State of Recycling in California
Updated 2016

CalRecycle

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Executive Summary

For nearly three decades, the California Department of Resources Recycling and Recovery (CalRecycle) has been tasked with monitoring and promoting recycling in California. During that time, the landscape and requirements for recycling in the state have dramatically changed. This report summarizes the current state of recycling in California, particularly with respect to the implementation of Assembly Bill 341 (AB 341, Chesbro, Chapter 476, Statutes of 2011), which established the new goal of 75 percent recycling statewide by 2020.

Following an overview of the major laws governing recycling and diversion, this report addresses seven questions:

1. How is recycling tracked and quantified in California?
2. What is the composition of recycled material in California?
3. How is the California recycling infrastructure organized and regulated?
4. How do recyclable materials flow within and across California?
5. How does California's recycling system operate for different material types?
6. How is California's recycling infrastructure supported at the state level?
7. How does California's statewide recycling system compare with other states and other countries?

Under each section, this report details what is currently known, discusses what is unknown or estimated, and highlights where data gaps exist in terms of amounts, types, facilities, and material flows as they relate to the recycling infrastructure in California. This report is paired with the annual *State of Disposal in California* report that focuses on the disposal infrastructure.

AB 341's 75 percent statewide recycling goal has three components: source reduction, recycling, and composting. This creates a more stringent recycling threshold in California than current, ongoing mandates and requires renewed focus by CalRecycle in implementing effective programs statewide.

The recycling infrastructure in California is large and complex; recyclable materials often travel through multiple facilities once they are collected from a generator. Some facilities, such as plastic reclaimers, may specialize in one type of recyclable material, while others, such as material recovery facilities, may process a variety. In 2014, Californians recycled and composted an estimated 37 million tons of material. Another 0.5 million tons of material was collected through various individual programs for specific types of hazardous waste, including used oil, covered electronics, and paint. In

addition, 6.6 million tons of disposal-related material (alternative daily cover, alternative intermediate cover, other beneficial reuse at landfills, transformation, and waste tire-derived fuel) were reported in 2014.

Of the estimated 37 million tons of recyclables collected in 2014, *less than 4 percent was systematically tracked at the state level*. With the passage of AB 901 (Gordon, Chapter 746, Statutes of 2015), CalRecycle will require reporting from recycling and composting facilities and operations. With the implementation of this law, CalRecycle will be able to track the number of recycling facilities in California, their current throughput, their actual capacity, and their ability to accommodate a growing in-state recycling market.

The 2016 *State of Recycling in California* report includes several new focus areas beyond last year's report. These include the composition of recyclables collected at municipal solid waste operations as based on CalRecycle's 2014 waste characterization study, the implementation of mandatory commercial recycling, the movement of post-consumer recyclable commodities into and out of California, and the handling of organic waste. These topics, in combination with updates to the infrastructure and material data from the 2015 report, provide a fuller picture of how recycling is managed in California. However, there are still significant gaps in what is known about the amounts, types, facilities, and material flows of post-consumer recyclable material.

CalRecycle must take a proactive role in developing the recycling infrastructure needed to achieve the 75 percent statewide recycling goal by 2020. This includes identifying efficient investment and tracking strategies in statewide infrastructure, siting facilities more effectively, and developing private-public partnerships. In advancing these areas, CalRecycle aims to move more solid waste to higher and better uses through 2020 and beyond. This report provides part of the foundation necessary for CalRecycle to achieve this goal.

Background

Californians generate solid waste at their homes and workplaces every day. Currently, about half of this material is source-reduced, recycled, or composted, and half is disposed at landfills (buried), disposed at transformation facilities (burned to produce energy), or handled through another disposal-related activity. While almost all of this material could and should be source-reduced, recycled, or composted, it is likely there will always be some remaining material that needs to be disposed or managed by alternative methods. In the nearly 30 years since the state was tasked with monitoring disposal, recycling, and composting through the California Department of Resources Recycling and Recovery (CalRecycle), the management of solid waste has changed tremendously, with greater emphasis on saving resources and reducing disposal. The solid waste collection, handling, and disposal infrastructure has also evolved. Even so, from initial generation to final disposition, about 37 million tons of material goes to disposal, or activities closely related to disposal, in California each year. That is nearly 1 ton (2,000 pounds) of solid waste for every resident every year.

Legislation

Beverage Container Recycling and Litter Reduction Act – AB 2020

In 1986 California passed AB 2020, the Beverage Container Recycling and Litter Reduction Act (Margolin, Chapter 1290, Statutes of 1986), which established a system for financial incentives and convenient return systems to help ensure the efficient and large-scale recycling of beverage containers. In the intervening three decades, the program has been amended by more than 75 bills. These include changes to processing and handling fees, enforcement authority, and eligible beverage containers. The original goal of the Act was to achieve an 80 percent recycling rate for all aluminum, glass, plastic, and bimetal beverage containers sold in California, thereby reducing the beverage container component of litter in the state.

Integrated Waste Management Act – AB 939

California adopted its first comprehensive solid waste management program in 1989. The California Integrated Waste Management Act (AB 939, Sher, Chapter 1095, Statutes of 1989) created a comprehensive statewide system for permitting, inspecting, and enforcing requirements for solid waste facilities to ensure public and environmental health and safety. The Act also required jurisdictions to implement programs to achieve 25 percent diversion of all solid waste from disposal by January 1, 1995, and 50 percent diversion by January 1, 2000. AB 939 has shaped the solid waste management landscape in California for the last 25 years with an emphasis on implementing local government (jurisdiction) diversion programs.

AB 2494 and SB 1016

With the passage of AB 2494 (Sher, Chapter 1292, Statutes of 1992), the system used to measure annual progress became disposal-based, and since 1995 CalRecycle has used the Disposal Reporting System (California Code of Regulations §18809.6, 18810.6, and 18811.6) to track solid waste disposal amounts and jurisdiction of origin. Prior to 2007, diversion rates were calculated using an adjustment method that relied on a complicated formula involving the amount of disposed waste, employment, population, and taxable sales adjusted for inflation.

Since the passage of SB 1016 (Wiggins, Chapter 343, Statutes of 2008), disposal rates are now calculated using a per capita disposal system that relies on existing reporting systems to determine whether the 50 percent diversion mandate has been met based solely on disposal and population. Under this system, waste generation is set based on the calendar years 2003 to 2006. This period corresponds to the time when California achieved 50 percent diversion statewide and to a boom in the housing market and strong economic activity. This base generation rate is then compared to the disposal rate for a given year. Statewide, the base waste generation level is 12.6 pounds per person per day, so on average California residents must (at home and at work) dispose of less than 6.3 pounds per person per day to meet the 50 percent diversion mandate. In practice, each jurisdiction has its own generation estimates and per capita disposal targets and its own unique waste generators and waste stream, so these targets cannot be compared to each other or to the statewide numbers.

AB 341

In 2011, the Legislature implemented a new approach to the management of solid waste. AB 341 (Chesbro, Chapter 476, Statutes of 2011) required that CalRecycle oversee mandatory commercial recycling and established a new statewide goal of 75 percent recycling through source reduction, recycling, and composting by 2020. This paradigm adds to the policies in AB 939 in several significant ways.

First, AB 341 established a statewide policy goal, rather than a jurisdictional mandate. This places the onus for achieving the goal on the state rather than on the cities and counties that are directly responsible for waste disposal and recycling. Under the law, individual jurisdictions are not required to meet the new policy goal.

Second, CalRecycle uses different metrics to calculate the statewide recycling rate. Under the 75 percent recycling goal, a base generation level is calculated using the average per resident generation from 1990 to 2010 (10.7 pounds per person per day). This estimated solid waste generation is lower than the statewide generation estimate of 12.6 pounds per person per day under AB 939, which was based on a near-peak time (2003 to 2006) of historical generation. For AB 341, all years for which data existed at the time were included in the generation estimate. This takes into account both high and

low years of estimated generation, and creates a more representative picture of California's average generation by minimizing the impacts of economic swings.

Finally, for the new statewide goal, CalRecycle uses a definition of recycling that differs from the AB 939 definition of diversion as described in the "What Counts as Diversion, Recycling, and Disposal?" section below.

AB 341 also required commercial generators of more than 4 cubic yards of waste per week, and multi-family residences of five or more units, to arrange for recycling services. This was later changed to 4 cubic yards or more by SB 1018 (Committee of Budget and Fiscal Review, Chapter 39, Statues of 2012). Furthermore, AB 341 requires jurisdictions to implement a commercial recycling program for those businesses subject to the law.

AB 1826 and AB 876

In 2014, AB 1826 (Chesbro, Chapter 727, Statutes of 2014) was signed into law. This law requires businesses to recycle their organic waste on and after April 1, 2016, depending on the amount of waste they generate per week. The implementation schedule for this law is described in Table 1.

Table 1. Organic waste recycling requirements for businesses that will be phased in starting in 2016.

On and After:	Business that Generates per Week:	Of Material:
4/1/2016	8 cubic yards or more	Organic waste
1/1/2017	4 cubic yards or more	Organic waste
1/1/2019	4 cubic yards or more	Solid waste
At CalRecycle's discretion if organic waste has not been reduced to 50% of 2014 disposal levels:		
1/1/2020	2 cubic yards or more	Solid waste

AB 1826 also requires local jurisdictions to implement organic waste recycling programs to divert this waste away from landfills beginning on January 1, 2016.

Beginning in August of 2017, AB 876 (McCarty, Chapter 593, Statutes of 2015) requires counties and regional agencies to include in their Electronic Annual Reports (EARs) an estimate of the amount of organic waste in their area over a 15-year period. It also requires an estimate of how much additional organic waste recycling facility capacity will be needed to process that material, and for counties and regional agencies to identify locations for new or expanded facilities.

AB 1594

Beginning in 2020, green material alternative daily cover (ADC) will no longer count as diversion under the 50 percent diversion mandate for local jurisdictions established by AB 939. Green material ADC will instead count as disposal from that year forward due to the passage of AB 1594 (Williams, Chapter 719, Statutes of 2014). Despite being counted as disposal, green material ADC will continue to be exempt from the state tipping fee for solid waste disposed at disposal sites.

AB 901

The passage of AB 901 (Gordon, Chapter 746, Statutes of 2015) changes reporting requirements for disposal, recycling, and composting operations and facilities. These facilities will be required to submit information directly to CalRecycle rather than to counties, who currently submit that information to CalRecycle. In addition, exporters, brokers, and transporters of recyclables or compost would also be required to submit periodic information to CalRecycle on the types, quantities, and destinations of materials that are disposed of, sold, or transferred inside or outside the state. CalRecycle also gains enforcement authority to collect this information. The development of regulations to implement this law will begin in 2016.

What Counts as Diversion, Recycling, and Disposal?

The definition of what counts as diversion for local jurisdictions and recycling for the statewide recycling goal differs under the various laws listed above. It is necessary to consider the context under which solid waste is discussed when thinking about what materials count as diversion, recycling, or disposal.

Under AB 939, which set the 50 percent diversion mandate for local jurisdictions, disposal includes landfilling, exported waste sent for disposal, and transformation (waste to energy), while diversion includes source reduction, recycling, composting, ADC, alternative intermediate cover (AIC), other beneficial reuse at solid waste landfills, transformation diversion credit, and related activities. In addition, material management practices such as approved land application or inert debris fill do not count as disposal. However, because they reduce the amount disposed at landfills and transformation facilities, these activities count as de facto diversion for jurisdictions.

Under the new statewide goal established by AB 341, CalRecycle uses a definition of recycling that differs from the AB 939 definition of diversion. The statewide 75 percent goal uses a non-technical definition of “recycling” as an umbrella term for just those activities that count toward the goal, which is limited to source reduction, recycling, and composting programs. Several activities that count toward diversion under AB 939 do not count toward recycling under AB 341, including ADC, AIC, other beneficial reuse at landfills, transformation credit, and waste tire-derived fuel. These five activities are instead defined as “disposal-related activities.”

Because of the different definitions of recycling and the different base periods used to determine generation, the estimated waste generation and disposal targets under AB 341 are different than under AB 939. In 2020, Californians must dispose (at home and at work) no more than 2.7 pounds per person per day on average statewide to meet the 75 percent recycling goal.[1] Table 2 provides a comparison of the different disposal definitions and goals between AB 939 and AB 341.

Table 2. Comparison of disposal definitions and goals under AB 939 and AB 341.

	AB 939	**AB 341**
Goal	50 Percent Diversion (Jurisdictional Mandate)	75 Percent Recycling (Statewide Goal)
Activities that Count Toward Goal	*Diversion:* Source Reduction Composting Recycling ADC AIC Other Beneficial Reuse Transformation Credit	*Recycling:* Source Reduction Composting Recycling
Activities that Do Not Count Toward Goal	*Disposal:* Landfill (Including Exports) Some Transformation Engineered Municipal Solid Waste (EMSW) Green Waste ADC (Beginning in 2020)	*Disposal:* Landfill (Including Exports) Engineered Municipal Solid Waste (EMSW) *Disposal-Related:* ADC AIC Other Beneficial Reuse All Transformation Waste-Derived Fuel
Baseline Waste Generation and Base Years in pounds per person per day (ppd)	12.6 ppd (2003-2006)	10.7 ppd (1990-2010)
Statewide Disposal Target in pounds per person per day (ppd)	6.3 ppd	2.7 ppd

There are several material types and handling processes that require special consideration regarding what counts as disposal, diversion, and recycling, including

source reduction, construction and demolition, biomass conversion, certain types of recyclable materials, certain types of beneficial reuse at landfills, and engineered municipal solid waste.

Source Reduction

Source reduction is any action that causes a net reduction in the generation of solid waste. This includes reusing materials, reducing the use of all materials, replacing disposable goods with reusable goods, reducing packaging, food rescue and donations, and increasing the efficient use of paper, cardboard, glass, metal, plastic, and other materials. Source reduction is considered by the United States Environmental Protection Agency (U.S. EPA) to be the most preferred method for managing waste. As will be discussed later, source reduction is very hard to quantify and is largely reported as an aggregate quantity with recycling and composting.

Construction and Demolition

Although the U.S. EPA does not include construction and demolition (C&D) materials in its definition of municipal solid waste, thereby excluding their reuse from its recycling calculations, California does include C&D in its definition of solid waste. Numerous facilities in the state process C&D for recycling and accept materials including lumber, drywall, metals, masonry, brick, concrete, carpet, plastic, pipe, rocks, dirt, paper, cardboard, and green waste related to C&D projects.

Biomass Conversion

Biomass conversion has not been part of the waste stream for goal measurement purposes, so it is not included in either column in Table 2. Biomass conversion is the production of energy by the controlled combustion of, or use of other non-combustion thermal conversion technologies on, non-food green waste. Under both laws, biomass conversion was not considered in the base year generation calculation and does not count toward recycling or disposal-related activities; thus, this process is outside the scope of the laws. In practice, increases in the amount of material sent to biomass conversion count as de facto diversion.

Other Recyclable Materials

There are several materials that CalRecycle oversees that are not considered part of the municipal solid waste (MSW) stream. These include used oil, paint, and certain types of electronics, which cannot be landfilled due to hazardous waste laws. However, their management provides insight into broader recycling practices.

Alternative Daily Cover and Alterative Intermediate Cover

Under AB 341, alternative daily cover (ADC) and alternative intermediate cover (AIC), including green waste, sludge, ash, compost, and C&D, do not count toward the 75

percent recycling goal. Furthermore, with the passage of AB 1594, green material ADC will no longer be counted toward diversion for local jurisdictions as of 2020. This declassification of ADC for the purposes of recycling and diversion may have consequences for jurisdictions as they implement the 50 percent diversion mandate and to the state as a whole for the 75 percent statewide recycling goal. For example, based on the 2014 per capita disposal calculations, nine jurisdictions would not have met their 50 percent mandate if green material ADC had not counted as diversion.

Engineered Municipal Solid Waste

Tires and biomass that are processed by engineered municipal solid waste (EMSW) facilities in order to generate energy count as de facto diversion under AB 341. However, other types of solid waste processed at EMSW facilities count as disposal.

How Is Recycling Tracked and Quantified in California?

Tracking and Reporting Requirements

Within California, recycled materials are not currently tracked or quantified comprehensively. However, certain material management programs and operations do have mandatory tracking components. For example, extended producer responsibility (EPR) programs have mandatory tracking requirements in order to ensure that manufacturers meet recycling goals. Consumer fee and reimbursement programs, including covered electronic waste and the beverage container recycling program, track overall quantities of materials in order to keep an accurate account of money coming into and out of the program. However, these programs account for a small proportion, by weight, of recycling efforts in California.

Current Reporting Programs

In addition to program-specific tracking requirements, CalRecycle also manages several tools that allow for tracking of the recycling and disposal infrastructure in California. The Department maintains the Facility Information Toolbox (FacIT) database, which allows for voluntary reporting of material throughput and capacity by recycling facilities. However, the nature of voluntarily provided data does not provide a complete picture of the recycling infrastructure.

CalRecycle tracks the amount of waste that jurisdictions send to permitted landfills in California through the Disposal Reporting System (DRS). DRS also provides information on the movement and quantity of disposal-related materials, such as ADC, AIC, and other beneficial reuse at landfills (see “State of Disposal in California” for additional information).

Information from DRS is used to calculate the per capita disposal rate for individual jurisdictions under AB 939 and SB 1016. Jurisdictions are required to provide an annual report on diversion program implementation to CalRecycle through the Electronic Annual Report (EAR), including information on the number of local programs aimed at improving diversion and recycling. CalRecycle formally reviews jurisdiction performance in two- and four-year cycles. However, the data collected in the EARs contains limited quantitative information; as a result, it is not always clear how effective the programs are or how widely they are used. CalRecycle staff gather information from many additional sources when evaluating overall program effectiveness.

New Reporting Programs

Although their management currently falls outside the scope of AB 341, the passage of SB 498 (Lara, Chapter 746, Statutes of 2014) requires biomass conversion facilities to

annually report to CalRecycle, beginning in 2016, on the source and quantities of processed and rejected materials and the destination of ash and other byproducts. This reporting could serve as a general model for CalRecycle as it develops a general reporting system for recycling facilities.

In 2016, CalRecycle will begin developing regulations to implement the tracking of recyclables under AB 901. This new state law requires the Department to collect information from recycling and composting operations and facilities on the types and quantities of materials that are sold, transferred, disposed, or exported. Once implemented, this program will dramatically improve CalRecycle's ability to understand the movement of recyclable materials within and through California.

In addition to requiring reporting from recycling facilities and operations, AB 901 also authorizes CalRecycle to collect disposal information directly from solid waste facilities and grants CalRecycle enforcement authority in collecting this information. Together, these changes will provide a clearer picture of the infrastructure surrounding solid waste and recycling in California and the flow of materials through solid waste and recycling facilities.

AB 901 brings California into closer alignment with other state-level recycling reporting requirements. Based on surveys performed by CalRecycle, at least 39 other states plus the District of Columbia currently require some level of reporting information on recycling in their state or jurisdiction. Each state manages their system differently. Some states, such as Oregon, have mandatory reporting requirements from municipalities, facilities, businesses, and haulers that handle post-consumer recyclables. Other states, such as South Dakota, rely on voluntary surveys from businesses and municipalities. States have also adopted mixtures of mandatory and voluntary reporting requirements.

In all but three of the states with recycling reporting requirements, the state requires facilities and local governments to report on the tonnage of material that either enters a facility (if facility-level reporting is required) or that is collected and recycled by a local government. This is different from the explicit requirements in AB 901, which does not mandate reporting on the total tonnage of collected materials. Instead, AB 901 tracks specific flows of materials from recycling facilities. This type of reporting is at least partially required by 15 other states.

Diversion and Recycling Rates

CalRecycle calculates a per capita disposal rate, a statewide diversion rate equivalent, and a statewide recycling rate in order to measure the state's progress towards various recycling goals.

The per capita disposal rates for the state and for individual jurisdictions are calculated based on the amount of disposed material and the population. A jurisdiction's per capita disposal rates is used as one indicator for assessing jurisdictional compliance with AB 939 and is calculated based on the jurisdiction's population or employment. As of 2014, fewer than five percent of jurisdictions have not met their per capita disposal targets. Figure 1 shows the 2014 disposal for jurisdictions as a percentage of their per capita disposal rate. Interestingly, most jurisdictions are well below their disposal target.

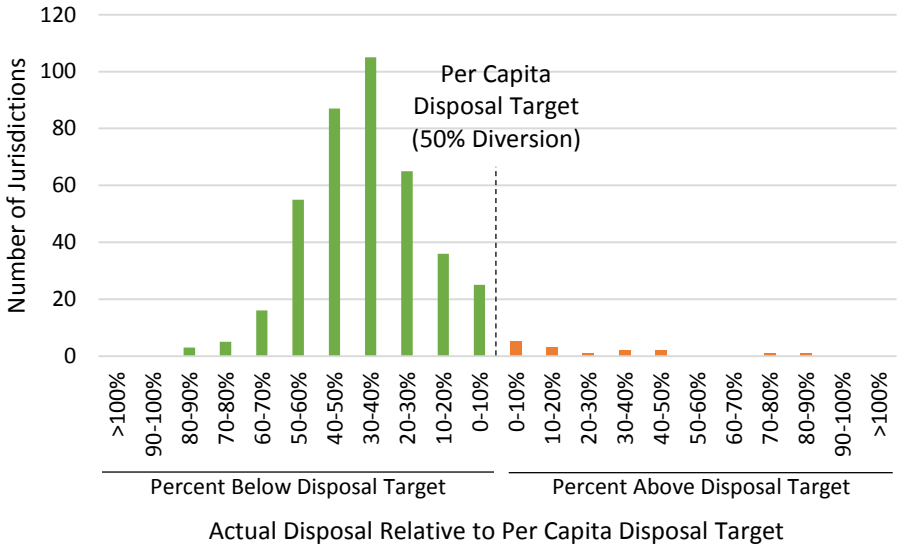

Figure 1. 2014 disposal for jurisdictions displayed as a percentage above or below their per capita disposal rate. Data from DRS.

In contrast to the per capita disposal rates, statewide recycling rates are not directly calculated based on the amount of recycled material because recycling is not systematically tracked in California under current laws. Instead, recycling rates are determined based on the measured amount of disposed waste and the calculated amount of generated waste. Without direct measurement of recycling, it is impossible to estimate the relative impact of economic downturns and improved recycling programs on the statewide recycling rate.

Assessing 75 Percent Recycling

In 2011, AB 341 established a new statewide goal of 75 percent recycling, including source reduction, recycling, and composting, by 2020. Under this program, a base

generation level is calculated using the average per resident generation from 1990 to 2010 (10.7 pounds per person per day). This value was chosen to minimize the impact of economic swings on generation. Residents and businesses must dispose of no more than 2.7 pounds per person per day on average statewide to meet this goal. This disposal includes traditional landfilling as well as disposal-related activities, including ADC, AIC, other beneficial reuse at landfills, transformation, and waste tire-derived fuel.

Using these metrics, California generated 74.9 million tons of waste in 2014. As shown in Figure 2, current disposal and disposal-related activities account for 50 percent of the total generated waste under AB 341. This corresponds to an estimated 37.1 million tons of material that was source-reduced, recycled, or composted in California in 2014.

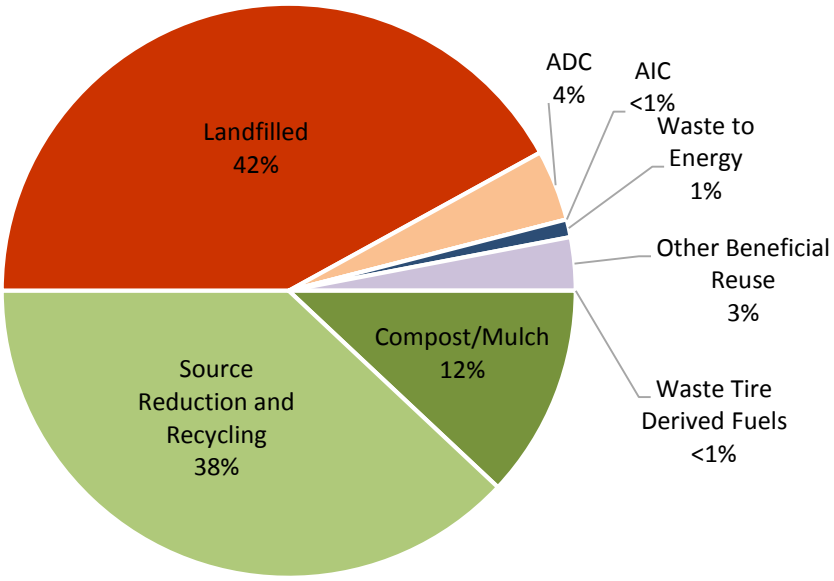

Figure 2. Estimated destination of 74.9 million tons of waste generated in California in 2014 based on AB 341 definitions. The total generation is determined from the 1990–2010 per person baseline and the 2014 population of California. Quantities of landfilled waste, waste to energy, ADC, AIC, and other beneficial reuse were obtained from the Disposal Reporting System (DRS). Quantities of waste tire-derived fuel are reported to CalRecycle. Estimates for amounts of composted and mulched material are based on published reports for chip and grind facilities and internal calculations for composting facilities. Source reduction and recycling accounts for the remaining generated waste. Some percentages in this graph have been rounded to maintain consistency with California's overall 50 percent recycling rate in 2014.

Under AB 341, California had a statewide recycling rate of 50 percent in 2014 (see Figure 3). This has been consistent for the past five years.

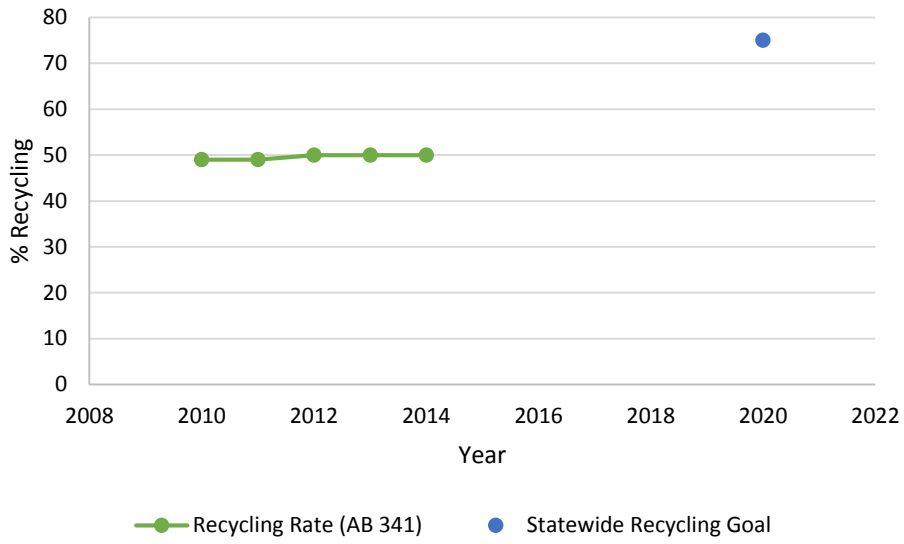

Figure 3. California statewide recycling rate since 2010. Data from www.calrecycle.ca.gov/75Percent/RecycleRate/default.htm.

Achieving 75 Percent Recycling

In order for California to reach a statewide recycling rate of 75 percent, at least half of the solid waste that is currently disposed would need to be recycled through source reduction, recycling, or composting. Using a medium-growth projection, California would expect to see a total of 36 million tons of landfilled material in 2020. After adding in the approximately 7 million tons of disposal-related activity, current estimates project a potential of 43 million tons of disposal in 2020 (see Figure 4). This corresponds to roughly 22 million tons of additional material that would need to be recycled in 2020 beyond current recycling amounts.

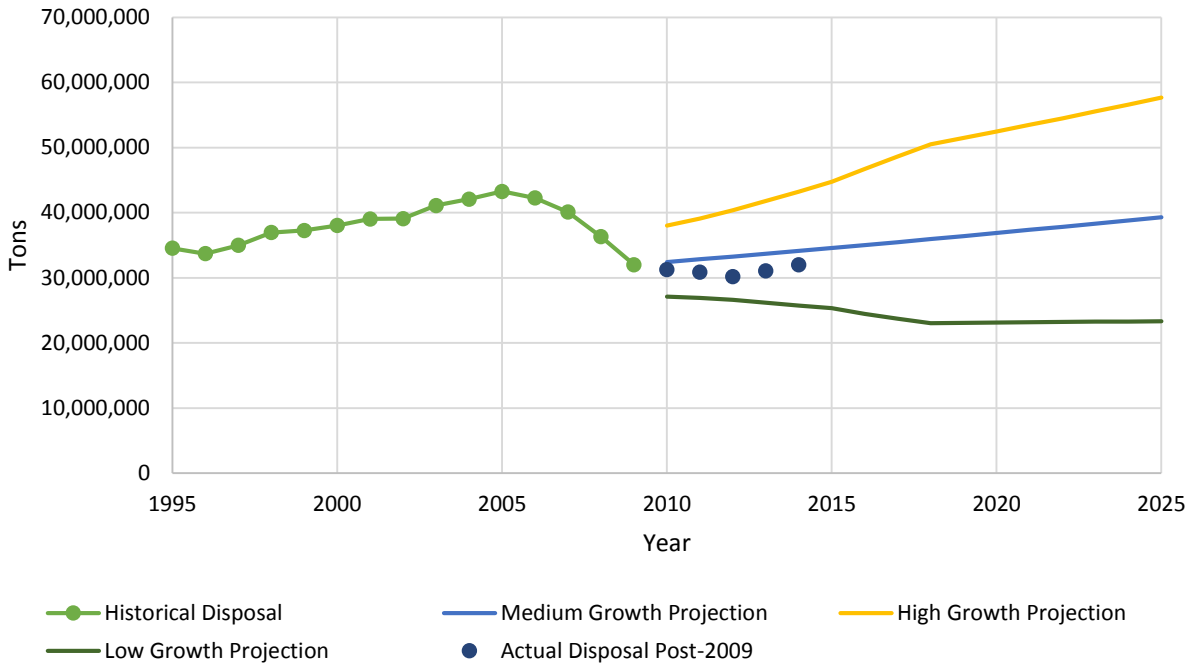

Figure 4. Historical and projected disposal for California, beginning in 2009. 1. Historical 1995-2009 solid waste disposal (landfilled, transformed, or exported for disposal) originating in California as reported to CalRecycle's Disposal Reporting System (connected green dots); 2. Projected 2010 to 2025 solid waste disposal using Woods & Poole Inc. econometric data to generate high (yellow line), medium (blue line), and low (green line) growth factors; and 3. Actual disposal (dark blue dots) for years after 2009 for comparison purposes (material disposed after 2009 was not used in the projection calculations). Data from FacIT and DRS.

CalRecycle has identified five priorities that will be critical for achieving the 75 percent recycling goal:

1. Moving organics out of the landfill
2. Expanding recycling and manufacturing infrastructure
3. Exploring new models for state and local funding of sustainable waste management programs
4. Promoting state procurement of post-consumer recycled content projects
5. Promoting extended producer responsibility[2]

CalRecycle's specific program recommendations are outlined in the *AB 341 Report to the Legislature*, which was released in August 2015.

Although the overall statewide recycling rate has remained steady over the last five years, CalRecycle continues to implement new strategies to reduce the amount of disposed material and encourage recycling efforts. These include departmental

implementation of mandatory commercial recycling and mandatory commercial organics recycling, in addition to other new programs.

As CalRecycle continues to work toward its statewide 75 percent recycling goal, it is also important to consider how the Department will quantify when and how that goal is reached. This report will summarize and evaluate the current tracking and reporting infrastructure that CalRecycle has to support its efforts, with a particular focus on the amounts, types, facilities, and material flows in recycling.

What Is the Composition of Recycled Material in California?

California periodically conducts statewide waste characterization studies in order to update information on the types and amounts of materials in California's waste stream. Studies were conducted in 1999, 2004, 2006, 2008, and 2014; CalRecycle's 2014 study was released in November 2015.

In addition to looking at the amount and type of waste disposed at solid waste facilities throughout the state, the 2014 study also evaluated materials recycled and composted by businesses. This dual-pronged approach allows CalRecycle to assess the composition of the disposed waste stream and the composition of recycled and diverted material originating from California businesses. For a more in-depth analysis of the composition of California's waste streams, please refer to the reports.[3]

2014 Disposal Facility-Based Waste Characterization Study

The facility-based portion of the 2014 waste characterization study[4] estimated the quantity and composition of the commercial, residential, and self-hauled waste streams at disposal facilities in California and aggregated the data to calculate the statewide overall composition of the solid waste stream. This was accomplished by sampling waste loads as they arrived at solid waste facilities and by surveying drivers at the facilities to determine waste-generating sectors, among other data.

During the analysis of the 2014 data, steep increases in the portion of the waste stream associated with the residential sector were detected. This appears to be an anomaly with the data driven by an apparent large change in the residential/commercial split of the Southern California region compared to previous studies. CalRecycle staff are continuing to determine if these results are real or an artifact of oversampling at sites that receive large amounts of residential tonnage, which was not accounted for in the study design. For the purposes of the 2016 *State of Recycling in California* report, all of the data reflects the 2014 sector percentages applied to the 2014 waste composition data.

Figure 5 shows the composition of California's overall disposed waste stream in 2014 as compared to 2008. There are several notable differences. First, food waste accounts for a larger percentage of the overall disposed waste stream (18.1 versus 15.5 percent), as do other organic materials. Second, lumber accounts for a smaller percentage of the overall waste stream (11.9 versus 14.5 percent), as does inerts and other. These changes may be a result of the data anomaly discussed above, or may reflect actual changes in the waste stream. For example, the decrease in lumber could be due to a reduction in construction waste due to the economic downturn, or from the overall apparent shift from commercial to residential sources of waste.

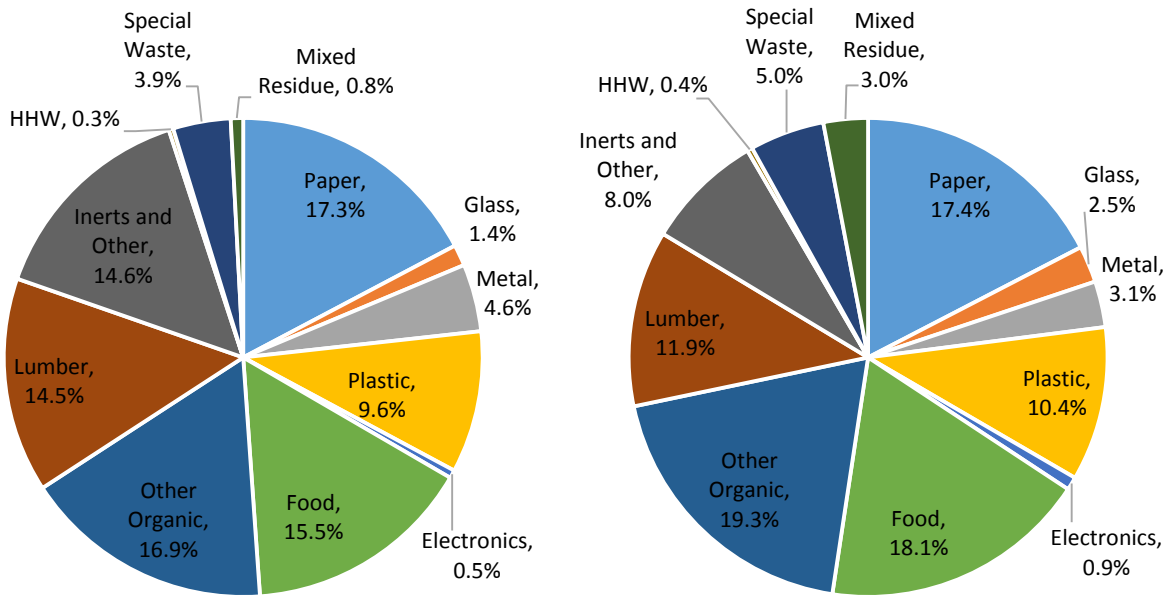

Figure 5. Composition of California's overall disposed waste stream in (a) 2008 and (b) 2014. The categories shown reflect those used in both studies, with the exception that food is separated from parent category of Other Organic, and lumber is separated from the parent category of Inerts and Other. Data from the 2014 waste characterization study and the 2008 waste characterization study.

In addition to characterizing the waste stream composition, the study also evaluated the recoverability of materials in the waste stream. Materials were aggregated into five recoverability groups: curbside recyclable, which includes materials collected, baled, and sold at most material recovery facilities; other recyclable, which includes materials that are readily recyclable at drop-off locations or through other programs but are usually not accepted by curbside programs; compostable and mulchable, which includes materials frequently accepted at commercial-scale composting programs or processing facilities for landscaping mulch; recoverable inerts, which includes various construction and demolition debris; and other materials.

More than 40 percent of disposed material statewide could be composted or mulched, and another 14 percent are accepted by curbside recyclers. Overall, 70 percent of material taken to disposal facilities could have been recovered through a recycling or composting program (see Figure 6).

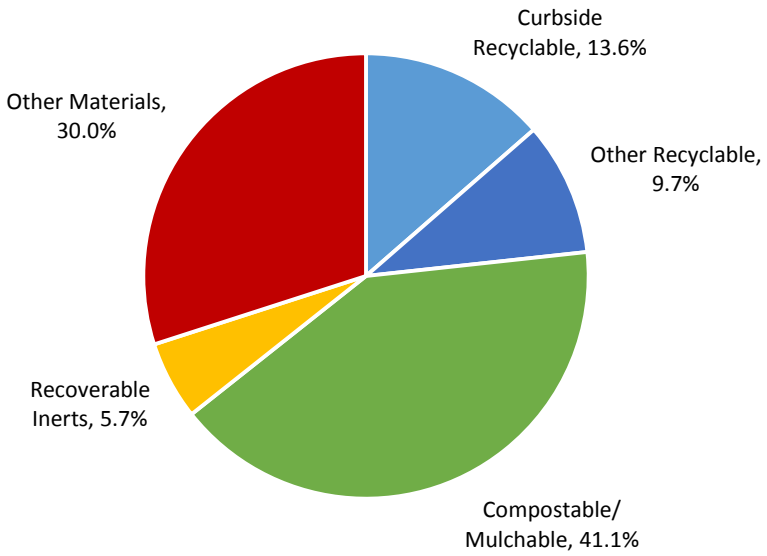

Figure 6. Recoverability of California's overall disposed waste stream in 2014. Data from the 2014 waste characterization study. The category "Other Materials" includes any material that does not currently have a recycling market in California.

This analysis suggests that there is significant potential to divert material away from landfills toward better uses. This is particularly true for food and other organic material, packaging, and cardboard. In addition, the recoverability analysis emphasizes the importance of developing an infrastructure to handle organic material as California moves toward its various state goals, as will be described in more detail later.

2014 Generator-Based Waste Characterization Study

The generator-based portion of the 2014 waste characterization study[5] performed an in-depth study of waste generated by California businesses and multi-family residences. Specifically, the study quantified how much of what materials were generated, by business type, and whether generated waste was placed in disposal bins, recycling bins, or composting bins, or otherwise diverted.

As shown in Figure 7, almost two-thirds of all waste generated at businesses was disposed, while the remaining one-third was handled by curbside recycling, curbside organics, or other diversion. The contamination rate of curbside recycling and curbside organics was generally low (16 and 2 percent, respectively). In contrast, the disposal stream contained large amounts of material that could be diverted: Almost half of the disposed stream was found to be composed of compostable material, and another quarter was recyclable material.

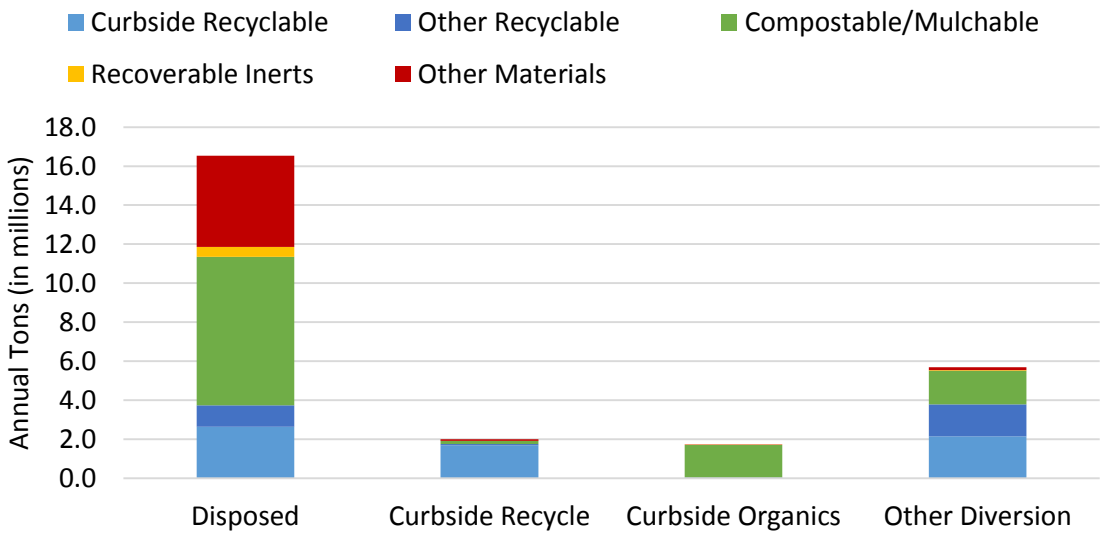

Figure 7. Recoverability of materials by stream for the overall commercial sector. Data from the 2014 waste characterization study.

Overall, the diversion rate for the commercial sector was 36 percent, with an average disposal of 1.13 tons per employee per year. Based on a recoverability analysis of the materials generated by the commercial sector, the potential recovery rate of material that is currently disposed is 81 percent. This generator study identified the top three diversion opportunities in the disposed stream as food (24 percent of the disposed stream), remainder/composite compostable paper (10 percent), and clean pallets and crates (4 percent). Food and remainder/composite compostable paper were always identified as two of the top three diversion opportunities in the disposal stream for all business subtypes.

This suggests a significant opportunity for California to achieve its commercial recycling and composting goals.

How Is the California Recycling Infrastructure Organized and Regulated?

California has several thousand facilities and operations in the statewide recycling infrastructure. However, there is currently no comprehensive statewide data repository for recycling facilities; not all recycling facilities are permitted or are required to provide any information to the state. In addition, CalRecycle has not yet implemented mandatory general reporting under AB 901 for recycling facilities or operations, so most of the available information on the quantity of materials handled by the recycling industry comes from voluntary reporting through the Facility Information Toolbox[6] (FacIT) and is refined based on Department estimates. As a result, all of the facility counts and throughputs are best estimates rather than absolute numbers. This makes it extremely challenging to evaluate how much additional recycling infrastructure will be needed to accommodate the approximately 22 million tons of additional recycling and composting capacity needed by 2020 under the statewide 75 percent recycling goal.

Source Reduction

Before waste ever enters the formal recycling infrastructure, source reduction plays a key role in minimizing the amount of material that has to be handled and processed. However, calculating statewide source reduction is challenging. In order to evaluate the contribution of source reduction to California's management of solid waste, it would be necessary to have firm, verified data on the quantities of materials handled through all of the state's other recycling and disposal activities. Then, material removed from the waste stream by source reduction could be estimated over time relative to the calculated statewide generation. Since this is not currently possible, CalRecycle groups source reduction with recycling for the purposes of evaluating California's recycling goals.

Local Programs

Local jurisdictions face a similar challenge when estimating the extent of source reduction in their jurisdictions. In addition, there is no established measurement system for quantifying the success of source reduction-focused programs at reducing the amount of waste that enters the recycling and disposal stream.

In recent years, jurisdictions have started to adopt aggressive waste reduction programs that aim to reduce the overall amount of waste that is sent to landfills; source reduction is one component of those programs. These include 75 percent diversion goals, which go beyond the 50 percent diversion mandate, and zero waste goals, which aim to divert 90 percent or more of generated waste from landfills. Based on an initial survey of jurisdictions, CalRecycle identified 14 cities with zero waste plans, 10 cities working toward a zero waste plan, and 15 cities that were educating their citizens about zero

waste. It is likely that these counts will continue to grow as local governments move more solid waste to higher and better uses.

Recycling and Composting Collection and Facility Infrastructure

The infrastructure that supports recycling in California can be broadly grouped into four categories: collection, processing, manufacturing, and organics-specific facilities and operations. These four classes of facilities will be discussed in greater detail below.

Collection Infrastructure

Recyclable materials are typically collected in one of four ways:

1. Collection programs offered by a city, town, or county, or by private haulers under contract with a local government agency.
2. Back-hauling by businesses, or private hauling under contract, that develop independent strategies for collecting and handling recyclable materials.
3. Pick-up of source-separated recyclables (for example, only cardboard) by independent recyclers.
4. Self-haul of recyclables to a recycling center, drop-off facility, or material recovery facility (MRF).

Residential customers generally use the first option for recycling collection. As shown in Table 3, there are approximately 600 curbside recycling programs that are registered with CalRecycle in California. In many cases, a single city or jurisdiction will have more than one curbside recycling collection program.

Based on 2014 data reported by jurisdictions in their EAR, 407 of 412 jurisdictions had a residential curbside collection program, and 412 jurisdictions had a commercial on-site pickup program. It is important to note, however, that there is significant variation across California on the type and extent of curbside collection that is offered to residents and commercial sites. For example, a jurisdiction may offer single stream collection, which separates recyclables from trash, mixed waste processing at a material recovery facility, which combines recyclable with the trash, or some combination of the two. Over 80 percent of jurisdictions reported offering single stream collection for residents and businesses in 2014.

Table 3. Active collection and transfer programs and facilities in California.

Facility Type	Statewide Active Facilities	Total Capacity (Tons/Year)	Current Throughput (Tons/Year)	Available Capacity (Tons/Year)
Curbside Program	624			
HHW/Electronic Waste Collection	232	304,000	227,000	77,00
Medication Collection	366	15	8	8
Sharps Collection	616	71,000	35,000	36,000
Used Oil Collection	2,857			
Carpet Collection	43			
Paint Recycler/Collector	11			
Recycling Centers (Beverage Containers)	2,076			
Transfer Station	467	60,000,000	25,100,000	34,900,000

Data accessed from FacIT on December 17, 2015. Data for recycling centers accessed from DORIIS on January 4, 2016. Facility counts reflect publicly listed facilities that are actively operating. Data gaps indicate unavailable information or fewer than three reporting facilities for an activity. Current throughput and available capacity may not add up to total capacity due to rounding. HHW/Electronic waste collection facilities include sites that accept any type of electronic waste.

In addition to general recycling curbside programs, there are several material-specific collection programs for household hazardous waste (HHW), electronic waste, medications, sharps, used oil, carpet, paint, and beverage containers. The number of collection points for a particular program depends on the specific material being collected, how long the program has been in place, and the handling needed to properly manage the material. In addition, the number of active facilities for HHW and electronic waste in Table 3 reflects the number of facilities that collect and deliver this material to processors or markets that have provided this information to CalRecycle; this number does not reflect all of the collection points, including those at retail locations, for HHW, paint, or electronic waste (approximately 500 statewide) in California. Typically, material-specific programs handle a small volume of material and will be discussed in greater detail later.

Transfer stations are facilities where municipal solid waste is aggregated before being sent to a landfill or to another facility for further processing. Recyclable material can also be received and sorted at transfer stations. It is challenging to calculate how much of the material that moves through transfer stations is part of the recycling stream rather than the disposal stream.

Recycling Processing Facilities

Once recyclable materials have been collected, they are sorted, consolidated, and prepared for end markets at a variety of facilities. Types of processing facilities, including general and specialized facilities, are listed in Table 4.

Table 4. Active recycling processing facilities in California.

Facility Type	Statewide Active Facilities	Total Capacity (Tons/Year)	Current Throughput (Tons/Year)	Available Capacity (Tons/Year)
Material Recovery Facility	162	36,100,000	15,300,000	20,800,000
Construction and Demolition Processing	519	51,600,000	24,100,000	27,600,000
Beneficiation (Glass)	9	1,290,000	1,040,000	250,000
Paper Stock Processing	65	7,020,000	4,830,000	2,190,000
Plastic Reclaimers	98	331,000	297,000	34,000
Plastic Shredding and Grinding	87	158,000	145,000	13,000
Scrap Metal Processing	144	155,000	80,000	75,000
Waste Tire Processing	49	1,760,000	870,000	890,000
Electronic Waste Processing	38	237,000	188,000	49,000
Beverage Container Processors	207			

Data accessed from FacIT on December 17, 2015. Data for beverage container processors accessed from DORIIS on January 4, 2016. Facility counts reflect publicly listed facilities that are actively operating. Data gaps indicate unavailable information or fewer than three reporting facilities for an activity. Current throughput and available capacity may not add up to total capacity due to rounding. Electronic waste processing facilities include sites that accept any type of electronic waste and include the 33 approved facilities that handle covered electronic waste.

A material recovery facility (MRF) receives recyclables and sorts the materials by type or grade to meet the commodity specifications of the end use markets. MRFs are not defined in statute or in regulation; as a result, there are many different types of facilities that could be classified as a MRF. Figure 8 shows the locations of MRFs listed in FacIT. The total of 162 facilities listed in FacIT is only an estimate; CalRecycle does not have a comprehensive list of MRFs in California. These facilities are distributed throughout the state, but most often correspond to urban centers.

Figure 8. Material recovery facilities in California. Data from FacIT as accessed on December 17, 2015.

The three most common types of MRFs are multi-stream, single-stream, and mixed waste processing. At a multi-stream MRF, incoming recyclables have usually been collected separately from each other; for example, a curbside program that separates

paper from glass or plastic prior to pick-up may feed to a multi-stream MRF. At a single-stream MRF, all incoming recyclables have been collected in one stream, such as in a residential blue bin program; recyclables collected in this manner often have a higher level of contamination than materials received at a multi-stream facility. Finally, a mixed waste processing facility (MWPF, or "dirty MRF") receives municipal solid waste which is then processed and sorted to recover recyclable commodities. In 2014, 39 jurisdictions reported having a mixed waste processing facility for residential curbside programs, and 84 jurisdictions reported this type of collection for commercial businesses.

Overall, FacIT lists MRF throughput at 15.3 million tons annually. Based on the 2006 CalRecycle report *Characterization and Quantification of Residuals from Materials Recovery Facilities*, between 6 percent (for multi-stream) and 81 percent (for mixed waste) of the incoming material at MRFs is residual and is usually sent to landfills for final disposal.[7] From the 2006 report, the extrapolated total quantity of MRF residuals was 7.4 million tons in 2005.

Due to the weight of C&D debris, this material is often handled separately from other recyclable materials. C&D is collected almost exclusively in large containers or in large-bodied trucks by the municipality, private haulers, or independent recyclers. Although some C&D materials are processed at MRFs, most C&D is collected and processed at specialty facilities or on-site. C&D processing facilities may specialize in pure material streams, such as concrete, or mixed debris, such as wood mixed with metal and other materials. The listed FacIT capacity and throughput for C&D processing is very high (51.6 and 24.1 million tons, respectively). It is likely that a portion of the material processed at these C&D facilities ultimately goes to landfills, some of which may be used beneficially at the landfill, and the estimated FacIT throughput may not be reflective of the actual volume of C&D material that is recovered for recycling.

Some recyclable materials, such as glass and plastic, go through secondary processing to improve the value of the material prior to its use in a manufacturing facility that uses recycled content feedstock. These facility types include glass beneficiation, paper stock processing, plastic reclaimers, plastic shredding and grinding, and scrap metal processing. These facilities have a modest throughput and have minimal available capacity. Figure 9 (blue squares) shows the distribution of processing facilities throughout the state. The majority of these facilities are located near urban areas, including Los Angeles and San Francisco.

Figure 9. Processing and manufacturing facilities for recyclables in California. The blue squares show processing facilities for glass, paper, plastic, and metal. The red triangles show manufacturing facilities for glass, paper, plastic, and metal. Data from FacIT as accessed on December 17, 2015.

Manufacturing Facilities Using Recycled Content

Once recoverable materials are collected and sorted or processed, they are delivered to recycling or manufacturing markets in California, in other states, and in other countries. There is minimal manufacturing infrastructure in California for recycled glass, paper, plastic, and tires, as shown in Table 5, in terms of the number of facilities and the estimated throughput. *If all of the reported material from processing facilities for glass, paper, and plastics went to manufacturing facilities in California, the supply would exceed the manufacturing capacity by more than 300 percent.*

Table 5. Active manufacturing facilities using recycled content feedstock in California.

Facility Type	Statewide Active Facilities	Total Capacity (Tons/Year)	Current Throughput (Tons/Year)	Available Capacity (Tons/Year)
Construction and Demolition Materials Manufacturing	40			
Glass Product Manufacturing	15	1,020,000	900,000	120,000
HHW Manufacturing	1			
Metals Refining or Manufacturing	8			
Other Recycling Manufacturing	36			
Paper & Paperboard Converting	4			
Paper & Paperboard Manufacturing	8	230,000	230,000	0
Plastics Manufacturing	38	71,000	68,000	3,000
Retreading	35			
Tire-Derived Product Manufacturing	22	9,000	6,000	3,000
Used Oil Transfer, Storage, or Processing	39			

Data accessed from FacIT on December 17, 2015. Facility counts reflect publicly listed facilities that are actively operating. Data gaps indicate unavailable information or fewer than three reporting facilities for an activity.

Figure 9 (red triangles) also shows the distribution of manufacturing facilities for recycled glass, paper, plastic, and metal. Although recycling manufacturing facilities are distributed throughout the state, they do not fully overlap with the geographic distribution of processing facilities. As discussed earlier, a significant portion of recyclables collected in California are exported for manufacturing into new products or other uses.

CalRecycle does not have an estimate as to the capacity of C&D processing facilities. However, it is unlikely that the 40 C&D plants could handle the estimated 24.1 million tons of material moving through C&D processing facilities. Instead, material may be processed on-site; go to landfills for disposal, road base, or other beneficial reuse; or be sent out of state.

There are 39 used oil transfer, storage, and processing facilities that are permitted in California; however, the majority of these facilities only store or transfer used oil. There are three used oil processing facilities in California that convert used oil into re-refined oil or fuel products.

Organics Processing Facilities

Most organic material, including food and yard waste, is processed through a different set of facilities than commodity recyclables (see Table 6).

Table 6. Active organics materials management facilities in California.

Facility Type	Statewide Active Facilities	Total Capacity (Tons/Year)	Current Throughput (Tons/Year)	Available Capacity (Tons/Year)
In-Vessel Digestion	13	560,000	146,000	414,000
Biomass Conversion	23	3,620,000	3,620,000	0
Composting	176	6,670,000	5,540,000	1,130,000
Composting - Research Operation	14	78,000	78,000	0
Chipping and Grinding	163	11,500,000	7,400,000	4,100,000
Other Organics Management	22	680,000	630,000	50,000

Data accessed from FacIT on December 17, 2015. Facility counts reflect publicly listed facilities that are actively operating. Current throughput and available capacity may not add up to total capacity due to rounding. Count for in-vessel digestion includes one facility located at a dairy that does not accept MSW.

Organic materials may be processed through composting, anaerobic digestion, or other technologies to produce soil amendments, liquid fertilizers, energy, fuels, or chemicals. Chipping and grinding facilities may size-reduce organics for composting or sell ground materials as mulch. The throughput for chipping and grinding facilities listed in FacIT is difficult to estimate and differs substantially from the throughput reported in industry surveys. The throughput at composting facilities has declined relative to last year's report due to facility closures. Other organics management includes specialty facilities, such as mushroom or worm farms. Overall, the available capacity at organics management facilities is relatively low.

Summary of Facilities

The facilities listed in Tables 3-6 form a complex web of interactions within California's recycling infrastructure. For example, one recyclable item might move from a consumer to a curbside collection program and a MRF before being exported for further processing, while another might be collected within the municipal solid waste stream, sent to a MWPF, reprocessed, and finally manufactured into a new product in-state. The movement of byproducts from each of these facilities further complicates the network, as materials move among facilities.

In addition, the facility information available from FacIT underrepresents the facilities within the recycling infrastructure in California.[8] Some recycling facilities do not require permits, are not regulated by CalRecycle, and do not voluntarily provide data to CalRecycle. In addition, not all of the facility types report on their capacity or throughput. Further inaccuracies in the reported capacity and throughput come from permits listing the maximum possible capacity, rather than the practical capacity, and overestimating current throughput. CalRecycle staff attempt to correct for this through internal analyses, but these estimates may not perfectly reflect the infrastructure.

The complicated network of facilities, coupled with incomplete records on the identity, throughput, and capacity of facilities, makes it challenging to track how many tons of recyclable material is processed in California and to evaluate how much additional infrastructure would be necessary to handle California's growing recycling system.

Permitting

CalRecycle regulates solid waste handling, processing, and disposal activities in order to protect public health, safety, and the environment. Although most facilities regulated by CalRecycle handle solid waste, permitted facilities also include material recovery facilities, composting facilities, and waste-to-energy facilities. CalRecycle identifies five tiers for facilities: full, standardized, registration, notification, and excluded. The first three tiers require a solid waste facility permit, whereas the latter two do not. Placement within a tier depends on the type of activity and the type and amount of solid waste handled at the facility.

Recycling Facilities

By statute (Public Resources Code §40200(b)(2)), CalRecycle does not permit facilities whose primary function is to process wastes that have already been separated for reuse and are not intended for disposal. CalRecycle's permitting procedure, developed by regulation, applies a three-part test in order to determine whether an operation qualifies as a solid waste facility, which is subject to permitting by CalRecycle, or as a recycling center, which is not. If a facility fails any component of the three-part test, then it falls under CalRecycle's permitting jurisdiction.

The three-part test stipulates:

1. A recycling facility shall only receive material that has been separated for reuse prior to receipt.
2. The monthly average of the residual amount of solid waste left after processing the material received at the facility is less than 10 percent by weight of the total amount of material received that is separated for reuse.
3. The amount of putrescible wastes in the material is less than 1 percent of the amount of separated for reuse material received by weight, and the putrescible wastes shall not cause a nuisance.

Under this classification scheme, “clean” MRFs that receive source-separated recyclables and meet the three-part test may not require a permit. Mixed waste MRFs, which separate recyclables from disposed materials, would require a permit. Recycling facilities, such as dedicated metal, fiber, resin, or glass recycling facilities, do not require permits if they meet the three-part test. Since these facilities may not have permits from the state, it is challenging to continuously determine if they should continue operating without a permit. Local enforcement agencies typically evaluate facilities in order to determine whether they need permits. Facilities associated with the beverage container recycling program are required to register with CalRecycle, but this is not a formal permitting process.

In addition, there are several activities that are excluded from regulatory requirements provided they do not accept solid waste that has not been separated for reuse. The activities include buy-back and drop-off centers, reuse salvage operations, and scrap metal recyclers and dealers.

A key concept behind the three-part test is that facilities receiving source-separated material should meet the two residual level provisions. However, glass beneficiators in California have expressed concern that glass residuals that are accepted at their facilities exceed the residual limit, despite the fact that the material has already been processed at a MRF or transfer station prior to arrival at the beneficiation facility. As a result, CalRecycle is considering how to work with all facilities in the recycling infrastructure to ensure that recyclable material is handled appropriately.

Organics Facilities

Composting and in-vessel digestion facilities are subject to specific CalRecycle regulations to ensure that compostable materials are handled safely and properly. The specific regulations vary based on the amount and types of feedstocks that are handled.

The Office of Administrative Law approved revised Compostable Materials, Transfer/Processing regulations on November 10, 2015, and filed the regulations with the Secretary of State on November 10, 2015; the regulations take effect on January 1,

2016. The regulations impose, beginning on January 1, 2018, a limit of 0.5 percent on physical contaminants in compost and compostable material applied to land. This limit is aimed at addressing concerns that compost can have large amounts of plastic, glass, or other contaminants that do not naturally decompose after the material has been applied to the land.

In addition, the new regulations provide a standardized regulatory framework for in-vessel digestion activities, including those at in-vessel digestion facilities. The regulations combine the handling of feedstock and residual waste material requirements from transfer/processing requirements, and end product standards from compostable material handling requirements; this should provide a consistent process for permitting new and existing facilities.

Recent legislation (AB 1045, Irwin, Chapter 596, Statutes of 2015) is aimed at further streamlining the permitting process for organic facilities by requiring CalRecycle to coordinate with related agencies in order to develop a policy for coordinated permitting and regulation of composting facilities. AB 1045 also creates a state agency working group to develop and implement policies to aid in diverting organic waste from landfills.

Siting Challenges

There are several siting issues associated with new facilities and the expansion of existing facilities. First, residents are increasingly demanding that facilities not be located near their neighborhoods. Odor and noise complaints can be routine, resulting in a limited number of urban locations where facilities can operate. This is a particular challenge for composting facilities, which can be more odorous than recycling facilities. When facilities near population centers close, this can result in longer transportation distances of materials to appropriate processing facilities. In order to help address concerns over odor, CalRecycle changed its regulations to provide a better mechanism to address odor complaints associated with compostable material handling activities.

In addition, waste facilities in general are regulated by multiple governmental agencies, including regional water quality control boards and air quality management districts. This can create challenges in complying with a myriad of requirements. For example, composting facilities in air quality districts with federal Clean Air Act compliance issues typically need to provide mitigation measures. In addition, the State Water Resources Control Board's recently adopted "Waste Discharge Requirements for Composting Operations" General Order now requires facilities to implement water protection measures. The recent closure of a large composting facility in Sonoma County is partially attributed to concerns regarding Water Board requirements.

Mandatory Commercial Recycling

CalRecycle has recently begun using state-level policies to help enhance the collection and processing infrastructure within California, particularly those targeting the commercial sector.

According to the 2014 waste characterization study, the commercial sector accounted for 50 percent of the disposed waste stream in California.[9] According to the Legislature, local governments have faced greater challenges in reducing disposal from commercial sources than in reducing disposal from single-family residential sources. In 2012, AB 341 initiated mandatory commercial recycling (MCR), which requires businesses that generate four cubic yards or more of commercial solid waste per week and multi-family residential dwellings of five units or more to arrange for recycling services. According to CalRecycle estimates, MCR impacts 250,000 businesses and 220,000 multi-family dwellings;[10] this accounts for 75 percent of business waste and 60 percent of multi-family dwelling waste.

Businesses can comply with AB 341 in several ways: by source-separating recyclable materials from solid waste and subscribing to a service to collect the recyclables; by self-hauling; by arranging for the pick-up of recyclables; or by subscribing to a recycling service, which may include mixed waste processing that yields diversion rates comparable to source separation. The MCR requirement that mixed waste processing yield diversion rates comparable to source separation poses difficulties. In developing the regulations for MCR, a working group determined that there were numerous challenges for defining this requirement. As a result, CalRecycle currently does not have a quantitative threshold for what constitutes “comparable to source separation.”

Surveying Implementation of MCR

Mandatory commercial recycling went into effect on July 1, 2012. The introduction of MCR was expected to have an impact on the amounts and types of materials that are processed by the existing recycling infrastructure in California and the amount of exported recycling.

Based on initial data collected from the 2013 Electronic Annual Report (EAR), all 413 reporting jurisdictions had commercial recycling of some type. In addition, 123 jurisdictions reported local ordinances that also required mandatory commercial recycling.

CalRecycle’s current reporting requirements are focused on ensuring that jurisdictions are providing education and outreach to businesses and annually monitoring how many are recycling. The law does not require jurisdictions to collect information on the number of tons diverted through these programs, but jurisdictions are required to report to CalRecycle their monitoring data on (1) the number of businesses and the number of multi-family residences in each jurisdiction that must comply with MCR, (2) the number

of businesses and the number of multi-family residences in each jurisdiction that must comply with MCR and that are not recycling, and (3) what they did to inform the regulated entities that are not recycling about the law and how to recycle in the jurisdiction. CalRecycle staff also collect data on what education and outreach each jurisdiction conducted. CalRecycle is reviewing each jurisdiction's reported information annually and formally reviews implementation of MCR programs on two- and four-year cycles; CalRecycle will also perform a waste characterization after 2020 to determine how the state is doing overall.

In order to compile preliminary information on the implementation of MCR, CalRecycle staff mined each jurisdiction's 2013 EAR to collect any numerical information provided by jurisdictions. Since this data reflects the first year of program implementation, it serves as an early snapshot of MCR, rather than as an evaluation of each jurisdiction's program. There is high variability in what type of information is reported and how accurate the estimates are. In addition, the absence or completeness of the monitoring data in the EAR does not mean that no action toward MCR is being taken, as CalRecycle staff are conducting annual visits to verify that education, outreach, and monitoring are occurring. To date there are no jurisdictions that have been referred to the Jurisdiction Compliance Unit due to lack of compliance with the law. In order to address the challenges in collecting data from the jurisdictions, CalRecycle will be revising the electronic reporting system beginning in 2017 to better capture the monitoring data.

In the 2013 EAR, 82 percent of jurisdictions reported the number of affected accounts for businesses (see Figure 10); jurisdictions that reported on this information are distributed throughout the state. Significantly fewer jurisdictions (58 percent) reported a stand-alone number for the number of affected multi-family residences; however, this is because some jurisdictions reported a single combined number for businesses and multi-family residences. In addition, it was not always clear whether jurisdictions were reporting on the total number of businesses in their jurisdictions, the number of businesses that were subject to MCR, or the number of businesses that were subject to MCR and other local recycling ordinances. Jurisdictions that did not provide any or part of the monitoring data in the annual report were notified by CalRecycle staff of the need to correct the reporting gap.

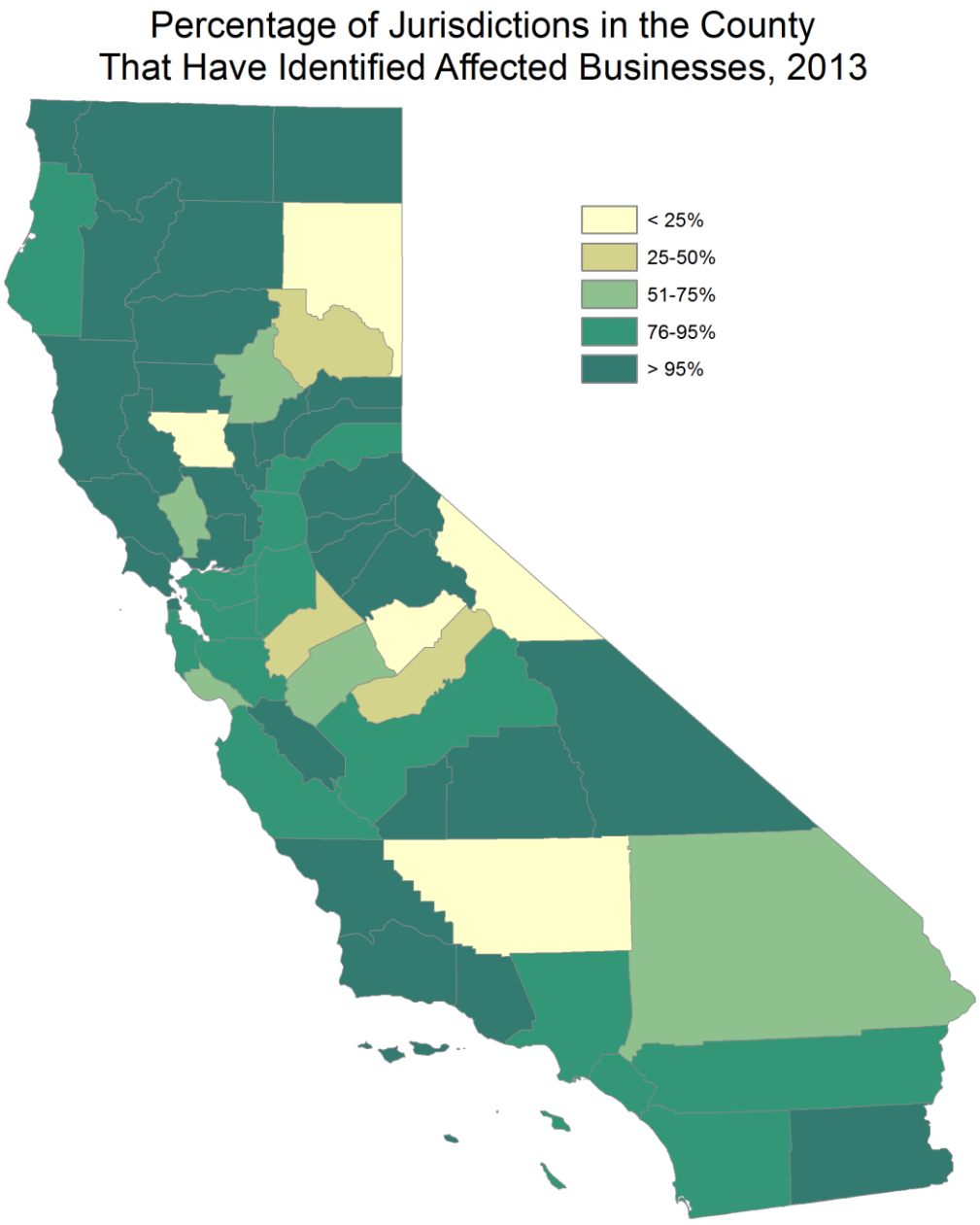

Figure 10. Percentage of jurisdictions within a county reporting to CalRecycle on whether or not they had identified businesses in their area that are affected by MCR, as described in the Electronic Annual Report for 2013.[11]

Based on the data reported in the 2013 EAR, more than half (58 percent) of reporting jurisdictions reported that they completed some sort of notification to alert businesses if they were not in compliance with MCR. This typically includes sending out additional educational materials and meeting with commercial customers.

Finally, the percent of businesses recycling in a given county was calculated using 2013 EAR data for the first full year of implementation. For the jurisdictions that reported numerical data in 2013, statewide, 80 percent of businesses identified in the 2013 EAR were reported as recycling. Although there is variability among counties, the data overall suggests that many businesses are complying with MCR. It is important to reiterate, however, that the data reported in the 2013 EAR is highly variable and may not reflect all local efforts or all businesses affected by MCR. In addition, the data do not indicate the extent to which individual businesses are actually recycling. Future years of reporting, particularly starting in 2017 when the reporting system is revised and more jurisdictions have a handle on their commercial sector participation, should provide additional information on jurisdiction compliance with MCR as well as more reliable data on business and multi-family residence participation and overall recycling.

In addition to the data provided in the EAR, CalRecycle surveyed more than 800 businesses on their diversion and recycling practices as a part of the 2014 waste characterization study. The surveys were conducted between September 2013 and October 2014, or one to two years into the implementation of MCR. When businesses were asked if they were aware of the state requirements for MCR, only 12 percent reported knowing about the law. While an individual employee responding to the survey may not be aware of requirements already adopted by the business owner, the data suggests that, at the time of the survey, improved educational efforts may have been needed. Alternately, the business may be unaware of the law but may still be subscribing to recycling services.

These initial surveys serve as a general indicator of whether California is increasing the collection infrastructure and the participation it needs to reach its 75 percent statewide recycling goal. Based on the first year of data reported in the 2013 EAR, many jurisdictions and businesses are implementing MCR. CalRecycle will continue to monitor the development of MCR as the program matures.

Mandatory Commercial Organics Recycling

In 2014, a new statewide mandatory commercial organics recycling program was established (Chesbro, AB 1826, Chapter 727). This program is similar in nature to MCR in that it is a policy tool designed to enhance the collection and processing of organic material generated by a specific sector. Based on the 2014 waste characterization study, 5.6 million tons of food waste, 2.7 million tons of green waste, and 2.1 million tons of clean lumber were landfilled; this is material that could instead be composted, mulched, digested, or otherwise processed for reuse.

As implementation of the program begins next year, CalRecycle is committed to help local governments develop their plans to handle material. CalRecycle staff will meet with each jurisdiction to review their organics recycling program or plans to implement a program, as is currently being done with MCR. The passage of AB 876 (McCarty, Chapter 593, Statutes of 2015) will further support this effort by requiring counties or regional agencies to estimate the amount of organic waste in a region over a 15-year period and how that material will be handled at facilities. As adequate processing capacity for organic material is crucial for the success of the mandatory commercial organics recycling program, CalRecycle continues to develop policies for encouraging the growth of the necessary infrastructure.

How Does Recyclable Material Flow Within and Across California?

The movement of recyclable commodities within California and across its borders is complex and difficult to accurately assess. Variations in facility ownership, hauling distances, and availability of processing facilities can impact how much of what materials are recycled. In addition, recycling brokers facilitate the movement of materials by buying and selling materials domestically and internationally without ever physically handling the goods. This adds complexity when trying to track recyclables throughout the process, particularly in the absence of routine reporting from recycling facilities.

As is the case with many commodities, recycling is a global industry. As a result, the broader recycling market can strongly influence where post-consumer recyclables are sent. The impacts of these national and international markets can be seen by the extensive export of recyclables from California by a variety of modes, including vessel, air, rail, and truck. Although the state of California does not track this information, the United States Census Bureau, Surface Transportation Board, and Department of Transportation all collect information on the movement of commodities within and across the United States. Taken together, the information from these sources provides insight on the magnitude of the import and export of recyclables into and out of California.

Post-Consumer Recycling Markets

One major driver of California's recycling efforts is the broader market for recyclable materials. In order for recycling to be economically viable, the cost of processing and using the recycled material must be less than that of virgin material.[12] One complication is that prices for materials can fluctuate wildly, leading to dramatic variations in the monetary reward for recycling.

Table 7 shows the value per ton of scrap material for various common recyclables. Overall, scrap values were lower in July 2015 than they were in 2014. As mentioned previously, these values can vary substantially. Recent reports suggest that national prices continue to change from month to month,[13] although indicators since July suggest that prices for recyclable commodities have been steadily decreasing.[14]

Table 7. Scrap value per ton for common recyclables. Data is from CalRecycle's monthly statewide weight average scrap value notices.

Scrap Value ($/Ton)	July 2013	July 2014	July 2015
Aluminum	$1,420.32	$1,676.45	$1,159.35
Glass	$3.95	$1.18	-$2.64
PET (Plastic #1)	$357.53	$388.01	$283.66
HDPE (Plastic #2)	$324.94	$420.09	$374.59

The prices of individual commodities are based on a range of factors, including global supply, demand, strength of the U.S. dollar,[15] inventories, consumer consumption, material quality and cleanliness, and the availability of facilities to process recycled materials. In addition to the inherent volatility of market prices for secondary materials, small changes in prices can have strong impacts on the profitability of secondary materials compared to virgin material. For example, falling oil prices and other factors have reduced the price of virgin plastic and made recycling plastics less economically feasible by reducing the scrap value of post-consumer recyclable plastic.[16] Figure 11 shows this relationship between the prices of crude oil and the scrap value of PET and HDPE plastics.

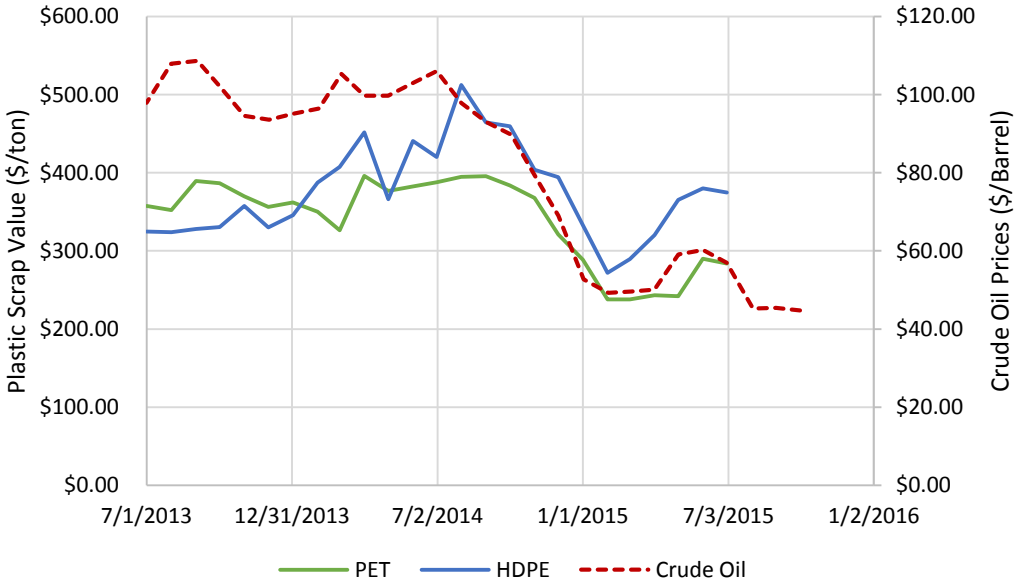

Figure 11. Data for PET and HDPE scrap values from CalRecycle's monthly statewide weight average scrap value notices. Data on crude oil barrel prices is from the U.S. Energy Information Administration.[17]

Market prices of secondary materials also affect whether the materials are exported from the state; exporting further increases their price and decreases their quantity in the United States. In order to help promote secondary material markets, governments may provide subsidies and incentives to increase the profitability of reusing materials. The availability of local recycled-content manufacturing facilities is also a key factor that affects the overall flow of materials. As discussed earlier, California's in-state manufacturing facilities currently have insufficient capacity to handle all post-consumer recyclable material generated in California.

Import and Export of Recyclables

One consequence of the extensive international post-consumer recycling market is that significant quantities of recyclable items are shipped out of California after their collection. In addition, recyclable materials may be imported to California either for processing in-state or for export to other countries. There are four primary methods by which recyclable commodities move: vessel, air, rail, and truck. Each mode of transport has different tracking, reporting, and regulatory requirements; as a result, it is difficult to develop a single analysis of how much material moves into or out of California. The following discussion will focus on each mode individually.

Seaborne Vessel Transport

CalRecycle publishes an annual report that primarily evaluates seaborne exports of recyclables from California's ports. The data in the report is obtained from WISERTrade, which is a company that aggregates U.S. Census Bureau data and other sources of information.

In 2014, California exported approximately 18.0 million tons of recyclable material overseas through the ports; recyclables exported at ports were valued at $6.9 billion.[18] Roughly 92 percent of the materials were metals and mixed paper, cardboard, and paperboard (see Figure 12).

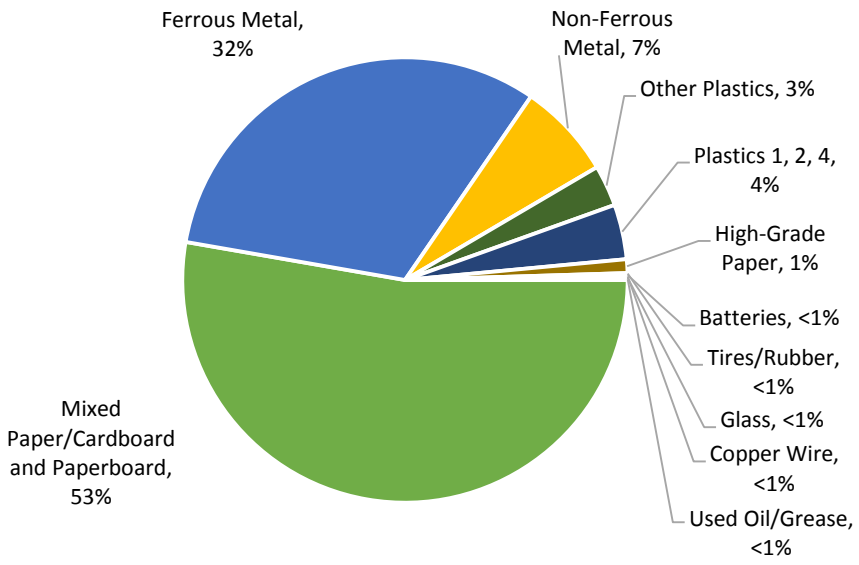

Figure 12. Composition by weight of 18 million tons of exported recyclable material from California sea ports in 2014. Data from "2014 California Exports of Recyclable Materials." Values may not add up to 100 percent due to rounding.

Although it is difficult to quantify how much of this material comes from California rather than neighboring states, it is likely that the majority (60 to 80 percent) originates in California. Imported recyclables from other states are not generally tracked, and as a result, it is challenging to determine if those materials are recycled in California or are directly taken to the ports for final export.

Recyclables that are exported through the port system are primarily distributed to China, Taiwan, and South Korea (see Figure 13). Some recyclables are actually processed into recycled content feedstock or new products after they are shipped overseas, but other materials are not, and it is difficult to track the final handling of materials. The lack of information on end-uses, lax adherence to environmental health standards, and uncertain regulatory compliance are potential concerns with the export of recyclable materials.

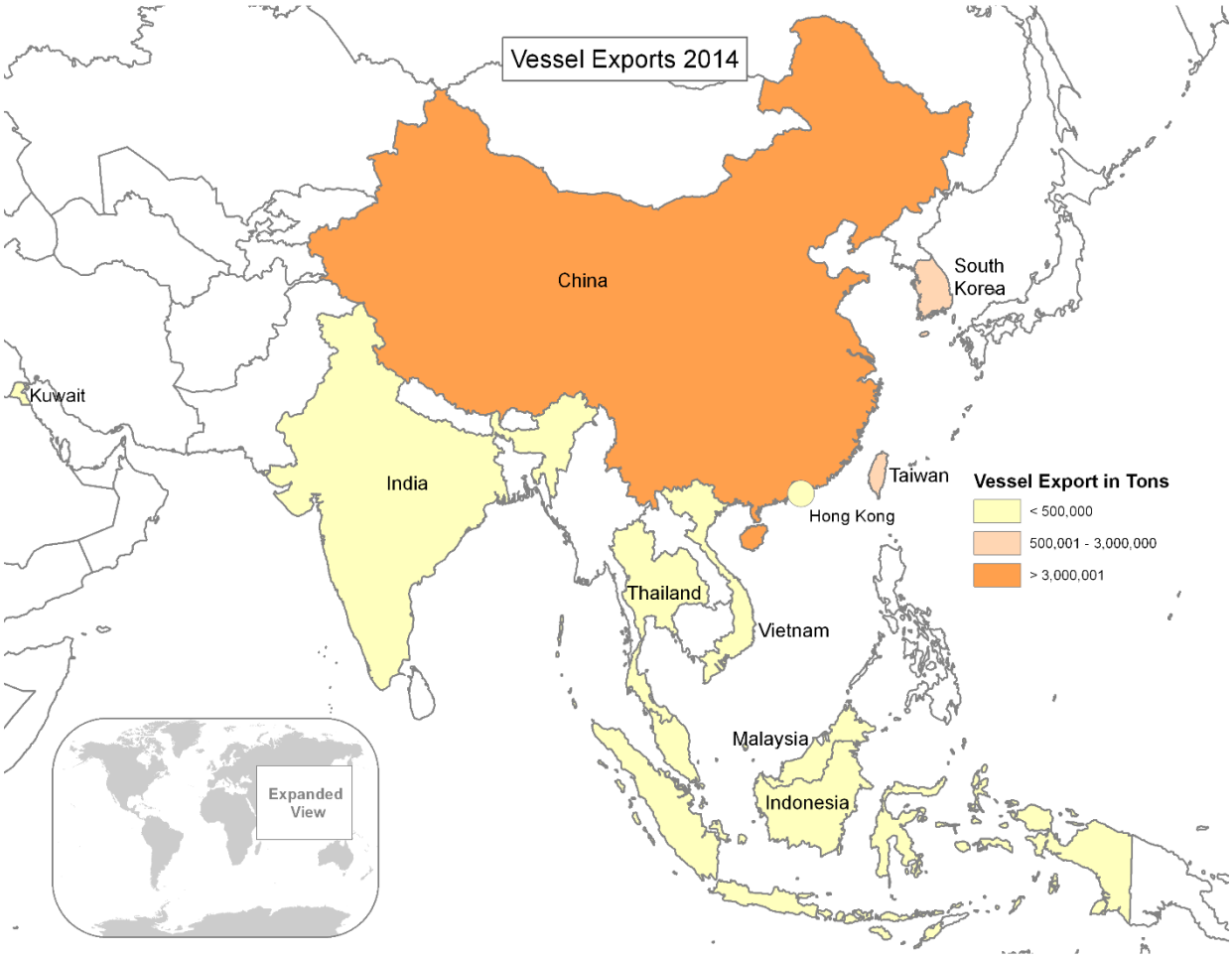

Figure 13. Top 10 destinations by weight for exported recyclable and scrap materials from California by vessel in 2014. Data from WISERTrade.

Overall, the amount of recyclable exports dropped about 3 percent from 2013 to 2014, and data for the first nine months of 2015 shows recyclable exports are down about 4 percent compared to the same period in 2014. This continues a larger trend of declining recyclable exports since 2011. As stated in "2014 California Exports of Recyclable Materials," this decline may be associated with "the Green Fence policy of China, the West Coast port dispute, a strengthening dollar relative to other currencies, the slowdown in China's economy, the drop in oil prices, and the decline in some U.S. recycling efforts."

In contrast to the 18.0 million tons of exported recyclables in 2014, only 56,000 tons of recyclables were imported at sea ports in 2014. Figure 14 shows the origins of this material. This highlights the large discrepancy between domestic and international

markets for recyclables, as California is a net exporter of post-consumer recyclable materials.

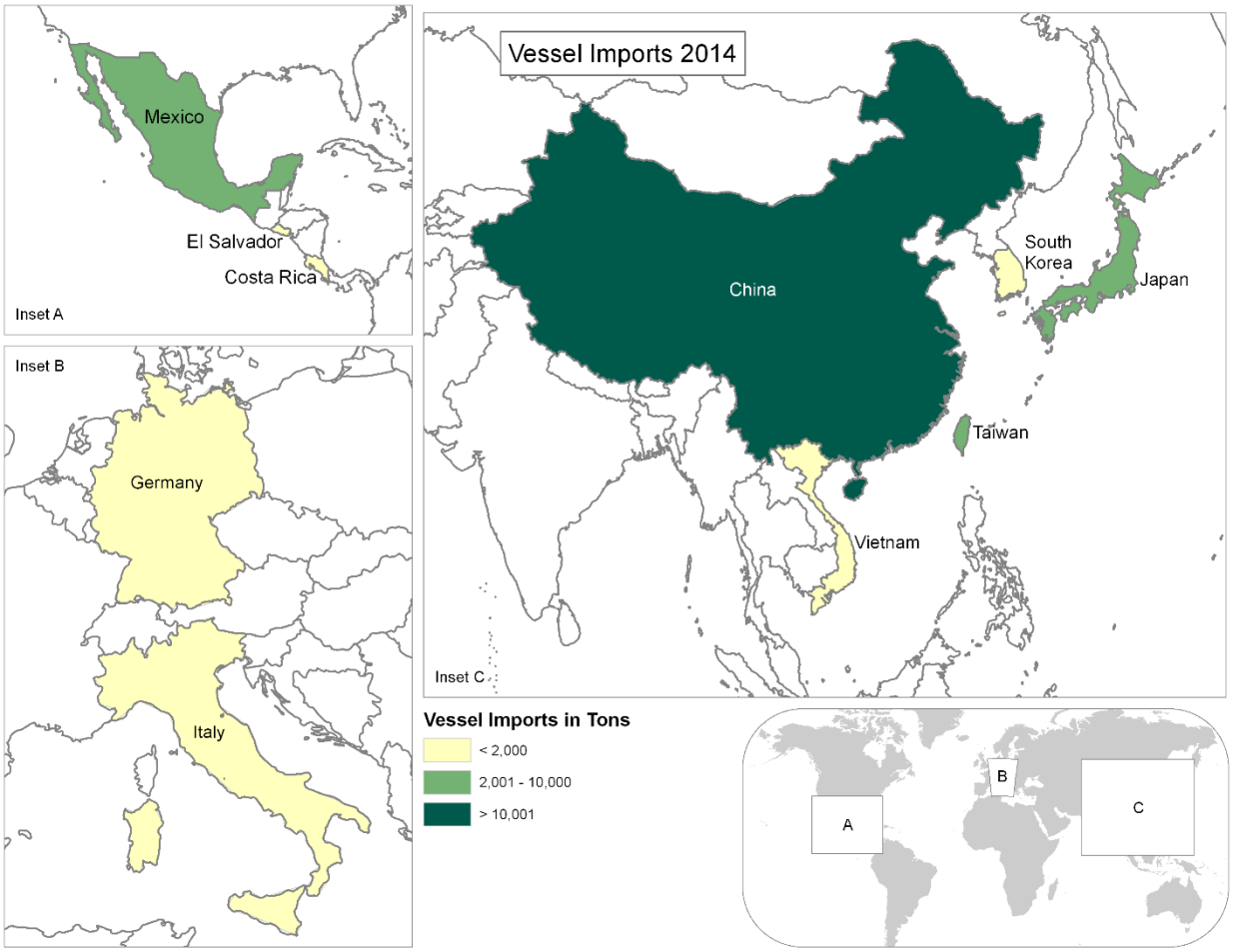

Figure 14. Top 10 origins by weight for imported recyclable and scrap materials into California by vessel in 2014. Data from WISERTrade.

Air Transport

Data on recyclable materials that enter or leave California by air are also tallied by the U.S. Census Bureau and are reported by WISERTrade. However, only a small amount of recyclable material is transported in this manner. In 2014, roughly 1,700 tons of recyclable materials were exported from California by air, and 61 tons were imported. This accounts for less than 0.01 percent of all of the state's recyclable material. In addition, material exported in this fashion is typically higher value non-ferrous metal. Figures 15 and 16 show the origins and designations of recyclable materials that were imported or exported from California by air in 2014.

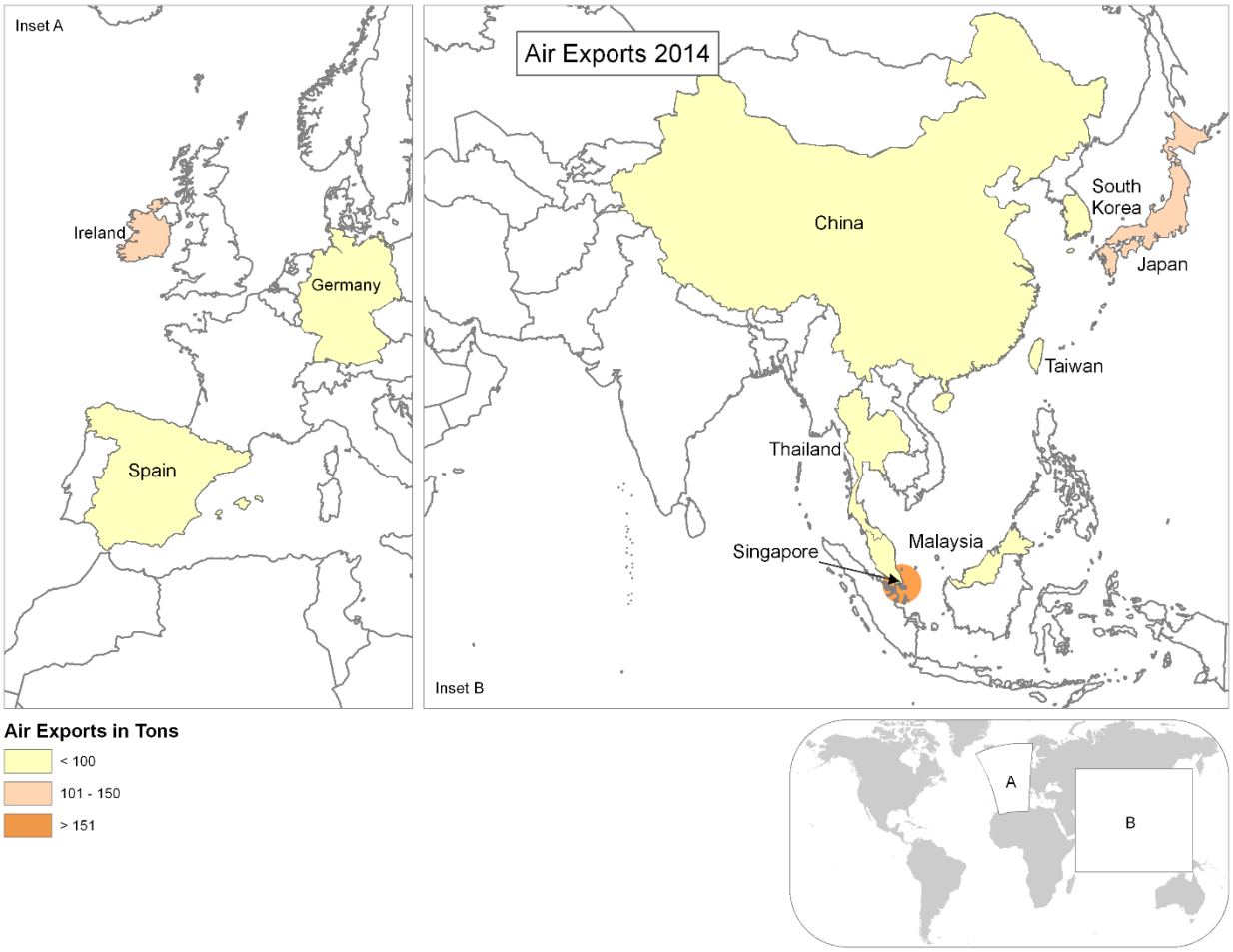

Figure 15. Top 10 destinations by weight for exported recyclable and scrap materials from California by air in 2014. Data from WISERTrade.

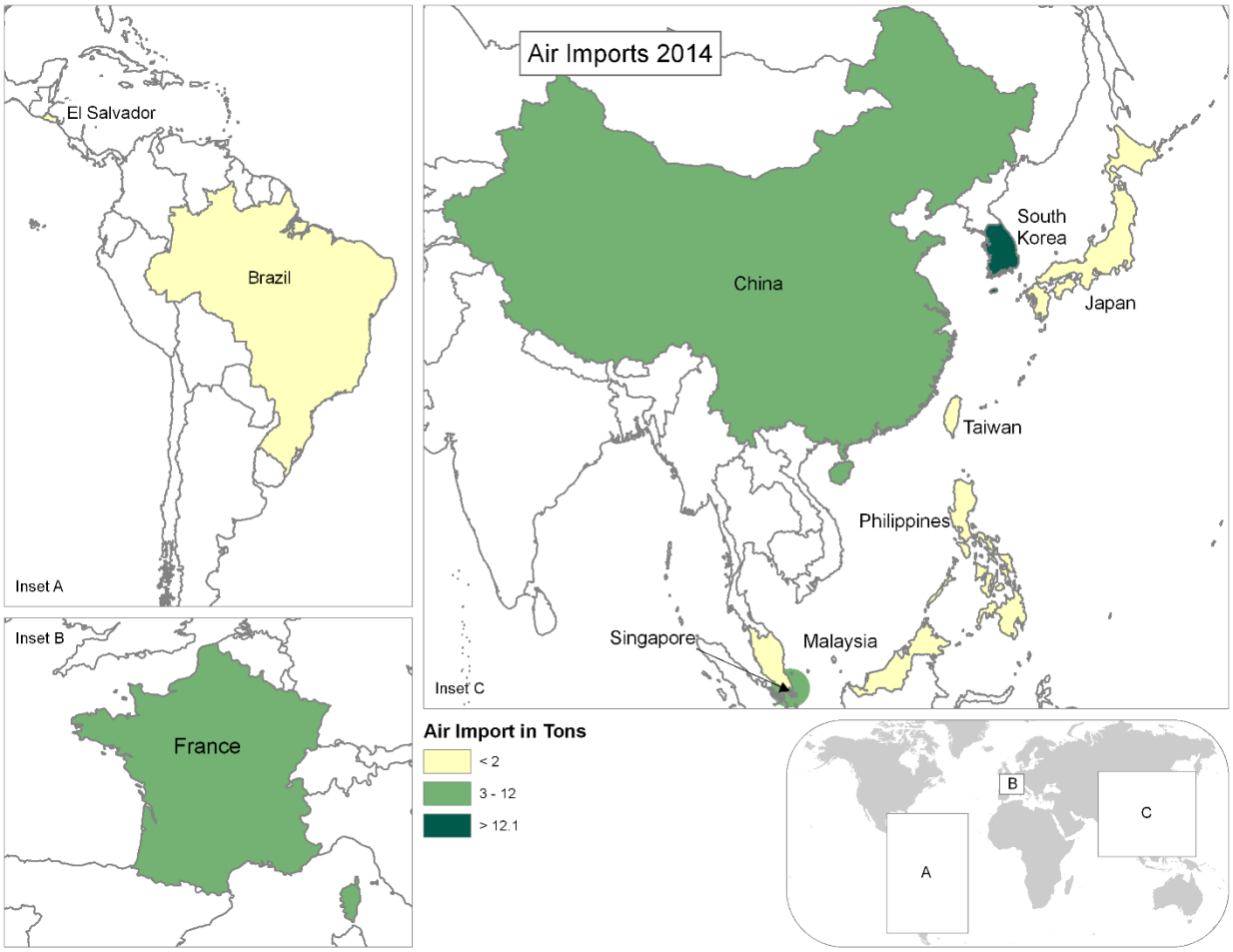

Figure 16. Top 10 origins by weight for imported recyclable and scrap materials into California by air in 2014. Data from WISERTrade.

Rail Transport

Although WISERTrade reports some information on recyclables transported by rail to and from California, the data is limited to the value of the shipment and excludes low-value shipments. In order to develop a more complete view of imports and exports of recyclable materials by rail, the 2014 Carload Waybill Sample prepared by the U.S. Surface Transportation Board (STB)[19] was used. This is a stratified sample of carload waybills for all U.S. large rail traffic carriers. The waybills contain data on the weight, value, origin, and destination of loads; however, in order to keep sensitive shipping and revenue information confidential, origin and destination information may be removed. In addition, STB uses a different set of classification codes to distinguish between materials than the codes used by the U.S. Census Bureau. As a result, it is not possible to directly correlate the rail data with the vessel and air data. The reported tons are also

a *minimum* of the total amount of material that enters and leaves California by rail since some rail carriers and small loads are excluded. In addition, the waybills have only limited information about imports and exports to and from Mexico and Canada because of the low volume of reported shipments to these countries.

In 2014, at least 340,000 tons of recyclable material was exported from California by rail. The majority of this material (54 percent) was scrap metal and waste paper, with Salt Lake City and Portland as the primary destinations. Figure 17 shows the export destination, when known, for rail-borne exports.

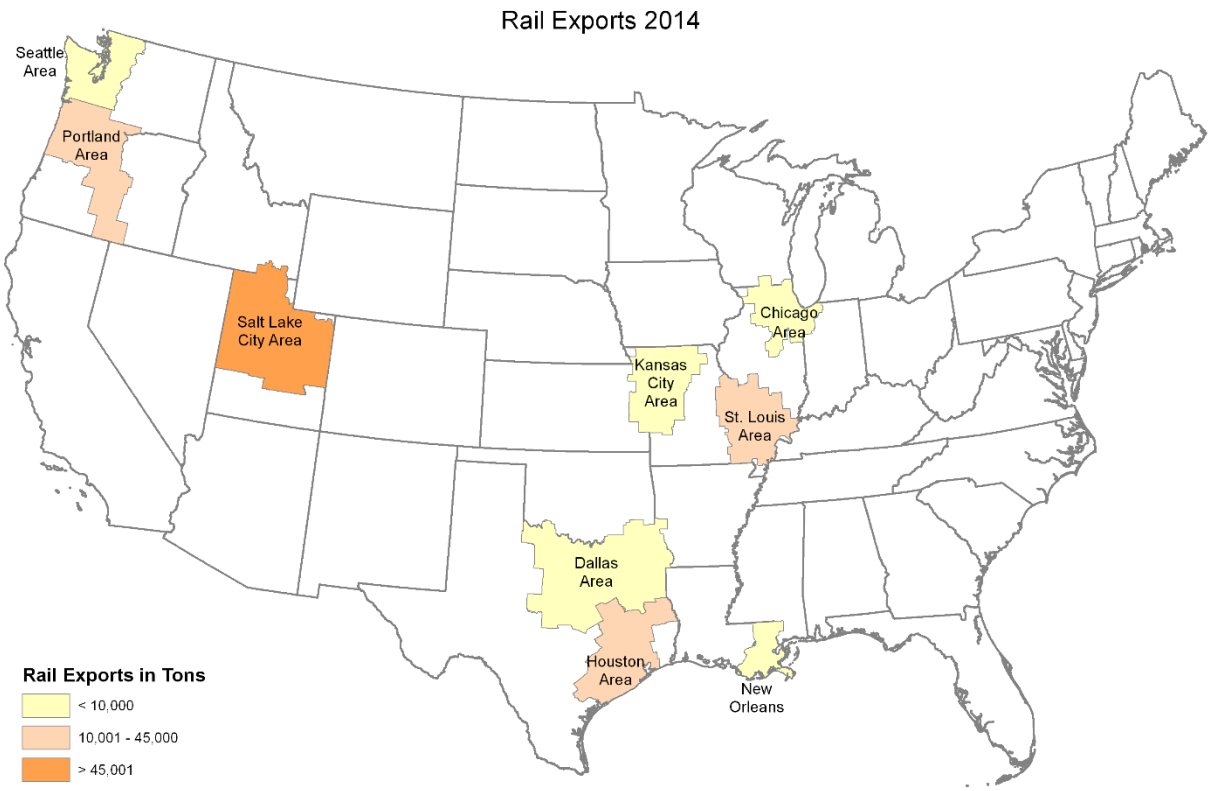

Figure 17. Destinations for exported recyclable and scrap materials from California by rail in 2014. Data from STB. Roughly 40 percent of destination locations were not specified.

In contrast, at least 1.5 million tons of recyclable material was imported into California by rail in 2014. Although the origin was removed from roughly half of the records, Chicago, Reno, and Albuquerque were the primary origin cities (see Figure 18). Although it is challenging to say what happens to this imported material, it is likely that

at least some portion goes directly to ports for further export to international destinations.

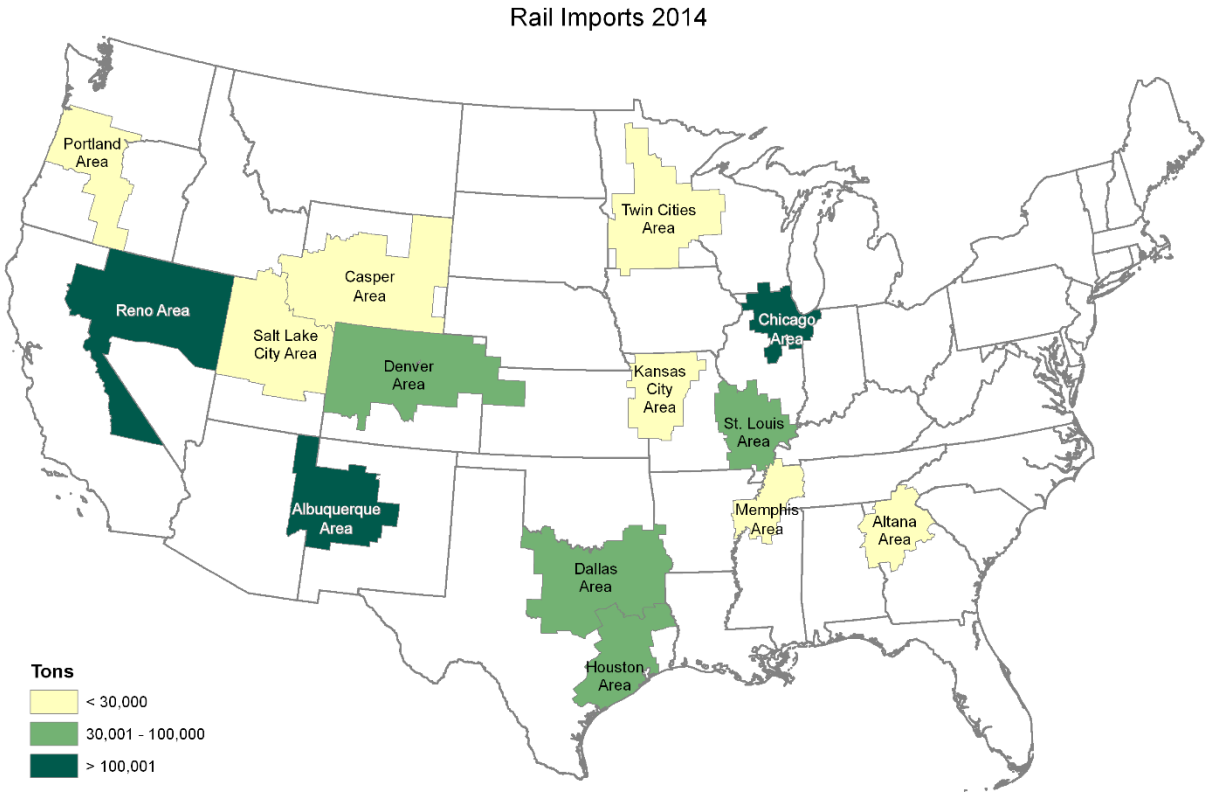

Figure 18. Origins for imported recyclable and scrap materials into California by rail in 2014. Data from STB. Roughly 50 percent of import locations were not specified.

In total, rail transport of imported and exported recyclable and scrap materials to and from California in 2013 amounted to at least 1.9 million tons of material, or 5 percent of all post-consumer recyclable material.

Truck Transport

Tracking the import and export of recyclable materials by truck is particularly challenging. Although WISERTrade provides some information on truck movement, it is not separated from rail or pipeline transportation, it is limited to shipment value, and it excludes low-value loads. The U.S. Department of Transportation conducts a shipper-based survey every five years as a part of the Economic Census, which is the only

publicly available source of commodity flow data for domestic truck shipments.[20] However, the Commodity Flow Survey is limited to a few industries (mining, manufacturing, wholesale, auxiliaries, and select retail and trade groups) that represent less than 20 percent of California businesses; as a result, it likely underestimates the total import and export of recyclable materials by truck. In addition, the survey uses a different classification system than the U.S. Census or STB, so the data is not directly comparable.

Despite these limitations, the 2012 Commodity Flow Survey identified more than 450,000 tons of waste and scrap material (including recyclables) that were exported from California to domestic locations by truck. An additional 1.8 million tons of material were imported from domestic locations in that same period. This suggests that large amounts of untracked recyclables are moving across California's border on a regular basis. As is the case with rail transport, it is likely that some portion of the material imported by truck goes directly to the ports for further transport to international destinations.

CalRecycle began to implement tracking requirements for trucks importing beverage containers into California beginning in 2014. Self-reported data collected from the Imported Material Reports (IMRs) show that at least 65,000 tons of recyclables were imported between January and October 2015.[21] This is a 40 percent increase from the preceding 10 months. However, the IMRs were focused on imported beverage containers and significantly underrepresent the total amount of import for all recyclable materials. It would be necessary to implement more dramatic tracking requirements in order to obtain accurate information on the import and export of commodity recyclables to and from California.

Key Trade Partners: China, Mexico, and Canada

Based on the data presented in the previous four sections, the vast majority of recyclable materials that are imported to or exported from California are transported on vessel from California to China. This is reflective of California's significant trade partnership with China: According to 2014 commodity value data from the U.S. Census Bureau, 34 percent of California's imports originated in China[22] and 9 percent of California's exports were destined for China.[23]

Canada and Mexico are also major trade partners to California, accounting for 17 percent of California's imports[24] and 29 percent of California's exports[25] by value in 2014. However, the amount of recyclable materials that is likely moving among these three countries is not reflected in this analysis. This may result from a large amount of material traveling by rail and truck, which lack the robust tonnage data available for vessel transport. Data for individual programs, such as covered electronic waste and tires, suggest that millions of tons of material are exported from California to Mexico annually. The more robust reporting requirements detailed under AB 901 should provide

additional information on the movement of recyclable materials within North America that is not currently available.

Quality of Exported Materials

The quality of recycled exports can be highly variable. When exported, some bales of "recyclable" materials contain trash, other non-recyclable items, or incompatible recyclable items; some bales shipped to China prior to 2013 reportedly[26] had up to 40 percent non-recyclable trash included in a "recyclable" bale. These bales are difficult to process at recycling facilities and can result in entire bales of mostly recyclable materials being sent to landfills.

In order to better understand the composition of baled recyclables, CalRecycle performed an exploratory bale survey in 2015 under the beverage container recycling program. Forty-two aluminum, PET, or HDPE bales, containing more than 250,000 containers, were sampled as a part of this survey, and the results are summarized in Table 8. The sampled bales were relatively free from contaminants (roughly 90 percent clean); however, significant amounts of dirt and debris, as well as incompatible recyclable contamination, were present. It is unclear whether this level of contamination is within the tolerance level for downstream recyclers.

Table 8. Initial findings from the 2015 bale rate survey by percent weight of total bale

Bale Type	Clean	Dirt and Debris	Other
Aluminum	94.6%	2.8%	2.6%
PET	89.8%*	2.5%	7.7%
Natural HDPE	95.6%	1.4%	3.0%
Colored HDPE	88.9%	2.3%	8.8%

* Includes PET bottles (85.9%) and PET thermoforms (3.9%).

Summary

Currently, exported recyclables comprise a major portion of California's recycling efforts and are counted as recycling toward the 75 percent statewide recycling goal. As discussed earlier, it is difficult to track and assess the extent and quality of recycling outside of California. Recyclables exported through California's ports account for approximately 17 percent of the total generated waste stream (see Figure 19, assuming that 70 percent of exported recyclables originate in California).[27]

Given the variability in quality of exported recyclables and final processing, counting all exported bales of recyclable material as 100 percent recycling may not be an accurate reflection of the amount of recycling that actually occurs. Under the carpet EPR program, no exported material is counted toward the EPR recycling goal; however, exported material still counts as diversion under AB 939. If this same approach of excluding all exported recyclables were taken for California's entire recycling stream,

California's statewide recycling rate would drop from 50 percent to at least 33 percent. This does not account for recyclable materials sent to Mexico or Canada via truck and rail; if those values were included, it is likely that the recycling rate would be even lower, although it is challenging to predict by how much.

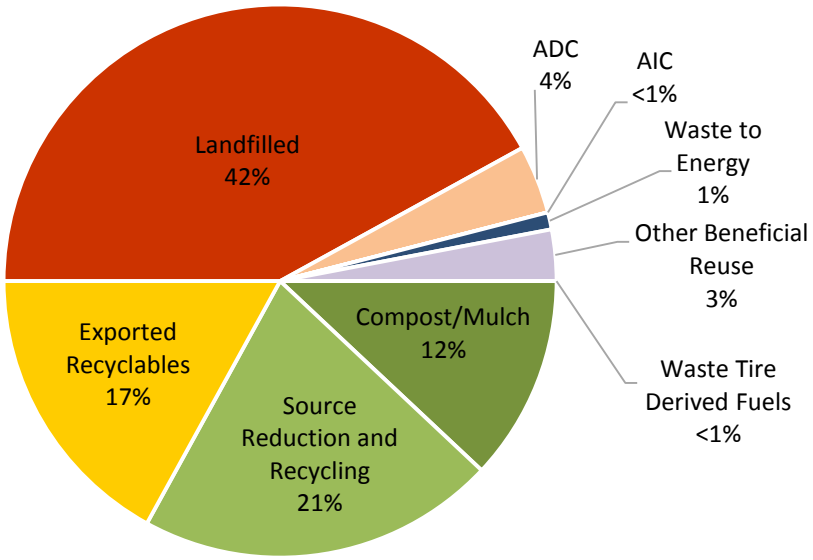

Figure 19. Estimated destination of 74.9 million tons of waste generated in California in 2013 based on AB 341 categories, including exports. Value for exported recycling is based on 70 percent of exported recycling originating in California, or 12.6 million tons. The remaining values are calculated as described for Figure 2 and may not add up to 100 percent due to rounding.

If exported recycling were instead handled by in-state recycling, there are several anticipated benefits to California in terms of increasing jobs and reducing greenhouse gas emissions. In CalRecycle's 2013 report *AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020*, it was estimated that if the manufacturing of exported recyclable commodities into usable materials was done domestically, it would create 58,000 new jobs in California.

In-state processing of recyclables also has the potential to reduce greenhouse gas (GHG) emissions. Using the California Air Resources Board (ARB) estimate that ocean-going vessels emit 19 g CO_2 equivalents per net-ton mile, the export of 18.0 million tons of recyclables by vessel releases approximately 2.2 million metric tons of CO_2 equivalents annually.[28]

A more robust California processing infrastructure could help reduce some of the volatility for California recyclables by reducing transportation costs and uncertainty related to availability in foreign markets. To completely close the loop, California would

need significant growth in the infrastructure for manufacturing new products from recyclable materials.

One mandate that CalRecycle has promoted to help drive in-state markets is the State Agency Buy Recycled Campaign (SABRC), which requires state agencies to purchase recycled-content products. SABRC and related programs will be key to assisting CalRecycle in achieving its 75 percent statewide recycling goal and developing California's recycled-content manufacturing infrastructure. In the most recent review cycle, however, many state agencies were not compliant with the purchasing requirements in specific categories, and CalRecycle referred 71 agencies to the Department of General Services for notification as part of the Department's annual review of state agencies' delegated purchasing authority. In addition, compliant purchases account for only 12 percent of all state purchases in fiscal year 2013-2014. While AB 2675 (Lowenthal, Chapter 617, Statutes of 2014) increases SABRC's overall procurement requirement to 75 percent for most categories beginning in 2020, the SABRC program is still not achieving its potential, and further changes are needed to provide greater direction and state agency accountability and to facilitate implementation.

How Does California's Recycling System Operate for Different Material Types?

Much of California's recycling programs and infrastructure are designed to handle specific material types. This section of the report focuses on key material types and programs in order to highlight how California's recycling system currently operates.

Organic Material

Local programs to incentivize composting and organics management have been in place for decades. However, a substantial amount of organic material still enters landfills. According to the 2014 waste characterization study, 12.7 million tons of material commonly accepted for composting or mulching was disposed in 2014; this corresponds to 41.1 percent of the overall waste stream. CalRecycle is in the process of implementing a number of laws aimed at reducing the disposal of organic materials (AB 1826, AB 1594, and AB 876).

In addition, the California Air Resources Board (ARB) has released a strategy for reducing the emissions of methane and other short-lived climate pollutants. As landfills are responsible for an estimated 20 percent of methane emissions in California, a key measure in the Short-Lived Climate Pollutant Reduction Strategy is to effectively eliminate organics from landfills; ARB is currently finalizing the timeline for this strategy.

As these various policies become operational, it is critical to consider how organic waste is currently managed in California and how California will adapt its infrastructure to meet these policy goals.

Composting Facilities

In California, composting facilities that accept material from off-site locations must receive a permit from CalRecycle. Current permitting regulations exclude home- and neighborhood-scale composting operations and agricultural composting facilities that do not bring on feedstocks or sell or give away finished product. Although solid waste facility permits and notifications set a maximum facility throughput and capacity, the Department does not currently require reporting on how much material is actually processed. In addition, CalRecycle does not regularly track what happens to the compost after it has been processed and leaves the composting site. Implementation of AB 901 will require reporting from these facilities.

There are approximately 170 active permitted or otherwise authorized composting facilities in California that process an estimated 5.5 million tons of material per year (see Figure 20). The total reported tonnage processed at composting facilities is lower than what was reported last year due to one large facility closure and revisions to CalRecycle's calculations of the actual processing capacity of the facilities. The 14

largest composting facilities in California account for approximately 50 percent of the current handling capacity, while roughly a third of active facilities manage 5,000 tons or less of organic material each year. Many of the high-throughput facilities are located in the Central Valley; they are distant from population centers that can generate large amounts of compostable material but close to the agricultural markets for their final product. It is likely that some of these composting facilities also accept feedstock from agricultural sources.

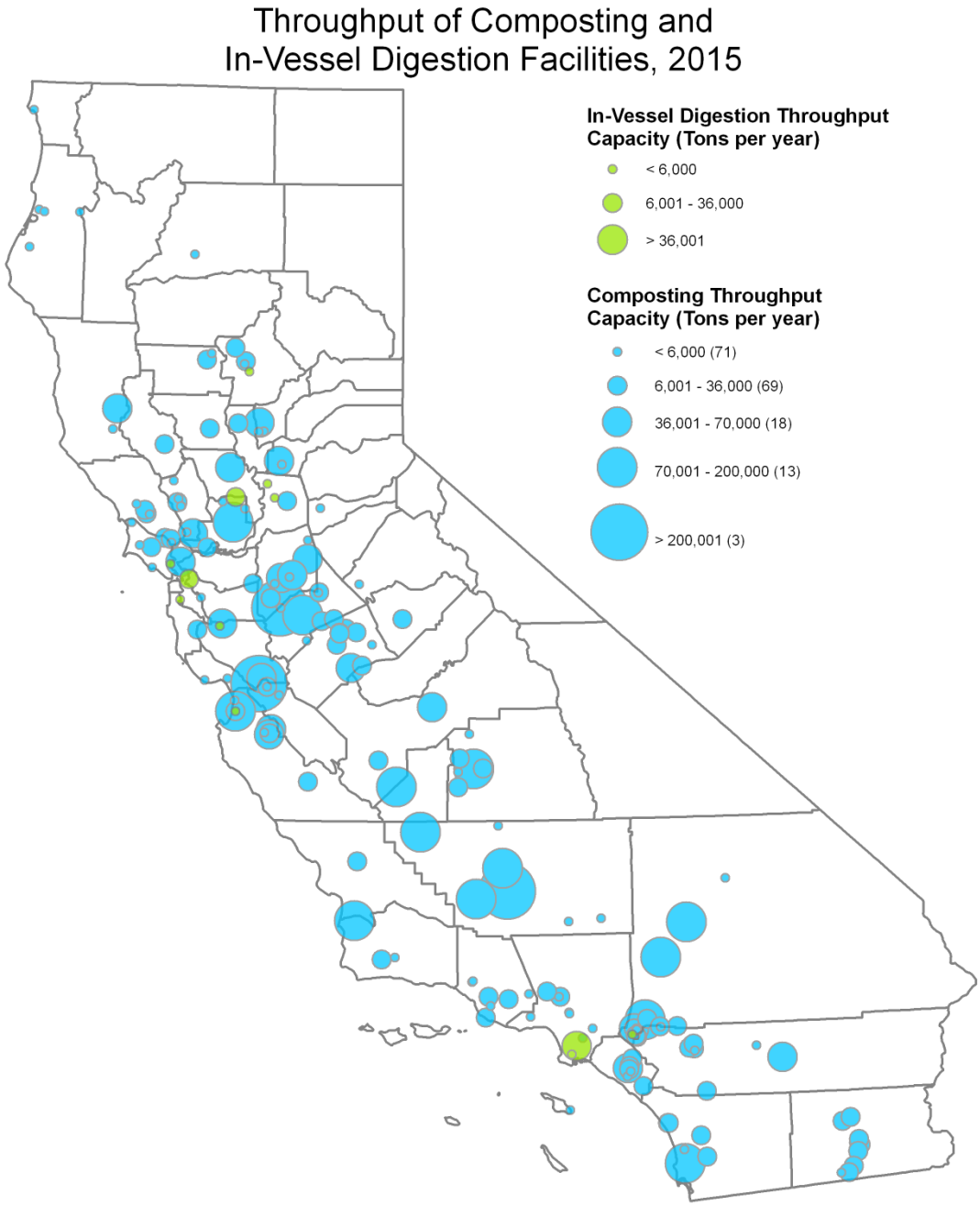

Figure 20. Throughput (tons per year) at composting and in-vessel digestion facilities. Data is from CalRecycle estimates of annual throughput, as listed in FacIT on December 17, 2015.

Mulch Processors, or Chip and Grind Facilities

There are more than 150 chip and grind operations in California, which separate, grade, and resize woody green wastes and/or lumber. Since these facilities must move materials off site within two to seven days, the material is not composted. The process therefore does not usually have the higher level of control over the amount of contaminants that a composting process provides. Chipped material can be sent to a composting facility, applied as landscaping mulch, used at a landfill for ADC, AIC, or erosion control, or sent to biomass facilities. All of the uses have acceptable thresholds on the amount of contaminants. CalRecycle, in cooperation with the California Department of Food and Agriculture, and the State Water Resources Control Board, have developed regulations to limit the level of pathogens, metals, and contaminants allowed in the material, and the amount and frequency that this material can be applied to land. These limits will be in effect and enforced January 1, 2018.

Current CalRecycle estimates of chip and grind capacity and throughput vary widely. Voluntary reporting on FacIT (see Table 6) reports a total capacity of 11.5 million tons per year and a current throughput of 7.4 million tons per year. In contrast, the 2010 contractor's report *Third Assessment of California's Compost- and Mulch-Producing Infrastructure—Management Practices and Market Conditions* reports only 3.6 million tons per year of throughput based on facility surveys.

The wide disparity in these numbers reflects a key challenge in assessing operations based on voluntarily provided data. Surveys can provide more accurate information, but they are time-intensive to complete and rely on participation from the facilities. Voluntarily provided data requires less effort to compile, but it is more likely to contain errors or inaccuracies. The passage of AB 901 will require additional reporting from composting operations; the implementation of this law should provide CalRecycle with better information on the actual processing capacity of chip and grind facilities in California. In evaluating organics processing for the purposes of this report, the smaller estimate of 3.6 million tons per year has been used as a more accurate reflection of the infrastructure.

In-Vessel Digestion

In-vessel digestion includes anaerobic digestion (AD) and is the only non-landfill organics management strategy in which food is the primary feedstock. It is a specific process in which biological decomposition of organic wastes occurs in a low- or no-oxygen environment. This includes stand-alone facilities as well as publicly owned treatment works (POTWs, also known as wastewater treatment plants) that have digesters and manure management on farms. In-vessel digestion facilities can both divert organic materials from landfills and produce low-carbon fuels or electricity, thereby making them attractive for achieving the dual goals of AB 341 and AB 32 (Núñez and Pavley, Chapter 488, Statutes of 2006). In addition, in-vessel digestion can

more easily accept certain types of organic wastes, such as food, than other types of organics facilities. These systems have been widely used in Europe, Canada, Japan, and Australia for decades and are beginning to see greater use in the United States.

California currently has 12 permitted, active in-vessel digestion facilities (excluding dairies) that process approximately 146,000 tons of material annually (see Figure 20). Another dozen or more in-vessel digestion facilities are planned or in the permitting process. Four POTWs are currently co-digesting food waste, as are 20 on-farm digesters.

Biomass Conversion

Another method for handling organic materials is biomass conversion, or the process of generating energy from forest residues, agricultural waste, urban wood waste, or other sources through thermal conversion. Charting the biomass infrastructure is challenging. As of December 2015, CalRecycle was able to identify 23 active biomass conversion power plants (excluding gasification plants, which are still a developing technology).[29] However, active facilities may become idle when closed for renovation or for economic reasons; as a result, it is challenging to accurately identify the number of active facilities in California at any given time.[30] The biomass industry has also expressed concerns that additional facilities may close permanently in the next few years as long-term utility contracts expire.

The broad range of feedstock sources and the complex distribution system make it challenging to assess the flow of material to individual facilities. Beginning in 2016, CalRecycle will require reporting from biomass conversion facilities on the amount and types of feedstock accepted or rejected and the final disposition of resulting ash under SB 498 (Lara, Chapter 746, Statutes of 2014).

Figure 21 shows the location of the 23 biomass conversion facilities that were active in 2015. The map also displays the distribution of material accepted in 2009 (forest, agricultural, or urban) based on data provided by the California Energy Commission (CEC). Biomass conversion facilities are primarily located in Central and Northern California. Regionally, the type of feedstock accepted at the facility corresponds with readily available materials (forest residues in Northern California and a mixture of agricultural and urban wastes in Central California).

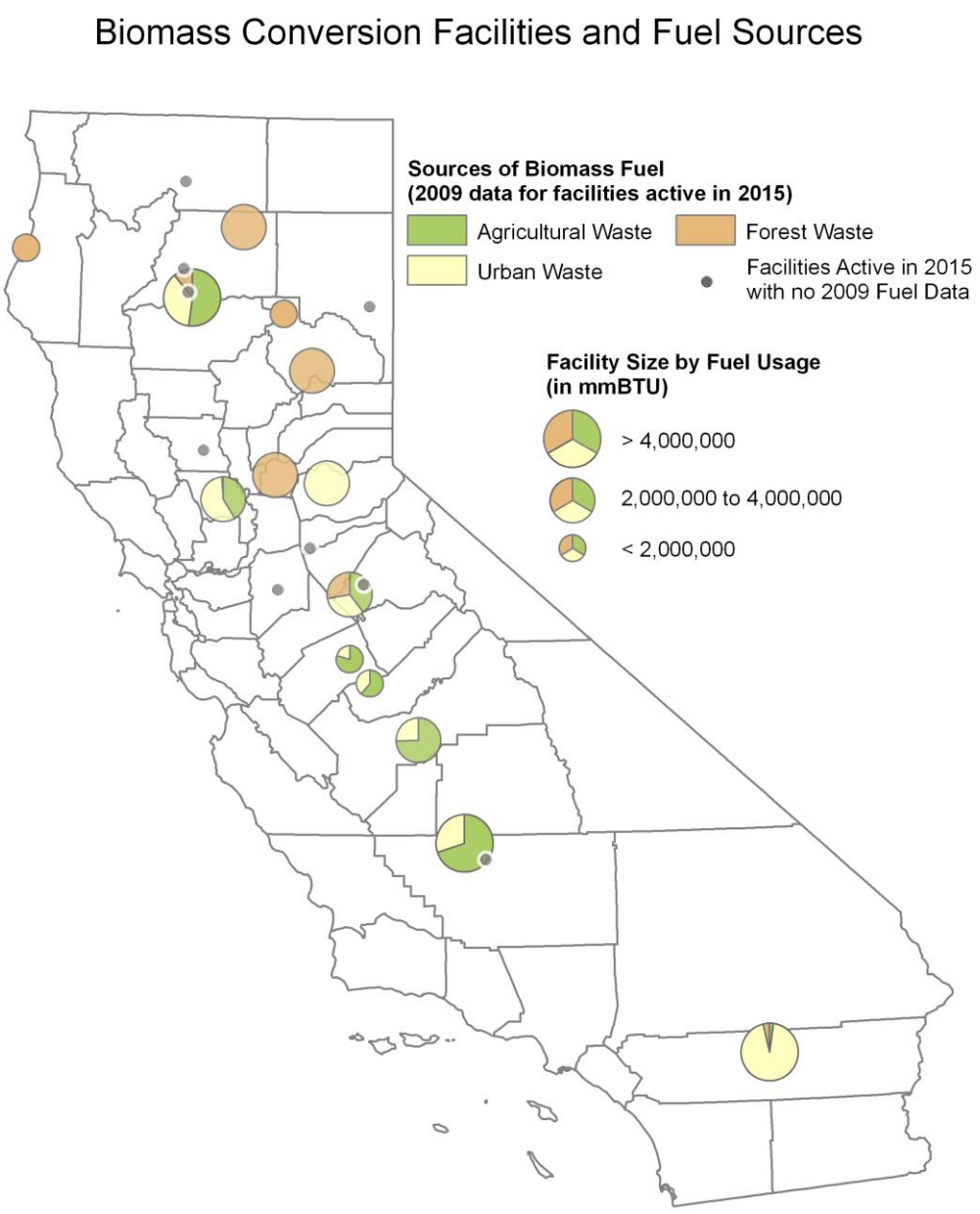

Figure 21. Active biomass facilities in 2015, shown alongside the reported fuel sources in 2009, if available. The active facility list was compiled from UC Berkley Woody Biomass Utilization Program, UC Davis California Biomass Collaborative, the California Biomass Energy Alliance, the California Energy Commission and CalRecycle's Statewide Technical and Analytical Resources Branch. The 2009 fuel sources data was provided by the CEC.

Based on industry estimates, 8 million tons of material was sent to biomass facilities from all sources in 2015. Of this, 3.1 million tons was attributed to urban sources. This

substantial amount of urban material is significant given that CalRecycle does not count material sent to biomass conversion in the calculated generation of municipal solid waste. Instead, material that is sent to biomass conversion facilities counts as de facto diversion under AB 939 and de facto recycling under AB 341.

As California moves toward the goal of removing 50 percent of organic materials from landfills under AB 1826 and effectively eliminating organic materials from landfills under the Short-Lived Climate Pollutant Reduction Strategy, it will be increasingly important to consider whether the material sent to biomass conversion facilities from urban sources should be added to total generation and counted as diversion or disposal. Although the amount of organic material currently sent to biomass facilities from urban sources is small relative to the total generation, it is likely that these facilities will play an ongoing role in handling material diverted from landfills.

Processing Organic Waste

The movement of materials for composting and general organics management is largely driven by type of organic material (food waste or green waste), the source of material (individuals or businesses), and proximity to appropriate facilities.

There are a variety of handling and processing options for green waste. Many jurisdictions already offer curbside collection of green waste for residents; in 2013, 371 jurisdictions reported having a residential curbside green waste collection program. Roughly half of those jurisdictions also reported tonnages associated with the collection program, which totaled 2.5 million tons in 2013. This suggests that the overall collection infrastructure for green waste is substantial and handles a significant fraction of the material diverted from landfills. However, it is important to note that in 2013 nearly 5 million tons of green waste (including leaves, prunings, and clean lumber) went to landfills, and about 1.5 million tons was used as alternative cover. Lumber is a large component of this material—it is the second-largest component of the waste stream based on the 2014 waste characterization study (2.1 million tons, 7 percent of the disposed waste stream).

Once collected, green waste that is diverted from landfills may go toward composting, chipping and grinding, anaerobic digestion (at dry facilities as a bulking agent), biomass conversion, direct land application, or other uses. The variety of handling options suggest that expanding this portion of the infrastructure to achieve the goals in AB 1826 and the Short-Lived Climate Pollutant Reduction Strategy is possible, although there are challenges to expansion, including funding, permitting, markets, and local acceptance.

In contrast to green waste, the handling options for food waste are more constrained. Although 219 jurisdictions reported having active food waste composting programs in their 2013 EAR, this number likely overestimates the number of active programs within California. CalRecycle believes that there are between 35 and 40 food waste collection programs for the residential and commercial sectors each, which roughly corresponds

to the 71 jurisdictions that reported tonnages associated with food waste collection. The total reported collection for food waste of 0.2 million tons further highlights the limited collection options currently available in California.

A significant amount of food goes directly to landfills; based on the 2014 waste characterization study, food is the largest single component of the waste stream at 5.6 million tons or 18 percent of total disposal.

Of the approximately 170 active composting facilities in California, only 32 accept food waste; these facilities have approximately 300,000 tons of available capacity. In addition, around half of the currently available composting capacity is located at sites permitted to accept biosolids. These sites would need permit revisions in order to accept food materials. This significantly limits the post-consumer processing of food waste. Food waste that is collected for recycling may be processed through composting or anaerobic digestion.

If all of the recoverable organic material that is currently disposed were instead recycled, the state's composting, chip and grind, and in-vessel digestion facilities would have to process an additional 12.7 million tons of organic material each year. As California moves toward greater organics processing, it is critical to consider whether the state has sufficient physical infrastructure to process this additional material. Most organics processing facilities run at levels close to capacity; current facilities could support at most 1.1 million tons of additional material per year (see Figure 22). As noted above, the current available capacity for food is much lower.

One alternate option for handling food waste is publicly owned treatment works (POTWs). According to the California Association of Sanitation Agencies, POTWs have sufficient excess capacity to handle a large portion of the 5.6 million tons of food waste that is currently being landfilled based on the 2014 waste characterization study. If food waste could be effectively redirected to POTWs, this would substantially expand the in-state handling capacity for organic materials. POTWs have the added benefits of being located near population centers where food waste is generated and of having on-site experience with AD systems.

However, the ability to utilize excess capacity at a POTW for the co-digestion of food waste is contingent on a number of variables, including cost effectiveness, options for managing resulting biosolids, and the ability to use the increased volume of generated biomethane. In addition, off-site pre-processing of food waste, including pulping, grinding, and cleaning, would be needed prior to delivery at a POTW, and the POTW would also need receiving facilities on site to accept the processed food waste.

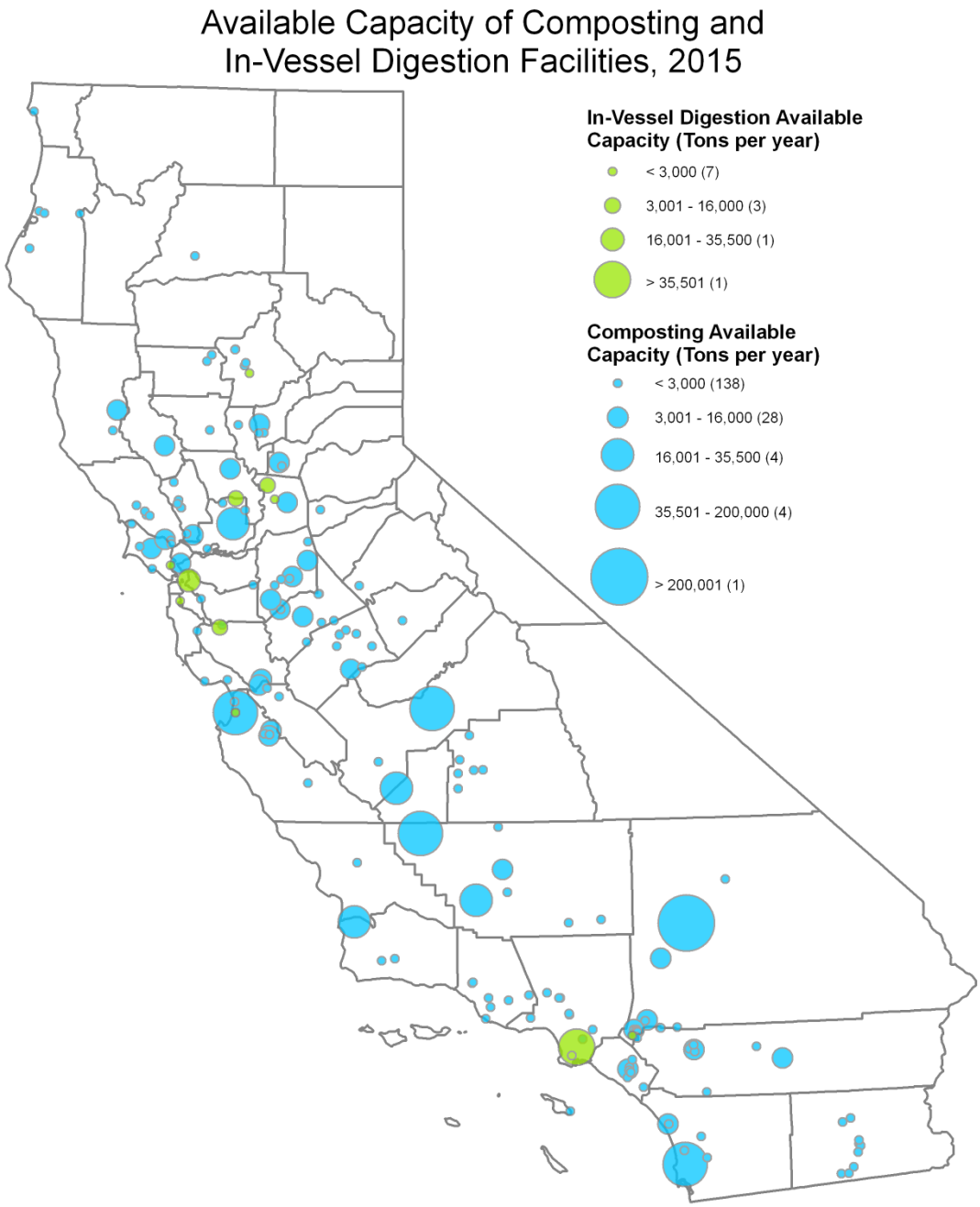

Figure 22. Additional capacity (tons per year) at composting and in-vessel digestion facilities. Data is from CalRecycle estimates of annual capacity and throughput, as listed in FacIT on December 17, 2015.

One funding source for expanding the available capacity for processing organic materials is CalRecycle's Organics Grant Program, which uses funds from the Greenhouse Gas Reduction Fund. The purpose of the grant is to lower overall greenhouse gas emissions by expanding existing capacity or establishing new facilities in California to reduce the amount of organic materials that are sent to landfills. In the first wave of grants, which were announced in November 2014, five entities were selected to receive $14.4 million in funding following a competitive scoring process from among 51 applicants. Future Greenhouse Gas Reduction Fund expenditures for organics management facilities are not guaranteed and depend upon approval from the Legislature.

Although these five facilities are not sufficient to address California's anticipated gap in organics management infrastructure (the facilities only account for 1.5 percent of the needed capacity to handle approximately 12.7 million tons of currently disposed organics), this funding structure provides an avenue for adding new facilities.

Another funding source for developing the organics management infrastructure is the Alternative and Renewable Fuel Program (AB 118, Núñez, Chapter 750, Statutes of 2007). This program, which is managed by the California Energy Commission, has assisted in the construction of several in-vessel digestion and biomass facilities since its implementation.

Resin, Glass, Metal, and Fiber

Resin (or plastic), glass, metal, and fiber (or paper) materials account for a large portion of the recycling infrastructure in California. In many areas, residential curbside services accept all four materials through mixed recycling, or "blue bin," programs that rely on users separating these recyclable materials from disposed items. Other communities collect recyclables alongside disposed items. Once the materials have been collected, the waste is sent to MRFs (if separated from disposed material) or MWPFs (if collected with municipal solid waste) for further processing and separation of recyclables. Material-specific manufacturing facilities in the recycling market can then purchase separated components in order to manufacture or sell new products or raw material. The number of jurisdictions with various types of recycling programs, including residential and commercial pick-up, scrap metal collection, and wood waste collection, has remained constant since 2000.

The collection of recyclables is strongly tied to the broader solid waste stream. Many of the facilities that send material to recycling facilities are key components in the disposal stream. Waste generators, haulers, transfer stations, and MRFs may all send material directly into recycling markets. In addition, transformation facilities and landfills may also send material for recycling.

Once the material has been collected, processors may handle material originating from a number of sources, including raw material, in-plant scrap, new scrap, and old scrap.

The movement of material within a processor and among other facilities creates additional complexity in tracking the total quantity of recycled material in the system. Once a material is processed, it generally proceeds to a fabricator or manufacturer. After a consumer introduces a product to the waste stream, recycling collection points will take the material for consolidation and processing. Commodities and final products also enter and leave California through import and export at various stages along the way.

One concern related to the processing of commodity recyclables is the increased use of multi-material flexible packaging, such as multi-layered pouches that incorporate aluminum and various plastics. Because the layers do not readily separate, this kind of packaging is typically much more difficult to process and recycle than traditional materials and may require new package design or end-of-use processing technologies in order to divert these items from the landfill.

Another challenge for the processing of plastics is the growing diversity in plastic resin types that are incompatible in the recycling process. Recyclers typically prefer homogenous material streams to ensure their equipment is not damaged and to maximize the value of the end product.

It is clear that a substantial amount of resin, glass, metal, and fiber are still being disposed. The 2014 waste characterization study identified that these four materials accounted for a third of the disposed waste stream. As California moves toward its 75 percent statewide recycling goal, programs to collect and efficiently process these materials will be important.

Quantifying the amount of plastic resin, glass, metal, and fiber materials that are collected and recycled in California is challenging. Many manufacturing facilities, glass beneficiation operations, and clean MRFs are not required to obtain permits from CalRecycle. There is also currently no mandatory statewide reporting requirement for recycling; however, the implementation of AB 901 will substantially improve CalRecycle's knowledge of how commodity recyclables are handled. The data the Department currently has suggests that the post-sorting capacity in California is not sufficient to handle growth in the amount of recyclables collected in the state.

In order to increase manufacturing of recycled-content products in California and to lower overall greenhouse gas emissions, CalRecycle established a Recycled Fiber, Plastic, and Glass Grant Program in 2014 using money from the Greenhouse Gas Reduction Fund. The first three grantees received a total of $5 million to process plastic and recycled fiber. Although CalRecycle has requested additional funding through the Greenhouse Gas Reduction Fund to continue this grant program, the proposal requires Legislative approval.

Beverage Containers

The California Beverage Container Recycling and Litter Reduction Act (AB 2020) established a system for financial incentives and convenient return systems to help ensure the efficient and large-scale recycling of beverage containers. Since its authorization, the core mechanism for the Beverage Container Recycling Program (BCRP) has remained the same. Consumers pay a California Redemption Value (CRV) fee when they purchase beverages from a retailer. The CRV is refunded when a consumer, or a collection center, redeems the containers at a recycling facility. Most beverages packaged in aluminum, glass, plastic, and bimetal containers are eligible for CRV; notable exceptions are milk, wine, distilled spirits, and large 100 percent juice bottles. CRV is currently set at 5 cents for each beverage container that holds less than 24 ounces and 10 cents for each container that holds 24 ounces or more.

Beverage Container Collection Infrastructure

Containers under that fall under the BCRP are first collected by recyclers, who refund CRV to consumers. In California, recycling collection programs fall into five categories: curbside programs, drop-off and collection programs, community service programs, recycling centers, and reverse vending machines. After collection, recycling collection programs transfer the containers to BCRP-certified processors. Certified processors reimburse the programs and consolidate the loose material into bales. This makes it less likely for the materials to go through the system more than once. Material handled by BCRP-certified processors is either exported or sold to in-state material processors, which convert the bales to intermediate materials. Those products are then sent to manufacturers or other end users in order to make new products.

Under the beverage container recycling program in fiscal year 2014-2015, CalRecycle received more than $1.2 billion in CRV payments from beverage distributors and paid out approximately $1.1 billion in CRV to certified processors; these facilities must be certified to receive payment. In addition, beverage manufacturers must register their products with CalRecycle to ensure that the labeling is compliant with state law. As a result, CalRecycle has detailed, accurate information on certified recycling centers, drop-off and collection programs, community service programs, processors, and the CRV material handled by registered curbside programs. CalRecycle also requires reporting of specific information from registered beverage manufacturers and distributors.

As of September 30, 2015, there were 3,372 operational collection facilities or programs for beverage containers in California (see Table 9). The majority of collection programs by count are recycling centers, which collected 77 percent of all returned CRV containers statewide in 2014. Curbside programs collected 19 percent, and drop-off and collection programs and community service programs account for the remaining 4 percent.

Compared to the same period last year, there are roughly 140 fewer recycling centers and 40 more community service programs. This is likely due to a requirement that went into effect on January 1, 2014, that reduced daily load limits at recycling centers to 100 pounds for aluminum and plastic and 1,000 pounds for glass. As a result, individuals or organizations that may have previously brought material to a recycling center are instead registering with CalRecycle as community service programs. In addition, the tonnage of CRV material processed at recycling centers and reverse vending machines dropped from 2013 to 2014; this is likely due to the same change in policy.

Table 9. Collection facilities or programs for beverage containers in California.

Facility Type	Active Facilities	Processed CRV (tons)	Percent of CRV Material Processed
BCRP Certified Processors	207		
Curbside Program	599	187,287	18.8%
Collection Program	210	39,634	4.0%
Community Service Program	194	4,154	0.4%
Recycling Centers and Reverse Vending Machines	2,076	766,845	76.8%
Total	**3,286**	**997,920**	**100%**

Data reflects facility counts on January 4, 2016, and reported tons of CRV materials in 2014. Percent of CRV material processed reflects the percentage of CRV containers collected at each facility type.

Collecting and Counting Beverage Containers

Under the beverage container recycling program, CRV is collected based on the number of eligible containers sold, but the fee may be refunded by count or by weight. Consumers must be paid by count for up to 50 containers of each material type, unless requested otherwise, and recycling centers may choose to only reimburse by count; reverse vending machines always refund consumers by count. When more than 50 containers of a material type are returned, the CRV is refunded based on the weight of the containers; this accounts for the majority of container redemption. In order to calculate the conversion rate between the weight of returned containers and their per-unit CRV for a given material type, CalRecycle performs biannual surveys of recycling collection programs.

In 2014, Californians returned 1 million tons of CRV containers. This translates into almost 50 million beverage containers recycled each day, or 17.7 billion beverage containers for the year. CalRecycle calculates that the beverage container program has achieved an 80 percent recycling rate for all materials statewide in 2014. This value is lower than the rate in 2013 and corresponds to efforts to limit defrauding of the program.

As described in Table 9, more than 95 percent of CRV containers were returned through curbside programs and recycling centers in 2014. Beginning on January 1, 2014, recycling centers are required to only pay consumers CRV on segregated loads (loads that contain only CRV containers separated by material type). As a result, most material that is collected at recycling centers and reported to CalRecycle is CRV by weight (see Figure 23). This is particularly true for aluminum and PET containers.

In contrast, curbside programs typically receive a commingled rate for mixed loads of CRV and non-CRV containers of the same material type. This type of mingled collection was intended to bring non-CRV containers into the larger collection mechanism of the BCRP to help reduce litter and help consumers in their returns. In 2014, curbside programs accepted 187,000 tons of CRV containers in addition to at least 325,000 tons of non-CRV containers that were accepted in curbside programs and reported to CalRecycle (see Figure 23). Calculated redemption rates take into account the ratio of CRV to non-CRV containers, and all of the material that is collected ultimately enters the recycling stream.

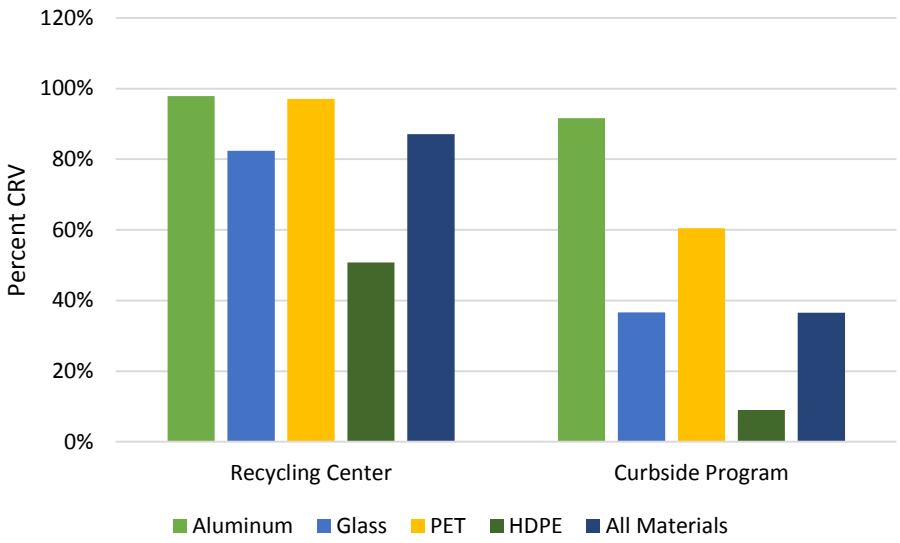

Figure 23. Percentage by weight of CRV containers redeemed at recycling center and curbside programs as a function of returned containers, broken down by material type, in 2014.

Data collected during the biannual rate determination survey allows for a detailed evaluation of what types of containers (both CRV and non-CRV) are returned under BCRP for curbside programs (see Figure 24). Most aluminum surveyed in curbside programs is CRV, with pet food containers as the primary non-CRV material identified in the survey. Nearly two-thirds of surveyed PET containers were CRV, although domestic food containers and large juice containers comprised 29 percent of the sampled containers. Less than half of glass identified at curbside programs is CRV, with wine

and distilled spirits containers accounting for 43 percent of the total surveyed glass. Only 2 percent of HDPE containers sampled at curbside programs during the survey were CRV. Milk jugs and laundry products were a significant portion of sampled HDPE containers (89 percent of all HDPE).

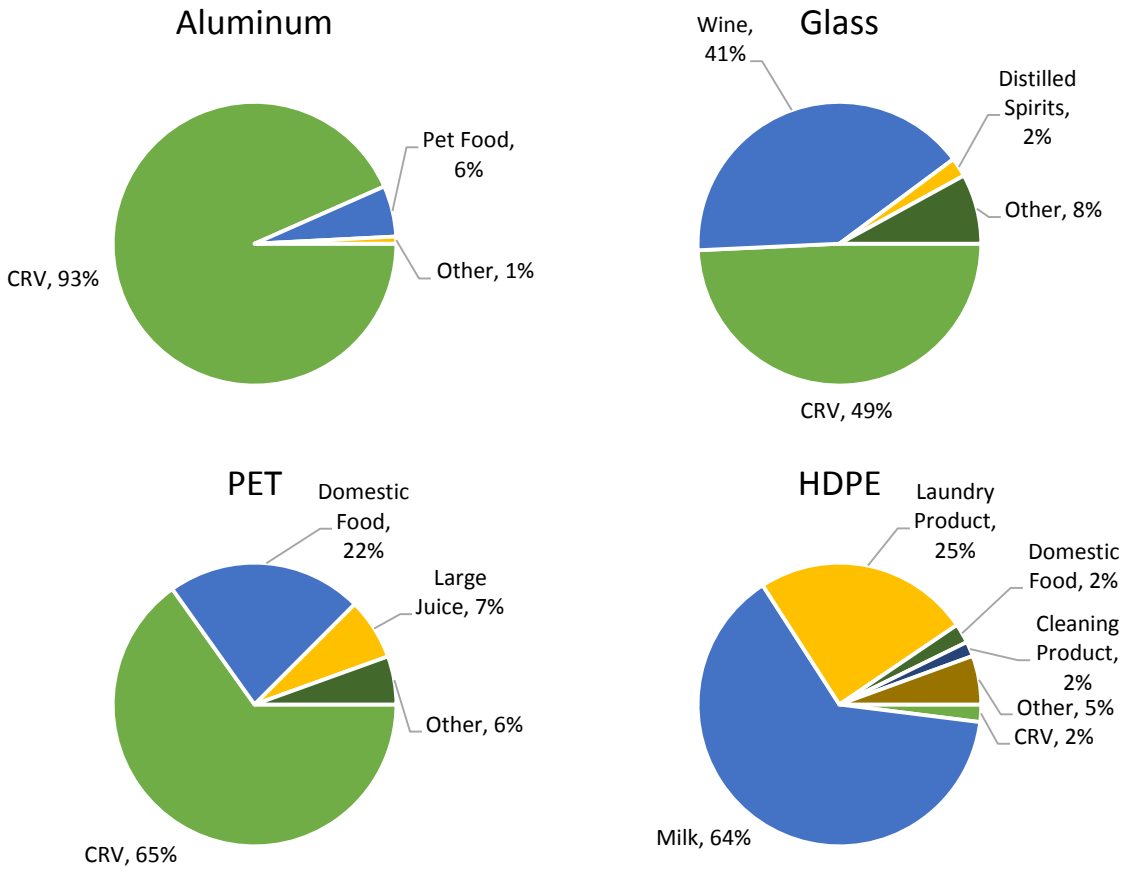

Figure 24. Types of containers returned at curbside programs, by weight, for aluminum, glass, PET, and HDPE. Data from 2015 rate determination survey.

The substantial presence of milk and wine containers suggest that curbside programs are effective in collecting both CRV and non-CRV materials for recycling. In addition, all materials (CRV and non-CRV) accepted by BCRP-certified facilities still count toward recycling under California's broader initiatives.

In-State Processing of Beverage Containers

As discussed earlier, once containers have been collected through the program, they are sold to processors for consolidation. The material is then exported or sent to in-state material processors and manufacturers. In order to promote in-state recycling markets,

CalRecycle offers financial incentives to plastic reclaimers and manufacturers who handle CRV containers and to glass beneficiators who clean and color-sort the material. These incentive payments allow for a more detailed picture of how CRV plastic and glass is handled in the downstream recycling infrastructure (see Table 10).

Table 10. In-state processing of CRV plastic and glass in 2014.

Material	CRV Collected (tons)	Material Processed or Manufactured in CA (tons)	Material Receiving Payments (tons)
Plastic	218,769	138,215	107,400
Glass	629,594	732,034	146,327

Data reflects tons of material collected in 2014. The Plastic category reflects the tons of PET and HDPE that were processed or manufactured in California and received a plastic market development payment. The Glass category reflects the tons of glass from curbside programs, collection programs, and community service programs that was cleaned and color-sorted at glass beneficiators and received a quality incentive payment. The amount of recycled glass manufactured in California is reported in CalRecycle's *2014 California Glass Container and Fiberglass Production Minimum Content Report*.[31] This number includes CRV and non-CRV glass.

Roughly half of the plastic containers received through the BCRP are at least partially processed in California, as determined by material that receives incentive payments for processing and manufacturing. About a quarter of the glass containers received incentive payments from CalRecycle in 2014, and a majority of the material is processed in-state. In-state processing of plastics accounts for most of the estimated capacity for plastics processing in the state (compare Tables 4 and 10). This suggests that the incentive program has been successful at promoting the recycling processing infrastructure within California for CRV containers. However, since there is only limited additional processing capacity for plastics in California, this reflects the broader trend of exportation of most recyclable material from California.

The incentive program for glass is intended to increase the quality of glass for downstream applications. As a result, it is likely that substantially more glass is handled in California but does not receive the incentive payment. In addition, the estimated processing capacity in California for beneficiation is much higher than the total amount of glass collected in the Beverage Container Recycling Program (see Table 4), so there is sufficient infrastructure in place to handle glass processing and manufacturing in California.

Challenges for Collection

In recent years, the Beverage Container Recycling Program has experienced various challenges, including concerns regarding fraud and structural deficits in the program's fund. During 2015, CalRecycle continued to implement several new enforcement programs in order to limit defrauding of the program and maintain better financial solvency. These programs include heightened processor oversight, handling fee audits,

and arrests of haulers entering California with illegal loads. This last change has led to several arrests in a $14 million fraud scheme spanning from 2012 to 2014.

CalRecycle continues to evaluate and implement new practices to reform the program.

Construction and Demolition

In CalRecycle's 2014 waste characterization study, typical materials from C&D (such as inerts, roofing, and gypsum) accounted for 7.9 percent of the total waste stream; lumber accounted for an additional 11.9 percent of the total waste stream.

Not all C&D facilities require a solid waste permit in order to operate. Forty C&D recycling facilities have voluntarily reported to the state through FacIT; however, this underrepresents the actual recycling that occurs. For example, concrete yards may reuse material on-site rather than ship it to an independent facility. The throughput of C&D materials at recycling facilities is also difficult to track. Permitted facilities are not required to provide their actual throughput to CalRecycle, and the permits often cite the maximum theoretical throughput at the facility.

Many C&D materials can be reused or recycled; locally, this type of mindful materials management is one component of the practice of sustainable or green building construction. In order to promote the recycling of C&D materials, the California Green Building Standards Code (CALGreen) requires that most new construction and some additions and alterations divert at least 50 percent of their construction waste. As a part of the 2015 CALGreen update, a proposal is being considered to increase the diversion requirement to 65 percent. If approved, this measure would have an effective date of January 1, 2017.

Extended Producer Responsibility (Paint, Carpet, and Mattresses)

Extended producer responsibility (EPR), also known as product stewardship, is a strategy to place a shared responsibility for end-of-life product management on all entities involved in the product change, instead of on local governments and the general public. CalRecycle currently oversees three statutory EPR programs for paint, carpet, and mattresses.

Paint

The California Paint Stewardship Law (AB 1343, Huffman, Chapter 420, Statutes of 2010) created an EPR program for paint to reduce its generation, promote its reuse, and properly manage unwanted leftover paint. Although paint is considered a hazardous waste, rather than a solid waste, its management under the EPR program provides an interesting example of how waste paint can be managed and tracked.

Within California, post-consumer paint is collected at household hazardous waste (HHW) facilities, participating drop-off locations, and other paint-specific programs organized by PaintCare, the stewardship organization currently implementing the Paint

Stewardship Program. As of June 30, 2015,[32] there were 733 permanent PaintCare collection sites in California, and there is a site located within 15 miles of 98 percent of the population. Not all HHW facilities participate in the PaintCare program; as a result, some paint is collected through HHW facilities that are outside of the PaintCare program.

For the 2014-2015 fiscal year, 65.7 million gallons of paint were sold in California. PaintCare assumes that approximately 10 percent of purchased paint will be left over and has set a stewardship goal of recovering 7 percent of the total paint sold each year (7 percent recovery rate). In 2014-2015, 2.7 million gallons of paint (4 percent recovery rate, approximately 13,590 tons) were processed through PaintCare. Roughly half of this volume was collected at HHW facilities, and HHW facilities also collected an additional 0.57 million gallons of paint outside the stewardship program.

As PaintCare expands its retail collection infrastructure and partners with local governments to manage paint collected at HHW facilities, total collection of paint has grown (see Figure 25). During this same period, the amount of paint collected and managed by local governments has decreased substantially. This is consistent with one of the primary goals of EPR programs, which is to shift the burden of end-of-life product management from local governments to producers.

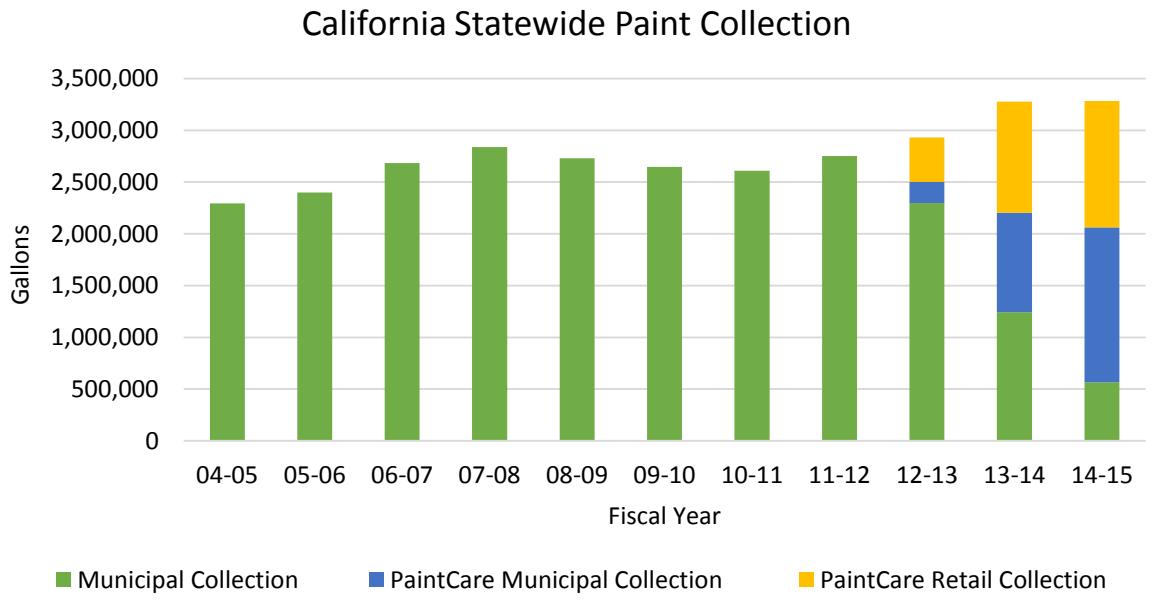

Figure 25. California statewide paint collection by local government HHW programs (Municipal Collection, green), PaintCare at HHW sites (PaintCare Municipal Collection, blue), and PaintCare at retail locations (PaintCare Retail Collection, yellow). Data from PaintCare and Form 303 reporting.

Once the paint has been collected, it can be reused, recycled, turned into alternative products, processed for energy recovery, incinerated, or landfilled; the fate of collected paint varies depending on a variety of factors, including its base composition, quality, and color. Of the 2.3 million gallons of latex paint processed in the 2014-2015 fiscal year, 3 percent was reused, 72 percent was recycled, 20 percent was turned into alternative products or beneficially reused (such as retaining wall blocks or energy recovery, respectively), and 5 percent was dry, unusable paint that was landfilled. In contrast, of the 0.5 million gallons of oil-based paint processed by PaintCare, most was managed by fuel blending for energy recovery (41 percent) or fuel incineration (57 percent), and 2 percent was reused. Although there are no requirements to process the paint in-state, PaintCare has reported sending paint to eight latex paint recyclers in California and stated that all of the paint collected is processed within the United States.

Currently, the program has sufficient processing capacity to handle PaintCare's goal of a 7 percent recovery rate. The amount of paint collected is expected to increase over the next few years, but if source-reduction efforts are effective in reducing the amount of excess paint sold, then less paint would be available for collection overall. PaintCare is also working to enhance the amount of paint that is reused, rather than recycled, under the stewardship program by increasing its incentive for local government reuse programs; this should assist in collected paint going to its highest and best use.

Carpet

According to the 2014 waste characterization study, discarded carpet accounted for approximately 1.8 percent of the waste by volume disposed in California, which corresponds to 570,000 tons of disposed material. The Carpet Stewardship Program (AB 2398, Perez, Chapter 681, Statutes of 2010) was established to address this part of the waste stream. It was the first carpet EPR program established nationally and is run by Carpet America Recovery Effort (CARE). Currently, CARE has a goal of recycling 16 percent of post-consumer carpet by 2016, and 24 percent by 2020.

In 2014, CARE reported that of an estimated 179,000 tons of post-consumer carpet generated in California,[33] 61,500 tons were collected by the stewardship program and 21,500 tons (12 percent) were recycled.[34] While the recycling rate increased in the program's first year, it has remained essentially flat in the last three years. CARE's annual report only reflects data that is provided by approved collection facilities, so the numbers provided in the report may not accurately reflect all carpet management. In addition, the amount of generated carpet used as a base line for CARE's recycling goal is based on the amount of new carpet sold, which differs substantially from CalRecycle's estimate in the 2014 waste characterization study.

The 2014 annual report also highlighted several significant changes in how diverted carpet was managed. The amount of carpet that was sent to kilns over previous years increased substantially (4,650 tons in 2014 versus 24 tons in 2013). Exports of collected

carpet were also high – 5,600 tons in 2014, or more than double the amount exported in 2013. This likely underrepresents the total amount of exports, as additional carpet may be collected outside of the CARE program and shipped out of the country for handling. The increase in export is surprising, given that exported carpet does not count toward CARE's recycling rate and does not receive financial incentives under CARE's stewardship program. However, there is nothing prohibiting the export of carpet for management under CARE's stewardship program.

In September 2014, CalRecycle found that CARE's stewardship program was out of compliance because it did not meet the minimum requirements described in regulation, and the program was not making continuous and meaningful improvements. In January 2015, CalRecycle agreed to several initial changes in CARE's stewardship plan, including increasing the incentive payment made to recyclers and increasing the fee paid by consumers when they purchase carpet, to bolster carpet recycling. CARE has since submitted two additional changes to its stewardship plan in order to address the noncompliance ruling, and CalRecycle is currently evaluating these changes. CalRecycle will determine whether these changes have brought CARE into compliance after receiving the 2015 annual report in July 2016.

Mattresses

The California Used Mattress Recovery and Recycling Act (SB 254, Hancock and Correa, Chapter 388, Statutes of 2013) was enacted to reduce illegal dumping and increase recycling of mattresses through a statewide EPR program. To facilitate collection efforts, the law requires free customer drop-off and retailer take-back of old mattresses upon the delivery of new mattresses. Currently, the stewardship organization is responsible for designing, implementing, and administering the program is the Mattress Recycling Council (MRC). CalRecycle received the MRC's stewardship plan in July 2015, granted conditional approval of the plan in September 2015, and received a revised plan on November 30, 2015.[35]

The MRC's plan sets a collection goal of 1.5 million mattresses and foundations in its first year of operation and establishes a 75 percent by weight recycling target for contracted recyclers. Although there is no California-specific data on the generation or handling of mattresses in-state, MRC estimated that 4.7 million new mattresses and foundations were sold in California in 2014 and about 370,000 mattress units were recycled.

The mattress stewardship program is scheduled to begin collecting fees on December 30, 2015. Be January 1, 2018, CalRecycle, in consultation with the MRC, will establish a mattress recycling baseline and mattress recycling goal for the program.

Other Collected Materials

CalRecycle manages several additional recycling efforts involving specific materials. For some materials, such as sharps, other household hazardous waste, and used oil, information on their management is not used to calculate the statewide recycling rate because the materials cannot be disposed in a solid waste landfill. Others, such as waste tires, can be disposed after processing; thus, any recycling would count toward the 75 percent recycling goal.

Household Hazardous Waste

CalRecycle and the Department of Toxic Substances Control (DTSC) are required to jointly maintain a database of all household hazardous waste collection facilities, events, and programs, and to collect information from local governments on the amount of material collected by type and by final disposition.

In fiscal year 2014-2015, more than 49,000 tons of HHW was collected by local governments; this is the highest amount reported since the reporting requirements were implemented in 2004. By weight, the largest three categories of returned items are electronic devices, reclaimable materials (including antifreeze, auto batteries, latex paint, and used oil), and flammables and poisons. Roughly two-thirds of this material was collected at permanent HHW facilities, although temporary facilities, recycle-only facilities, and other locations also serve as key collection points.

Once the HHW has been collected, almost 60 percent is recycled (see Figure 26). Most of the recycled material is electronic waste, universal waste (including batteries), and reclaimable materials. Another 17 percent is managed by stewardship organizations; this corresponds to returned paint managed by PaintCare. The remaining material is handled according to the hazardous nature of the material.

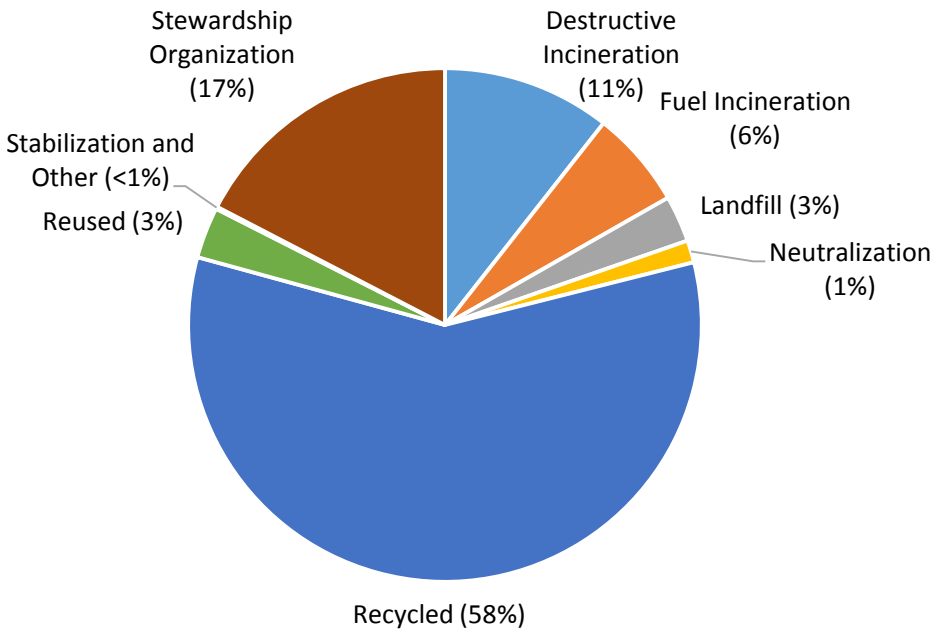

Figure 26. Final disposition of household hazardous materials collected by local governments for fiscal year 2014-2015, as reported on Form 303.[36] The terms destructive incineration, fuel incineration, neutralization, and stabilization are further described in the glossary.

Used Oil

The Used Oil Recycling Program (AB 2076, Sher, Chapter 817, Statutes of 1991) aims to avoid illegal disposal of used oil by establishing a statewide collection network. Currently, there are more than 2,800 certified used oil collection points in California, which robustly cover the collection of lubricating oil in the state. The amount of lubricating oil sold and collected in California is reported to CalRecycle in connection with the used oil fee.

In 2014, approximately 110 million gallons of lubricating oil were sold for use in California. CalRecycle estimates that, due to unavoidable losses during use, only 101 million gallons were available for collection and reprocessing. Facilities in California collected approximately 86 million gallons of lubricating oil (approximately 317,000 tons), which corresponds to a 78 percent collection rate and an 85 percent recycling rate.[37] Figure 27 shows the changes in lubricating oil sold and recovered over the 20 years of the used oil program. The amount of recycled lubricating oil has remained relatively steady over the last 10 years. However, lubricating oil sales dropped significantly in 2008, leading to a collection rate of more than 70 percent. The drop in oil sales was attributed to the recession, but the subsequent lack of a rebound in oil sales can be attributed to a number of factors, including less frequent oil changes, slightly lower spending in general, and fewer miles driven.

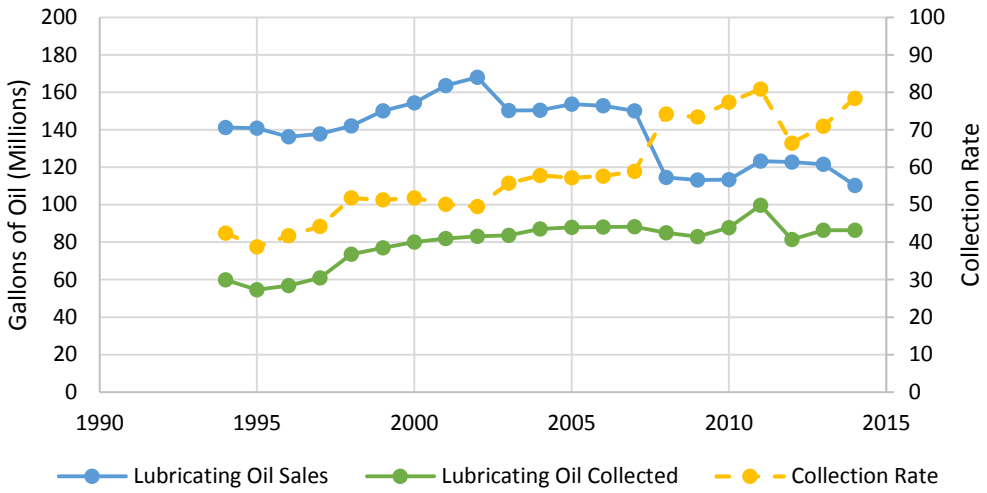

Figure 27. Sales, collection, and collection rate for used lubricating oil. Data includes some adjustments relative to the 2015 State of Recycling report to account for different allocations to recycled lubricating and industrial oil.

Industrial oil is also collected and managed by the used oil infrastructure in California, although these oils are not included in CalRecycle's fee and incentive program. In 2014, 104.6 million gallons of lubricating and industrial used oil were collected. Of that, roughly 14 million gallons of used oil were shipped out of state to prior to processing; while much of this used oil is likely to have been used as fuel, CalRecycle is not able to track its final fate. The remaining oil is processed in state, where approximately 25 percent is re-refined into new lubricating and industrial oils; the remaining material is processed into light or heavy fuels.

Covered Electronic Waste

The Electronic Waste Recycling Act of 2003 (AB 20, Sher, Chapter 526) established a program in which fees paid by consumers at the time of purchase for covered electronic wastes are used to offset the cost of waste recovery, processing, and recycling activities. CalRecycle staff verify processing claims prior to repaying electronic waste processors, which helps to reduce fraud and accidental errors in reimbursements. Covered electronic devices include cathode ray tube devices; televisions and computer monitors containing cathode ray tubes (CRTs); televisions, computer monitors, laptop computers, and personal portable DVD players containing liquid crystal displays (LCDs); and plasma televisions. Through this program, CalRecycle works with DTSC to ensure that the materials are handled appropriately.

As of December 2015, there were approximately 485 approved collectors and 33 approved recyclers in California. Between 2007 and 2014, recyclers collected on average 200 million pounds of covered electronics annually, or 1.9 billion pounds since

the start of the program in 2005. In 2013, approximately 98 percent of the collected devices by weight contain CRTs. However, this dropped to 95 percent for the first nine months of 2015, which likely reflects the increase in discarded modern LCD devices. Since LCD devices are typically more challenging and expensive to recycle than CRT devices, this raises questions about how these devices will be recycled as their collection becomes more common.

All covered electronic waste that is claimed through the program is dismantled within California under strict universal waste and hazardous waste rules administered by DTSC. The majority of the derived residuals, generated through the dismantling of the covered electronic waste, is shipped out of the state or out of the country; this includes CRTs and CRT glass, as well as plastics, metals, and other materials. For the past several years, most residual CRTs and CRT glass was sent, directly or indirectly, to Videocon in India for use in the manufacture of new CRT devices. However, Videocon stopped accepting new sources of CRT glass in 2015, and a recent report stated that the company is currently not in operation or accepting any CRT glass.[38]

The loss of this key market for using CRT glass has significant impacts on the broader recycling markets for this material. In particular, CalRecycle has had to consider whether otherwise legal dispositions of CRT glass (such as landfilling) were appropriate for residuals derived from processed covered electronic waste. As a result, new emergency regulations were enacted in August 2015 to allow for Resource Conservation and Recovery Act (RCRA) hazardous waste CRT glass generated from covered electronic waste dismantling to be disposed in Class 1 landfills or under universal waste laws. RCRA non-hazardous waste may be separated, further processed, tested, and disposed in Class 2 or 3 landfills.

With recycling options greatly reduced, some CRT glass is being disposed under these new regulations, presenting an unfamiliar option for handling CRT glass than what was available under previous markets. Although some CRT glass disposal is occurring, recyclers and state program administrators continue to evaluate various proposals to reuse this material.

Tires

Under the Tire Recycling Act of 1989 (AB 1843, W. Brown, Chapter 974), California has worked to divert tires from landfills; CalRecycle has a goal of reaching 90 percent diversion of tires by 2015. In 2014, an estimated 44 million passenger tire equivalents (PTEs) were managed and tracked in California. Tires can be recycled to produce crumb rubber for products, rubberized asphalt concrete, and tire-derived aggregate and related civil-engineering applications, or they can be combusted as fuel (e.g., cement kilns, cement manufacturing plants, or EMSW). Unlike other recycling programs in California, almost all of the end-use destinations for tires are tracked, permitted, and quantified. The “California Uniform Waste and Used Tire Manifest” provides monitoring

information to CalRecycle on waste tire loads and movement within the state. The waste tire manifest system ensures that almost all waste tires generated and transported in California have been accounted for and are delivered to permitted end-use facilities. However, there are some gaps in the collected data, as some facilities provide inconsistent responses or have failed to respond to surveys, and some flows are not manifested. CalRecycle also conducts an annual market survey to determine the distribution of tire end-use activities, which has had minor variations since 2011 (see Figure 28).

There are a few significant trends in the management of waste tires in the last several years. First, both the diversion and the recycling rate have dropped from their all-time high in 2012, which corresponds to increases in landfill disposal. According to the contractor's report, this "was partly due to disruptions at one large processor, and may have also been influenced by disruptions in export flows."[39] Second, the use of waste tires to produce crumb rubber has declined by more than 30 percent since 2012. Although there are a variety of reasons that may explain this decline, weaker markets and concern about health impacts likely play a role. In addition, the actual recycling rate, which excludes ADC, exports, and waste tire-derived fuel, is only around 40 percent. It is unclear if the current market, and the nature of various supporting grant programs, is sufficient to overcome these barriers and significantly increase the recycling rate.

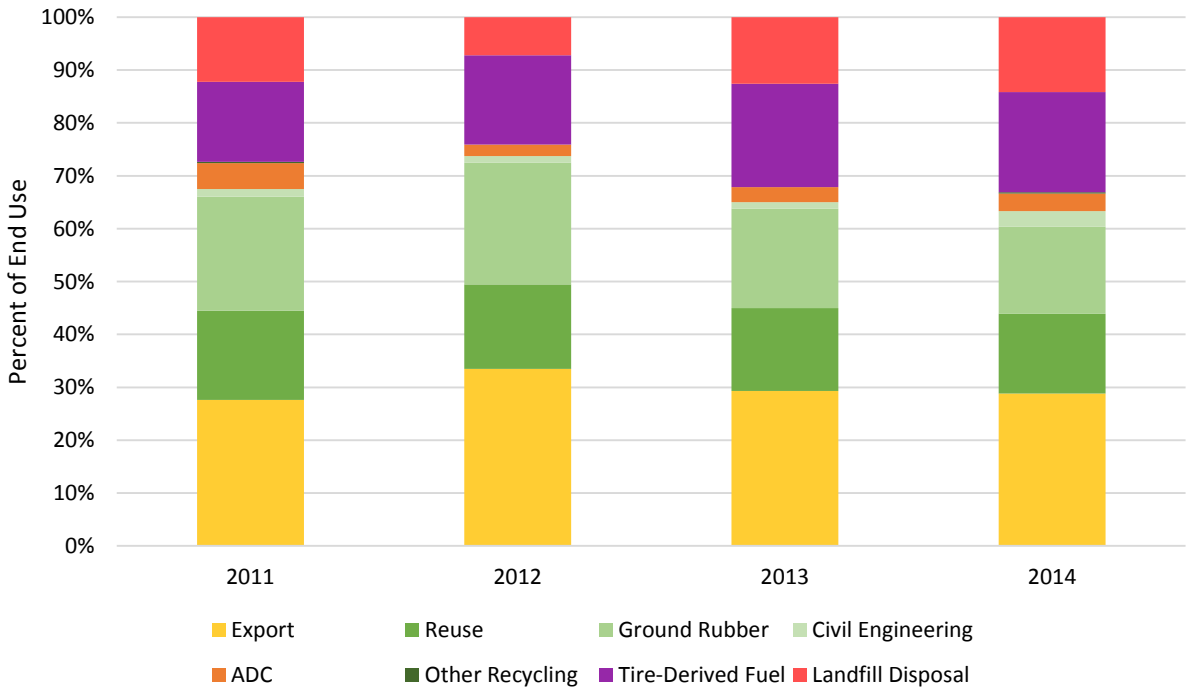

Figure 28. Estimated end-use of California-generated waste tires. Data from "California Waste Tire Market Report: 2014."

Disposal-Related Activities

Several types of material flows that are labeled as disposal-related activities under the 75 percent recycling goal count toward diversion under AB 939. These include ADC, AIC, other beneficial reuse at landfills, transformation, and waste tire-derived fuel. All five of these processes were determined not to be recycling under the intent of AB 341.

ADC, AIC, other beneficial reuse at landfills, and transformation are all tracked at the county level through the Disposal Reporting System (see *State of Disposal in California, Updated 2016* for more detail). As a result, CalRecycle has fairly detailed information on the quantity of materials handled under these four processes. Waste tire-derived fuels are tracked as described above. Table 11 highlights the amount of material managed by these activities in 2014, which totaled 6.6 million tons.

Table 11. Material managed through disposal-related activities in 2014.

Activity	Tons
ADC	3,423,840
AIC	60,776
Other Beneficial Reuse at Landfills	2,228,942
Transformation	817,613
Waste Tire-Derived Fuels	84,000
Total	**6,615,171**

Overall Evaluation of California Statewide Data

Overall, CalRecycle only tracks a small portion of the 37.1 million tons of the source reduction, recycling, and composting calculated under AB 341; this is unchanged from the analysis in the 2015 *State of Recycling in California* report.[40] Figure 29 shows the distribution of total estimated recycling relative to programs with tracking or reporting requirements. The beverage container recycling program accepted 1 million tons of recyclable material in 2014, which accounts for 2.7 percent of the recycling stream. EPR programs, which have robust reporting requirements, only collected 35,090 tons of material. Since used paint is a hazardous waste, paint collected under the EPR program does not count as solid waste recycling. As a result, from the EPR programs, only the 21,500 tons from the carpet program add to the amount of recycled solid waste, or less than 0.1 percent of the recycling stream. The 281,000 tons of waste tires that were exported, reused, ground for rubber, or applied in civil engineering programs account for 0.8 percent of the recycling stream. *CalRecycle does not have firm tracking data for an estimated 35.8 million tons of recyclable materials, or 96.5 percent of all estimated recyclables.*

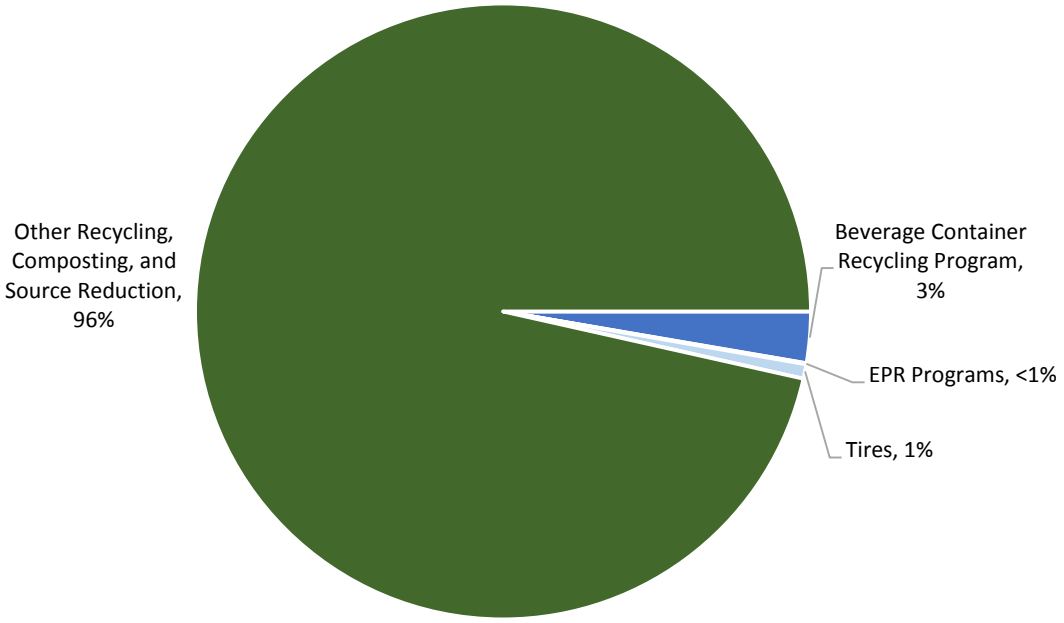

Figure 29. Tracked recycling in 2014, as a percentage of the estimated recycling waste stream. Programs shown in blue (beverage container recycling, carpet EPR, and tire programs) are tracked, whereas the remaining recyclables collected in California, shown in green, are not. Data based on 37.1 million tons of recycling projected under AB 341.

Without direct tracking of recycling, it is impossible to firmly state how much of what materials are recycled. The passage of AB 901 in 2015 should provide more accurate information on how much of what materials are recycled in California.

How Is California's Recycling Infrastructure Financially Supported at the State Level?

CalRecycle Funding Mechanisms

CalRecycle's recycling programs, grants, and loans are funded entirely through special funds. Table 12 lists the revenue sources for the Department in fiscal year 2014-2015. The Integrated Waste Management Account is funded through a tipping fee on landfilled materials (see below). Product fees on beverage containers, tires, oil, and covered electronic wastes are used to fund the programs directly associated with those materials. CalRecycle has also received money through the Greenhouse Gas Reduction Fund and will begin receiving money through the Used Mattress Recycling Fund in fiscal year 2015-2016.

Table 12. Revenue sources for CalRecycle in fiscal year 2014-2015

Fund	Revenue
Integrated Waste Management Account	$43,633,000
Used Oil Recycling Fund	$23,657,000
Tire Recycling Management Fund	$56,332,000
Beverage Container Recycling Fund	$1,247,968,000
- Glass Processing Fee Account	$5,699,000
- Bi-Metal Processing Fee Account	$1,490,000
- PET Processing Fee Account	$4,660,000
Electronic Waste Recovery and Recycling Account	$59,367,000
Carpet Stewardship Account	$275,000
Architectural Paint Account	$275,000

Integrated Waste Management Fee

The majority of CalRecycle's waste management programs are funded through a tipping fee collected on landfilled materials. The fee is statutorily capped at $1.40 per ton and is deposited in the Integrated Waste Management Account. When the tipping fee was first established in 1989, the intent of the fee was to fund the overall operations of CalRecycle, including regulating solid waste, permitting facilities, financing, establishing a system for jurisdictions to reach their diversion mandates, and reviewing compliance with state-mandated programs. In the 26 years since the tipping fee was established, a growing array of general disposal, diversion, and recycling programs and goals continue to rely on this revenue source.

Ultimately, CalRecycle's mission to protect the environment and public health from activities related to waste management, and the Department's efforts to achieve California's recycling and climate goals, are largely dependent upon funding generated from the disposal of materials in landfills.

Since the $1.40 per ton landfill tipping fee funds CalRecycle's general waste management obligations, the long-term stability of tipping fees as a funding structure is a growing concern. As the amount of landfilled material decreases, there will be less revenue available to support California's increasing recycling efforts and to finance CalRecycle's reasonable regulatory oversight of these efforts. If in 2020, 22 million tons of additional material is diverted from landfills under the 75 percent statewide recycling goal, then the state fund will have a net revenue loss of about $30 million. A more sustainable funding structure is needed to achieve and maintain the 75 percent statewide recycling goal.

In 2015, Assembly Member Das Williams introduced AB 1063, which supported funding for market incentives to help achieve California's recycling goals and to put CalRecycle on a sustainable funding path; the bill is still pending in the Senate Environmental Quality Committee. In its current form, AB 1063 would raise the tipping fee to $4 per ton and require a portion of that money to be used to promote recycling infrastructure development. The bill would also establish a generator-based charge on waste generation to supplement the tipping fee. In light of this discussion, CalRecycle hosted public workshops in December 2015 to gather stakeholder input on how to best generate the funding needed to help achieve the 75 percent statewide recycling goal and to sustainably fund the Department's activities. CalRecycle will continue to engage stakeholders in the development of a sustainable funding structure.

Product Fee Programs for Specific Items

In addition to the tipping fee, California uses product fees on items to encourage recycling and fund programs associated with those items. The fee is assessed on consumers or manufacturers when the product is sold in California. In some cases, CalRecycle uses the fee to compensate consumers when the product is recycled, and uncollected recycling payments are used to administer the program and provide other incentives. For example, the beverage container recycling program collected $1.25 billion from CRV purchases and paid out $1.09 billion in CRV returns in fiscal year 2014-2015; this same mechanism is used for the covered electronic waste program and the used oil program. In other cases, the fee is collected by a stewardship organization and is used to fund post-consumer handling and departmental oversight, as is the case for the paint, carpet, and mattress programs.

Grant, Payment, and Loan Programs

CalRecycle has a long history of administering grants, payments, and loans to help develop and maintain the recycling collection and processing infrastructure. CalRecycle

annually awards roughly $100 million across more than 1,000 entities, which include local governments, private organizations, and local conservation corps, to assist in the safe and effective management of the waste stream. These awards target cleanup, enforcement, market development, and collection programs for beverage containers, tires, and used oil. Many of the programs have the ability to modify program criteria annually based on the priorities of the Department and input from stakeholders. This helps CalRecycle set the direction for the statewide management of generated waste.

California Climate Investments

The California Global Warming Solutions Act of 2006 (AB 32, Núñez and Pavley, Chapter 488, Statutes of 2006) established the world's first comprehensive program of regulatory and market mechanisms to achieve real, quantifiable, cost-effective reductions of greenhouse gases. In response to AB 32, the California Air Resources Board (ARB) developed the *Climate Change Scoping Plan*, which contains the main strategies California will use to reduce greenhouse gases.

According to ARB's updated scoping plan, approximately 8 million tons of carbon dioxide equivalent are released annually by California landfills, generally in the form of methane. Recycling organic waste provides significant reductions in greenhouse gases compared to landfilling. In addition, other types of recycling efforts can also lead to dramatic reductions in the release of greenhouse gases. As a result, the 2014-2015 budget allocated $20 million in grants from the Greenhouse Gas Reduction Fund to fund shovel-ready recycling projects.

In November 2014, CalRecycle announced eight facilities that received $19.5 million under the Organics Grant Program and the Recycled Fiber, Plastic, and Glass Grant Program (as described earlier). Funds were awarded on a competitive basis for projects that contributed to the state's greenhouse gas reduction targets and advanced California's 75 percent recycling goal.

The California Legislature has not yet approved allocations from the Greenhouse Gas Reduction Fund for the 2015-2016 budget year, so it is unclear whether CalRecycle will continue to have access to this funding source.

How Does California's Statewide Recycling System Compare with Other States and Other Countries?

California has long been a leader in implementing new programs for the management and recycling of solid waste. However, it is instructive to consider California's efforts in the context of other strategies that are employed within the United States and internationally.

Recycling Practices in Other States

General Recycling

In 2014, the Columbia University Earth Engineering Center released its report *Generation and Disposition of Municipal Solid Waste (MSW) in the United States—A National Survey.* This report builds on the biannual "State of Garbage in America" surveys conducted from 2002 to 2010. The Columbia University report compiled waste management data collected in 2013 to explore national trends. Overall, the survey showed that the United States generated 389 million tons[41] of municipal solid waste: 29 percent was recycled or composted, 7.6 percent was sent to waste-to-energy facilities, and 63.5 percent was landfilled. In comparison, the survey determined that California generated 66.3 million tons of waste and recycled 41.8 percent, composted 11.5 percent, combusted 1.3 percent, and landfilled 45.3 percent.[42] Based on this data, California generates 17.0 percent of all waste nationally; however, California only accounts for 12 percent of the national population and the gross domestic product.

Although California compares favorably with other states in terms of its recycling and composting rate, it is important to consider how other states manage their recycling efforts. By evaluating how California's recycling infrastructure compares to other states, new opportunities may appear for assessing and tracking California's 75 percent recycling goal.

One developing tool for evaluating state efforts is the U.S. EPA's Sustainable Materials Management tool. This effort to aggregate recycling and disposal information across all 50 states aims to create a national data clearinghouse that allows for comparisons across states and regions. Data aggregated from the 2013 survey was released in March 2015 and highlighted data and programs from 32 states and the District of Columbia. As more states participate in the survey, the U.S. EPA hopes to use the data to create a national mechanism for sharing successful programs and comparing efforts nationwide.

Organics Management

California has recently adopted several programs to manage organic wastes, including AB 1826 and the proposed Short-Lived Climate Pollutant Reduction Strategy; these measures would lead to an effective elimination of organics from landfills by 2025. However, implementation of these measures has not yet begun.

Several other states have already adopted a variety of organics management strategies that are aimed at dramatically reducing the amount of organic material in the landfill. Based on a survey conducted by the Environmental Research and Education Foundation,[43] 20 states have full landfill bans on yard waste and another four have partial landfill bans; these states are primarily located in the East and Midwest. In addition, several other states have food waste disposal programs that will go into effect in 2016 or later. The most dramatic example of this is Vermont's Universal Recycling Law (AB 148), which bans disposal of green waste by July 1, 2016, and food scraps by July 1, 2020. This is in addition to a general landfill ban on recyclables that went into effect on July 1, 2015.

Recycling Practices in Other Countries

Recycling practices vary dramatically across countries and are often reflective of unique political and social forces within those countries. For example, Japan builds on a history of citizen responsibility by requiring extensive source separation of recyclables, rather than post-collection sorting at MRFs as is common in California. Canada and Europe have government mandates to implement extended producer responsibility programs for paper, packaging, medications, and many other materials. While it is unlikely that every international program would be directly applicable to California, there are important lessons that California can draw on as it moves toward achieving the 75 percent statewide recycling goal.

European Union

The European Union (EU) provides an interesting case study to evaluate overall recycling practices in comparison to California. The EU has ambitious recycling and solid waste reduction policies and collects extensive data on the waste management of its member states. Data for this section is aggregated from the Environment Directorate General of the European Commission and Eurostat, the statistical office of the European Union.

Solid waste treatment options in the EU include landfilling, recycling, composting, and incineration for disposal and energy recovery. The EU also exports waste, including recyclables, to Asia. The increase in waste exports comes as rapid economic growth in Asia has created demand for raw materials and offers lower environmental and financial costs for waste management. EU waste management policies have forced member states to find new approaches for treating and diverting waste, and moving waste

across borders allows access to recycling and disposal opportunities that are unavailable or more expensive in the source country.

The EU municipal waste sector, which primarily consists of waste generated by households but may also include small businesses and public institutions, generated approximately 266 million tons of waste in 2013, or 2.9 pounds per person per day. This is substantially less than the projected generation of waste per person per day in California (10.7 pounds); this disparity is likely due to differences in waste management policies and the exclusion of various industries from the EU's definition of municipal waste, including C&D waste. Since the EU began tracking the fate of its generated waste in 1995, there has been a steady decrease in the percentage of waste that is landfilled and a steady increase in composting, recycling, and incineration (see Figure 30). In 1995, 67 percent of waste was landfilled, 7 percent was composted, and 12 percent was recycled; in 2013, only 31 percent was landfilled, while 15 percent was composted and 28 percent was recycled. During this same period, incineration of waste has increased substantially (15 percent to 26 percent), which is consistent with the EU's emphasis on incineration as a waste management strategy.

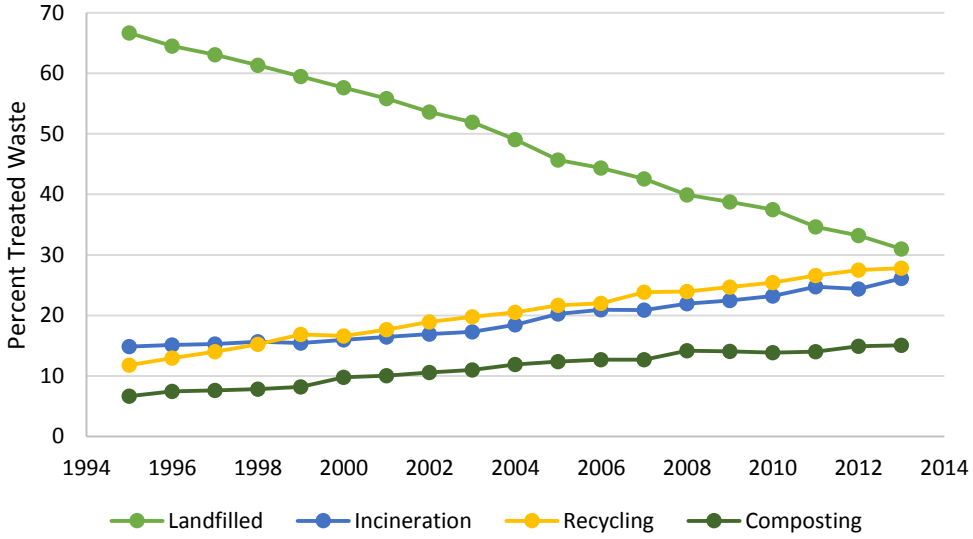

Figure 30. Fate of municipal waste in the European Union between 1995 and 2013. Data from Eurostat "Municipal waste generation and treatment, by type of treatment method."[44]

The European Union has several key pieces of legislation for waste policy. The Waste Framework Directive establishes a legal framework for the treatment of waste and sets targets for member states to achieve 50 percent recycling of municipal waste and 70 percent recycling of construction waste by 2020. Additionally, the landfill directive mandates member states to reduce the amount of organic waste sent to landfills to 35 percent of 1995 levels by 2016. In July 2014 the EU adopted a legislative proposal that

set waste management targets, including increasing recycling and re-use of municipal waste to 70 percent by 2030; increasing recycling and re-use of packaging waste to 80 percent by 2030; reducing food waste by 30 percent by 2025; and phasing out landfilling of recyclable materials by 2025.

The EU has much more extensive data on solid waste treatment and recycling than California does, since the EU requires member states to track and report the treatment of waste, including recycling. However, it is difficult to compare the waste management data of a single state to a conglomeration of 28 countries. In 2014, California source-reduced, recycled, and composted 50 percent, or 37.1 million tons, of an estimated 75 million tons of waste generated, while the European Union recycled 36 percent, or approximately 1 billion tons, of 2.76 billion tons of its total waste. Both California and the European Union have set lofty goals to reduce waste and increase recycling and have innovative policies in place to try to meet those goals.

Conclusions

California has made significant strides in recycling over the last 25 years. Jurisdiction-level efforts have led to the adoption of thousands of local recycling and diversion programs. Sweeping statewide measures, including mandatory commercial recycling, are intended to further enhance recycling programs, although it is not yet clear how broadly this program has been implemented. In addition, overall estimated recycling, diversion, and disposal rates compare favorably to other states at the national level.

California will achieve its 75 percent recycling goal when statewide disposal is no more than 2.7 pounds per person per day. California's landfills are tracked with relatively high efficiency (see *State of Disposal in California, 2016 Update* for additional information), and this metric can be easily determined from that data. However, in order to understand whether the 2.7 pounds per person per day target accurately reflects 75 percent recycling from the amount of waste generated in a given year, it is critical to have a more nuanced view of the overall recycling infrastructure.

Currently, CalRecycle has limited insight on the quantities and flows of material traveling through the recycling stream. The materials that are currently tracked typically have money associated with the management programs (including the beverage container recycling program) or have a hazardous component (such as used oil and paint). As a result, less than 4 percent of the estimated recycling stream was tracked by the state in 2014.

CalRecycle has attempted to assess California's in-state processing and manufacturing capacity using voluntarily provided data, Department estimates, and industry surveys. Based on this data, California's current in-state manufacturing capacity is insufficient to handle the state's post-consumer recyclables or organic materials. One result of this limited infrastructure is that at least half of post-consumer recyclables (an estimated 12.6 million tons in 2014) were exported from California for final processing, in addition to significant amounts of material exiting the state by truck and rail.

The adoption of AB 901 in 2015 provides an avenue for the broader tracking of recyclable and compostable materials in California. CalRecycle will begin developing regulations to implement this law in 2016. Full implementation of AB 901 will allow the Department to accurately access facility throughput and capacity and the flows of material between facilities, thereby providing critical information to CalRecycle as it invests in the infrastructure necessary to reach the 75 percent statewide recycling goal.

Questions for Further Consideration

What role does vertical integration, or the arrangement in which one company manages multiple steps of processing, play in recycling and the movement of material among facilities?

How can CalRecycle evaluate state efficacy in promoting programs without sufficient reporting information?

How can CalRecycle better determine whether businesses are implementing MCR and the mandatory commercial organics recycling program?

What are the impacts of biomass conversion on California's recycling efforts? In particular:

- Should biomass conversion continue to be excluded from generation?
- If biomass conversion is included in CalRecycle's calculation of waste generation, should it count as disposal or recycling for the statewide 75 percent recycling goal?
- Regardless of whether it is disposal or recycling, is this a technology that CalRecycle wants to encourage and incentivize?
- How will CalRecycle establish consistent policies in distinguishing between biomass conversion, biological digestion of waste (such as anaerobic digestion), and thermal treatment of municipal solid waste (though transformation, thermal resource recovery, or other technologies)?
- As CalRecycle begins to collect data from biomass facilities under SB 498, is this a type of facility that should be tracked, permitted, or regulated differently?

How can CalRecycle decouple recycling and disposal from broader economic drivers (such as oil prices, wages, and others) in order to reach the Department's various goals?

How can CalRecycle develop in-state manufacturing infrastructure to close the loop and keep recyclable materials in California?

What types of partnerships between state and local governments are necessary to develop the infrastructure for composting and commodity recyclables?

How can CalRecycle determine when recycling markets and demand are sustainable?

What are the potential community impacts of expanding the in-state infrastructure for composting and commodity recyclables?

Abbreviations and Acronyms

AB – Assembly Bill

AD – Anaerobic Digestion

ADC – Alternative Daily Cover

AIC – Alternative Intermediate Cover

ARB – California Air Resources Board

BCRP – Beverage Container Recycling Program

C&D – Construction and Demolition

CALGreen – California Green Building Standards Code

CalRecycle – California Department of Resources Recycling and Recovery

CARE – Carpet America Recovery Effort

CEC – California Energy Commission

CRT – Cathode Ray Tube

CRV – California Redemption Value

DORIIS – Division of Recycling Integrated Information System

DPH – California Department of Public Health

DPS – Diversion Program System

DRS – Disposal Reporting System

DTSC – Department of Toxic Substances Control

EAR – Electronic Annual Report

EMSW – Engineered Municipal Solid Waste

EPR – Extended Producer Responsibility

EU – European Union

FacIT – Facility Information Toolbox

GHG – Greenhouse Gas

HDPE – High-Density Polyethylene

HHW – Household Hazardous Waste

IMR – Imported Material Report

LCD – Liquid Crystal Display

MCR – Mandatory Commercial Recycling

MRC – Mattress Recycling Council

MRF – Material Recovery Facility

MSW – Municipal Solid Waste

MWPF – Mixed Waste Processing Facility

PET – Polyethylene Terephthalate

POTW – Publicly Owned Treatment Work

PTE – Passenger Tire Equivalent

RCRA – Resource Conservation and Recovery Act

SABRC – State Agency Buy Recycled Campaign

SB – Senate Bill

SRRE – Source Reduction and Recycling Element

STB – Surface Transportation Board

SWIS – Solid Waste Information System

U.S. EPA – United States Environmental Protection Agency

WTE – Waste to Energy

Glossary of Terms

Alternative daily cover (ADC)/Alternative intermediate cover (AIC): The use of materials to cover disposed waste in a landfill cell at the end of the landfill operating day (daily cover) or at some other interval (intermediate cover) to control odors, fire, vectors, litter, and scavenging.

Anaerobic digestion (AD): The process of biologically decomposing organic matter with little or no oxygen in a fully enclosed structure (in-vessel digestion) to produce biogas, liquid fertilizer, and compost.

Beneficiation: The process of upgrading the value or utility of glass, typically by sorting, removing contaminants, and crushing so it can be used as an industrial feedstock for glass manufacturing facilities.

Biomass conversion: The process of using controlled combustion of specified types of organic materials (essentially wood, lawn, or crop residue) to produce electricity.

Chipping and grinding: The process that separates, grades, and resizes woody green wastes or used lumber to be sent to a composting facility, a landfill to be used for ADC, or miscellaneous end markets such as feedstock at biomass to energy plants.

Construction and demolition (C&D) materials: Materials generated in the course of construction and demolition activities that include, but are not limited to, concrete, wood, and drywall.

Destructive incineration: The treatment of hazardous waste by thermal destruction at a high temperature, resulting solely in the physical destruction of the material.

Disposal Reporting System (DRS): The system used to track disposal information in California. For more information go to:
http://www.calrecycle.ca.gov/LGCentral/DRS/default.htm

Disposal: The process of collecting municipal solid waste and transferring it to a transfer station, landfill, or transformation facility.

Facility Information Toolbox (FacIT): Informational database on disposal and recycling activities in the state of California. For more information go to:
http://www.calrecycle.ca.gov/FacIT/

Food waste: All surplus food scraps.

Fuel incineration: The treatment of hazardous waste by thermal destruction in which the waste, either by itself or blended with another material, is burned to recover its potential thermal energy.

Green waste: Urban landscape waste generally consisting of leaves, grass clippings, weeds, yard trimmings, wood waste, branches and stumps, home garden residues, and other miscellaneous organic materials.

Household hazardous waste (HHW): Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients, other than used oil. HHW is not considered to be municipal solid waste material.

Inerts: Waste that includes concrete, asphalt, asphalt roofing, aggregate, brick, rubble, and soil.

Landfill: A permitted facility that provides a legal site for final disposal of materials including mixed solid waste, beneficial materials used for landfill construction, ADC, and specialized material sites such as waste tires and construction and demolition waste.

Material recovery facility (MRF): An intermediate processing facility that accepts source-separated recyclables or mixed waste from an initial collector and processes them for wholesale distribution.

Municipal solid waste (MSW): Refuse that may be mixed with or contain nonorganic material, processed industrial materials, plastics, or other recyclables with the potential for recovery. It includes residential, commercial, and institutional wastes.

Neutralization: The treatment of hazardous waste by chemically adjusting the acidity or basicity of the waste such that the material can be discharged into a POTW.

Organic materials management: Processes that grind, chip, and/or decompose organic wastes in a controlled process for intermediate or final use as a landscape material or soil amendment.

Other beneficial reuse: The use of a waste byproduct or other low-value material for a productive use, other than ADC/AIC, at a landfill within regulatory guidelines.

Per capita disposal: A numeric indicator of reported disposal divided by the population (residents) specific to a county, region, or state.

Residue: Unusable waste byproducts remaining after recyclables are processed.

Self-hauler: A person who hauls their own residential or business waste themselves to a solid waste facility.

Solid Waste Information System (SWIS): The database that tracks solid waste facilities in California. For more information go to: http://www.calrecycle.ca.gov/SWFacilities/Directory/Default.htm

Stabilization: The treatment of hazardous waste by chemically stabilizing the material into a solid or semi-solid state such that it can be managed as a non-hazardous waste.

Tipping fee: The amount of money per ton of waste charged at the gate of a landfill.

Transfer station: A facility that receives, temporarily stores, and ships unprocessed waste and recyclables.

Transformation: The use of incineration, pyrolysis, distillation, or biological conversion (other than composting) to combust unprocessed or minimally processed solid waste to produce electricity.

Waste tire-derived fuel: Waste tires used as fuel in a power plant or cement kiln.

Source Reference Notes

[1] More information about recycling rate calculations can be found here: <www.calrecycle.ca.gov/75Percent/Sept2012Wksp/WhyHowMeasur.pdf>.

[2] *AB 341 Report to the Legislature*, California Department of Resources Recycling and Recovery, 2015, <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1538>.

[3] *2014 Disposal-Facility-Based Characterization of Solid Waste in California*, California Department of Resources Recycling and Recovery, 2015 <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1546>; *2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California*, California Department of Resources Recycling and Recovery, 2015 < http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1543>.

[4] *2014 Disposal-Facility-Based Characterization of Solid Waste in California*, California Department of Resources Recycling and Recovery, 2015 <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1546>.

[5] *2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California*, California Department of Resources Recycling and Recovery, 2015 < http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1543>.

[6] For more information, visit: <www.calrecycle.ca.gov/FacIT/>.

[7] *Targeted Statewide Waste Characterization Study: Characterization and Quantification of Residuals from Materials Recovery Facilities*, California Department of Resources Recycling and Recovery, 2006 <http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1182>.

[8] FacIT imports information from the Solid Waste Information System (SWIS), the Disposal Reporting System (DRS), and Division of Recycling Integrated Information System (DORIIS). However, the databases do not all track the same facilities for the same purposes and do not generally request information on current throughput or capacity.

[9] This includes commercial and commercial self-haul loads. However, the report identified some concerns as to whether this figure accurately reflects the breakdown between the commercial and residential sectors.

[10] *Mandatory Commercial Recycling: Frequently Asked Questions*, California Department of Resources Recycling and Recovery, <http://www.calrecycle.ca.gov/Recycle/Commercial/FAQ.htm>, December 22, 2015.

[11] Changes to the electronic annual report in 2017 will improve the quality of this data. The 2013 data presented in this figure reflects an initial staff analysis and should be considered a rough estimate. Jurisdictions may have provided additional information on the status of their programs that is not reflected in this figure.

[12] Virgin and recyclable materials may receive government subsidies in order to increase their profitability.

[13] Robert Boulanger, "Post-Consumer Recycling Materials Markets Still Fluctuating," *Waste360*, October 8, 2015, <http://waste360.com/commodities-pricing/post-consumer-recycling-materials-markets-still-fluctuating> (October 15, 2015); Robert Boulanger, "Post-Consumer Recycling Market Trends Continue to Vary in 2015," *Waste360*, May 28, 2015, <http://waste360.com/commodities-pricing/post-consumer-recycling-market-trends-continue-vary-2015> (October 15, 2015).

[14] Indicators from <RecyclingMarkets.net>.

[15] James R. Hagerty and Bob Tita, "U.S. Is Awash in Glut of Scrap Materials," *The Wall Street Journal*, June 7, 2015, <http://www.wsj.com/articles/the-big-business-of-u-s-scrap-takes-a-hit-1433669402> (November 24, 2015).

[16] Georgi Kantchev and Serena Ng, "Recycling Becomes a Tougher Sell as Plastic Prices Drop," *The Wall Street Journal*, April 5, 2015, <http://www.wsj.com/articles/recycling-becomes-a-tougher-sell-as-plastic-prices-drop-1428279575> (October 15, 2015); Lizzie O'Leary, "One victim of falling oil prices? Recycling," *Marketplace*, September 4, 2015, <http://www.marketplace.org/topics/sustainability/one-victim-falling-oil-prices-recycling> (October 15, 2015).

[17] *Petroleum and Other Liquids: Cushing, OK WTI Spot Price FOB*, U.S. Energy Information Administration, <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=D> (November 1, 2015).

[18] *2014 California Exports of Recyclable Materials*, California Department of Resources Recycling and Recovery, 2015, <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1539>.

[19] The Public Use Waybill may be accessed here: <http://www.stb.dot.gov/stb/industry/econ_waybill.html>.

[20] The Commodity Flow Survey may be accessed here: <http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html>.

[21] Between January and October 2015, 65,000 tons of recyclable material was reported on the IMRs. Of the reported material, 25,700 tons were of CRV-containing material.

[22] *State Imports for California*, U.S. Census Bureau, <http://www.census.gov/foreign-trade/statistics/state/data/imports/ca.html>, (November 1, 2015).

[23] *State Exports from from California*, U.S. Census Bureau, <http://www.census.gov/foreign-trade/statistics/state/data/ca.html>, (November 1, 2015).

[24] *State Imports for California*, U.S. Census Bureau, <http://www.census.gov/foreign-trade/statistics/state/data/imports/ca.html>, (November 1, 2015).

[25] *State Exports from from California*, U.S. Census Bureau, <http://www.census.gov/foreign-trade/statistics/state/data/ca.html>, (November 1, 2015).

[26] Elizabeth Royte, "China's Too Good for Our Trash. Yay?" *OnEarth*, October 23, 2013, <http://archive.onearth.org/articles/2013/10/china-to-u-s-we-dont-want-your-stinking-trash>, (October 15, 2015).

[27] Exports by truck and rail are not included in this analysis, since CalRecycle currently has no estimates as to what percentage of these shipments originate in California.

[28] *Method for Estimating Greenhouse Gas Emission Reductions from Recycling*, California Air Resources Board, November 14, 2011, <http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf>. Assumes all exports travel from Los Angeles to Shanghai (6497 miles). 18.0 million tons x 6497 miles x 19 g CO_2E/ton-mile = 2.2 $MMTCO_2E$. The 2014 ARB Climate Change Scoping Plan projects that if the 75 percent recycling goal is met by 2020, this will result in a 20 to 30 $MMTCO_2E$ reduction in GHG per year.

[29] This list was compiled using several sources, including lists created by the UC Berkley Woody Biomass Utilization Program, UC Davis California Biomass Collaborative, the California Biomass Energy Alliance, the California Energy Commission and CalRecycle's Statewide Technical and Analytical Resources Branch.

[30] Peter Tittman, "The wood in the forest: Why California needs to reexamine the role of biomass in climate policy," *California Agriculture*, 2015, *69*, 133-137. <http://californiaagriculture.ucanr.edu/landingpage.cfm?article=ca.v069n03p133>

[31] *2014 California Glass Container and Fiberglass Production Minimum Content Report*, CalRecycle, 2015, <http://www.calrecycle.ca.gov/BevContainer/Publications/GlassRpt2014.pdf>.

[32] *California Paint Stewardship Program 2015 Annual Report (Year Three)*, PaintCare, November 3, 2015, <http://www.calrecycle.ca.gov/Paint/AnnualReport/2015/PaintCare.pdf>.

[33] This number may be lower than what was determined from the 2014 waste characterization study for a variety of reasons, including different calculation methods and large carpet loads sampled at landfills skewing the final amount of material.

[34] *Annual Report to California Department of Resources, Recycling, and Recovery (CalRecycle): January 2014–December 2014*, California Carpet Stewardship Plan, 2015, <http://www.calrecycle.ca.gov/files/Carpet/CARE2014.pdf>.

[35] *Used Mattress Recovery and Recycling Plan*, Mattress Recycling Council, 2015, <http://www.calrecycle.ca.gov/Mattresses/Plans/November2015.pdf>.

[36] The data from Form 303 may be accessed here: <http://www.calrecycle.ca.gov/HomeHazWaste/Reporting/Form303/>.

[37] The collection rate is calculated based on the amount of used oil returned relative to the amount of used oil sold. The recycling rate is calculated relative to the calculated amount of used oil available for collection and reprocessing.

[38] Bobby Elliott, "Videocon shuts down furnaces – and stokes concerns," *Resource Recycling*, October 22, 2015, <http://resource-recycling.com/node/6575> (November 1, 2015).

[39] *California Waste Tire Market Report: 2014*, California Department of Resources Recycling and Recover, 2015, <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1532>.

[40] *State of Recycling in California*, California Department of Resources Recycling and Recovery, 2015, <http://calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1522>.

[41] The U.S. EPA projection of generated MSW was only 254 million tons in 2013. This value is generated using "a materials flow methodology that relies on a mass balance approach. […] Using data gathered from industry associations, business, and government sources, such as the U.S. Department of Commerce and the U.S. Census Bureau, we estimate tons of materials and products generated, recycled, and discarded." This differs from the methodology used in the Columbia University study, which sums estimates of waste generation and disposal from the states.

[42] The discrepancy in numbers between this paragraph and other sections of the report is due to a difference in definitions. The Columbia University study uses U.S. EPA definitions of MSW and recycling, which excludes C&D and other materials that are included in California's definitions.

[43] Debra Kantner, "Differences in Recycling and Diversion Policies: Implications on Organics Management," *Presentation at EREF's Regional Summit on Sustainable Solid Waste Practices and Research: Management of MSW Organics*, July 17, 2015.

[44] "Municipal waste generation and treatment, by type of treatment method," Eurostat, <http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsdpc240&language=en> (November 1, 2015).