Analysis of the Progress Toward the SB 1383 Organic Waste Reduction Goals

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Executive Summary

Senate Bill (SB) 1383 (Lara, Chapter 395, Statutes of 2016) established ambitious but necessary short-lived climate pollutant reduction mandates. To meet those mandates, SB 1383 required CalRecycle, in consultation with the California Air Resources Board (CARB), to develop regulations to reduce the disposal of organic waste 50 percent below 2014 levels by 2020 and 75 percent by 2025. In addition, recognizing the significant levels of food insecurity in the state, the Legislature further required that CalRecycle include requirements to increase food recovery by 20 percent by 2025.

Reducing disposal of organic waste is a critical part of the Short-Lived Climate Pollutant Reduction Strategy (SLCP Reduction Strategy), which was mandated by SB 1383 and outlines the State's plans to meet the SB 1383 requirements and goals, and is essential to achieving California's climate goals.. Organic waste, as defined by SB 1383, includes materials primarily comprised of carbon such as food scraps, food-soiled paper, paper products, green material, landscape and pruning waste, organic textiles and carpets, and wood waste.

Organic waste in landfills accounts for 20 percent of the methane generated in California. Methane, a powerful greenhouse gas 72 to 84 times more potent than carbon dioxide, has a short-term atmospheric life, but a long-term impact on the climate. By recycling these materials into compost, fuel, and other products, California can avoid generating 4 million metric tons of CO2 equivalent (MMTC02e) annually by 2030 while also generating jobs and producing valuable resources in the state. Beyond avoiding methane generation at landfills, compost has demonstrated benefits for soil health, food security, and climate stabilization, and it is a critical tool for meeting California's goal for carbon neutrality by 2045.[1] Ensuring organic material is directed to its highest and best use, such as compost creation and use, rather than going to landfill, will help California meet many of its goals, including but not limited to those in SB 1383.

CalRecycle estimates that approximately 27 million tons of organic material will need to be redirected from landfills in 2025 to meet the SB 1383 reduction goal, including edible food and approximately 18 million tons of organic waste that will need to be processed at compost, anaerobic digestion (AD), chip-and-grind, or other organic waste processing facilities.[2] Reducing the amount of organic waste generated, producing compost, generating electricity and renewable gas through AD, recovering edible food for human consumption, and recycling of paper and cardboard are critical strategies to achieve the goal.

While organics recycling and recovery infrastructure is growing, significant expansion is necessary to provide the recycling capacity needed to meet the SB 1383 disposal reduction goals. Based on current capacity projections, the infrastructure in the state will be able to process about 10 million tons of the 18 million tons. However, with greater focus on mandatory organics recycling programs, procurement, and other policies and

investments, California can achieve the reductions in methane generation envisioned in SB 1383.

CalRecycle recognizes COVID-19 has dramatically impacted the lives of all Californians and created additional economic challenges for local governments. However, to meet climate change goals and to protect human health and the environment from negative impacts of greenhouse gas emissions, California must not delay the implementation or change the diversion or compliance goals set in SB 1383. CalRecycle is committed to providing technical assistance to entities so SB 1383 compliance is achieved.

Progress Analysis

SB 1383 requires CalRecycle to conduct an analysis of waste sector, state government, and local government progress toward meeting the 2020 and 2025 organic disposal reduction goals. Public Resources Code (PRC) §42653 requires the analysis to include:

1. The status of new organics recycling infrastructure development
2. Commitment of state funding and appropriate local service rate increases to support organics recycling infrastructure expansion
3. Progress in reducing regulatory barriers to siting organics recycling facilities
4. The timing and effectiveness of policies that will facilitate permitting of organics recycling facilities
5. The status of markets for compost, biomethane, and other products generated by facilities, including cost-effectiveness of electrical interconnection and common carrier pipeline injection

SB 1383 permits CalRecycle to include incentives or additional requirements in the regulations adopted pursuant to SB 1383. The statute additionally states that the department may, upon consultation with stakeholders, recommend to the Legislature revisions to the organic waste reduction goals.

Findings

In consultation with CARB, CalRecycle staff identified and analyzed data and information to gauge the progress that has been made toward achieving the 2020 and 2025 goals. This data included a survey of organics recycling and processing infrastructure, waste characterization data, markets for recovered organic waste products, funding sources, local rate structures and organic waste recycling policies, and edible food recovery programs.

The analysis indicates that:

1. Organics recycling and recovery infrastructure is growing, but still needs significant expansion to provide the recycling capacity necessary to meet the SB 1383 disposal and methane reduction goals.

2. Mandatory collection programs are critical for organics recycling and recovery infrastructure development and to help attract private investments.
3. The permitting and regulatory requirements in place are necessary to protect human health and the environment and to ease community concerns regarding organics recycling facilities.
4. The procurement requirements in SB 1383 regulations are necessary to develop markets for compost and biomethane and are essential components of achieving the overall methane reduction goals.

CalRecycle recommends maintaining the disposal reduction targets set forth in SB 1383. The SB 1383 regulations build on the state's previous organic waste reduction targets and create a compliance road map. The state has funded $140 million in grants and loans for organic waste infrastructure, and adoption of the regulations will provide regulatory certainty for continued investment from the private sector. In addition, CalRecycle will release a customizable model franchise agreement and model enforcement ordinance for jurisdictions. The SB 1383 procurement requirements will also increase markets for recovered organic waste products by providing certainty for demand of the finished product.

Successfully meeting the organics reduction goals of SB 1383 by the dates set in statute is a critical component of the statewide strategy to avoid the most extreme climate consequences of global climate change. Sustainably managing organic waste will strengthen California's economy and provide national and global leadership on the fight against climate change.

Introduction

The implementation of the state's organic waste reduction regulations adopted under SB 1383 is a critical step to protect Californians, our environment, and our economy from the impacts of climate change. Organic waste in landfills accounts for 20 percent of the methane generated in California. Methane, a super-pollutant 72 to 84 times more potent than carbon dioxide, has a short-term atmospheric life, but a long-term impact on the climate. Targeting reductions in methane emissions is an effective mechanism for combating climate change and moving toward a more sustainable future.[3]

Californians have seen what a changing climate means for our state:

- Record heat
- Devastating wildfires
- Cyclical droughts
- Rising seas
- Coastal erosion
- Extreme weather events
- Unhealthy air

Action Now Could Mitigate Devastating Climate Impacts

California's latest Climate Change Assessment projects even more intense impacts by the year 2100, especially if we don't act now.[4] The most likely and devastating impacts reported include:

- Average daily maximum temperature could increase by 5.6 to 8.8 degrees Fahrenheit
- 77 percent more of the state could experience devastating wildfires that endanger lives and structures
- 31 to 67 percent of Southern California's beaches could completely erode because of sea level rise
- Heat-related deaths could triple
- Snowpack, which is California's largest water reserve, could decline by 75 percent by 2050

California needs to take immediate action to turn our trajectory from this probable future.

SB 1383 Reduces Methane and Extends Landfill Life

California needs to reduce its organic waste disposal as part of its strategy to lower statewide greenhouse gas (GHG) emissions to 40 percent below 1990 levels by 2030, a goal outlined in SB 32 (Pavley, Chapter 249, Statutes of 2016). Implementation of SB 1383 is one of the most essential actions the state will take to reduce the disposal of

organics, which make up two-thirds of the waste stream. By significantly reducing the amount of organic waste sent to landfills, we can lower one of the top sources of methane contributing to climate change, maximize landfill life spans, and transform organic waste into value-added resources like compost, biofuel, and electricity. Doing so will contribute to our state's economic health by creating jobs and strengthening the circular recycling economy within our state.

SB 1383 Directs Edible Food to California's Food-Insecure

SB 1383 also established a goal to recover at least 20 percent of the edible food that is destined for landfills and redirecting it to needy Californians by 2025. Achieving this goal requires the development of robust edible food recovery programs that will combat hunger in communities throughout the state. More than 5.5 million tons of food waste are disposed in California landfills each year, which is especially tragic when there are currently 1 in 5 children who go hungry every night.[5]

COVID-19 Related Impacts

More Residential Food Waste

COVID-19, and the resulting economic downturn expected, will likely impact disposal, but it is difficult to estimate by how much and for how long. During the Great Recession from 2007 to 2009, landfill disposal dropped by 21 percent, illustrating the correlation between disposal and economic activity.[6] However, as the generation of food waste temporarily moves from the commercial sector to the residential sector—due to restaurants shifting from dine-in to take-out and customers buying groceries in bulk—the volume of food waste, and associated packaging waste, may increase.[7,8] A survey of 195 California jurisdictions found that only 4 percent of the respondents offer food waste collection to single-family residences and 11 percent offer it to multi-family residences, compared to 39 percent that offer food waste collection to commercial businesses.[9]

Cardboard Packaging Increase from Online Ordering

Old corrugated cardboard (OCC) disposal has increased dramatically between 2014 and 2018, possibly due to the combination of higher e-commerce sales and lower commodity prices (See Finding 5-3). The amount of packaging disposed will likely increase temporarily due to increased demand for online sales during Shelter in Place orders. For instance, in March 2020, Amazon announced it would hire 100,000 new employees to meet a surge in online sales.[10] However, if demand for online purchases continues to rise, California could see an even greater rise in the amount of packaging generated and ultimately disposed of in landfills.

Process for Determining Progress

SB 1383 requires CalRecycle to conduct an analysis of waste sector, state government, and local government progress toward meeting the 2020 and 2025 organic disposal reduction goals. In consultation with CARB, CalRecycle staff identified and analyzed the following data and information to gauge the progress that has been made toward achieving those goals:

- A survey of the organics recycling and processing infrastructure, including:
  - The number of facilities, feedstock sources and types, products, and markets for compost, mulch, digestate, biogas, and other products
  - Technology approaches to managing potential environmental impacts to air and water
  - Barriers to facility expansion, including regulatory, statutory, local land use, market, and other economic barriers
- A comparison of data from the 2014 Statewide Waste Characterization Study with data from the 2018 Waste Characterization Study
- An analysis of the infrastructure and markets for other organic waste handling processes (e.g., biomass conversion, animal feed production, and alternative daily cover)
- State agency funding and incentives to support organics recycling infrastructure development
- Other funding sources, including local incentives and private investments that are available to fund organics recycling infrastructure development
- Local rate structures and other policies that encourage organics recycling infrastructure development
- Edible food recovery and food waste prevention programs, including an estimate of edible food that is disposed, recycled, or recovered for human consumption.

Analysis and Findings

Analysis Item 1: Status of New Organics Recycling Infrastructure Development

Finding 1-1: Achieving the SB 1383 Disposal Reduction Goals Requires Expansion of Organics Recycling and Recovery Infrastructure

California's organics recycling and recovery infrastructure is growing, but it still needs significant expansion to provide the recycling capacity necessary to meet the SB 1383 disposal reduction goals. Available capacity in 2025 for composting, AD, and chipping and grinding of previously disposed material is estimated in Table 1. CalRecycle estimates that 27 million tons will have to be redirected from landfills in 2025, including edible food and approximately 18 million tons of organic waste that will need to be processed at compost, AD, or chip-and-grind facilities. However, based on current capacity projections, the state will only be able to process about 10 million tons of this material.

Table 1. Estimated Composting, Anaerobic Digestion, and Chip-and-Grind Capacity in 2025 (Million Tons)

Technology	Estimated Anticipated Capacity, 2025*	Estimated Needed Capacity, 2025	Difference
Compost	5.3	9.6	(4.3)
Anaerobic Digestion	1.0	2.7	(1.7)
Co-Digestion†	0.12	2.4	(2.3)
Chipping and Grinding	3.5	3.3	0.2
Total	9.9	18.0	(8.1)

* Estimated anticipated capacity to divert *additional* tons from landfills to compost, anaerobic digestion, and chip and grind.
† The State Water Resources Control Board estimates that WWTPs have digester capacity to co-digest at least 2.4 million tons of food waste. For more information, see the section on *Co-Digestion at Waste Water Treatment Plants* below.

Composting

Composting is the process of controlled aerobic decomposition of organic material such as leaves, twigs, grass clippings, and food scraps. Finished compost is a soil amendment with a wide variety of nutrients, micronutrients, and organic matter, all of which benefit the soil. CalRecycle estimates that the state composted about 6 million tons of organic waste in 2017. We will need to compost an additional 9.6 million tons in 2025 to meet the disposal reduction goal required by SB 1383. Based on current capacity projections, the state will only be able to process about 5.3 million tons of this material.

Existing Compost Capacity

Currently, there are approximately 180 compost facilities in California. Many of these facilities are small, or operate under a tier that limits the type of feedstock they can accept (e.g. limited to agricultural materials). Of these 180 facilities, approximately 80 actively receive material from the municipal solid waste stream (e.g. commercial and residential collection services). There are currently 35 compost facilities that accept and recycle food.

CalRecycle conducted research and determined that California compost facilities composted approximately 6 million tons of solid waste in 2017. These composting facilities have permitted capacity to compost an additional 4 million tons of material. While available annual permitted capacity is significant, other factors, including operational capacity, air and water permitting, access to feedstock, and hauler competition, may limit the feasibility of using that capacity.[11]

Expanding Compost Capacity

Since 2018, new and expanded compost facilities brought an additional 200,000 tons of annual capacity into operation statewide. Fourteen compost facilities are anticipated to begin operations for additional capacity of 1 million tons of organic waste recycling within the next few years. CalRecycle has awarded grants to 12 of these facilities. In March 2020, CalRecycle announced grant awards to an additional three compost facilities that are projected to add another 100,000 tons of capacity per year.

Full use of existing capacity, along with the projected expanded capacity, would allow California to compost an additional 5 million tons of organic waste in the next few years.

Anaerobic Digestion

Stand-Alone AD Facilities

AD is a biological process in which microorganisms break down biodegradable material in the absence of oxygen. Materials that are suitable for AD include food waste, green

waste, and manure. AD results in the generation of a solid material called digestate, which can be composted; and biogas, which consists mostly of methane and carbon dioxide. Methane generated from AD, referred to as biomethane, is used to produce electricity, heat, and low carbon transportation fuels, such as compressed renewable natural gas (RNG).

CalRecycle estimates that approximately 350,000 tons of solid waste was recycled at stand-alone AD facilities in 2017. Annual AD capacity in 2017 was approximately 400,000 tons‡. Since 2017, two AD facilities began operations with an estimated combined annual capacity of 90,000 tons. Eight AD facilities are anticipated to begin operations with new or expanded capacity within the next few years, including three that received grants from CalRecycle. These facilities will bring an additional 850,000 tons of annual recycling capacity into operation within the next few years. Finally, in March 2020, CalRecycle announced grant awards to an additional three AD projects expected to add 300,000 tons of capacity per year.

In the next few years, full utilization of existing annual permitted capacity, and use of projected expanded capacity coming online, will provide the ability to digest approximately 1 million tons of organic waste currently disposed of in landfills.

Co-Digestion at Wastewater Treatment Plants

Approximately 26,000 tons of food waste were diverted from landfills and co-digested at three wastewater treatment plants (WWTPs) in 2017. However, if fully utilized, these three facilities could manage an additional 74,000 tons of material. Six WWTPS are anticipated to start co-digesting food waste and will bring an additional 140,000 tons of capacity online by 2025.

A forthcoming State Water Resources Control Board (State Water Board) report estimates that California WWTPs have enough existing excess digester capacity to accommodate between 2.4 and 8.6 million tons of municipal food waste. This range reflects different assumptions regarding digester operating conditions, including system redundancy, varying retention times, and loading rates. Maximizing the use of excess capacity would require expanding the capacities of other key wastewater treatment components, such as biosolids dewatering, and biogas utilization systems.[12]

Using this existing infrastructure could reduce the number of new AD facilities that need to be built, and potentially significantly lower the capital investment needed to add new capacity. CalRecycle estimates that the state needs to divert approximately 3.8 million tons of food waste to AD by 2025. Given that the forthcoming State Water Boards report estimates that statewide WWTPs have digester capacity for at least 2.4 million tons of food waste, local jurisdictions should consider working with these facilities to determine the upgrades necessary to co-digest food waste. Jurisdictions should also consult with

‡ Includes estimates for several facilities that did not respond to the 2018 survey.

WWTPs to determine the most feasible way to collect and deliver food waste to the facility. Many sewer districts do not want food waste conveyed through the sewer because it can increase corrosion and methane generation within the sewer lines.

Edible Food Recovery

The CalRecycle 2018 Waste Characterization Study estimated that approximately 1.1 million tons of potentially donatable food is currently disposed in landfills.[13] SB 1383 set a goal to divert 20 percent of this edible food and instead recover it for human consumption by 2025. The study results suggest that at least 225,000 tons of edible food would need to be recovered in 2018 to meet the SB 1383 metric. The study provides the first indication of the minimum level of food recovery necessary to achieve the SB 1383 food recovery target. Future waste characterization studies, data reported under the SB 1383 regulations, and additional analyses will be necessary to determine how much food was edible and could have been consumed at the time of disposal. Achieving the 2025 goal may require more aggressive food recovery efforts, and CalRecycle will assess if additional regulatory tools are needed.

Organizations that received food recovery grants from CalRecycle provided information that report the capacity to rescue at least 80,000 tons of edible food per year statewide. Additional work is needed to determine the existing and needed capacity for edible recovery to achieve the reduction goals established by SB 1383. CalRecycle will also release a model edible food agreement that will reflect the requirements of SB 1383 to increase food recovery efforts.

Additionally, as a portion of the edible food recovery education and outreach requirements, local jurisdictions are required to provide commercial edible food generators with information about actions that commercial edible food generators can take to prevent the creation of food waste.

Chipping and Grinding

Chipped and ground organic material has not gone through the decomposition process of composting, and therefore it is not a soil amendment, like compost. It may be used as a protective layer over the soil to control weeds, retain moisture, prevent erosion, and buffer temperature extremes.

CalRecycle estimates that an additional 3.5 million tons of organic materials, including green waste, lumber, and branches and stumps, will need to be processed at chip-and-grind facilities by 2025 to meet the SB 1383 disposal reduction goal. However, CalRecycle does not anticipate a significant expansion in chip-and-grind capacity will be needed. This is because chip-and-grind operations are not necessarily anchored to permanent infrastructure, and mobile chip-and-grind operations can fluctuate in capacity by relocating their operations to meet current demand in different regions.

Chipped and ground wood and green waste meet the definition of recovery in SB 1383 regulations when used for the following:

- Mulch
- Biomass conversion
- Land application of uncomposted organics
- A soil amendment for erosion control, revegetation, slope stabilization, or landscaping at a landfill

Biomass Conversion

Biomass conversion uses controlled combustion, or noncombustion thermal technologies, to convert organic waste materials into heat, fuels, or electricity. Organic waste used for biomass conversion includes green waste, lumber, and branches and stumps. Biomass conversion of urban wood and green materials has decreased in recent years. At one time, California had more than 60 biomass-to-energy plants. These plants processed woody materials from sawmills, agricultural residues, and urban sources. Many chip-and-grind and compost facilities sent the woody fraction of their feedstocks (including composting overs) to biomass plants to diversify markets and to generate revenue. Historically, biomass markets were a critical outlet for chip-and-grind operations and an important outlet for composting facilities. In 2010, compost facilities sent almost 600,000 tons of material to biomass (about 10 percent of all products produced by compost facilities). In 2017, this number was down to 170,000 tons, or about 3 percent. The 2018 Waste Characterization Study indicates that approximately 5 million tons of material is disposed of in landfills each year that could be sent to biomass conversion.[14]

Biomass Cost Exceeds Sell Price of Renewable Power

From 2000 to 2017, the amount of urban wood waste consumed by biomass facilities decreased by 1 million tons, and the downward trend continued in 2018, with biomass facilities accepting just over 1 million tons of urban woody waste.[15,16] This decline is due to a combination of factors, though the most important is that electricity from other renewable sources (e.g., solar, wind) is cheaper.

SB 1383 May Increase Demand for Biomass Conversion

In 2016, the legislature passed SB 859 (Chapter 368, Statues of 2016) to facilitate biomass plants processing dead and dying trees in response to the tree mortality crisis in California. However, while SB 859 increased demand for forest sources of biomass, it did not increase demand for urban woody wastes. The procurement requirements in the SB 1383 regulations (discussed in Analysis Item 4 below) may increase demand for urban sources of biomass at biomass conversion facilities that are adjacent to urban areas and have excess capacity.

Notably, combustion of biomass results in criteria pollutant emissions, which negatively affect human health. That is why any biomass conversion should be conducted consistent with permitting and at facilities that do not increase criteria pollutant emissions, particularly in areas that are out of attainment for criteria pollutant emissions, and especially in disadvantaged communities.

Animal Feed

Using organic waste for animal feed is another way to recycle it and further reduce the amount sent to landfills. To analyze animal feed opportunities, the California Department of Food and Agriculture (CDFA) conducted a survey of commercial feed licensees regulated by CDFA's Commercial Feed Regulatory Program. Sixty-four surveys were returned with an average tonnage per year reported from all 64 firms totaling 12.5 million tons of livestock feed in 2019. The survey represents more than half of the 22.5 million tons of livestock feed reported to have been sold within California. The survey offers valuable insight into the types of byproducts, coproducts, and waste that could be diverted from landfills and then repurposed as livestock feed in a typical year of feed commerce within California.

Surveyed producers report that approximately 37.5 percent of their feedstock is grain or other products specifically grown or manufactured for animal feed, while another 62.5 percent of their feedstock is categorized as byproducts or coproducts. Much of the material in the byproduct/coproduct category is organic material that has not traditionally been landfilled, is unlikely to become solid waste, and therefore would not be counted as a reduction in disposal. This includes spent brewers' grains, vegetable culls from packing operations, and almond hulls. These materials are typically never commingled with solid waste and can be sold as a product to animal feed operations. In the absence of animal feed markets, the material can be recycled by being tilled into the soil (land application). A substantial amount of the animal feedstock used by surveyed operators (4.7 million tons) is grown or manufactured for animal feed, often out of state. The animal feed industry could potentially replace some of that material with municipal organic waste that is currently disposed.

Quality Standards to Turn Food Waste into Animal Feed

Processing organic waste from the commercial or residential solid waste stream for animal feed may require investments in equipment capable of separating feed-quality organic waste from contaminants in the collection stream. Such processing should occur at a location with a solid waste facility permit authorizing the facility to separate and process solid waste. However, if such processing investments enable a solid waste facility to produce feed-quality material from organic waste, there is potentially a significant amount of capacity and demand for the final product. In order to protect and preserve public health and safety, animal feed is strictly regulated by CDFA and must meet quality standards, such as pathogen destruction, that are necessarily higher than quality standards for material recycled and used as a soil amendment. At the time of

this analysis, there is only one operation in the state licensed by CDFA to process commercial solid waste into animal feed. If this market expanded, the amount of additional, new end-use organics recycling (e.g., compost AD facilities) capacity could be mitigated. Additional market conditions such as location and transportation distances, which impact all facilities, would also affect this method of organic waste recycling.

CalRecycle will continue to work with stakeholders and CDFA to determine the types and quantities of organic waste material that could potentially be diverted from landfills to animal feed production.

Paper Processing and Recycling

Background

Unlike other organics that are processed locally due to transportation costs associated with putrescible materials, California paper has historically been exported to other countries to be processed into recycled paper products. In 2018, California exported 8.5 million tons of paper, of which 67 percent was old corrugated cardboard (OCC), 32 percent was mixed paper, and 1 percent was high grade paper.[17] CalRecycle assumes that 70 percent of the material exported from California ports was generated in the state. Total paper exports have been generally decreasing since 2011. With global markets demanding paper bales with low contamination, exports of mixed paper material are expected to continue declining.[18] The decline in newspaper generation and the explosion of e-commerce has also significantly changed the makeup and the nature of paper recycling.

While the total generation of paper in California is unknown, paper is a significant component of our disposal stream as well as our recyclable exports. Paper is the second-largest class of materials sent to disposal in 2018, with an estimated 6.5 million tons landfilled.[19] Though more paper was disposed of in 2018 than in 2014, the proportion of paper in the overall waste stream has decreased from 17.4 percent to 16.6 percent.

For this analysis, CalRecycle focuses on the capacity to produce “bales of paper” used as feedstock for manufacturing. Due to California’s prominent curbside collection programs, there is a robust infrastructure for producing paper bales.

Existing Paper Processing Capacity

The move toward single-stream recycling (all recyclables in one bin) in California over the last 20 years has necessitated a parallel growth in sorting and processing facilities. Materials recovery facilities (MRFs) accept material that is aggregated from residential and commercial curbside recycling bins and moved through a series of positive or negative sorts, where machines and/or workers remove and segregate the recyclable

from the non-recyclable material. Though single-stream recycling collection is the most common collection method in California, some jurisdictions have mixed-waste collection, in which customers place solid waste and recyclables in the same bin. A small number have dual-stream recycling, where paper is placed in separate bins apart from other recyclables to reduce contamination.

It is difficult to estimate the capacity for producing paper bales for many reasons. California has 319 material recovery and mixed-waste processing facilities.[20] The capacity of any one facility is generally determined by its size and the operator's ability to move material quickly through and off the property. While facilities have a permitted maximum capacity, many do not operate at this level. Facilities also have some flexibility to sort and segregate different materials based on current markets and demand from brokers, so the production of paper bales will not be consistent from month to month or year to year. In addition, operational capacity is generally determined by the availability of workers, the speed of the sorting lines, and the amount of available space for storing bales of sorted material.

Other factors that influence the production of paper bales are the availability of non-contaminated material and seasonal demand of paper. Globally, contamination standards for paper bales are becoming more stringent. In response, facilities are slowing down their sorting lines to remove more potential contaminants that could result in more residual paper being sent to disposal. In winter, paper contamination increases because more paper is wet and cannot be recovered. Seasonal trends in e-commerce also impact the amount of paper coming into sorting facilities.

Expanding Paper Processing Capacity

Expanding capacity to produce paper bales would result from new processing facilities coming online or retrofits of existing facilities. CalRecycle is not aware of any large-scale projects for new facilities processing paper from curbside or specialized collection programs. There has been increased discussion about secondary processing facilities (often called secondary MRFs) that re-sort residuals sent from MRFs. A recent report published by Titus Services, a company that runs a pilot facility in Los Angeles, states that its facility recovers 50 percent of the residual stream. Of this, 30 percent is fiber. After Titus' Pacific Northwest Secondary Sorting Demonstration Project, the company estimated that it could recover 23,000 tons of mixed paper and 2,800 tons of cartons from Oregon and Washington.[21]

Retrofits of existing facilities to expand paper capacity include increasing a facility's physical footprint to build more storage and holding space or technological upgrades. Common improvements include adding optical sorters, specialized screens, and robotics. Many of the upgrades made in the last two years have been in response to international demand for reduced contamination in paper bales. A Recology facility in San Francisco completed a $14 million upgrade in 2018 that included new optical

sorters and equipment for sorting smaller materials that will help the company meet new quality standards.[22]

Because processing facilities have some flexibility in production, there is the opportunity for facilities to increase the amount of paper bales produced. This is bounded by the quality and amount of the incoming material as well as the value of the bales on the domestic and international markets. When scrap paper value is high, processors are incentivized to make more of these bales.

Expanding Markets for Bales

The capacity to use paper bales is growing in North America. Seventeen planned projects being built through 2022 will add about 3.5 million tons of capacity for OCC and mixed paper recycling. This includes new paper mills and changes to existing mills or machines brought out of retirement or converted to make different products. Most of the increasing capacity is for OCC, but mixed paper (specifically residential) will be accepted by at least six of the facilities. Two others will accept beverage cartons, aseptic packages, and commercial food-contaminated paper.[23] Two of the 17 expansions are in Mexico. Further growth in the export of paper to Mexican facilities may be forthcoming, as Los Angeles Sanitation has publicly stated that it is pursuing trade agreements with mills in Baja California.[24]

Finding 1-2: Collection Programs Are Critical for Infrastructure Development

The SB 1383 Infrastructure and Market Analysis report found the following:

1. Developing mandatory organics collection programs is key to growing the state's organics processing infrastructure.
2. Facilities only expand when new collection programs are implemented or existing programs broaden.
3. Seventy-eight percent of respondents cited new processing contracts as a reason to enlarge their facility.[25]

According to a CalRecycle survey of compost operators, economic barriers to facility expansion include challenges acquiring feedstocks (18 percent). Respondents also reported that competition from lower-priced disposal alternatives is a barrier to expansion, including direct land application (16 percent) and alternative daily cover (ADC) (12 percent)[§]. The report states that dedicated feedstock contracts are necessary to overcome the cost and risk faced by compost facility developers when creating new processing capacity.[26]

[§] Note that organic material used for ADC is not considered a reduction in landfill disposal under the SB 1383 regulations.

Likewise, AD operators have noted the importance of obtaining long-term feedstock agreements. Several operators have had to scale back or delay expansion plans, delay start of operations, or shut down completely due to lack of feedstock agreements. For AD facilities, consistent biogas production—a primary source of revenue—depends on consistent sources of quality feedstock.[27]

The requirement in the SB 1383 regulations that jurisdictions implement mandatory organics collection programs for all organic waste generators is designed to facilitate organics processing infrastructure expansion and development. Collection of source-separated organic waste, and feedstock agreements between haulers and organic waste processing facilities, will help facilities justify the expenditures necessary to expand and develop additional capacity.

Analysis Item 2: Commitment of State Funding and Adjustment of Local Rate Structures for Solid Waste and Recycling Services to Support Infrastructure Expansion

Finding 2-1: The State Has Awarded Nearly $140 Million in Grants to Organics Recycling and Recovery Projects

The state has awarded nearly $140 million in grants to organics recycling and recovery projects, in the form of grants and loans to encourage infrastructure development. These investments are largely funded through California Climate Investments using Cap-and-Trade auction proceeds.

Since 2014, CalRecycle has received 185 applications seeking $338 million in grant funding. To date, CalRecycle has awarded $72.5 million in grants to 16 compost and nine AD infrastructure projects, expanding total annual capacity to recycle organic material by about 1.5 million tons. Nearly $20 million has been awarded to 64 food prevention and rescue grants. The 2020 Annual Report to the Legislature on California Climate Investments reports CalRecycle's Waste Diversion programs are among the most cost-effective mechanisms to reduce greenhouse gas generation.[28]

CalRecycle is one of several state agencies investing in organics processing infrastructure. The California Energy Commission (CEC) has awarded $48 million in grants to AD and AD-related projects. The California Clean Water State Revolving Fund (CWSRF) has funded a handful of co-digestion projects and should be explored as a potential source of funding for future co-digestion projects.

The California State Treasurer's Office provides additional incentives. The California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) provides sales and use tax exclusions to projects that create jobs and reduce greenhouse gas emissions, and the California Pollution Control Financing Authority (CPCFA) provides tax-exempt private activity bonds that facilitate low-cost financing to qualified waste and recycling projects. Both CAEATFA and CPCFA are administered by the State Treasurer's Office.

As the state looks toward economic recovery after the fallout of COVID-19, continued and expanded investment in developing organics recycling collection and infrastructure provides unique opportunities to create reliable, in-state jobs while also achieving our climate goals.

The federal government offers funding programs for green infrastructure that could be utilized by local jurisdictions and facility operators. In June 2020, the U.S. House of Representatives released H.R. 2, the Moving Forward Act, which, if passed, would include tax incentives that could be utilized for biogas projects.[29,30] In addition, CalRecycle has 13 shovel-ready organics projects if the federal stimulus money is made available and directed toward organics infrastructure development. These compost and anaerobic digestion grant projects passed CalRecycle's Organics Grant Program scoring criteria; however, there was not enough funding available for the projects.

Achieving the goals of SB 1383 will require continued and expanded investments from the public sector, including federal, state, and local government funding, and the private sector. Funding should continue to include incentive programs and market development, in addition to grants and loans.

At the state level, expanded funding could be generated through increases to the landfill tip fee. The landfill tip fee is the Integrated Waste Management Act's (IWMA's) principal funding source and supports CalRecycle programs and oversight cost. It was derived from a per ton disposal fee that was capped at $1.40 in 1995 and remains one of the lowest fees in comparison to other states and developed countries. If the tip fee were modernized and adjusted for inflation, it could provide a sustainable funding stream at the state level to support organic waste recycling and disincentivize disposal.

Finding 2-2: Expansion of Local Programs for Residential and Commercial Collection, Recycling, and Recovery of Organic Waste Will Be Necessary

Building on statewide efforts to implement AB 341's Mandatory Commercial Recycling Law (Chesbro, Chapter 476, Statutes of 2011) and AB 1826's Mandatory Commercial Organics Recycling Law (Chesbro, Chapter 727, Statutes of 2014), achieving the goals of SB 1383 will require increased participation in residential and commercial organics collection programs. To meet the SB 1383 goals, the regulations mandate that all organic waste generators—residents and businesses—must receive and actively participate in organic material collection programs. While most of the state's jurisdictions already require mandatory residential organics collection service, that is not the case with respect to commercial collection services. Jurisdictions that are implementing mandatory commercial organics recycling programs are better positioned to meet the requirements of the regulations. Currently, there are more than 200 jurisdictions that are expanding their commercial collection programs to provide for mandatory commercial organics recycling collection programs. These jurisdictions are addressing rate changes, education, and monitoring activities necessary to improve overall participation in commercial collection programs. By implementing mandatory collection programs, these jurisdictions will likely be able to meet regulatory requirements before January 1, 2022.

Jurisdictions that have not made progress in planning and implementing organics recycling programs under previous statutes will require more significant actions to implement and fund programs to meet the requirements of SB 1383. Importantly, SB 1383 regulations allow implementation flexibility to help these communities achieve compliance. For example, jurisdictions can choose to meet the collection services requirement by having residents and businesses source-separate their material or by having a more robust processing facility that separates the material.

While some jurisdictions may need to expand their services to comply with SB 1383, there will be economic benefits to local jurisdictions and ratepayers through economic development and improved environmental quality. Direct economic benefits include the creation of more than 12,000 permanent recycling and manufacturing jobs and will provide job opportunities to disadvantaged and low-income communities.[31] There will be increased revenues from sales of products including recycled content paper, cardboard, compost, and renewable gas. This will be especially important for economic recovery after the COVID-19 pandemic ends. Environmental benefits include improved air quality and therefore decreased health impacts—such as premature deaths and hospital visits—especially for sensitive groups such as children, the elderly, and people with chronic heart or lung disease. This will result in hundreds of millions of dollars saved in health care costs throughout the state.

Analysis Item 3: Progress in Reducing Regulatory Barriers to Siting Organics Recycling Facilities and Timing and Effectiveness of Policies to Facilitate Permitting of Organics Recycling Facilities

Significant expansion in infrastructure is needed to provide the recycling capacity necessary to meet the SB 1383 disposal reduction goals. To ease community concerns on new or expanded solid waste facilities, the SB 1383 regulations updated Title 27 Regulation, to require a facility operator to hold a public meeting with any affected disadvantaged communities within 180 days of submittal of a permit application package. The enforcement agency also must hold informational meetings for new and revised full solid waste facilities permit applications; the meetings must be located close to the facility and close to affected disadvantaged communities.

Finding 3-1: Regulatory, Permitting, and Land-Use Challenges and Policies to Facilitate Permitting of Compost Facilities

Composters seeking to expand their facilities face a number of challenges. Compost facilities are ideally located between areas where organic waste is generated—which is often in dense urban centers—and the primary market for finished compost, which is agriculture. Appropriate organic materials management includes complying with state and local requirements and regulations that are designed to protect air quality, water quality, and public health. These requirements are also necessary to ease community concerns and address local land-use issues.

To support the goals and requirements of California legislation—including AB 1045 (Irwin, Chapter 596, Statutes of 2015), AB 341, and SB 1383—CalEPA, CalRecycle, the State and Regional Water Boards, CARB, air districts, and CDFA have been collaborating to effectively develop organic waste processing and recycling infrastructure and promote product uses to increase the diversion of organic wastes from landfills.

CalEPA has recommended these agencies continue to address technical barriers to constructing and permitting compost facilities statewide.[32] Since statewide laws and planning requirements set minimum pollution control standards that apply to organic materials management infrastructure, and local and regional authorities establish the rules and enforce the laws, technical and complex processes are required to develop protective solutions.

Air Quality Requirements

State agencies, air districts, the composting industry, and stakeholders have acknowledged the challenges inherent in siting and permitting new and expanded organics recycling facilities while protecting air quality. In response to these challenges, CalRecycle and CARB convened a Compost Working Group, which also includes many of the air districts and the California Air Pollution Control Officers Association (CAPCOA). The Compost Working Group collaboratively developed a discussion paper that identified specific action items to assist composting project planners with the air permitting process.[33] To support this effort, CalRecycle is in the process of implementing a research contract that will assist both compost facility operators and regional air district staff on how composting operations can be managed to reduce air pollutants. CalRecycle recognizes the importance of working with all agencies and stakeholders involved to achieve statewide goals that reduce greenhouse gas emissions while also protecting the environment, public health, and communities.

While diverting organic waste from landfills reduces methane, the composting process and the equipment used at compost facilities can, at the local level, generate criteria air pollutants such as volatile organic compounds (VOCs), nitrogen oxides (NOx), and particulate matter. Equipment used at compost facilities can generate NOx and fine particulates. Based on federal and state ambient air quality standards and attainment status, local air districts may require best management practices (BMPs) or implementation of Best Available Control Technologies (BACT) to reduce emissions. BMPs to reduce pile emissions include feedstock holding-time limits, maintaining adequate moisture and oxygen content, and controlling dust. Emissions control technologies typically include forced aeration with full enclosure, fabric covers, or biofiltration. BMPs to reduce emissions from equipment used at compost facilities include replacing old diesel engines with newer ones or converting diesel engines to electric-powered equipment. Converting a facility to forced aeration or bringing three-phase electric power to a relatively remote composting site are generally multi-million-dollar projects.

Two Types of Commercial Composting

There are two basic types of commercial composting methods: open windrows and aerated static piles (ASP). According to a 2018 survey, about 71 percent of compost facilities in California use an open-windrow composting system.[34] Research has shown that ASP composting systems can lower emissions compared to open-windrow systems.[35]

ASP systems use electric blowers to either push or pull air through the compost pile using various fabric covers, finished compost caps, or biofilters that can significantly reduce VOCs and ammonia during the composting process. ASP systems with compost caps are also effective at reducing VOCs and ammonia, but need to be re-applied with

every new pile. ASP systems with a fabric cover are increasingly popular. ASP systems with adequate air flows and a minimum of 80 percent reduction in VOC emissions are mandatory for new facilities in some air districts and will soon be required in others. ASP systems are fast becoming the industry standard. About 25 percent of the compost facilities surveyed in 2018 used an ASP composting system.[36] All new composting sites funded by CalRecycle greenhouse gas grants use a variation of ASP.

Water Quality Requirements

CalRecycle worked closely with the State Water Boards, Regional Water Boards, and various stakeholders to develop the State Water Boards' General Order for Composting Operations (General Order). Compost operations in California must comply with Waste Discharge Requirements (WDRs) to protect water from leachate produced during the composting process. While some compost facilities operate under individual WDRs, most are enrolled in the General Order. The requirements to protect water quality include installing engineered concrete pads, ponds, and drainage conveyance for facilities that process more than 25,000 cubic yards. The General Order assists the permit processing by providing standardized requirements that are both predictive and protective of the environment and public health.

Finding 3-2: AD Facilities Experience Fewer Regulatory, Permitting, and Land-Use Challenges than Composting Facilities

While AD facilities must comply with all federal, state, and local environmental regulations, operators have reported very few challenges with permitting or meeting air or water quality requirements when siting facilities. However, several proposed AD projects have either been delayed or have not moved forward because of concerns from the public, including proposed projects in Anaheim, Glendale, and Glenn County. Local land-use concerns about AD projects include increased traffic, odors, fire or explosion from a methane gas leak, and potential groundwater pollution from runoff.

Analysis Item 4: Status of Markets for Compost, Biomethane, and Other Products Generated by Facilities, Including Cost-Effectiveness of Electrical Interconnection and Common Carrier Pipeline Injection

To create markets for products generated by organic waste recycling facilities, the SB 1383 regulations will require local governments by January 1, 2022, to purchase a

percentage of diverted organic waste in the form of recovered organic waste products. CalRecycle will notify each jurisdiction annually of its recovered organic waste product procurement target based on a formula described in the regulations. Jurisdictions may procure the following recovered organic waste products to comply with the requirements:

- Compost
- Mulch that meets the land application requirements in SB 1383 regulations
- Renewable gas used for fuel for transportation, electricity, or heating applications
- Electricity generated from biomass conversion of municipal-solid-waste-derived organic waste

Finding 4-1: While Markets and Demand for Compost Are Currently Strong, SB 1383 Will Substantially Increase Production, thus Driving a Need for Expanded Demand

Approximately 1.8 million tons of compost were produced by permitted compost facilities in 2017.[37] While markets and demand for compost are currently strong, SB 1383 will substantially increase compost production. With successful implementation of SB 1383, CalRecycle estimates that an additional 5.5 million tons will be produced by 2025. As described further in Finding 4-4, increased end-use markets will be required to avoid disposal of compostable material.

Compost facilities produce a variety of products, including compost, mulch, and fuel for biomass facilities, as well as "overs" that are often sent to landfills for use as ADC[**] and other beneficial uses including erosion control and slope stabilization. Overs are produced at the end of the composting process when the finished compost is sorted by size through mechanical screens. The finer material is what most people think of as compost, while the rest is considered the overs. Overs are commonly recycled back into the compost process, although they can be contaminated with plastics and other non-organic material. Contamination, which is more common in waste streams that contain food waste, impacts the marketability of compost. Thirty-eight percent of respondents to the 2018 survey stated that they limit contamination by not accepting food scraps.[38]

Thirty percent of the respondents stated that contaminated feedstock is a barrier to expanding their facility.

The 2018 survey of compost facilities found that about 65 percent of the compost produced by survey respondents in 2017 was sold to agriculture, including both conventional and organic farmers. Certified organic farmers operate under an approved

[**] Note that organic material used for ADC is not considered a reduction in landfill disposal under the SB 1383 regulations.

organic system plan that ensures that compost meets United States Department of Agriculture National Organic Program (NOP) standards, administered in California by CDFA. These plans include documentation of compost use. Approximately 40 percent of the respondents to the 2018 survey receive organic certification from CDFA's Organic Input Material Program (OIM) and the Organic Material Review Institute's (OMRI) compost registration program.[39] In 2016, there were more than 1 million acres in organic farming production in California with crops worth nearly $3 billion.[40]

Nurseries, landscapers, California Department of Transportation (Caltrans), and local municipal programs are also important markets for compost. California's Model Water Efficient Landscape Ordinance requires compost application at a rate of 4 cubic yards per 1,000 square feet for all planted areas for new or remodeled landscapes.[††] Low impact development is a growing field, and compost can be an important part of engineered soil mixtures to reduce runoff and promote water percolation. Caltrans used about 80,000 tons of compost in 2016 along state highways to reduce erosion and support vegetation. According to the 2018 survey, 5 percent of the compost produced by respondents in 2017 was used by Caltrans.[41]

Co-Benefits of Compost Use

Governor Brown signed Executive Order B-55-18, setting a goal of achieving carbon neutrality no later than 2045 and directing the California Natural Resources Agency, the California Environmental Protection Agency, CARB, and CDFA to include sequestration targets in the Natural and Working Lands Climate Change Implementation Plan.

Beyond reducing methane generation in landfills, composting organic waste has demonstrated benefits for soil health, food security, and climate stabilization, and is a critical tool to meeting California's goal for Carbon Neutrality by 2045. Applying compost to rangelands can sequester carbon for up to 30 years, enhance productivity, increase water infiltration, and recharge groundwater.[42] CalEPA found that applying compost can sequester carbon and enhance water-holding capacity, forage production, and nutrients in soil.[43] Finally, CARB found that application of compost can reduce irrigation and landscaping water demands and help with erosion control after fires.[44]

Requirements for State Departments to Use Compost

AB 2411 (McCarty, Chapter 238, Statutes of 2018) requires the Department of General Services (DGS) and CalRecycle to maintain specifications for the purchase of compost by the state and allows CalRecycle to develop a program to increase the use of compost products in agriculture applications. AB 2411 also requires the Department of Forestry and Fire Protection (Cal Fire), the Department of Parks and Recreation (Parks), and DGS to initiate programs to restore public lands using compost and other

[††] Compost use is not required if soils have greater than 6 percent organic matter in top six inches of soil.

products wherever possible, and requires CalRecycle to evaluate compost, co-compost, and chemically fixed sewage sludge as landfill cover materials. CalRecycle staff will provide an update on specifications for the purchase of compost by the state, programs to increase use of compost products in agriculture, utilization of compost by Cal Fire, Parks, and DGS to restore public lands, and an evaluation of compost, co-compost, and chemically fixed sewage sludge as landfill cover materials at CalRecycle's monthly meeting by December 2020.[45]

Municipal Markets

The 2018 survey found that 3 percent of the compost produced by respondents in 2017 was sold to municipal projects.[46] The procurement requirements in the SB 1383 regulations will require local governments to procure products made from organic waste, and are intended to help drive demand for the increase in the production of compost and mulch to create end-use markets. This will ensure that the goals of SB 1383 are met by ensuring diversion of organic material from disposal.

Finding 4-2: Procurement Requirements and Market Mechanisms Will Help Fuel Energy Markets and Reduce Economic Barriers for AD Projects

While AD facilities experience fewer regulatory challenges to building and expanding capacity, uncertainties about markets for biomethane create economic and market barriers. Due to high capital expenses, AD facilities often rely on revenue from renewable energy incentives to make projects economically feasible. The SB 1383 procurement requirement will be an additional important tool to help increase demand for energy and fuel derived from biomethane generated by AD facilities. There are three primary markets for biomethane utilization: vehicle fuel or as a feedstock to produce a vehicle fuel; general use including industry, commercial and residential heating; and stationary electricity generation (large power plants or distributed generation, e.g., small engine generators and fuel cells).

Vehicle Fuel

While upgrading biogas to RNG for use in natural gas vehicles (as CNG or LNG) remains a strong market for biomethane generated from AD, there are uncertainties that create potential economic and regulatory barriers. The cost to produce RNG fuel is higher than the cost to produce fossil fuels (compressed natural gas and diesel) and, therefore, the price of RNG fuel would be higher than the price of fossil fuels in the absence of a carbon credit market or other incentives. As the supply of RNG fuel increases with SB 1383 implementation, the procurement requirements will help to increase demand. As RNG becomes more accessible, jurisdictions with fleets (e.g., buses) that already use compressed natural gas (CNG) can easily switch those vehicles to RNG if they have not already done so. According to CARB, currently, more than 70

percent of CNG and LNG demand for transportation in California is already met by RNG.[47]

Credit markets are an important mechanism to help offset the higher costs of production and lower the price of RNG fuel. There are two credit markets that RNG fuel producers can take advantage of: The Federal Renewable Fuel Standard (RFS) and the California Low Carbon Fuel Standard (LCFS).

Renewable Fuel Standard (RFS)

The Renewable Fuel Standard (RFS) is a federal regulation mandating that transportation fuel sold in the United States contain a minimum volume of renewable fuel. Biofuels are tracked and traded with Renewable Identification Numbers (RINs) issued by the Environmental Protection Agency (EPA). Obligated parties under the RFS are refiners or importers of gasoline or diesel fuel, and compliance is achieved by either blending renewable fuels into transportation fuel, or by obtaining RINs to meet an EPA-specified Renewable Volume Obligation (RVO).

AD projects may be eligible to generate RINs under the RFS if the biogas is processed into a transportation fuel and used in the transportation sector. Each fuel type is assigned a D-code based on the feedstock, fuel type produced, energy inputs, and GHG reduction thresholds. Cellulosic biofuel, D3, is the most valuable RIN currently available. RNG from landfill gas projects and projects that digest animal manure, crop residues, separated yard waste, or wastewater sludge are eligible for the higher-value Cellulosic Biofuel D3 RIN, which between January and April of 2020 was priced from $0.88 to $1.51/RIN.[48] However, projects that digest food waste (that is not predominantly cellulosic) are eligible for the far less valuable Advanced Biofuel D5 RIN, which was priced from $0.39 to $0.62/RIN for the same time period. The fact that fuel produced from landfill gas is eligible for D3 RIN value creates a disincentive for food waste diversion through AD. Further, if a wastewater treatment plant or green waste digester receives any amount of food waste, they are no longer eligible for D3 RIN and instead earn D5. There are currently two stand-alone digesters in the state that receive RINs.

Food waste digestion facilities producing transportation fuel are negatively impacted financially because they receive less valuable RINs, and the RFS program's prioritization of incentives for landfill gas projects is at odds with California's landfill diversion goals. The statutory definition of cellulosic biofuel excludes food waste, and therefore Congress would have to revise the definition of food waste for it to be eligible for D3 RINs.

Low Carbon Fuel Standard (LCFS)

The goal of the Low Carbon Fuel Standard (LCFS) is to reduce the carbon intensity of transportation fuels by at least 20 percent by 2030. Under the LCFS, the "carbon

intensity" (CI) value of a fuel is calculated using life cycle analysis (LCA), which considers the GHG emissions during the entire fuel cycle, including feedstock production, conversion to fuel, transport to market, and fuel use. Credit generation is calculated based on the alternative fuel's CI relative to the annual CI standard (benchmark). Each credit represents 1 metric ton CO_2 equivalent. Credit prices averaged $192 per credit in 2019. Credit price can be translated to a dollar value per unit of alternative fuel with a given CI using the LCFS Credit Value Calculator available on the LCFS Dashboard; RNG can earn LCFS credit value ranging from $8 to more than $80 per MMBtu of fuel. Recently approved amendments to the LCFS would set a price cap at $200 per credit in 2016 dollars, adjusted for inflation, as a cost containment measure. CARB estimated that for a 100,000-ton-per-year AD facility to be economically viable, LCFS credit prices need to be between $150 and $200 per credit, assuming a RIN price of $0.50 per RIN and a carbon intensity of -15 gCO_2/MJ.[49]

LCFS pathway applicants may obtain a certified CI score by submitting an application with a minimum of three months of operational data to CARB through the LCFS Alternative Fuels Portal. The applicant calculates a CI using one of CARB's Simplified CI Calculators for LCA models and documentation. The operational data must be validated by an accredited third party, and CARB reviews and certifies the application. Once certified, the CI can be used to report quarterly fuel transactions and generate credits in the LCFS Reporting Tool and Credit Bank and Transfer System (LRT-CBTS). To maintain a valid CI, fuel pathway holders are responsible for supplying annual CI data. A third party must verify the CI data, which is an additional cost for the applicant. Two stand-alone food and green waste AD facilities in California are participating in the LCFS program as of May 2020 and are generating credits.

Under the LCFS, opportunities for biogas are not limited to their use as renewable CNG and LNG. In addition, hydrogen and electricity produced from biogas is eligible for LCFS crediting.

Low-CI electricity produced from biogas can be used in transportation including electric vehicle charging, fixed guideways, transit buses, electric forklifts and other electric cargo handling equipment, and electricity for ocean-going vessels at berth. Such projects must supply biogas directly to the generator, and may either use the electricity onsite or supply it to the California electrical grid. The LCFS requires retirement of renewable electricity certificates (RECs) to demonstrate deliverability and ensure that the low-CI electricity is not also counted under the state's renewables portfolio standard (RPS) or other voluntary programs. This option allows for remote AD projects that lack access to the natural gas common carrier pipeline to supply transportation fuel and participate in the LCFS.

Hydrogen is commonly produced from natural gas using steam methane reformation (SMR). An AD project may pipeline inject or directly supply RNG to a hydrogen production facility to displace its use of fossil natural gas. The renewable hydrogen fuel is eligible for LCFS crediting when used in fuel cell vehicles, or when used in the

production of another transportation fuel that is consumed in California. For example, hydrogen is used in hydrotreating to produce renewable diesel and jet fuel from used cooking oil or inedible animal fats. Under the LCFS, the renewable diesel's CI would reflect the decreased GHG emissions from its use of RNG, rather than NG, to produce hydrogen. Similarly, conventional petroleum refineries can generate credits for using RNG-derived hydrogen in place of natural gas.

General Use Including Industry, Commercial, and Residential Heating

Injecting biomethane into the common carrier pipeline is an effective way to distribute RNG for a variety of uses, including for use as fuel for transportation. AB 1900 (Gatto, Chapter 602, Statutes of 2012) required the California Public Utilities Commission (CPUC) to adopt standards for biomethane specifying concentrations of constituents of concern (COCs) to protect public health and ensure pipeline integrity and safety, as well as requirements for monitoring, testing, reporting, and recordkeeping. The bill required the four investor-owned utilities (IOUs) to comply with those standards and requirements and to develop tariffs that incorporated them. The bill also directed the CPUC to develop programs and policies to encourage in-state production and distribution of biomethane.

In January 2014, the CPUC issued Decision 14-01-034, which identified concentrations for 12 COCs to protect human health and five to protect pipeline safety and integrity, for which monitoring, testing, reporting, and recordkeeping are required.[50]

The cost to connect to the common carrier pipeline is expensive. Southern California Gas Company (SoCalGas) estimates that the interconnection capacity study and preliminary and detailed engineering studies could cost up to $680,000 combined, and that these studies could take up to 275 days to complete.[51] Pacific Gas & Electric (PG&E) estimates that interconnection costs $2 million to $5 million and could take up to 24 months, depending on the project's scope, the season during which construction happens, and the location of the project.[52] SoCalGas and San Diego Gas & Electric Company (SDG&E) estimate the costs of monitoring and testing could be as high as $39,000 the first year and $25,000 in subsequent years. They also project the post-injection ongoing costs of maintaining and operating the biomethane facility at $3,500 per month.[53]

In 2015, the CPUC authorized funding of $40 million for a monetary incentive program that allowed biomethane producers that successfully inject into the pipeline as much as 50 percent of a biomethane project's interconnection costs, up to $1.5 million.[54] In 2016, AB 2313 (Williams, Chapter 571, Statutes of 2016) increased this monetary incentive from $1.5 million to $3 million and extended the incentive program from June 11, 2020, to December 31, 2021.

Currently there is one municipal solid waste (MSW) AD facility in California that injects biomethane into the pipeline. The CR&R Waste and Recycling Services AD facility in

Perris, Calif., invested more than $7 million to install 1.4 miles of pipeline and gas upgrading and monitoring equipment.[55]

On January 27, 2020, the CPUC initiated Rulemaking 20-01-007, which states that state and local climate change policies will result in reduced demand for natural gas over the next 25 years. One of the stated goals of the order is to "implement a long-term planning strategy to manage the state's transition away from natural gas-fueled technologies to meet California's decarbonization goals."[56] Although state laws and policies promote the production and distribution of biomethane, it is unclear how this transition away from natural gas will impact AD in the future. CalRecycle will continue to monitor this rulemaking and analyze its impact on biomethane pipeline injection from digestion of MSW at AD facilities in California.

Electricity Generation

Most AD facilities in California, including five stand-alone AD facilities and three WWTPs, currently generate electricity, which is sent to the electrical grid

The Bioenergy Market Adjusting Tariff (BioMAT) program was established through SB 1122 (Rubio, Chapter 612, Statutes of 2012). BioMAT is a feed-in tariff program, requiring California's major electrical IOUs (SDG&E, PG&E, and SCE) to collectively procure up to 250 MW of bioenergy from small bioenergy renewable generators. These generators are defined as less than 5 megawatts (MW) in nameplate capacity, export less than 3 MW to the grid, and must utilize organic waste feedstocks from eligible Fuel Resource Categories (i.e., Category 1, 2, and/or 3). At least 110 MW of the required 250 MW must be procured from eligible generators that utilize the Category 1 fuel sources to produce electricity. These fuel sources are municipal biogas from wastewater treatment, municipal organic waste diversion, food processing wastes, and co-digestion.

Electricity procured by the IOUs through a BioMAT Power Purchase Agreement (PPA) will be purchased at a fixed contract price over the delivery term (10-, 15-, or 20-year terms) and counts toward the utilities' RPS targets. The contract price for each Fuel Resource Category began at the first BioMAT auction in February 2016 at a set floor price of $127.72/MWh, but each category's price is independently adjusted each period depending on the market response and interest.

In general, participation in BioMAT has been minimal, especially for Category 1 Biogas, which remains at the floor price of $127.72/MWh. Seven Category 1 PPAs have been signed to date: Zero Waste Energy Development (ZWED) in San Jose, Kompogas San Luis Obispo, Central California Fuel Cell 2 in Tulare County, Organic Energy Solutions in San Bernardino, Napa Recycling & Waste Services' Napa Recycling Biomass Plant, Tajiguas Resource Recovery Project AD Facility in Santa Barbara County, and Lakeside Biogas.

BioMAT is currently undergoing a program review at the California Public Utilities Commission with the intent to simplify the program, expand participation, address program barriers, and better align it to help achieve statewide goals. Current barriers of significance for the BioMAT program include interconnection burdens and high costs and the contract pricing mechanism, both of which are under evaluation in the BioMAT program review underway.

One of the most significant barriers for the BioMAT program is interconnection costs and timelines. Currently, projects are required to complete an interconnection study to apply for participation in BioMAT. Then, they will stay in their IOU's interconnection queue and the BioMAT queue until they accept a contract price. This means projects must pay for the interconnection studies and queue costs without a signed PPA, which is a significant financial burden for small generators. The sometimes lengthy process and potential delays of interconnection can also create uncertainty about whether a project can meet its operation date outlined in their PPA. These delays could inhibit a project from meeting its contracted operational date, causing a project to be in breach of its PPA. This could result in PPA termination and substantial monetary losses. This uncertainty further limits program participation and increases financing costs for projects that do participate.

Some of these interconnection hurdles, however, were addressed in the CPUC's 2016 implementation of SB 840 for Category 3 projects (i.e., sustainable forest biomass projects, which utilize feedstocks from high hazard zones for wildfire and falling trees). These projects can now leave the interconnection queue while remaining in BioMAT. This measure was intended to provide streamlined interconnection requirements and accelerated price adjustments for sustainable forest biomass projects. CPUC's SB 840 Proposed Decision states that legislative changes for Categories 1 and 2 will "be the subjects of further development of the record and subsequent Commission decisions."[57]

Another barrier under review is the market depth pricing mechanism. This currently requires that, after at least one of three projects has accepted a contract price, at least five additional applicants are needed to trigger another price adjustment. However, due to low participation in the program and a low number of projects entering these queues, PPA contract prices for the purchase of electricity have remained low, especially for Category 1 Biogas projects. Consequently, multiple projects have entered into BioMAT Fuel Resource Category queues but have not yet accepted offer prices or executed PPAs because they are waiting for the price adjustment. Requiring a higher market depth before a price adjustment will be made could cause applicants to not accept a contract price and to instead wait in their respective queue for a contract price increase. This may put these renewable bioenergy projects on hold from development.

Finding 4-3: Commodities Prices, National Sword, and E-Commerce Align with the Increase in Disposal of Cardboard

According to the 2018 Waste Characterization Study, the amount of paper disposed in California increased by 1.4 million tons between 2014 and 2018. Eighty-three percent of this increase was from old corrugated cardboard (OCC), which increased 122 percent, from just under 1 million tons to 2.1 million tons.[58] During the same time period, the amount of OCC recovered domestically at U.S. paper and board mills increased by only 10 percent, or 2.1 million tons[59], and the amount of OCC exported from California increased by only 15 percent, or 737,891 tons.[60]

All U.S. exports of OCC and kraft paper increased 30 percent in 2018, but this was not enough to keep up with consumption. Exports (from California ports) to China increased in the last quarter of 2018 as Chinese importers attempted to purchase as much material as possible before new quotas took effect in 2019.[61] In 2019, U.S. OCC exports declined by 1.9 million tons,[62] and California OCC exports declined by 526,996 tons.[63] Recent statements by China's Ministry of Ecology and Environment suggest that China is likely to ban imports of recovered fiber, including OCC, by 2021.[64] Due to these import restrictions on recovered paper, many North American paper mills have announced plans for expanded domestic processing capacity. However, these expansions are not expected to be operational for at least several more years.[65, 66]

Average OCC domestic commodity prices for the Bay Area in December 2018 ($55 to $60 per ton) were about half what they were in January 2014 ($110 to $120 per ton), and prices continued to drop in 2019. As of February 2020, the domestic price was $20 to $25 per ton. The price for OCC exported to China also dropped by about 15 percent from January 2014 ($180 to $183 per ton) to December 2018 ($152 to $155 per ton).[67, 68, 69]

Consumption of OCC has increased dramatically as e-commerce sales have increased. According to RISI, the amount of OCC used in e-commerce and mail-order retail is seven times higher per dollar of sales than in traditional retail sales. In 2018, 17 percent of retail sales came from e-commerce and mail order sales.[70] The U.S. Department of Commerce estimates that e-commerce sales have increased by 68 percent, from $305 billion in 2014 to $514 billion in 2018.[71, 72] This dramatic increase in e-commerce, combined with a decline in domestic prices and import quotas that limit the amount of OCC China accepts, could explain why disposal of OCC increased so significantly between 2014 and 2018.

While these materials are technically recyclable, the amount of paper and OCC disposal in 2018 alone exceeds the 5.7-million-ton disposal target required by SB 1383. This suggests additional measures may be necessary to address this specific portion of the waste stream.

Finding 4-4: SB 1383 Procurement Requirements Are Necessary to Help Achieve the Organic Waste Diversion Goals by Driving Markets for Compost and Biomethane

CalRecycle estimates that in 2025 there will be an additional 5.5 million tons of compost and more than 14 billion cubic feet of biomethane produced as a result of SB 1383 implementation. Strong end-use markets must be encouraged and developed to absorb this increase in recovered organic material to meet the goals of SB 1383. Increased end-use markets will ensure that this substantial increase in recovered organic material remains diverted from disposal. SB 1383 regulations require jurisdictions to annually procure a quantity of recovered organic waste products including compost, renewable gas for transportation, electricity from biomass conversion, or mulch. These procurement requirements will increase markets for compost by providing certainty for demand of the finished product. Purchasing and using compost and mulch increases carbon storage and water retention in soils and thus reduces the need for fertilizers, pesticides, and water. The procurement requirements will also help drive demand for products derived from biogas generation at AD facilities.

The procurement requirements will motivate local jurisdictions to ensure food and green waste generated by their citizens has very few contaminants, as it would cost them much more to have it removed from the product they are required to procure. It would be unacceptable to the public for jurisdictions to use material in public spaces, parks, and landscaping that has visible contamination. Through education, monitoring, and enforcement, jurisdictions will be well positioned to ensure their generators do not contaminate the feedstock.

Several state policies support procurement of products produced by organics recycling. AB 1045 (Irwin, Chapter 596, Statutes of 2015) required CalEPA—in coordination with CalRecycle, SWRCB, CARB, and CDFA—to "develop and implement policies to aid in diverting organic waste from landfills by promoting the use of agricultural, forestry, and urban organic waste as a feedstock for compost and by promoting the appropriate use of that compost throughout the state."

In its November 2018 report, CalEPA recommended that "CalEPA, CalRecycle, CARB, and CDFA should consider working with other state offices to determine if opportunities exist to enhance state and local government procurement of compost and other value-added soil amendments, as well as biogas products for the transportation sector to help drive the market for such products." The report further recommended that CalRecycle "consider including local government procurement requirements in its SB 1383 regulations as an additional incentive to help to foster a more vibrant market for value-added organic materials products."[73]

SB 1383 required the California Energy Commission include recommendations for the development and use of renewable gas, including biomethane and biogas, as a part of its 2017 Integrated Energy Policy Report (IEPR). The 2017 IEPR includes the recommendation that "state agencies should consider and, as appropriate, adopt policies and incentives to significantly increase the sustainable production and use of renewable gas" and that "CalRecycle and CARB should determine methods for promoting the use of renewable gas from organic waste recycling in the waste sector."[74]

Compost

A CalRecycle study found that 36 percent of compost facilities sold about 3 percent, or 32,000 tons, of the compost produced in 2017 to municipal projects.[75] CalRecycle estimates that in 2025 local governments would need to procure about 400,000 tons of compost to meet the procurement requirements. This would be enough compost to amend 40,000 acres of parklands per year at an estimated cost of about $12 million to jurisdictions statewide.

Procurement requirements are supported by findings in the SB 1383 Infrastructure and Market Analysis Report. Forty percent of survey respondents said they believe that there will need to be more market development to manage the increase in available compost after SB 1383 regulations are implemented; 24 percent of respondents said they need expansion of existing markets prior to committing to expanding their facilities; and 52 percent responded that the state should work to increase markets for compost. Thirty-six percent already sell compost to municipal markets.[76]

Biomethane

Increased demand for biomethane used for transportation fuel because of the procurement policy, coupled with LCFS and RFS credit markets, could help offset the cost of biomethane fuel production, thereby decreasing the price of fuel at the pump. CalRecycle estimates that the procurement requirements could result in the production of up to 28 million diesel gallon equivalents (DGE) annually—enough to fuel more than 3,000 CNG transit buses per year—at a cost of $10-13 million per year statewide.

CalRecycle estimates that the procurement requirements could result in at least 200 megawatts (MW) of electricity from biomethane production annually—enough electricity to power the Los Angeles City Hall building for 10 years—at an annual cost of about $6.5 million. As more AD facilities come online and participate in the BioMAT program, and as California moves toward 100 percent renewable electricity by 2045 as required by California's Renewables Portfolio Standard (RPS), procuring electricity from biomethane will become more widespread and cost-effective for local governments.

Conclusions

California is the fifth-largest economy in the world, and the state's commitment to the climate-protecting goals of SB 1383 will drive innovation and influence organics policy throughout the nation. As the state looks toward economic recovery after the fallout of COVID-19, building the next generation of recycling infrastructure will create 12,000 permanent green jobs in California.[77] Redirecting organic waste to cleaner activities such as composting and anaerobic digestion will clean our air and prevent $10.4 billion in costs associated with emergency room visits, hospitalization, and mortality.[78]

SB 1383 states that, if this analysis shows that significant progress has not been made, CalRecycle may include incentives or additional requirements in the regulations promulgated pursuant to the statute or provide further recommendations to the Legislature regarding revisions to the organic waste reduction goals. Importantly, the SB 1383 procurement requirements will increase markets for compost, biofuel, and electricity by providing certainty for demand of these finished products, which will ensure significant progress will be made in meeting the state's organic waste reduction goals. CalRecycle estimates that in 2025 there will be an additional 5.5 million tons of compost and more than 14 billion cubic feet of biomethane produced as a result of SB 1383 implementation. This makes it necessary for the state to encourage strong end-use markets to absorb this increase in recovered organic material remains diverted from disposal.

While organics capacity has increased over the past four years by nearly 400,000 tons, disposal of organics increased by more than 2 million tons between 2014 and 2018. California will need to make significant progress to meet the goals of SB 1383. However, recent surveys indicate that the adoption of regulations and new feedstock contracts drive the development of new and expanding organics recovery facilities. [79]

Considering the urgency of reducing short-lived climate pollutants and the importance of regulatory certainty, CalRecycle recommends maintaining the disposal reduction targets set forth in SB 1383. Since the regulations are not effective until January 1, 2022, and entities are currently in the planning or early implementation stages, CalRecycle cannot conclude at this time whether the targets need to be adjusted. The SB 1383 regulations provide jurisdictions with multiple options to comply with SB 1383. For example, the procurement requirements allow for multiple recovered organic waste products (compost, mulch, RNG, electricity) to qualify, and jurisdictions have the flexibility to meet the collection services by having entities source separate or by having a more robust processing facility.

Even after the regulations take effect, there are opportunities for entities to come into compliance rather than being issued a penalty immediately. The regulations build in a

compliance evaluation and enforcement process that provides substantial timelines for jurisdictions to come into compliance before penalties are issued.

As to additional requirements in the regulations, as mentioned in Finding 4-3, existing trends suggest that a more comprehensive approach may be necessary to reduce the disposal of paper and OCC in California. Going forward, CalRecycle may need to place a greater focus on the diversion of the organic portion of packaging waste to meet the SB 1383 targets. Through CalRecycle's packaging workshops and analysis, the department has identified tools that would assist in reducing the disposal of paper and paperboard, such as requiring manufacturers to produce new products with minimum recycled content.

Implementation of SB 1383 is critical to protecting communities from the risks of short-lived climate pollutants and should not be delayed. The adoption and implementation of the regulations will be the leading driver for organics infrastructure development and associated job creation in California. Meeting the state's organic diversion goals by the dates set in law will protect public health, support economic development, and demonstrate California's leadership in the fight against climate change.

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