers of recycled materials.³⁶

While there are fairly good data concerning the quantity of recyclables exported through California ports, the amount of this material that is generated in California, as opposed to collected, consolidated, and shipped from other states through California, is less clear. CalRecycle reports that "Some estimates say 60 percent to 80 percent may originate in California, but that is a rough estimate and a large range."³⁷

CalRecycle also found that much of the higher-level processing of bulk or baled materials, including paper, plastic, and metals, has been occurring in other countries, particularly China and other countries in South Asia. Moreover, according to CalRecycle, "For most materials, there is not enough capacity at facilities within California to handle the materials that are currently being exported."³⁸ Without development of new processing and manufacturing facilities, the lack of adequate capacity will become an even bigger barrier to California realizing the potential employment and economic benefits of recycling the additional 23 million tons needed to meet the 75 percent goal by 2020. While noting the state's vulnerability to the vagaries of the commodity export markets, the department correctly concludes that "if we increase our recycled content manufacturing capacity, then more of these materials could be processed into products here in California. It would mean more jobs created in California, less greenhouse gases associated with long distance transport, and ensure that these resources stay in California's material stream and economy."³⁹

Endnotes

- 1 AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020 (CalRecycle), August, 2013 available at <http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1463>
- 2 Assembly Bill 341 as enacted, available at http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0301-0350/ab_341_bill_20111006_chaptered.pdf.
- 3 AB 341 covers multi-unit housing of five units or more, which is estimated to be about 73% of all multi-unit dwellings in the state.
- 4 The Numbers! What Does 75% Recycling Mean, CalRecycle, May 2012 <http://www.calrecycle.ca.gov/75percent/WhatItMeans.pdf>.
- 5 The Numbers! What Does 75% Recycling Mean, CalRecycle, May 2012 <http://www.calrecycle.ca.gov/75percent/WhatItMeans.pdf>.
- 6 Update on AB 341 Legislative Report, "Statewide Strategies to Achieve the 75 Percent Goal by 2020," CalRecycle, October 2013, available at <http://www.calrecycle.ca.gov/75percent/>. Note that a final report is expected in early 2014.
- 7 More Jobs, Less Pollution: Growing the Recycling Economy in the U.S., Tellus Institute and Sound Resource Management, 2011. http://docs.nrdc.org/globalwarming/files/glo_11111401a.pdf.
- 8 AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020 (CalRecycle), August, 2013 available at <http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1463>
- 9 Note that this report does not consider the jobs that might be associated with cleaning up litter, as there are no reliable data in this area.
- 10 Though the export of recyclables to foreign markets means that some of the jobs associated with processing recycled materials and their use in manufacturing will be created in the importing countries (especially China and others in Southeast Asia), this is partially offset by the export-related jobs created in the U.S., such as dockworkers, shipping, longshoremen, etc. These export-related jobs are beyond the scope of the present study.
- 11 California 2008 Statewide Waste Characterization Study, Cascadia Consulting Group for the California Integrated Waste Management Board, August 2009. <http://www.calrecycle.ca.gov/publications/Documents/General/2009023.pdf>.
- 12 CalRecycle is currently working on an update of this information through the 2014 Waste Characterization Study. This update will also provide enhanced data on the management of commercially-generated waste, which should help fill an important information gap. See: <http://www.calrecycle.ca.gov/wastechar/2014Study.htm>.
- 13 CalRecycle no longer tracks C&D waste separately in its Waste Characterization studies. The closest category is "Inerts and Other," which in the most recent (2008) Statewide Waste Characterization Study comprised 29.1 percent of the overall waste stream. This category includes concrete; asphalt paving; asphalt roofing; lumber (at 14.5% equals about half the total of 29.1%); gypsum board; rock, soil, and fines; and remainder/composite inerts and other. This category is imperfect as "it represents only a portion of the total statewide disposal from all C&D activities." Thus, there are other materials (paper, cardboard, plastics, metals) that are also generated/ disposed from C&D that are not in this Inerts and Other category. Similarly, not all the disposed lumber in this category is from C&D activities. With these significant caveats, C&D represents approximately 30% of the overall waste stream.
- 14 The disposed waste stream refers to waste that is landfilled; it does not include waste that is diverted through recycling or composting.
- 15 As defined in section 20230. SWRCB - Inert Waste (C15: Section 2524) of Title 27, Environmental Protection--Division 2, Solid Waste, "Inert waste is that subset of solid waste that does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives, and does not contain significant quantities of decomposable waste." As mentioned in the previous footnote, inert materials include concrete, rock, soil and fines. "Composite inerts" refers to a mixture of these materials such as may be generated at a construction site.
- 16 The Numbers! What Does 75% Recycling Mean, CalRecycle, May 2012 <http://www.calrecycle.ca.gov/75percent/WhatItMeans.pdf>. Note, however, that per resident generation rates were below 10 pounds per resident per day in the 1990s and have ranged between 10.7 and 13.6 pounds per resident per day from 2000 to 2010. As discussed throughout this report, CalRecycle's waste generation data, including this per capita figure, includes both MSW and C&D, and reflects both residential and commercial waste.
- 17 Report P-1 (County), State and County Population Projections, July 1, 2010-2060 (5-year increments), California Department of Finance Demographic Research Unit, January 31, 2013.
- 18 The Numbers! What Does 75% Recycling Mean, CalRecycle, May 2012 <http://www.calrecycle.ca.gov/75percent/WhatItMeans.pdf>.
- 19 Under CA regulations (see <http://www.calrecycle.ca.gov/Laws/Regulations/Title27/ch3sb4a.htm#20690>), "daily cover" refers to material (generally six inches of compacted earthen material) placed on active landfill units at the end of each operating day, or at more frequent intervals if necessary, to control vectors, fires, odors, blowing litter, and scavenging. Alternative daily cover (ADC) refers to alternative materials or thickness that may be permitted with various restrictions, including a demonstration by the landfill owner or operator that such use of such material will not present a threat to human health and the environment. ADC materials includes geosynthetic fabric or panel products; foam products; processed green material (yard trimmings, untreated wood waste, paper products); sludge and sludge-derived materials; ash and cement kiln dust materials; treated auto shredder waste; contaminated sediment, dredge spoils, foundry sands, energy resource exploration and production wastes (with certain restrictions); processed construction and demolition wastes and materials; shredded tires; and spray applied cementitious products. Intermediate cover" is compacted earthen material at least twelve inches placed on all surfaces of the fill where no additional solid waste will be deposited within 180 days to control vectors, fires, odors, blowing litter, and scavenging.
- 20 The Numbers! What Does 75% Recycling Mean, CalRecycle, May 2012 <http://www.calrecycle.ca.gov/75percent/WhatItMeans.pdf>.
- 21 Note: The terminology "clean" does not necessarily mean that the materials will be recovered in a greater percentage or that the more contaminated material will not be recycled. It indicates that less processing would be required than for more contaminated materials, but is not correlated to processing capability at the facility receiving the material. In addition, there are other alternatives for contaminated paper that would still count for "recycling" under AB 341 such as composting food-soiled paper.
- 22 More Jobs, Less Pollution: Growing the Recycling Economy in the U.S., Tellus Institute and Sound Resource Management, 2011. http://docs.nrdc.org/globalwarming/files/glo_11111401a.pdf.
- 23 See pages 31-35 of the More Jobs: Less Pollution report for a detailed description of methodology used to develop the job production factors, including original sources relied upon.

24 The higher job production factor for recyclables collection versus trash collection is partially due to the fact that recyclables are generally not compacted in the collection vehicles and therefore recycling collection vehicles collect less tonnage per trip than trash compacting trucks. This means that collection vehicles for recyclables require more trips (and therefore more time and labor) to handle the same amount of tonnage as trash compacting vehicles.

25 The growth in single-stream collection of recyclables is motivated by the prospect of saving upfront collection costs, simplifying the system for consumers in order to increase participation, and decreasing worker injuries through automating collection processes. Notwithstanding the growing popularity of single-stream collection, there are potential downsides as well, most importantly higher contamination rates for the collected material, higher downstream processing costs, and in some cases, lower value materials.

26 Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania, DSM Environmental and MidAtlantic Solid Waste Consultants for the Northeast Recycling Council, 2009.

27 More Jobs, Less Pollution: Growing the Recycling Economy in the U.S., Tellus Institute and Sound Resource Management, 2011, pp. 31-35. http://docs.nrdc.org/globalwarming/files/glo_11111401a.pdf.

28 According to the Remanufacturing Industries Council, "Remanufacturing is a comprehensive and rigorous industrial process by which a previously sold, worn, or non-functional product or component is returned to a "like-new" or "better-than-new" condition and warranted in performance level and quality. Remanufacturing is not the same as "recycling" or "repairing." Unfortunately, this definition is not broadly understood and the term "remanufacturing" is often misused to describe manufacturing using recycled material inputs.

29 Note that many high-value products that are reused or remanufactured (e.g., capital goods such as manufacturing, mining, and agricultural equipment, and consumer durables such as computers, auto parts, and laser toner cartridges) are made of several materials, so the job production estimates are not precisely linked to specific materials. Rather, they relate to product categories in which certain materials may dominate (e.g., metals for auto parts or plastic for laser toner cartridges).

30 Update on AB 341 Legislative Report, Statewide Strategies to Achieve the 75 Percent Goal by 2020, CalRecycle, October 2013, p. 9.

31 AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020, CalRecycle, July 2013, available at <http://www.calrecycle.ca.gov/publications/Detail.aspx?PublicationID=1463>.

32 For its study, CalRecycle reviewed 16 prior studies of job creation in recycling, including ones that were state, regional, and national in scope and others that were focused on specific materials. CalRecycle used the Tellus methodology and job production factors, noting that "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." Using the Tellus methodology, CalRecycle estimates over 109,000 potential jobs created from reaching 75% recycling in 2020, an almost identical figure to the 110,000 jobs estimated in the current Tellus study. The small difference between the CalRecycle and Tellus estimates (about 1,300 jobs total) are attributable to slightly different job production factor assumptions for the collection and processing of "other" wastes; based on our 2011 national study, Tellus uses a figure of 1.95 jobs per 1,000 tons other waste collected while CalRecycle uses 1.45 jobs per 1,000 tons.

33 Remanufactured Goods: An Overview of the U.S. and Global Industries, Markets and Trade, United States International Trade Commission, October 2012.

34 Zero Waste Business Case, Draft for Expert Review, Innes Hood Consulting, Inc. for the Environmental Standards Branch, British Columbia Ministry of the Environment, May 2013, p. 42.

35 2012 California Exports of Recycled Materials, California Department of Resources Recycling and Recovery (CalRecycle), July 2013. The report covers only materials shipped from California by sea; it does not include recyclables exported by truck to either Mexico or Canada, though such quantities are presumably relatively small. Plastics exports in 2012 included 488,000 tons of PET, HDPE and LDPE plus 658,000 tons of PVC, polystyrene, and other plastics (pp. 12-13).

36 Note that according to the CalRecycle report cited above, 2012 recycled material tonnages exported from California ports were about 11% lower than in 2011. Also, in February 2013, the Chinese government began implementing Operation Green Fence, an effort to increase inspections of imported recyclables in order to reduce the volume of contaminate loads, and meet the existing Chinese government quality standards. Figures from the first few months of 2013 show continued decline in exports of recyclables to China, but it is too early to ascertain the ultimate impact of Operation Green Fence.

37 2012 California Exports of Recycled Materials, California Department of Resources Recycling and Recovery (CalRecycle), July 2013, p. 24.

38 Ibid.

39 Ibid.



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