State of Disposal and Recycling in California:
For Calendar Year 2017

CalRecycle

California Department of Resources Recycling and Recovery

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STATE OF CALIFORNIA

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Executive Summary

This report summarizes the state of disposal and recycling in California for calendar year 2017.

At $2.75 trillion of gross domestic product (GDP), California has the fifth largest economy in the world with a robust and varied commercial sector. It also has a large and diverse population. When combined with the complex geography and numerous climate zones, these factors make California's waste stream correspondingly large at about 77.2 million tons of generation (which includes recycling and disposal) and complex with over 100 material types generated in the residential and commercial sectors. The waste stream continues to evolve due to changes in economics, demographics, and the types of products sold.

To address this burgeoning and dynamic waste stream, California has been a national and international leader whose Governor and state Legislature sets ambitious goals for recycling and materials management. Since 1972, California has passed eight forward-thinking recycling goals and mandates—with three in just the last seven years. Major recycling targets are rapidly approaching in 2020, 2022, and 2025.

The California Department of Resources Recycling and Recovery (CalRecycle) partners with local jurisdictions and other stakeholders to implement the policies and programs to promote recycling, achieve the recycling goals and mandates, and to protect California's resources, public health and safety, and environment. CalRecycle's goals go beyond just addressing how fast landfills are filling up; effective management of solid waste and materials is a key component of environmental stewardship with wide ranging benefits from reducing the impacts of resource extraction to addressing the climate crisis. Because of this, CalRecycle assesses progress and success through many lenses with responsible use and protection of the environment as the underlying goal. For the last three decades, CalRecycle has guided its partners in local government toward their diversion mandates, incentivized development of the infrastructure needed to meet the mandates, implemented programs to manage difficult and dangerous materials, and provided the leadership needed to move California to a more sustainable and environmentally sound future. On all these fronts, California is moving forward.

In 2011, Governor Brown signed Assembly Bill (AB) 341 into law. This law set an aggressive goal for California to reach 75 percent statewide recycling by 2020. Unfortunately, the state is not on track to reach this goal. In 2017, overall disposal increased for the fifth year in a row to 44.4 million tons. By subtracting overall disposal from the 77.2 million tons of generation, CalRecycle estimates that Californians recycled, composted and source reduced almost 32.8 million tons. This corresponds to a recycling rate of 42 percent, which has continued to decline since the peak of 50

percent in 2014. To reach the 75 percent goal in 2020, Californians would need to recycle more than 26 million additional tons annually.

The state's waste management system is facing some major challenges. Residents and businesses are generating and disposing of more material every year, driven by the economic recovery since the end of the Great Recession in 2009. For too long, California (and much of the developed world) has approached recycling with a collect, sort, and export model with limited domestic manufacturing of recycled materials. It is no longer viable to rely on export markets as a primary strategy to meet California's recycling goals. With the volatility of international markets for recyclable materials, California's exported recyclables have decreased by almost 2 million tons, or about 11 percent, in the last three years. The exact fates of these tonnages is uncertain; some may have found other markets, some may be in long-term stockpiles, and some have been sent to landfills.

To respond to these challenges, reduce environmental impacts and reach the 75 percent statewide recycling goal, CalRecycle needs new tools and new approaches. CalRecycle is exploring ways to:

- Decouple generation and disposal from economic growth;
- Use source reduction to decrease the massive amounts of materials generated;
- Improve the quality and marketability of recyclable materials that continue to be generated;
- Address products and packaging that cannot feasibly be recycled or composted; and
- Incentivize the development of sustainable recycling infrastructure and markets in California.

In addition, California faces two challenges to recycling progress brought on by climate change. Due to the extended drought, there are 129 million dead and dying trees. California must manage these trees effectively or they may enter the waste stream by overburdening organic processing and recycling infrastructure. These trees also serve as fuel for more frequent and devastating wildfires. Wildfire recovery efforts can send hundreds of thousands, or even millions, of tons of disaster debris and construction waste to landfills. For example, the recent 2018 fall fires in northern and southern California will result in additional millions of tons of disposal. CalRecycle takes an active role in helping communities recover from these wildfires by coordinating the post-fire debris removal. California will continue to have more frequent and destructive wildfires and will need to manage the resulting disaster debris disposal.

California can rise to meet these challenges and reach 75 percent statewide recycling—but not by 2020. California met the 50 percent statewide diversion goal in 2005 rather than 2000, but the state finally succeeded. It takes time, energy, resources, and effective strategies to create systemic change in an area as complex as California's waste stream. Regardless of how difficult this change will be, it must be accomplished to address the far-reaching secondary impacts of solid waste disposal such as climate change and habitat loss. CalRecycle is building the necessary framework from every angle and forging ahead. In 2016, Governor Brown signed Senate Bill (SB) 1383 (Lara, Chapter 395, Statutes of 2016) into law, creating a new model to manage the challenging organics waste stream. CalRecycle will monitor progress toward the 75 percent statewide recycling rate and guide program development, using the reporting system authorized by Governor Brown's signature on Assembly Bill (AB) 901 (Gordon, Chapter 746, Statutes of 2015) and up-to-date data on waste composition from waste characterization studies. Moving forward, CalRecycle will have better tools to facilitate science-based, data-driven decisions to address challenges and spur progress.

Complex and Dynamic Waste System

Solid Waste Generation

California's 14 million residences[1] and 1.5 million businesses[2] generate 77.2 million tons of material annually. On average, each California resident disposes of about 6.2 pounds of solid waste at their home and workplace every day. A plethora of individual materials, products, and packaging combine to produce this massive amount of material. In the 2018 waste characterization study, CalRecycle's contractor sorted waste into approximately 100 different material types. For example, the paper category includes nine material types. Each type encompasses many different items. Office paper, for example, includes: colored ledger, computer paper, manila folders, manila envelopes, index cards, white envelopes, white window envelopes, white or colored notebook paper, ground wood computer paper, junk mail, and carbonless forms. The actual number of distinct items, packaging, and products made from a single material type is far larger and much more diverse than any list could capture.

Not only is California's waste stream complex but it is also very dynamic. Solid waste generation is constantly changing due to the production of new material types and commodities, patterns of consumption, economics, and demographics. These challenges require the solid waste industry to be flexible, adopt new technologies, site additional facilities and find new markets. The examples that follow illustrate California's evolving materials landscape. Familiar recyclable products like daily newspapers have diminished while new, hard-to-recycle products like stand up laminated pouches have proliferated. With the increase in e-commerce, the number of small cardboard boxes in the residential sector has increased significantly. This has resulted in facilities getting new machinery to sort cardboard from other material. There are also new hard-to-recycle items included in the shipped e-commerce boxes, such as ice packs.[3] Changes in the materials used for products and packaging can also complicate material handling and affect profitability and recycling rates. For example, there has been a shift from aluminum beverage containers to polyethylene terephthalate (PET) beverage containers. PET containers made up less than less than 2 percent of the total recycled containers in 1990 but rose to almost 50 percent in 2017, making it the predominant container material sold. In that same time frame, aluminum containers declined from 80 percent of the total recycled containers to just 38 percent.

Recycling does not happen in a vacuum. Recycled materials need to compete with virgin materials in the manufacturing sector. According to the Center for International Environmental Law, the energy sector is investing $164 billion for 264 new/expanded plastic production facilities in the United States. By 2025, production of virgin ethylene and propylene may increase by about a third. Plentiful, cheap virgin material could undermine source reduction efforts, undercut prices for recovered plastics, and exacerbate plastic litter and marine pollution issues.[4]

Solid Waste Handling

Source reduction prevents materials from entering the waste stream. Once a material is made, a product is purchased, or an item reaches the end of its first life, it may follow several paths. It could be reused, recycled, composted, buried in a landfill, burned in a transformation or engineered municipal solid waste (EMSW) facility, or end up as litter or ocean debris. The decisions of individual Californians at their homes and businesses influence the particular path of a given item. The suite of programs selected by local jurisdictions also affects the fate of materials. To be successful, California's waste management system must provide services to every location in this large, geographically diverse state.

Collection:

California has 482 municipalities and 58 counties, some of which have combined together to yield a total of 419 reporting jurisdictions. To accomplish the collection of solid waste, recyclables, and organics, local jurisdictions and regional agencies contract with over 144 residential sector haulers according to their 2017 Electronic Annual Reports. Some jurisdictions conduct residential collection with jurisdiction staff. The jurisdictions contract with over 152 commercial sector haulers. Many independent haulers collect solid waste generated by businesses in jurisdictions without franchise agreements, so there may be many more.

According to CalRecycle's 2014 waste characterization study, the professionally hauled residential sector contributes about 30 percent to statewide disposal. The professionally hauled commercial sector contributes about 50 percent to statewide disposal. The remainder is material self-hauled directly to disposal by generators. Residential self-haulers accounted for about 3 percent of statewide disposal while commercial self-haulers accounted for about 17 percent.

Processing:

To recover materials and improve their chances of being composted or recycled, California processes solid waste, recyclables, and organics at 94 mixed-waste processing facilities that sort solid waste loads to recover materials, 225 material recovery facilities (MRFs) that sort source-separated recyclables, and 138 intermediate processors that further clean, process, or add value to recovered materials. Local systems that process waste are complicated. The main facilities within these systems may be combined with smaller facilities, vertically or horizontally integrated, and include multiple sorting lines so the number of different facility types may overlap.

Disposal:

California aggregates solid waste through 466 transfer stations and disposes of it at 126 landfills, 2 transformation facilities, and 4 EMSW facilities. In 1987, media coverage of

the New York garbage barge and a lack of landfill capacity in California prompted new awareness of solid waste and the drive for more recycling. As a result, California passed the Integrated Waste Management Act of 1989 (AB 939, Sher, Chapter 1095, Statutes of 1989), establishing the 50 percent diversion mandate for local jurisdictions. Since that time, the number of landfills has decreased due to stricter permitting requirements, but the average size of landfills has increased, as existing landfills expand and newer, larger landfills open. Lifetime remaining landfill capacity in California remains sufficient for decades at the state and regional level, even if disposal does not decline. Local capacity in some areas may not be as robust. CalRecycle projects that under a business-as-usual disposal scenario, California has sufficient statewide disposal capacity to handle landfilled waste until 2057. Once California achieves its 75 percent statewide recycling goal, our remaining landfill capacity could extend into the 2080s.

Solid Waste Handling Dynamics

Solid waste handling, processing, and disposal practices are also dynamic and continue to evolve with changes in business practices, disposal infrastructure, disposal trends, diversion mandates and programs, recycling infrastructure, and market dynamics.

Consolidation:

The solid waste management industry has undergone significant transformation since the passage of the Resource Conservation and Recovery Act (RCRA) and AB 939. There has been considerable industry consolidation, moving toward a few large companies rather than numerous smaller ones. Currently, the four largest companies Waste Management, Republic, Waste Connection, Inc., and Recology, collected approximately 72 percent of commercial waste and 30 percent of residential waste from jurisdictions in 2017, per CalRecycle's Facility Information Toolbox (FacIT). These companies operate more than a quarter of facilities with Solid Waste Facility Permits.

Infrastructure Changes:

Before 1978 when the first landfill permitting began, there were only unpermitted dumps. Since then, 51 landfills have closed, 5 are closing, 8 are inactive, and 1 is planned. Waste flows and handling practices adapt to each change. For example, Southern California disposal flows changed dramatically with the closure of Puente Hills Landfill (in Los Angeles County) in 2014. Now 48 percent of Los Angeles County waste flows to other counties.

Landfill Disposal Amounts:

CalRecycle estimates that statewide traditional landfill disposal was 44 million tons in 1989. Landfill disposal declined for several years as jurisdictions implemented new programs to reach the 50 percent diversion mandates. Through the late 1990s landfill

disposal stayed relatively flat. Then landfill disposal started to increase and hit a peak of 42.2 million tons in 2006. Largely due to the Great Recession, landfill disposal dropped to 29.3 million tons, just seven years later. As the economy has improved, landfill disposal has again increased for the last five years to 37.8 million tons in 2017.

Diversion Mandates and Programs:

As California's solid waste industry worked closely with local jurisdictions to meet the 50 percent diversion mandate, they greatly expanded the number of sorting, processing, composting, and recycling facilities to recover materials. Throughout California, the overall trend is toward more processing of materials using increasingly sophisticated methods. Now, the norm is complicated multi-stream facilities that separate and recover materials ingusing a variety of methods from hand sorting to the latest technologies, such as optical sorters, robotic arms and artificial intelligence. Once facilities recover materials, they must find markets for them.

Domestic Markets:

One major constraint of California's recycling efforts is the market for recyclable materials. In order for recycling to be economically viable, a manufacturer's cost of processing and using the recycled material must be competitive with that of virgin material. This challenge is even harder for materials in which the extraction and manufacturing of virgin material is less expensive due to government subsidies or incentives. For example, tax deductions on oil drilling costs lower the cost of oil-derived plastics. Another complication is that prices for materials can fluctuate wildly, leading to dramatic variations in monetary compensation for recycling. For example, from 2011 to 2017 the regional southwest USA price of baled PET plastic fluctuated between $620 per ton and $329 per ton[5]. The price of loose aluminum cans in the regional southwest declined 60 percent from $1,210 per ton to $490 per ton, over the same period.[6]

Recycled Content Product Manufacturing in California:

California does not have sufficient recycled-content product manufacturing to absorb California's recyclables (discussed more in the Increasing Recycling Capacity section of this report). As a result, California relies primarily on a collect, sort, and export model that relies heavily on foreign markets.

International Markets:

Recycling is a global industry, so California's recyclables must weather the instability of international markets, price fluctuations, other countries' trade policies, and the ramifications of international trade wars. The 14.6 million tons, worth $5.1 billion of recyclable materials shipped from California ports in 2017 illustrates California's reliance on international markets to manage recyclables at their end-of-life (see CalRecycle's 2017 California Exports of Recyclable Materials report for more details). California

recyclables going to all countries dropped almost 35 percent from 2011 to 2017 (22 million tons to almost 15 million tons). The 39 percent drop in California's recyclables going just to China during this same period (13.3 million tons to 8.1 million tons), shows the volatility of the international recyclables export markets.

Goals and Mandates

California has been a national and global leader in setting ambitious statutory goals for recycling, resource conservation, and preventing climate change. California has a complex and dynamic waste stream, and CalRecycle is tasked with implementing policies to achieve statewide goals and protect California's resources, public health and safety, and environment. Active environmental stewardship in relation to solid waste and recycling began nearly 50 years ago, and California has increasingly embraced more ambitious environmental goals.

Sampling of Statutory Goals and Mandates

Below are a few of California's goals and mandates related to waste management, in chronological order:

- To address the increasing volume and variety of solid waste generation, California enacted the Solid Waste Management and Resource Recovery Act of 1972, SB 5, (Nejedly-Z'Berg-Dills, Chapter 324, Statutes of 1972), placing the primary responsibility for adequate solid waste management and planning on local government.
- To reduce litter, the Beverage Container Recycling and Litter Reduction Act of 1986 AB 2020, (Margolin, Chapter 1290, Statutes of 1986) established a goal of an 80 percent recycling rate for all aluminum, glass, plastic, and bimetal beverage containers sold in California.
- To combat a looming landfill capacity crisis, California established the 50 percent diversion mandate for local jurisdictions in the California Integrated Waste Management Act of 1989 (AB 939, Sher, Chapter 1095, Statutes of 1989).
- To confront climate change, the California Global Warming Solutions Act of 2006 (AB 32, Nunez, Chapter 488, Statutes of 2006) created a comprehensive program to reduce Greenhouse Gas (GHG) emissions in California to 1990 levels by 2020. Because the decomposition of organic wastes in landfills is a major source of GHG emissions, AB 32 sets an additional impetus for reducing waste.
- To increase recycling, particularly in the commercial sector, AB 341 (Chesbro, Chapter 476, Statutes of 2011), established the statewide goal of 75 percent

recycling by 2020 and the Mandatory Commercial Recycling (MCR) program to reduce waste from California's businesses.

- To reduce illegal dumping, increase recycling, and substantially reduce public agency costs for the end-of-use management of used mattresses, the California Used Mattress Recovery and Recycling Act (SB 254, Hancock, Chapter 388, Statutes of 2013) requires an industry-run, statewide program to increase the recovery and recycling of mattresses at their end of use.

- To discourage another source of GHG emissions from landfills, Governor Brown signed AB 1594 (Williams, Chapter 719, Statutes of 2014) mandating that green material used as alternative daily cover (ADC) will count as disposal toward the AB 939 jurisdiction diversion mandates starting in 2020.

- To reduce organic wastes (and their associated GHG emissions) from California businesses, Governor Brown signed AB 1826 (Chesbro, Chapter 727, Statutes of 2014) establishing the Mandatory Commercial Organics Recycling (MORe) program.

- To reduce emissions of Short-Lived Climate Pollutants (SLCP) that are even more potent than carbon dioxide, Governor Brown signed SB 1383 (Lara, Chapter 395, Statutes of 2016), which requires a 50 percent reduction in the level of the statewide disposal of organic waste by 2020 and a 75 percent reduction by 2025. It also requires a 20 percent recovery rate of disposed edible food by 2025.

- In the area of extended producer responsibility, California enacted AB 1158 (Chu, Chapter 794, Statutes of 2018) to establish a 24 percent recycling goal for postconsumer carpet by 2020.

Recycling Highlights for 2017

To accomplish the legislative goals and mandates previously discussed, CalRecycle has advocated for more robust source reduction policies, increased recycling in the state, and overseen the management of solid waste for the past 30 years. Due to the ongoing efforts of local jurisdictions, the solid waste and recycling industry, and individual Californians, this period has seen many accomplishments.

Progress of Local Government Partners:

Based upon preliminary review of data, almost all local governments have met and surpassed the 50 percent diversion mandate of AB 939. Of the 419 reporting jurisdictions/entities in California, 393 had reduced their per-capita disposal sufficiently to meet the AB 939 mandate in 2017. The remaining 26 jurisdictions had disposal above the AB 939 per-capita disposal target. Note: Some jurisdiction data from 2017

was still under review at the time this report was published and may be subject to change. CalRecycle has approved eight rural jurisdiction requests for reduced diversion requirements. Others are jurisdictions that have made a good faith effort to implement programs and achieve the mandate but have fallen short; a jurisdiction's ability to reach its per-capita disposal reduction target is only one measure of its success. Every year CalRecycle reviews all jurisdictions' progress and efforts toward meeting the diversion mandates and implementing their programs, as well as their progress in implementing Mandatory Organics Recycling and Mandatory Commercial Recycling. CalRecycle identified 16 jurisdictions whose performance warranted a more in-depth compliance review and issued four compliance orders in the last two years.

Targeted Products and Sectors:

This section highlights some of the progress being made using strategies that target certain materials and specific sectors of the waste stream. These strategies include the nation's most successful beverage container recycling program, an intensive drive to recycle more traditional recyclables and organics from the commercial sector, and a system of producer responsibility programs for targeted, priority products.

Improving Performance in Beverage Container Recycling:

Californians led the nation by recycling more than 18.4 billion beverage containers in 2017. About 75 percent of beverage containers were recycled in 2017 at about 1,600 recycling centers and through curbside collection. The recycling rate had met the legislative goal (set by AB 2020) of 80 percent for the past several years. However, the recent drop to 75 percent is likely due to a combination of factors, including the increase of 4 million beverage containers sold from 2011 to 2017, a decline in the market value of recyclables, an improvement of the overall economy as discussed in the Economy Induced Disposal section, and successful enforcement measures to reduce fraud. The number of all material containers recycled increased from 16.7 to 18.4 million from 2011 to 2017, but the generation of containers increased even more. SB 458 (Wiener, Chapter 648, Statutes of 2017) allows CalRecycle to approve of up to five pilot beverage container recycling programs in order to provide redemption opportunities in unserved areas.

Strengthening Efforts in Commercial Recycling:

The commercial sector generates nearly 70 percent of the solid waste in California, so it is critical that businesses do their part by generating less and recycling more. Under CalRecycle's Mandatory Commercial Recycling program, mandated by AB 341, larger businesses and multifamily residential dwellings must arrange for recycling collection services. Additionally, local jurisdictions must implement a commercial recycling program that consists of education, outreach, and business monitoring. Out of the 419 jurisdictions that reported for the year 2017, about 80 percent (more than 175,000) of

covered businesses were engaged in recycling and more than 85 percent (about 100,000) of multi-family complexes were recycling. While this is good participation for a program in its infancy, more commercial recycling is needed to reduce waste going to disposal in landfills and help the state reach its 75 percent recycling goal.

Under CalRecycle's Mandatory Commercial Organics Recycling program, mandated by AB 1826, businesses and multifamily residential dwellings must arrange for organic recycling collection services. Out of the 419 jurisdictions that reported for the year 2017, a little more than 30 percent (about 22,000) of the covered businesses were engaged in organics recycling and 53 percent (about 38,000) of multi-family complexes were recycling organics. If CalRecycle determines that the statewide disposal of organic waste in 2020 has not been reduced by 50 percent of the level of disposal during 2014, the organic recycling requirements on businesses will expand to cover businesses that generate two cubic yards or more of commercial solid waste per week.

Implementing Extended Producer Responsibility Programs for Targeted Products:

Senate Bill 254 established an industry-run, statewide Extended Producer Responsibility (EPR) program to increase the recovery and recycling of mattresses. The Mattress Recycling Council (MRC) is the certified stewardship organization responsible for developing, implementing, and administering the program, under CalRecycle's oversight. Due to the MRC's efforts, 1.3 million mattresses were collected in 2017.[7] Almost 20,000 tons of materials were recycled, donated, reused, renovated, or converted to biomass. Of total mattress weight, about 59 percent was recycled or reused, 20 percent was landfilled, and 21 percent was sent to waste-to-energy (WTE) facilities (Figure 1). CalRecycle established the state's mattress recycling baseline and recycling goals, effective January 1, 2018. CalRecycle used 2016 data to set the baseline amounts, with year-over-year percentage increases in collection and total recycling rate by weight, and a goal for the MRC to recycle 75 percent of the materials from all mattresses collected by 2020. Beginning July 1, 2019, the MRC must report on its efforts to comply with the state's mattress recycling goals. Additionally, the MRC must describe its objectives consistent with the state's solid waste management hierarchy, including reuse and source reduction, and report on its efforts towards meeting those objectives.

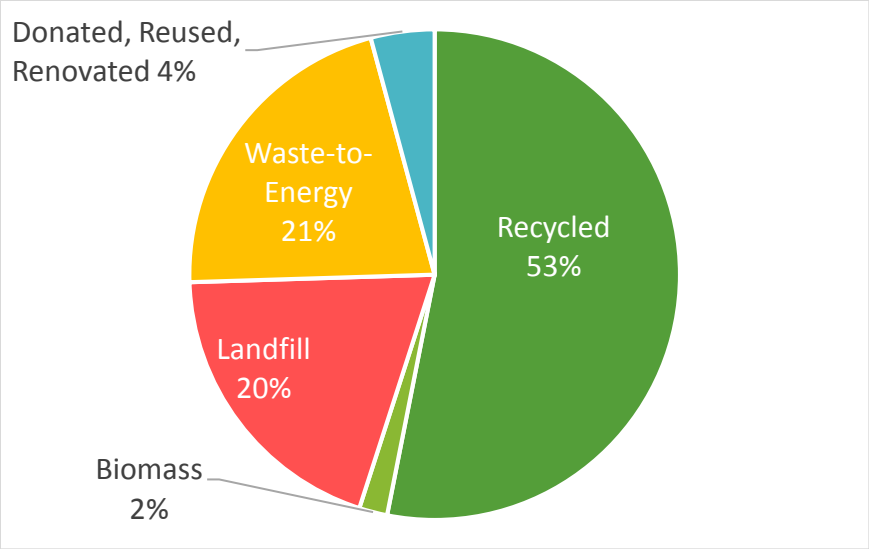

Figure 1. Mattresses destinations in 2017. Data from Mattress Recycling Council 2017 Report.

Another EPR program that CalRecycle oversees is the carpet recovery program, mandated by AB 1158. CalRecycle's oversight of the carpet stewardship organization, Carpet America Recovery Effort (CARE), has been robust. In March of 2017, CalRecycle issued an Accusation seeking penalties against CARE for failure to achieve meaningful continuous improvement in carpet recycling for 2013, 2014, and 2015. After a hearing held in September of 2017, the Office of Administrative Hearings issued a Proposed Decision. On April 25, 2018, CalRecycle's Director accepted the Office of Administrative Hearings' Proposed Decision with modifications. The Director's modifications reduced the penalty amount to be consistent with the penalties specified in the statute. CalRecycle continues to enforce the statute and regulations in order to fulfill the intent of the law.

Developing Needed Infrastructure for Organics and Traditional Recyclables:

To meet the numerous mandates (SB 1826, SB 1383) related to organic materials and GHG/SLCP reductions, California must have enough organics management infrastructure to handle the increased flow of materials. Because organics are heavy and putrescible, they are difficult and expensive to export or transport over long distances. Currently, there is a significant gap between existing infrastructure and adequate infrastructure to meet the needs and goals of the legislative mandates. In fiscal year (FY) 2017-2018, CalRecycle's Organics Grant Program (funded by the Greenhouse Gas Reduction Fund (GGRF)) selected ten entities to receive $24 million to expand existing capacity or establish new facilities in California in order to reduce the amount of organic materials sent to landfills and lower overall GHG emissions. The Legislative Analyst's Office reports CalRecycle's Cap-and-Trade grant programs are

among the most cost-effective and most oversubscribed compared to other agencies statewide. CalRecycle estimates the average cost effectiveness is $23 per metric ton of CO2 for the organics grant program. These facilities will help address California's gap in organics infrastructure by adding about 600,000 tons of processing capacity. Since the beginning of the program CalRecycle has awarded grants totaling more than $64 million which has added about 1,360,000 tons of processing capacity.

To increase recycling rates of traditional recyclables, California needs to develop reliable markets for materials recovered from the waste stream by encouraging development of manufacturing infrastructure. CalRecycle approved $9,000,000 for FY 2016-2017 in GGRF funding for the Recycled Fiber, Plastic, and Glass Grant Program. The purpose of this competitive grant program is to lower overall greenhouse gas emissions by expanding existing capacity or establishing new facilities in California that use California-generated postconsumer recycled fiber (old corrugated cardboard, paperboard, or textiles), plastic, or glass to manufacture products.

One strategy to encourage domestic market growth is to create demand for recyclable materials and incentivize California manufacturers who use recycled material generated in the state. Through its Recycling Market Development Zone (RMDZ) program, CalRecycle combines recycling with economic development to support new businesses, expand existing ones, create jobs, and divert waste from landfills. This program provides low-interest loans, technical assistance, and free product marketing to businesses located in one of the 40 zones throughout California that use materials from the waste stream to manufacture their products. CalRecycle approved three loans totaling over $3 million in FY 2016-2017 and four loans totaling nearly $7 million in FY 2017-2018.

The existing funding sources for growing California's recycling and organics infrastructure are not guaranteed or adequate. Future Greenhouse Gas Reduction Fund expenditures depend on approval from the Legislature. The historical level of funding is not sufficient to incentivize the infrastructure growth needed to meet the recycling goals and achieve the related climate benefits. The state will need to do more with regard to curbside materials, payments, incentives, and market development as discussed in the Increasing Recycling Capacity section.

The 75 Percent Statewide Recycling Goal

The 75 percent statewide recycling goal was a turning point in how California approaches its waste stream. The older mandates of AB 939 focused on jurisdiction efforts to reduce disposal. In its implementation of the newer 75 percent statewide recycling goal, CalRecycle is taking a more holistic approach that considers the entire

suite of environmental benefits and impacts beyond saving landfill space. This evaluation of statewide recycling strategies makes it clear that there is no single approach that will lead to success. Instead, success will require reducing waste generation, expanding California's recycling markets and recycled-content manufacturing infrastructure, exploring new models for state and local funding of programs and oversight, promoting post-consumer recycled content products, and implementing Extended Producer Responsibility where appropriate. The 75 percent statewide recycling goal is an important recognition of the need for an ambitious goal with rigorous measurement, but it lacks specific mandates with enforcement mechanisms. The next step in this evolution is SB 1383 that targets organics, the largest component of the waste stream. The complimentary goals and oversight embodied in SB 1383 provides a more comprehensive and enforceable approach.

It is very unlikely that California will reach 75 percent recycling in the 2020 goal year; it is an ambitious goal with a short timeline. To reach 75 percent recycling by 2020, California would need to recycle an additional 26 million tons annually (in addition to the current 33 million tons of annual recycling). This next section provides a snapshot of progress toward the goal for calendar year 2017.

Recycling Rate

Based on Public Resources Code Section 41780.1(a), the measurement system for the statewide recycling goal uses "recycling" as an umbrella term to encompass the three activities that count toward the goal: source reduction, recycling, and composting. CalRecycle does not directly measure recycling tonnages, so progress toward the statewide recycling goal is determined using the amount of overall disposal (landfill disposal plus disposal-related activities) compared to a calculated base generation of solid waste in California.

According to CalRecycle calculations, after adjusting for population growth, California generated a total of 77.2 million tons of waste in 2017. Based on reports submitted to CalRecycle, overall disposal in 2017 equaled 44.4 million tons. This accounts for 58 percent of the total generated waste. By subtraction, that leaves an estimated 32.8 million tons of material that were recycled (through source reduction, recycling, and composting) in 2017. California's 2017 statewide recycling rate was 42 percent, down from the high of 50 percent in 2014 (Figure 2).

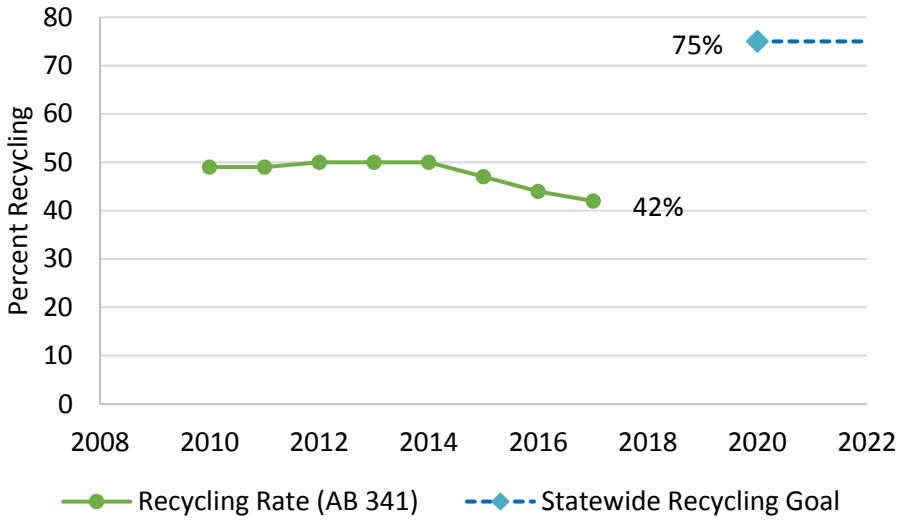

Figure 2. California's statewide recycling rate since 2010. Data fromhttps://www.calrecycle.ca.gov/calendar/75percent/recyclerate . Accessed 8/7/2018.

Traditional Landfill Disposal and Disposal-Related Activities

To calculate the overall disposal amount for the statewide recycling rate, CalRecycle adds landfill disposal (as used in the AB 939 jurisdiction calculations) to disposal from six disposal-related activities. The disposal-related activities are alternative daily cover (ADC), alternative intermediate cover (AIC), other beneficial reuse at landfills (such as construction activities, landscaping, and erosion control), transformation, EMSW, and waste tire-derived fuel.

In 2017, 37.8 million tons were landfilled either at landfills in California or in out-of-state landfills. An additional 6.6 million tons of materials went to disposal-related activities. California had a per capita overall disposal rate of 6.2 pounds per resident per day in 2017 with a population of 39.5 million (Figure 3).

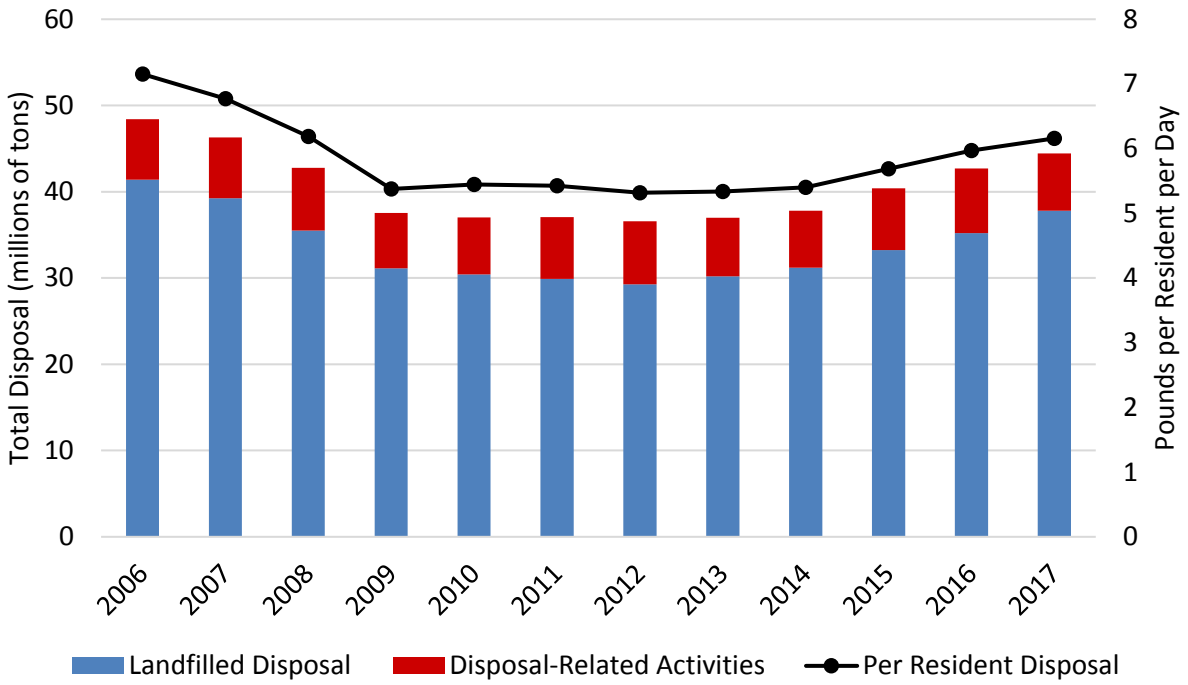

Figure 3. California's statewide per resident and total disposal (2006-2017). The left Y-axis represents millions of tons of disposal in landfills (blue), and millions of tons of disposal-related activities (red). The right Y-axis represents the number of pounds of disposal per resident per day as shown by the black line. Data is from the Disposal Reporting System (DRS) with population from the Department of Finance. Accessed 8/7/2018.

For the six types of disposal-related activities in the state, ADC was the most common, with almost 3.7 million tons used (Figure 4). Landfills used 2.1 million tons for other beneficial reuse and almost 61,000 tons for AIC. Annually, transformation continued to process more than 700,000 tons of material, EMSW only handled 91 tons, and waste tire-derived fuel managed 84,000 tons.

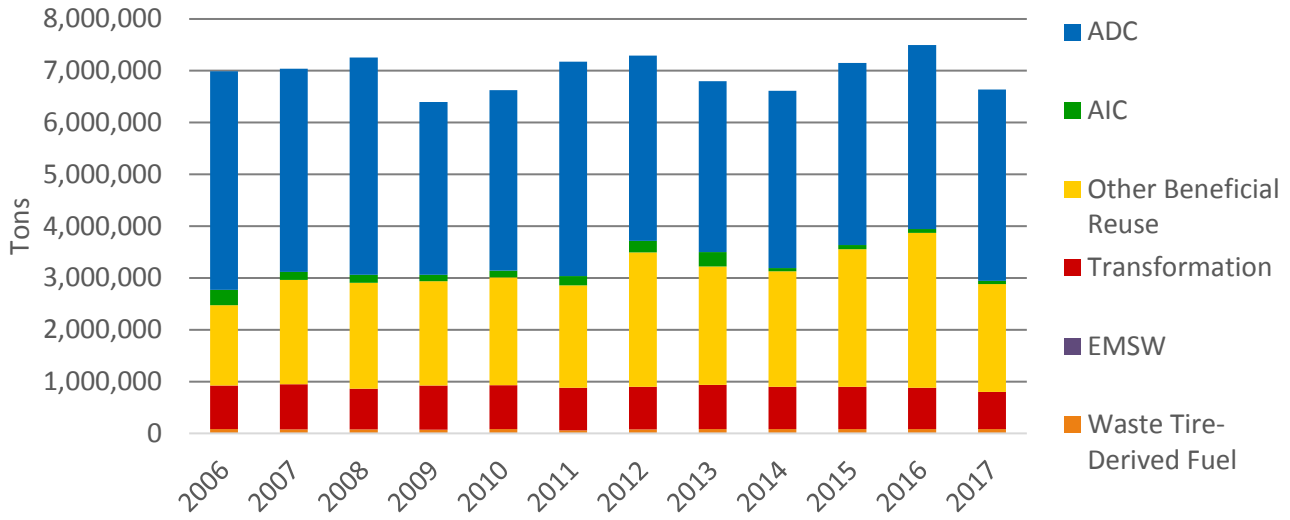

Figure 4. Disposal-related tonnage in California from 2006 to 2017. Data from DRS and waste tire derived fuel reported to CalRecycle. Accessed 8/7/2018.

As in prior years, the largest single component of ADC was green material (1.5 million tons). The prevalence of green material ADC is significant, because beginning in 2020 green material ADC will count as disposal for determining whether jurisdictions are meeting their AB 939 targets. Some jurisdictions may redirect the green material they control to other destinations or uses. However, most jurisdictions will still meet the 50 percent diversion mandate even if they do not redirect the green material and it counts as disposal.

In 2017, other beneficial reuse at landfills fell by almost one million tons from 2016. Although CalRecycle requests that landfills report on the material types used for other beneficial reuse, over a third of this material was uncategorized. This limits the department's ability to understand current practices, characterize the material, and identify potential misuse, overuse, or misreporting.

The Lift Needed to Reach 75 Percent Statewide Recycling

In 2017, 44.4 million tons of material went to overall disposal. That amounts to 6.2 pounds per resident per day or over one ton of solid waste for every resident every year. To meet the goal in 2020, Californians must reduce disposal (at home and at work) to an average of 2.7 pounds per resident per day. This corresponds to less than half of a ton of waste each year. More than half of the solid waste that is currently disposed still needs to be source reduced, composted, or recycled.

In addition, 2017 marks the fifth consecutive year that total disposal has increased. Currently, California is not on track to reach 75 percent recycling by 2020. The state needs to tackle some significant challenges that continue to drive disposal upward.

Challenges in Reducing Disposal

Overall disposal grew considerably faster than population over the past five years. Overall disposal went from 37 million tons to 44.4 million tons and population grew from 38 million to 39.5 million (20 percent and 4 percent, respectively). Therefore, the data indicates that factors other than population are primarily responsible for the increase in disposal. These factors include increasing disposal driven by economic growth, collapse of international markets for recyclable materials, and drought induced impacts from 129 million dead and dying trees, and larger, more frequent, wildfires that produce ash and/or debris that is difficult or impossible to recycle.

Economy Induced Disposal

The environment and the economy can and should thrive together. Unfortunately, in solid waste and materials management, an improving economy usually means increases in generation and disposal. Landfill disposal dropped precipitously during the Great Recession (21 percent from 2007 to 2009), illustrating the correlation between disposal and economic growth. Over the long-term, California has experienced robust economic growth. Californian's median household income rose from about $36 thousand in 1989[8] to almost $68,000 in 2016[9]. The GDP of California was $0.72 trillion in 1989 and rose to $2.75 trillion in 2017[10]. Over the same period, population increased from 28.8 million to 39.5 million. During much of this period, California's disposal declined or remained relatively stable, showing that aggressive implementation of diversion programs can, at least partially, decouple the growth in disposal from economic growth.

CalRecycle's evaluation of economic indicators and disposal trends show that the current economic growth is likely a major driver of the disposal increases. In an improving economy, increased business activity leads to more generation from the commercial sector (manufacturing, services, sales, etc.) and higher wages lead to increased consumption and waste generation in the residential sector. Economic

indicators, like wages and construction starts, show a positive correlation with total disposal (Figure 5 and Figure 6). In 2017, wages increased by about 5 percent over the previous year, while disposal increased by over 7 percent from the previous year. In addition, a continuing rise in home construction of single-family housing also correlated with the rise in disposal. As current projections show continued increases in wages, disposal will also increase unless new policy and programmatic changes are developed that effectively decouple disposal from economic growth. Because disposal depends on the behavior and choices of millions of Californians, if they choose to source reduce, reuse, recycle or compost the materials generated disposal could decline regardless of the improving economy.

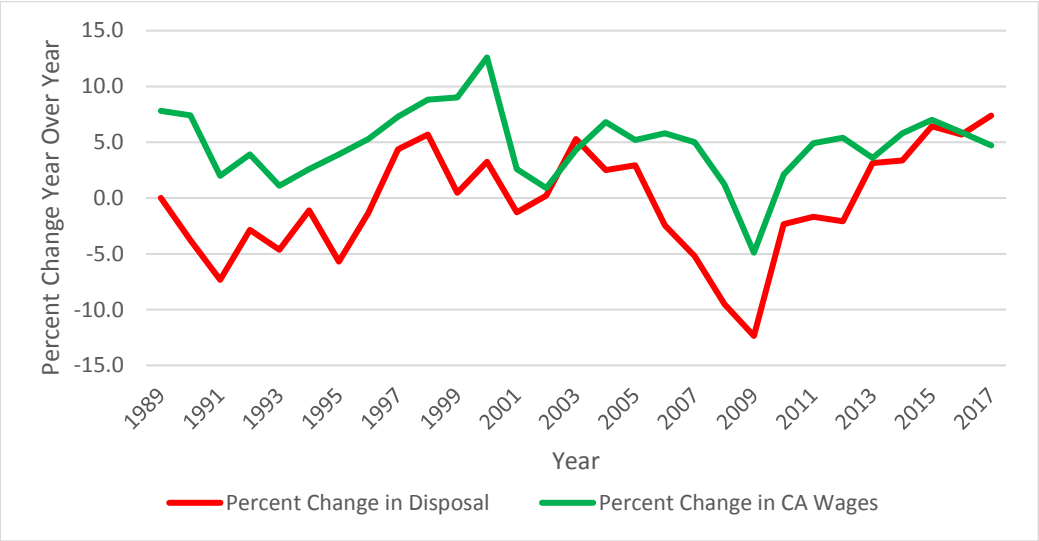

Figure 5. Percent change in disposal in California (red line) compared to the percent change in wages (green line). Data is from the Bureau of Economic Analysis, California Department of Finance, and DRS. Accessed 8/7/2018.

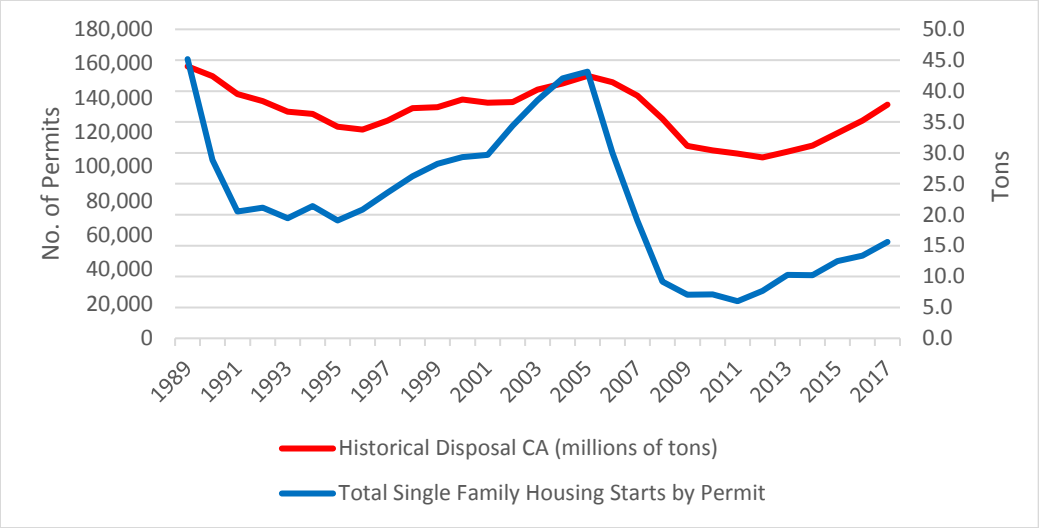

Figure 6. Change in disposal in California (red line) compared to the percent change in housing starts (blue line). Data is from Economic Forecasting, California Department of Finance, and DRS. Accessed 8/7/2018.

Drought Induced Impacts

The prolonged drought in California is causing the death or slow demise of 129 million trees. As a result, California must deal with approximately 225 million bone-dry tons of potential wood waste. These trees must be managed and may put further strain on the already overtaxed organics processing infrastructure. Traditionally, biomass conversion facilities would have burned this material to create energy. However, since the 1980s more than half of the biomass conversion facilities have closed (24 are currently open, down from over 50), reducing how much of this material can flow to biomass facilities. Because material sent to biomass conversion is not included in the calculated generation of solid waste, additional material flowing to them does not increase disposal or decrease California's recycling rate. It is unknown how many dead or dying trees not utilized in biomass conversion are going to landfills. However, if this woody material or other displaced organics flow to landfills, it would increase statewide disposal accordingly.

For the 2017 reporting year, CalRecycle received reports from all 24 operating biomass facilities. The facilities accepted over 3.7 million tons of woody biomass, and rejected less than 0.5 percent of the material, primarily due to contamination (updated since the presentation on biomass at the May 15, 2018 CalRecycle monthly meeting). As shown in Figure 7, roughly one-third of the woody waste sent to biomass facilities originated from urban sources (1.2 million tons); another quarter of the material originated from agricultural sources, and the remainder came from mill residue and forest sources. Although the distribution of sources has remained somewhat constant over the years, there has been a 24.6 percent decline in total material sent to biomass facilities since

2015. Multiple facility closures, changes in facility capacity, and changing energy contracts have all contributed to this decline in handled material.

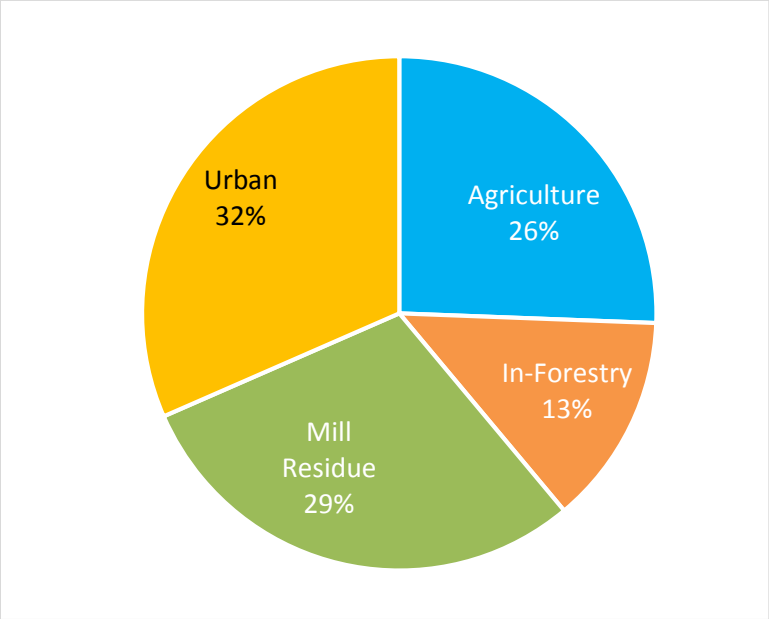

Figure 7. Source sector for more than 3.7 million tons of woody biomass sent to biomass conversion facilities in 2017. Data reported directly to CalRecycle pursuant to Public Resources Code Section 44107.

By requiring public utility companies to obtain some energy from biomass conversion facilities, SB 859 (Chapter 368, Statutes of 2016) mandates the use of dead and dying trees as an energy source and reduces the hazards associated with them. As a result, SB 859 could be responsible for about 300,000 tons (of the 500,000 tons) of "In-Forestry" material converted. While this increase is a step in the right direction, it only accounts for about 0.1 percent of the potential dead tree source material.

Additionally, the energy contracts signed under the SB 859 mandate are only five-year contracts set to expire around 2022. On May 10, 2018, Governor Brown issued executive order B-52-18, which deals with tree mortality, droughts, fires, and climate change overall. Order number 18 requests that the California Public Utilities Commission review and update its procurement programs for small bioenergy renewable generators to ensure long-term programmatic certainty for investor-owned utilities and project developers, as well as benefits to ratepayers.

Disaster Debris

Disasters such as forest fires, earthquakes, mudslides, and floods also increase disposal. Disasters can temporarily create significant amounts of debris from destroyed or damaged structures that must be landfilled immediately for the health and welfare of

the public. While most disaster debris has been required to be disposed, more than 147,000 tons of concrete and more than 24,000 tons of metal have been recycled since 2014. CalRecycle will continue to pursue opportunities to recycle these materials. Disaster cleanups increase the amount of materials landfilled in a county; a single large disaster can create more waste in a jurisdiction than the typical annual total for that jurisdiction. In these cases, CalRecycle can grant special exemptions to jurisdictions so that materials do not count as disposal for the purposes of the AB 939 mandates. However, for the statewide recycling rate, CalRecycle includes all sources of disposal, including disaster debris.

Recent examples of disasters that generated increased waste flow include the Tubbs Fire, Detwiler Fire, Helena Fire, Wind Complex Fire, and the Sulphur Fire. The Tubbs Fire was a highly destructive wildfire affecting Sonoma, Napa, and Lake Counties. The other 2017 fires affected Mariposa, Trinity, Nevada, Yuba, and Butte Counties. Debris removal due to the Tubbs Fire was complete as of May 10, 2018 and included 2.2 million tons of debris (1.9 million tons of which came from Sonoma County alone).[11] Debris removal from the other 2017 fires resulted in removal of more than 131,000 tons of debris. Since these fires took place from July to December of 2017, they contributed to the increase in 2017 disposal. They will also increase disposal in 2018. Overall, the combined disaster debris from these fires could contribute 3 percent to total waste generation for 2017-2018. From all sources, just under 600,000 tons of non-hazardous disaster debris was disposed of at California landfills in 2017.

The extent to which drought induced impacts will cause disposal to increase cannot be determined, but they will continue to have effects on California's overall disposal and statewide recycling rate. CalRecycle played a key role in coordination and site cleanup for several of these 2017 massive wildfires, and the department understands the challenges of handling disaster debris. CalRecycle has achieved great success with its agency partners in remediation of home disaster debris to ensure the health and safety of the public.

Decline of International Markets

This section of the report focuses on the impacts of the decline in international recyclable materials markets on California's overall disposal and the statewide recycling rate. Please refer to CalRecycle's "2017 California Exports of Recyclable Materials" report, for more details on California's export of recyclable materials.

In the past three years, exported recyclables have decreased by 1.8 million tons. California relies heavily on foreign markets to absorb the materials recovered from California's waste stream. Because domestic markets do not exist for the volume and many types of material exported, without robust international markets many of these materials would likely be disposed. The ultimate duration and severity of this situation is

unknown, as it continues to unfold amongst market dynamics, new trade policies, and import restrictions.

Reliance on International Recyclable Materials Markets:

Local jurisdictions rely on the export of baled recyclable materials to foreign markets as part of their suite of programs used to reach their diversion mandates. Exports have also been a major component of the statewide recycling rate.

In 2011, seaborne recyclables peaked with California exporting 22.3 million tons of recyclables internationally which represented approximately 62 percent of total calculated statewide recycling. China alone accounted for 37 percent of that amount. From 2011 to 2017, international exports decreased 34.5 percent to 14.6 million tons (Figure 8).

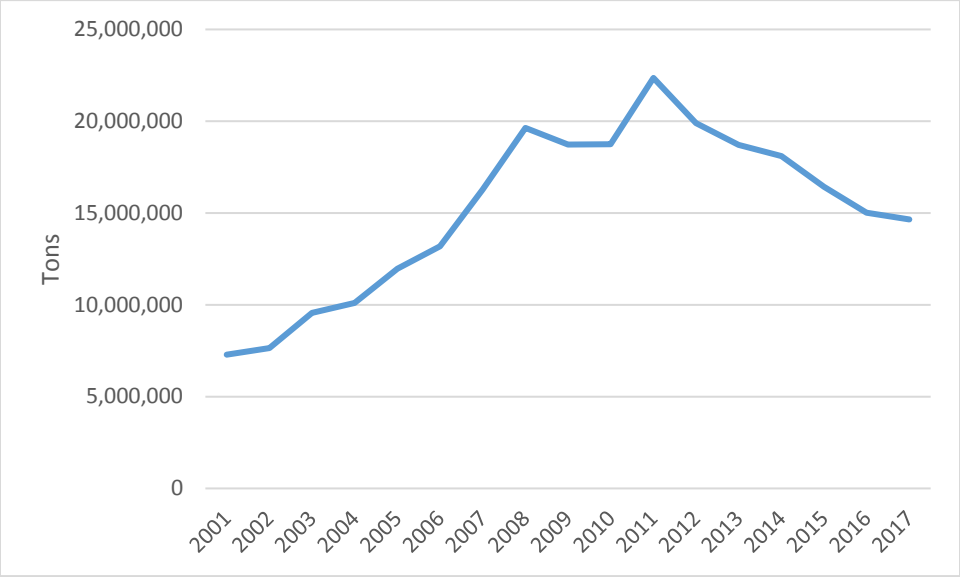

Figure 8. Internationally exported recyclables data is derived from WISERTrade.

Even with this decrease, California still exported 13 percent of the recyclable material generated in 2017 (Figure 9). This amount equates to almost a third of the estimated total recycling tonnage in 2017.

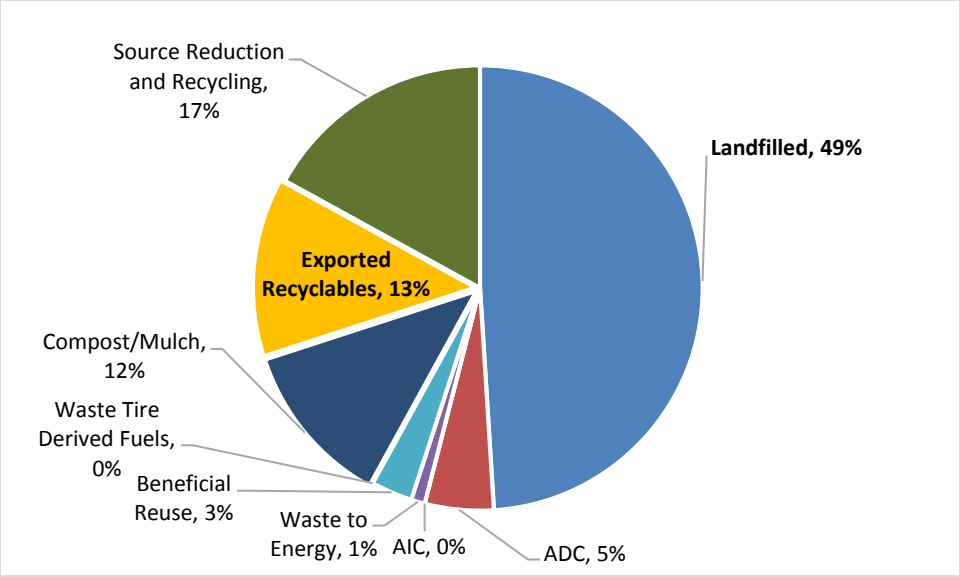

Figure 9. Estimated management of 77.2 million tons of waste generated in California in 2017. The total generation is determined from the 1990-2010 per person baseline and the 2017 population in California. Quantities of landfilled waste, waste to energy, ADC, AIC, and other beneficial reuse are derived from DRS. Waste tire derived fuel is calculated based on data reported to CalRecycle. Exported recyclables is derived from WISERTrade. Estimate for amount composted and mulched is 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.

Changes in China's Import Policies for Recyclables

In 2013, China implemented Operation Green Fence, which aimed to reduce their pollution by limiting the import of contaminated recyclable commodities and increasing inspections of recyclable commodity imports. While this initiative resulted in slightly cleaner, less contaminated imported material, it did not meet China's goals for restricting scrap and recyclable materials imports. In California, the Green Fence policy resulted in backups at shipping ports and a reduction of recyclable exports to China.

In July 2017, China announced a revision to the Green Fence initiative and called the new policy National Sword. China notified the World Trade Organization (WTO) of the 24 recyclable commodities banned from entering the country starting January 2018. The notice also increased enforcement and limited contamination rates to 0.3 percent for recyclable plastic and mixed paper. In November 2017, China revised standards to a 0.5 percent contamination rate and changed the effective date to March 1, 2018. The National Sword policy also included restrictions in waste import licenses and more stringent inspections of imported materials. China developed this policy to protect human health, their environment, and to improve their domestic solid waste reuse and

recovery. While the 2018 start date may suggest that National Sword did not have an impact in 2017, that assumption would be incorrect. As the repercussions of Chinese policy changes reached the industry, exports of recyclables started to fluctuate as facilities started to preemptively adapt to the new rules and changed their practices to avoid paying for the return of materials from China.

Materials Impacted

National Sword restrictions cover many materials, most notably unsorted mixed paper (which includes cardboard, newspaper, and unsorted paper) and mixed plastics. California's jurisdictions and recycling facilities face strict new limits and contamination standards for these exported recyclable materials. Per WISERTrade, in 2016, California ports exported approximately 8 million tons of paper and almost 460 thousand tons of plastic to China. In 2017, California exported almost 7 million tons of paper and about 345 thousand tons of plastic to China.

Consistent with the concept of supply and demand, as the overall capacity of the market to absorb materials shrinks, the price of recyclable materials can drop if the quantity is large and there is no ready buyer. Due to China's declining import of recyclable paper from the United States, there is an oversupply of mixed paper and its bale value has dropped considerably.

Unable to ship their bales to China because of material bans and contamination or to other destinations due to low prices, some recycling facilities are stockpiling these materials, hoping to eventually find viable markets for them. Some bales of recovered materials have been disposed of in landfills, but CalRecycle does not have a mechanism to quantify the amounts.

Because of the role of exports in California's disposal infrastructure and recycling goals, if China had banned all recyclable paper and plastic exports in 2017, the statewide recycling rate would have declined from 42 percent to 33 percent (Figure 10). This assumes that there are no domestic markets to absorb the excess paper and plastic and all these materials are disposed.

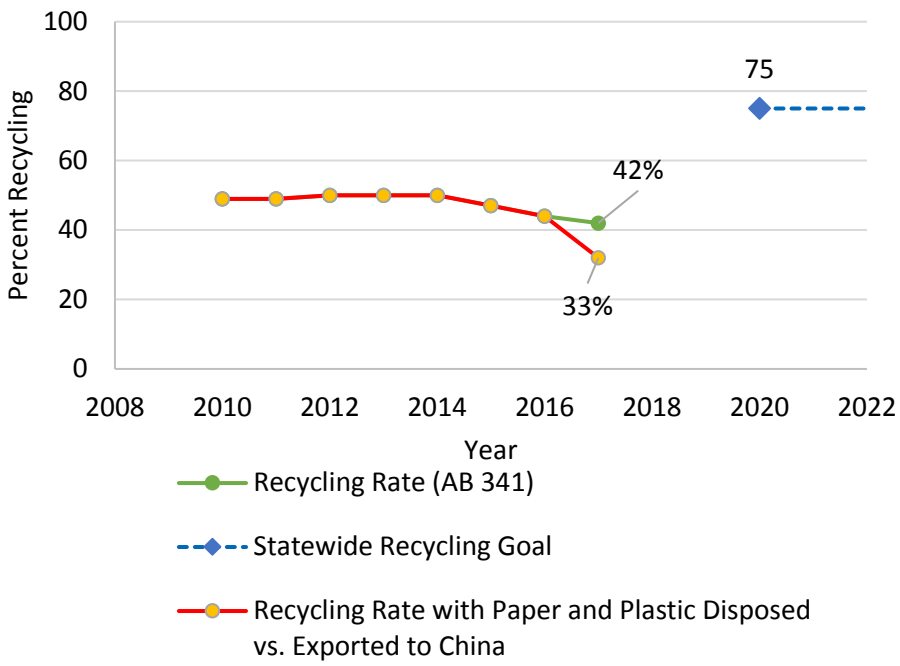

Figure 10. Recycling rate in 2017 if recyclable paper and plastic not exported to China and, instead, disposed in CA. Data from WISERTrade and DRS. Accessed 8/7/2018.

Other Avenues for Recyclables

One way to offset the lack of markets for recyclables in China is to find replacement export destinations. In the last three years, exports of California recyclables have increased to some countries and decreased to others (Figure 11). For example, exports to Vietnam increased by over 700,000 tons from 2015 to 2017.

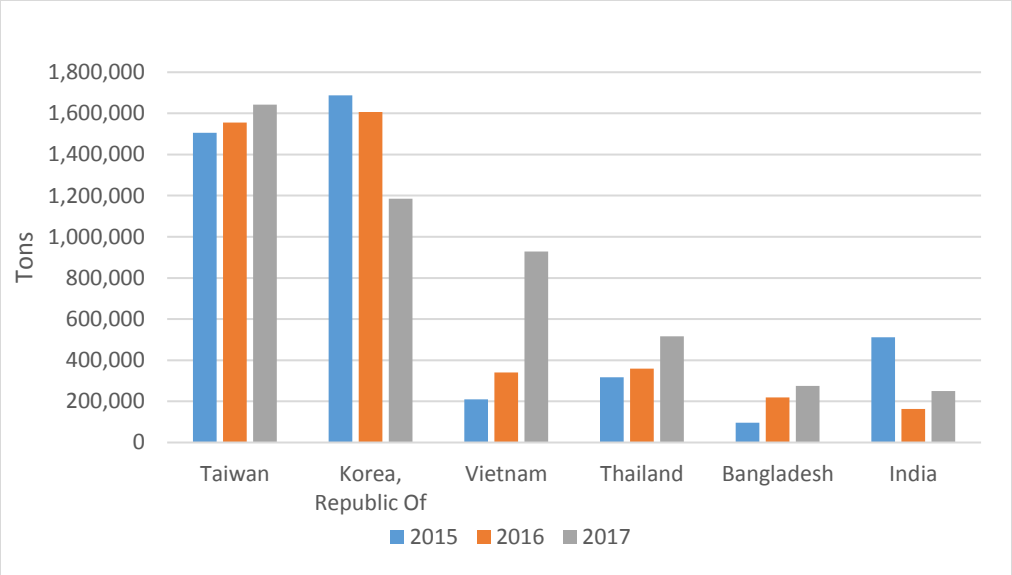

Figure 11. Increases and decreases in exports to countries beside China from 2015 to 2017. Data from WISERTrade.

While this type of redirection may help alleviate some of the impacts of National Sword, historically these markets have not accepted the level of materials accepted by China, and may not have adequate capacity to handle that volume of material. From 2016 to 2017, California's exported recyclables to China decreased by 1.2 million tons, while exports to other countries increased by almost 800,000 tons. This increase was not enough to make up for the shortfall (Figure 12).

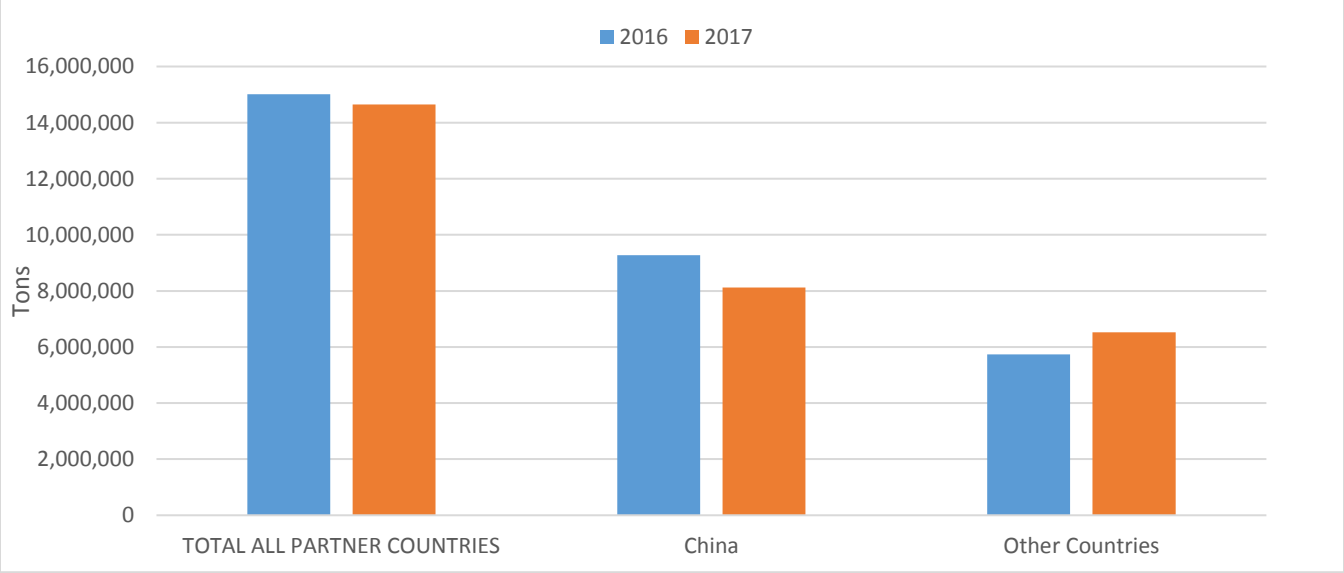

Figure 12. Exported recyclables from 2016-2017 China and Other Countries. Data from WISERTrade. Total All Partner Countries is a WISERTrade data description.

By mid-2018, Vietnam, Thailand, Malaysia and Taiwan all began taking steps to restrict the import of scrap and recyclable materials. If other countries continue to follow China's lead, California would need to source reduce or find suitable domestic markets for 6.5 million tons. If domestic markets do not exist and cannot be developed, some or all of that material may go to landfills.

The collect, sort, and export model has also helped nearly every jurisdiction meet or exceed the 50 percent diversion mandate in AB 939. However, that model has faltered with the decline of the recyclable materials markets in China. While other countries have begun accepting more materials, the development of domestic markets and California infrastructure is the most sustainable and reliable long-term solution to increase recycling and reduce disposal.

Increasing Recycling Capacity

There is a way forward. California needs new tools, strategies, and models to address these ongoing waste management and recycling challenges to reach 75 percent statewide recycling. CalRecycle is exploring new ways to manage materials and confront these challenges.

Within California's collect, sort, and export model of waste management, many manufacturers are still selling products that are infeasible to recycle into new products domestically, and for which only foreign markets exist. These foreign markets are outside of California's influence or control. As a result, exported materials that are assumed to be recycled may give a false sense of environmental benefit if they are actually disposed. Additionally, the level of environmental protection associated with them is unknown, as is the safety of the workers and the communities surrounding the destination facilities. Consequently, the lack of certainty and accountability means suggests that in some cases, the negative impacts outweigh the benefits. While some exports of some materials will continue to play a useful and reasonable role, overreliance on export markets is unsustainable for California's future.

Reducing the amount of waste generated, increasing funding to support new recycling infrastructure, and building a connection between what we buy off the shelves and what can be recycled will go a long way to shifting the course of recycling in California.

Increase California Recycling Infrastructure

Increasing market demand for recyclable materials and organics is key to pulling materials out of the flows destined for landfills. One way to accomplish this is to strategically build infrastructure that is cost effective, consistent with recycling policies, and that target the specific needs of California. The state could spur this development through direct incentives for infrastructure growth (such as grants and loans) and/or through incentive payments for increased processing tonnages.

A more robust California processing infrastructure would reduce some of the volatility for California recyclables by reducing transportation costs and uncertainty related to foreign markets. California would need significant infrastructure growth to increase the manufacturing of new products from recyclable materials and completely close the loop. In addition to the recycling benefits, if materials were completely recycled within California, the state could avoid creating 1.8 million metric tons of CO_2 emissions annually from transporting the materials[12], and create 58,000 new jobs according to CalRecycle's 2013 report *AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020*.

In order for California to meet its 75 percent recycling goal in 2020, an additional 26 million tons of disposal needs to be source reduced, composted, or recycled annually. To reach this tonnage, California could target the largest components in the waste stream for additional recycling. According to CalRecycle's 2014 waste characterization study, the four biggest material categories are: Other Organic, Inerts and Other, Paper, and Plastic (Figure 13). Alternatively, CalRecycle could target specific product types or groupings. Packaging, for example, comprises approximately one fourth of the waste stream and is composed of several material types. Overall, organics comprise about two thirds of disposal.

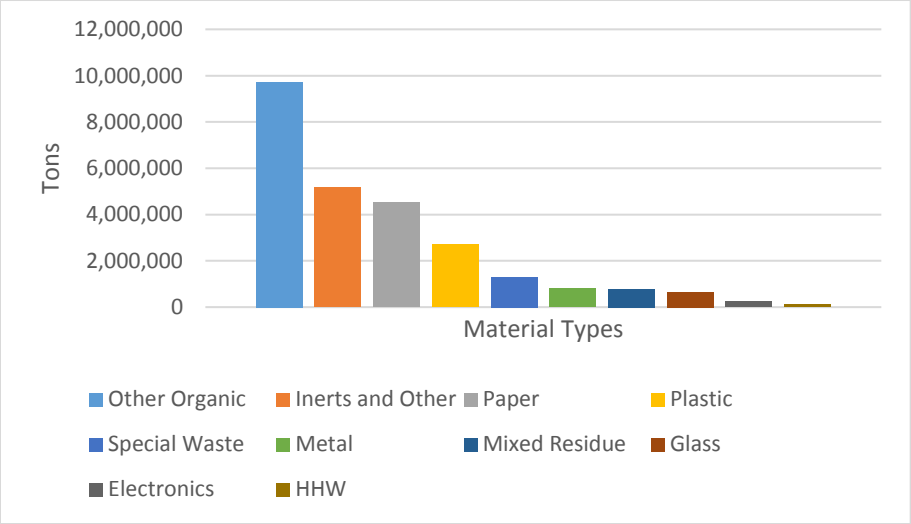

Figure 13. 26 million tons of additional material that need to be recycled, broken down by material category. Data from 75 Percent initiative and 2014 Waste Characterization Study. Accessed 8/7/2018.

Existing Infrastructure for Recyclables

CalRecycle has limited information on the number and capacity of recycled-content product manufacturers in California. The information contained in Table 1 is self-reported by the facilities and the extent and breadth of their activities have not been

examined or verified by CalRecycle. With additional tools, CalRecycle could find additional incentives and approaches to increase recycled content product manufacturing.

Table 1. Recycled Content Product Manufacturers using various feedstocks. Data from CalRecycle's FacIT. Accessed 8/7/2018.

Feedstock Category	Recycled Content Product Manufacturers
Plastic	63
Organics	48
Glass	8
Paper	15
Inerts, Construction and Demolition	72
Metal	13
Electronics	3
Residue	0
HHW	2
Aggregated Flows	15

CalRecycle has a long and successful history of administering grants, payments, and loans to help develop and maintain the recycling collection and processing infrastructure. CalRecycle annually awards $100 million across almost 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. CalRecycle can modify the program criteria for some programs annually based on department priorities and stakeholder input. This helps CalRecycle influence the direction for statewide materials management.

CalRecycle established the Recycled Fiber, Plastic, and Glass Grant Program in 2014 using funds from the Greenhouse Gas Reduction Fund in order to increase manufacturing of recycled-content products in California and to lower statewide GHG emissions. There were three grants approved for $9,000,000 to support recycled fiber, plastic, and glass in FY 2016-2017. These grants will divert almost 65,000 tons of plastic and almost 80,000 tons of glass from landfills.

The passage of AB 3056 (Committee on Natural Resources, Chapter 907, Statutes of 2006) created the Plastic Market Development Payment Program to develop California markets for recycled empty plastic beverage containers. Subject to the availability of funds, CalRecycle will make payments of up to $15 million dollars for FY 2018-2019, and $10 million for the following years until 2022.

While there are many recycled-content product manufacturers in California, they do not have enough capacity to absorb an additional 26 million tons of material. California's heavy reliance on export markets also suggests limited in-state infrastructure for processing many materials.

Existing Infrastructure for Organics

California has many organic processing facilities handling an array of materials including ones dealing directly with food waste. CalRecycle has some information regarding these facilities that is incomplete and outdated. With full implementation of AB 901, CalRecycle will gain a clearer picture of the infrastructure of organic waste recycling and disposal. Per the 2014 Waste Characterization Study, organic materials make up over two thirds of the disposed waste stream. There is not enough current infrastructure to manage this amount of organic material and to meet the requirements of SB 1383, California will require still more.

In addition to the Organics Grants Program as discussed above in the Developing Needed Infrastructure section, CalRecycle administers the Food Waste Prevention and Rescue Grant Program pursuant to Public Resources Code section 42999. The purpose of this competitive grant program is to lower overall GHG emissions by establishing new, or expanding existing, food waste prevention projects (source reduction or food rescue for people) in California to reduce the amount of food being disposed in landfills. CalRecycle awarded 20 grants of $5 million for FY 2016-2017 and 12 grants of more than $4.3 million for FY 2017-2018.

Improved organics management must play a central role in any viable plan to reach 75 percent statewide recycling. As an added benefit, recycling organics reduces the emissions of GHGs and SLCPs. CalRecycle estimates that the organics recycling infrastructure needs to more than double to accommodate the regulatory mandated reductions in SB 1383.

Challenges to Increasing Instate Infrastructure

California needs to site additional facilities to address the insufficient recycling and organics infrastructure. There are several challenges to siting new facilities or expanding existing facilities. Two primary ones are, resistance by neighborhoods, and insufficient economic supports or incentives to spur infrastructure growth. Two approaches have been suggested that could minimize these challenges:

First, project proponents and local governments should engage in a meaningful way with the neighborhoods and ensure that facilities are sited appropriately and in the least disruptive manner. Communities usually do not view waste management facilities as desirable neighbors. Residents do not want them or the expected negative impacts (such as increased noise, odors, and traffic) in their neighborhoods. As a result, there are few locations where these facilities can be easily sited, especially in urban locations.

While California needs this new infrastructure, it does not need to come at the detriment of California's communities.

Facilities can take steps to avoid, minimize, or mitigate impacts on their surrounding communities. New facilities can bring green jobs, stimulate the local economy by bringing people and resources into the community, and bring other benefits into neighborhoods. One of the keys to make facility siting more equitable and productive is early outreach by proponents and local governments. As part of the formal proposed regulations for SB 1383, proponents of new or expanded solid waste facilities would be required to provide evidence that the operator held a public meeting with any affected disadvantaged communities prior to submittal of the permit application package.

CalRecycle is committed to including individuals, communities, and regulated businesses in the decision-making process. CalRecycle's Environmental Justice program is also taking steps to improve this process to benefit all Californians while supporting a healthy environment and economy, including working to:

- Ensure CalRecycle's vision for solid waste recycling infrastructure includes minimizing negative impacts on disadvantaged communities.
- Increase community knowledge and capacity through environment-based education.
- Advance opportunities for community members to participate in the decision-making process, prior to the actual point when decisions are being made, so they have a say in decisions that affect their well-being. This includes working with local enforcement agencies, planning departments, cities, and counties on information sharing about local-level decisions.

Second, sufficient funding should be secured to support building of the needed recycling and composting infrastructure and to incentivize the flow of material to these higher and better uses. Adequate funding is required to build recycling infrastructure and to make its operations viable over time. The GHG Reduction Fund expenditures discussed earlier in this report have provided a stopgap measure to fund some of the needed infrastructure, but a sustainable and reliable funding source is needed to incentivize the recycling and composting markets and infrastructure in California. Currently, no funding source exists that could accomplish a task of this magnitude. CalRecycle's primary revenue source is the Integrated Waste Management Fee (IWMF), a $1.40 per ton fee on landfill disposal. This fee does not generate the revenue to leverage necessary private investment for this level of infrastructure and market building. CalRecycle will continue to explore options for securing sustainable funding to help California meet the statutory statewide recycling and climate goals.

Decouple Generation and Disposal from Economic Growth

As discussed in the Challenges in Reducing Disposal section of this report, waste generation and disposal have been tied to economic growth. These factors must be decoupled if California is to succeed at reducing disposal in the midst of a healthy state economy. Studies suggest[13] a few tools that would move towards this decoupling: economics tools such as recycling incentives, consumer education tools, and cooperative efforts on waste reduction. To be successful, the department will need legislative authority to enact regulations and implement programs that include enforcement provisions.

Another key effort to decouple waste from economic growth is the strategic effort to reduce overall packaging waste and improve packaging's overall recyclability. About one quarter of California's waste disposal stream is packaging. Decreasing the amount of these wasted materials through voluntary and regulatory actions, while minimizing the impact on economic activity would be a bold first step towards decoupling these factors.

For many years, there have been ongoing discussions regarding discarded packaging. CalRecycle is developing concepts for a comprehensive, statewide packaging reform program. This program, developed over a six-year period of stakeholder engagement, will provide policy recommendations drawing on many elements of a decoupling platform, including upstream management, sustainable funding, support for robust recycling markets, and greater manufacturer responsibility to improve recyclability and decrease overall waste.

Increase Source Reduction

Source reduction is at the top of the hierarchy of waste management (PRC Section 40051). By not consuming unneeded goods, purchasing more durable products, reducing or rejecting packaging, buying and building for reuse, and finding second lives for unwanted items, Californians can help decouple economic growth from waste generation and reduce how much waste they each generate and dispose every day. Food waste can be source reduced through education about better meal planning, storage of food, reuse of leftovers, and recovery of edible food. Construction and demolition waste can be source reduced by renovating existing buildings rather than constructing new ones and utilizing construction methods that provide for efficient disassembly or reuse of materials. Ultimately, source reduction reduces the amount of material disposed. It also reduces the amount of material that must be collected, sorted, and then marketed either domestically or internationally. Finally, it reduces the amount of virgin material that must be harvested, mined or extracted to create most products in the first place; this aspect alone produces significant environmental benefits.

Currently, source reduction is notoriously hard to measure because it is material that is never created nor enters the waste stream. CalRecycle has tried various methods to evaluate source reduction and currently, has limited means to estimate its contribution

to California's management of solid waste. As a result, CalRecycle groups source reduction with recycling, for the purposes of evaluating California's recycling goals.

Local Efforts at Source Reduction

Jurisdictions across California have taken action to reduce the amount of waste generated. They face a similar challenge when quantifying source reduction in their areas. In addition, there is no agreed-upon measurement system for measuring the impact of source reduction programs.

Through their Electronic Annual Reports (EAR), local jurisdictions have self-submitted source reduction information based on eight categories: Backyard and On-Site Composting/Mulching, Business Waste Reduction Program, Government Source Reduction Programs, Material Exchange/Thrift Shops, Other Source Reduction, Procurement, School Source Reduction Programs, and Xeriscaping/Grasscycling.

As shown in Figure 14, about 56 percent of jurisdictions are implementing parts of Xeriscaping/Grasscycling programs, and 25 percent are implementing parts of School Source Reduction programs. Implementation in most other categories of source reduction programs is more successful.

CalRecycle staff cannot quantitatively assess the extent and penetration of source reduction programs across California given the information submitted in the EARs. For example, a jurisdiction that promotes a Grasscycling program does not mean that most or all of its residents are Grasscycling. Some local jurisdictions could implement more source reduction programs. Some California businesses have found that source reduction not only reduces the cost of disposal but also increases efficiency and saves money up front. CalRecycle is exploring ways to encourage or incentivize source reduction more directly at the statewide level.

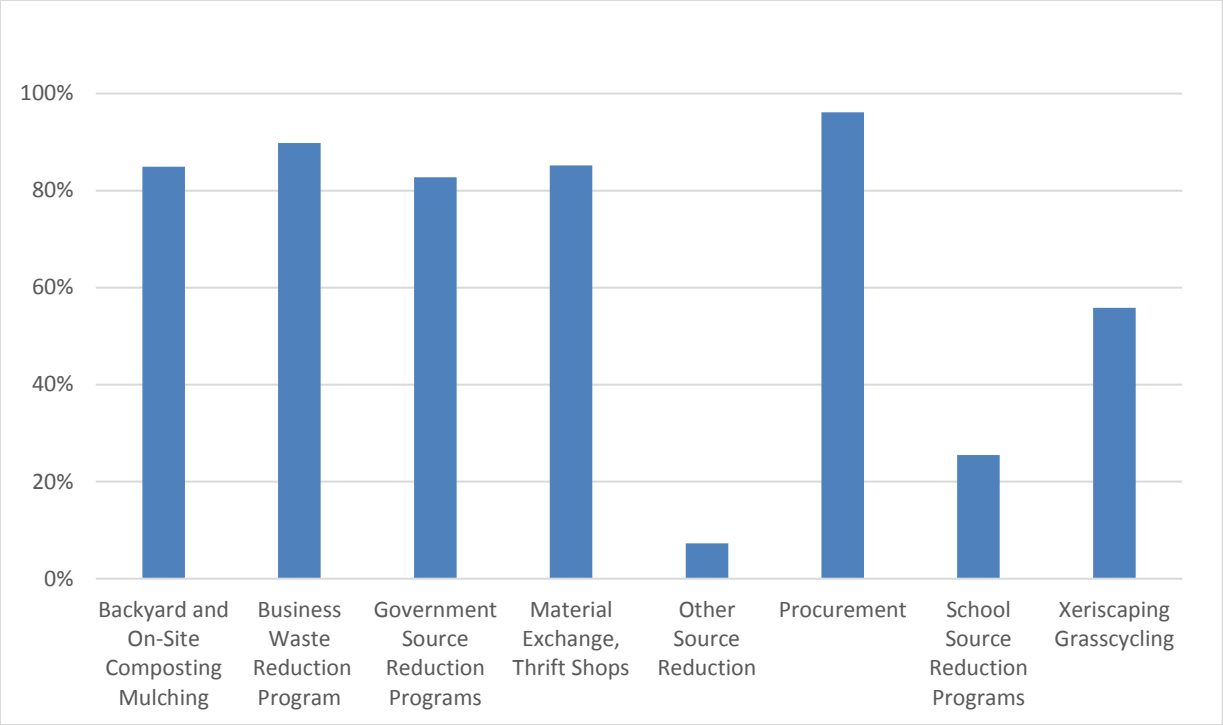

Figure 14. Jurisdictions reporting source reduction programs. Data from Diversion Program Jurisdiction Program Status 2016 (2017 data was not available at time of publication). Accessed 8/7/2018.

In addition to these source reduction measures, many California jurisdictions have adopted aggressive waste reduction programs that aim to reduce the overall amount of waste sent to landfills. 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. CalRecycle has identified 25 cities with zero waste plans as of 2017. This is almost double than the 14 cities that had zero waste plans two years ago. Another 12 cities are working toward a zero waste plan or educating their citizens about zero waste.

Product Bans

In 2016, California voters approved a proposition that allowed for the implementation of the statewide Single-Use Carryout Bag Ban (SB 270, Padilla, Chapter 850, Statutes of 2014), resulting in the statewide single-use carryout bag ban. As a result, most grocery stores, retail stores with a pharmacy, convenience stores, food marts, and liquor stores can no longer provide single-use plastic carryout bags to their customers. Instead, these stores may provide a reusable grocery bag or recycled paper bag to a customer at the point of sale for a charge of at least ten cents.

On September 20, 2018 Governor Brown signed AB 1884 (Calderon, Chapter 576, Statutes of 2018), which prohibits a full-service restaurant from providing single-use plastic straws to consumers unless requested by the consumer.

The governor also signed the Sustainable Packaging for the State of California Act of 2018 (SB 1335, Allen, Chapter 610, Statutes of 2018), which requires a food service facility located in a state-owned facility to only use types of food service packaging approved by CalRecycle. This food service packaging must be reusable, recyclable, or compostable as determined by CalRecycle through adopted regulations.

Extended Producer Responsibility

EPR, also known as Product Stewardship, is a strategy to place a shared responsibility for end-of-life product management on the producers (product manufacturers) and all entities involved in the product chain instead of on the general public consumers. EPR can incentivize more sustainable, less toxic and easier to recycle products. By using less material in products and making them last longer, there is source reduction. EPR can affect the waste stream overall by relieving stress on government waste management programs. California's carpet, mattress, and paint stewardship programs are designed, implemented, and managed by product manufacturers through their respective industry-created stewardship organizations. CalRecycle's oversight role is critical to ensure that recycling and materials management goals are achieved. Since some materials do not fit in the current recycling model and can actively hinder the recycling process by introducing dangerous elements into the waste stream, Governor Brown signed SB 212 (Jackson, Chapter 1003, Statutes of 2018) into law on September 30, 2018, which creates a new stewardship program for proper management and disposal of covered drugs and home-generated sharps waste.

Connecting What We Buy With What Can Be Recycled

Uncertainty in scrap markets is forcing a reconsideration of what "recyclable" means and whether or not certain post-consumer materials currently considered recyclable actually fit the definition.

Defining Recyclability

The determination of whether a post-consumer object can be reused or processed into something new actually depends on a number of factors including: the technical and economic feasibility of recycling those materials; the availability of downstream markets for those recycled materials; and the environmental effects of the recycling process. All materials have inherent energy and sending that energy to a landfill in the form of post-consumer material is a waste. However, the economic or environmental cost of the recycling process may outweigh economic or environmental benefit. For example, while it is technically feasible to recycle plastics 3-7, the processes in doing so are so labor-

intensive and expensive, that it is not always economically feasible to recycle these plastics.

Materials That Are Difficult to Recycle

What happens to materials that fall outside of the definition of “recyclable”? If adequate markets do not exist, then the material may end up being disposed.

In order to create markets for recycled material, governments may incentivize and subsidize recycling of a material that otherwise could not feasibly be recycled. Incentive payment programs use economic and policy tools to harness the forces of the marketplace to adopt public policy goals. An example of an incentive payment program to stimulate recycling markets is CalRecycle’s Quality Incentive Payment Program for empty glass beverage containers collected by curbside recycling programs, drop-off, or collection programs. Participating entities may be paid up to $60 per ton for cleaned and color-sorted glass beverage containers that meet CalRecycle’s qualifying criteria. Government subsidies, cash grants or loans given to a company without a history of profitability, can also be utilized in order to encourage recycling. For example, in May of this year, CalRecycle awarded a $1 million loan to Ecologic Brands, a San Joaquin Valley company that manufactures bottles from recycled paper and plastic.

Local governments may also seek to eliminate materials that cannot be feasibly recycled from their waste streams. Many governments have achieved limited material usage by banning or imposing fees on certain post-consumer materials that are not feasible to recycle. For example, single-use plastic bags and polystyrene products have been banned in cities across California and abroad. By banning certain materials and goods, local governments hope to spur manufacturers to stop producing materials that cannot realistically be recycled.

Some stakeholders have advocated for redefining recycling to include burning (or otherwise converting) hard to recycle materials into energy. Supporters of waste to energy transformation argue that there is ample solid waste feedstock and established markets for the energy. However, the waste management hierarchy in Public Resources Code Section 40051 directs CalRecycle to prioritize and promote source reduction first, recycling and composting second, and puts environmentally safe transformation and environmentally safe land disposal last. However, building more capacity for transformation activities would require contracts that could destine materials that are currently being recycled, or could be recycled, to be feedstocks for transformation.

Addressing Contamination

China implemented a strict contamination standard and has sent a global signal that finished bales need to be as free of contaminants as possible. California could increase education about contamination in the waste stream, incentivize and subsidize better

sorting and cleaning technologies for material recovery facilities, and open new domestic or export markets in order to meet the new global contamination standards.

Contamination degrades the quality of recyclables and can result in entire containers of otherwise good recyclables being sent to landfills. The first step to reducing contamination of recyclables is putting the correct material in the correct container. Recycling service providers and local jurisdictions must provide their customers clear direction on what materials belong in which containers.

CalRecycle is generally exploring what the definition of 'recyclable' means in California in terms of economic, market, and technological feasibility. A better understanding of what is recyclable will provide a firmer foundation for a robust discussion of different strategies tailored for different materials and products, such as new approaches to market development, effective source reduction strategies, potential product bans, incentives or effective subsidies, and/or increased education opportunities. CalRecycle's implementation of SB 1335 will facilitate and further this discussion as the department defines recyclability in relation to food service packaging at State facilities.

Looking Ahead – Making Progress and Measuring It

Along with its partners in local government and the solid waste and recycling industry, CalRecycle is taking steps to address the challenges ahead. This includes striving to reach 75 percent recycling, to reduce environmental impacts of material generation and disposal, and to reap the downstream social, economic and environmental benefits of managing solid waste effectively. Every CalRecycle policy and program is evaluated in this broader environmental context and each will need to contribute to California's success: from recycled content product manufacturing to extended producer responsibly programs, from upstream source reduction policies to downstream market incentives. Undertaking systemic change in an area as complex as California's waste stream and materials management system is not easy. However, the department is creating the groundwork in various sectors and making progress.

California must manage its organic waste domestically. Organic waste is a significant portion of the waste stream and a major contributor to climate change. CalRecycle's implementation of SB 1383 is required by statute to take a more active and more prescriptive statewide approach to organic waste management, as opposed to the approach used in AB 939 that allows each jurisdiction to select the materials to target and programs to implement.

With AB 901's reporting of both disposal and recycling, as well as up-to-date waste characterization studies, CalRecycle will be able to guide fact-based policy development and program implementation efforts that are needed to meet these challenges.

SB 1383 – A New Model for CalRecycle Oversight

One of the important new paradigms for California is implementing the short-lived climate pollutants (SLCP) strategy. SLCP are powerful climate forcers that include methane, fluorinated gases like hydrofluorocarbons (HFCs), and black carbon. They can heat the atmosphere, tens, hundreds, or even thousands of times greater than CO_2 resulting in changes to the climate. The impacts of SLCP are especially strong over the short term.

Emissions resulting from the decomposition of organic waste in landfills are a significant source of methane, a potent part of SLCP. Organic materials—including waste that can be prevented, recycled, or composted—account for a significant portion of California's overall waste stream. Food waste alone accounts for approximately 18 percent of total landfill disposal and nine of the ten most prevalent waste material types are organic waste (Figure 15). Increasing food waste prevention, encouraging edible food rescue, and expanding the composting and in-vessel digestion of organic waste throughout the state will help reduce methane emissions from organic waste disposed in California's landfills.

Methane from organic materials is being addressed, in part by SB 1383, by establishing statewide organic material reduction targets. For the purposes of SB 1383 formal proposed regulations (release date January 18, 2019) "organic waste" means solid wastes containing material originated from living organisms and their metabolic waste products, including but not limited to food, green material, landscape and pruning waste, organic textiles and carpets, lumber, wood, paper products, printing and writing paper, manure, biosolids, digestate, and sludges. SB 1383 also establishes an additional target that not less than 20 percent of currently disposed edible food is recovered for human consumption by 2025. Figure 16 illustrates targets of SB 1383.

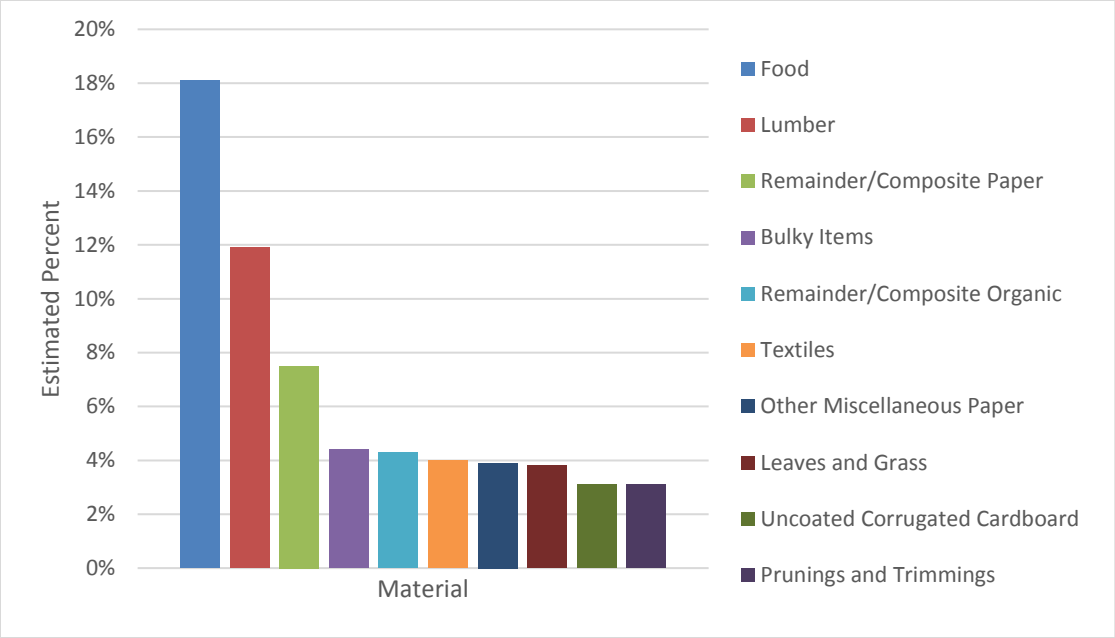

Figure 15. Ten most prevalent material types in California's disposed waste stream. Chart equals 64% of total waste stream, not 100%. Data from 2014 Waste Characterization Study.

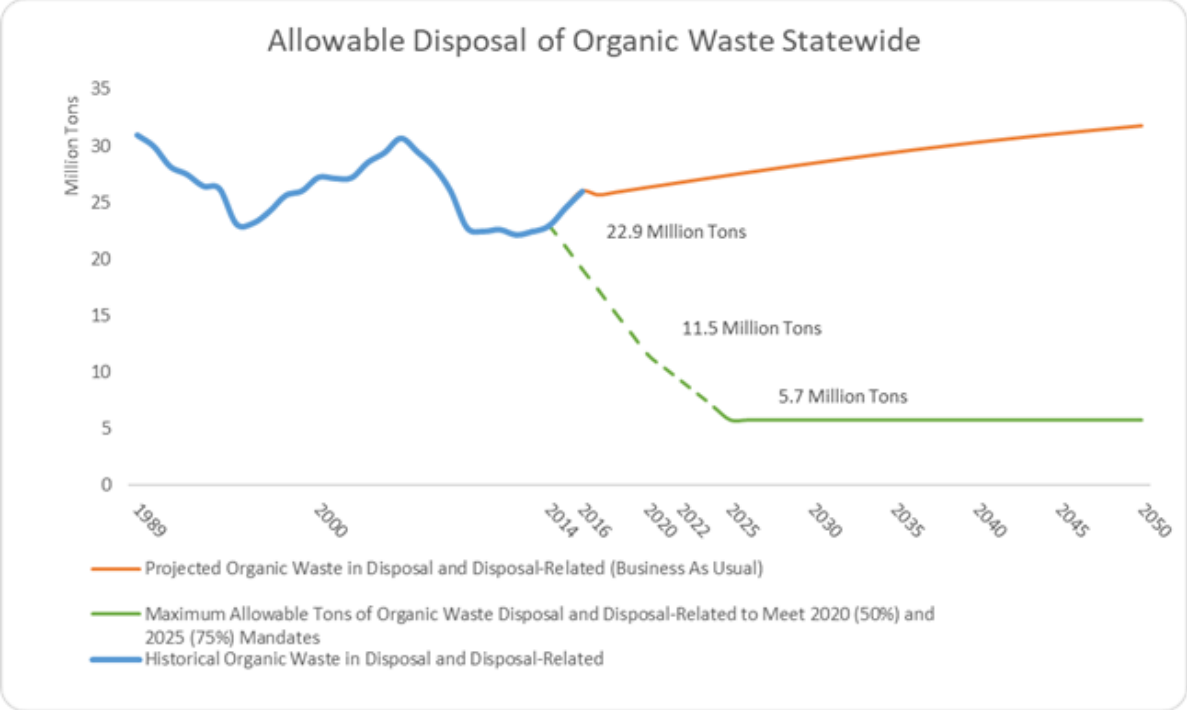

Figure 16. Projections of allowable disposal of organic waste statewide. Data from CalRecycle.

CalRecycle entered the 45-day formal comment period for SB 1383 on January 18, 2019. The regulations are expected to be adopted in late 2019. Although the regulations will not take effect until 2022, initiating rulemaking and adopting them early allows regulated entities several years to plan and implement necessary budgetary, contractual, and other programmatic changes. Jurisdictions, haulers, and generators should begin taking actions to implement programs to be in compliance with the regulations on January 1, 2022.

As of January 1, 2020, the state must achieve a 50 percent reduction in the level of the statewide disposal of organic waste from the 2014 level. By July first of the same year, CalRecycle, in consultation with the Air Resources Board, will analyze the progress that the waste sector, state government, and local governments have made in meeting the organic waste reduction targets of 50 percent in 2020 and 75 percent in 2025. If the department determines that significant progress has not been made in meeting the targets, CalRecycle may include incentives or additional requirements in the regulations to facilitate progress toward achieving the organic disposal reduction targets. The department may also recommend revisions to the targets to the Legislature.

CalRecycle will be networking, providing technical assistance, and developing tools, model ordinances, contracts, and case studies to support efforts at the local level to meet the organic waste reduction targets and comply with the regulatory requirements.

On January 1, 2022, CalRecycle's regulations to meet the organic waste reduction targets for 2020 and 2025 take effect and are enforceable by CalRecycle.

Gathering the Information Needed to Make Science-based, Data-driven Decisions

Recycling and Disposal Reporting System

AB 901 (Gordon, Chapter 746, Statutes of 2015) changes how organics, recyclable material, and solid waste are reported to CalRecycle. Disposal, recycling, and compost facilities, as well as exporters, brokers, and transporters of recyclables or compost will be required to submit information directly to CalRecycle on the types, quantities, and destinations of materials that are disposed of, sold, or transferred inside or outside of the state. CalRecycle also has enforcement authority to collect this information.

The Recycling and Disposal Reporting System (RDRS) being developed to collect the information required by AB 901 will replace CalRecycle's Disposal Reporting System (DRS). Under DRS, the waste flow picture is incomplete, but RDRS will fill in many of the blanks such as material flows, levels of processing, and the fate of materials. AB 901 dramatically improves the department's and local jurisdictions' ability to measure progress toward mandated goals and programs by expanding reporting to include data on recycling and composting, increasing timeliness and accuracy of reports, and creating an enforcement mechanism to improve reporting accountability. The proposed

regulations implement the mandates of AB 901 in order to accomplish three important goals.

First, the proposed regulations improve the department's understanding of material flows within the State's recycling infrastructure. The data collected will enable the department to estimate total recycling and composting, understand the flow of materials, and track progress towards statewide goals.

Second, the data collected under the proposed regulations will augment the department's ability to respond to changes in the recycling marketplace. Analysis of the data will increase the department's ability to target state resources to enhance the recycling infrastructure.

Third, the proposed regulations will improve the department's enforcement procedures to require accurate and timely reporting. This additional tool will enhance and expand the department's ability to verify the accuracy of recycling infrastructure information and the accuracy of disposal information.

CalRecycle published the notice of the proposed regulations in the California Regulatory Notice Register by the Office of Administrative Law (OAL) on January 26, 2018. CalRecycle anticipates adoption of the regulations in early 2019. The development of the electronic reporting system is ongoing. CalRecycle plans to conduct outreach and training in the spring of 2019. Reporting will commence with the third quarter of 2019, so the first reports will be due starting in October of 2019.

Waste Characterization Studies

CalRecycle is conducting a 2018 Statewide Waste Characterization Study. CalRecycle's contractor will collect samples from facilities and generators in late 2018 and early 2019. Field crews will sort the samples into about 100 different material types. Since the last waste characterization study was completed back in 2014, CalRecycle expects to have interesting data to share that reflects the many changes in solid waste generation, handling, processing, and markets in the last four years.

Summary and Recommendations

California's robust economy, diverse populous, and large geographic size produce a complex and dynamic waste management environment. While there are many challenges, California continues to be a leader nationally and internationally by expanding successful programs and developing innovative new ones. However, California's 2017 recycling rate of 42 percent is considerably less than the 75 percent recycling rate the state would like to achieve by 2020. To meet the goal on time, annual recycling tonnages would need to almost double in three short years. While the state is unlikely to reach 75 percent by 2020, CalRecycle and its partners in local government

and industry are moving forward to increase recycling, reduce disposal and protect California's environment. Even reaching 75 percent recycling will be a stepping stone to the future of waste management. To overcome the challenges and reach the aggressive critical or important goals set by California's Governor and Legislature, CalRecycle and its partners will need to examine issues from new perspectives, use new approaches and tools, and make data-driven, science-based decisions on how to proceed.

CalRecycle is exploring a variety of new ways to decrease disposal and continue to promote the manufacturing of post-consumer recyclable material into new products. This report highlighted five areas that CalRecycle could explore: decoupling generation and disposal from economic growth, increasing source reduction to shrink waste generation, improving recyclability of materials in California's waste stream, managing products and packaging that are difficult to recycle, and building sustainable domestic markets.

California has long been a leader in recycling. Despite recent increases in disposal, California remains committed to increasing recycling, mitigating secondary impacts of solid waste disposal like resource depletion, and preserving natural resources. By building a strong framework and focusing on the goal of reducing disposal and conserving resources, CalRecycle and Californians will continue to lead through 2020 and beyond, and the state will continue to make progress towards meeting and exceeding 75 percent recycling.

Abbreviations and Acronyms

AB – Assembly Bill

ADC – Alternative Daily Cover

AIC – Alternative Intermediate Cover

CalRecycle – California Department of Resources Recycling and Recovery

DRS – Disposal Reporting System

EPR – Extended Producer Responsibility

EMSW – Engineered Municipal Solid Waste

GHG – Greenhouse Gas

IWMF – Integrated Waste Management Fee

MCR – Mandatory Commercial Recycling

MRC – Mattress Recycling Council

MSW – Municipal Solid Waste

OAL – Office of Administrative Law

RDRS – Recycling and Disposal Reporting System

SB – Senate Bill

SLCP – Short-Lived Climate Pollutants

WTE – Waste-to-energy

Glossary of Terms

Alternative daily cover (ADC) and 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.

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.

Disposal Reporting System (DRS): The system used to track disposal information in California.

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

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.

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.

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.

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.

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

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.

Waste-to-energy: Incineration process in which solid waste is converted into thermal energy to generate steam that drives turbines for electricity generators.

Resources

[1] Department of Finance. E-5 Population and Housing Estimates for Cities, Counties, and the State, 2011-2018 with 2010 Census Benchmark. Table 1. E-5 County/State Population and Housing Estimates, 1/1/2017

[2] Employment Development Department, Labor Market Information Division. Table 1_SOB17_2.

[3] https://www.nbcnews.com/business/consumer/all-online-shopping-has-cardboard-consequences-n773656. Accessed 8/7/2018.

[4] Center for International Environmental Law. "Fueling Plastics; How Fracked Gas, Cheap Oil, and Unburnable Coal are Driving the Plastics Boom."

[5] Price Index by Recycling Data Management Corporation. RecyclingMarkets.net

[6] Price Index by Recycling Data Management Corporation. RecyclingMarkets.net

[7] Mattress Recycling Council, California Annual Report, 2017: <https://www.calrecycle.ca.gov/docs/cr/mattresses/annualreport/2017annualrpt.pdf>.

[8] U.S. Department of Commerce. SB/93-1. February 1993.

[9] U.S. Department of Commerce. Household Income: 2016. American Community Survey Briefs, September 2017.

[10] U.S Department of Commerce. Bureau of Economic Analysis. GDP by state. Accessed 8/7/18.

[11] Gudel. "Major Debris Removal Operations are Complete Following October 2017 Wildfires In Northern California." *Cal OES News,* May 10, 2018.

[12] *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). 14.6 million tons x 6497 miles x 19 g CO_2E/ton-mile = 1.8 $MMTCO_2E$.

[13] Waste & Resources Action Programme. "Decoupling of Waste and Economic Indicators." October 24, 2012.