Following Through on California's Compost Promise

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EXECUTIVE SUMMARY

As the state of California works towards ambitious environmental goals, the organics recycling sector has been cast in a lead role. This diverse group of public, private, and on-farm recycling operators uses methods both ancient and high-tech to turn organics materials into compost, and in so doing is poised to help California reduce its carbon footprint, manage its droughts and transition to a greener economy. But current market conditions endanger the sector's ability to deliver on its potential and regulatory structures undercut the state's vision for the crucial role of organics recycling. This report addresses both of these dimensions, charting a path forward on how we can fulfill the *promise of* and *promises to* California compost.

Composting is the biological decomposition of organic materials by microorganisms under controlled aerobic conditions that produce a soil amendment and fertilizer prized by farmers. Of the estimated 30.2 million tons of waste that California currently disposes of in landfills annually, more than 40 percent is suitable for organics recovery strategies like composting.[1] The failure to divert organic compostables from the state's landfills results in anaerobic decomposition of these materials, which causes the release of methane, a greenhouse gas (GHG) 25 times as potent as CO2. Composting organic material produces a fraction of the GHGs emitted by the same material in landfills, and there are other important benefits to applying finished compost to agricultural soils including improved soil carbon sequestration, microbial activity, soil water content, water infiltration, and total organic matter and nitrogen. In aggregate, compost production and use has enormous potential to help address some of California's most formidable challenges, like climate change mitigation and groundwater management.

In fact, the state government has acknowledged compost's central role in addressing these issues, passing legislation setting ambitious standards that require diverting 50 percent of the state's organic waste from landfills by 2020, and 75 percent by 2025, in addition to bold GHG reduction targets. Based on these benchmarks, however, an estimated 169 new facilities need to be built to meet the 2025 target and few experts believe the industry will achieve this given the compost industry's underdevelopment.

At precisely the moment when the sector must rise to the challenge of an aggressive growth trajectory, a confluence of new and existing challenges instead have slowed expansion:

1. regulatory complexity, confusion and conflict,
2. imperfect information faced by regulators, and current and potential compost consumers,
3. underproduction of compost due to positive externalities,

4. overuse of landfilling and other cheap alternatives to organics recycling due to negative externalities, and

5. underinvestment by the state that fails to mitigate these regulatory and market obstacles.

The objective of this report is to identify policy alternatives that will eliminate the regulatory and economic obstacles currently limiting the production of abundant, affordable, high quality compost throughout the state. The policies recommended aim to increase the share of organic waste diverted from landfills across the state, encourage the vitality of on-farm composting and ultimately result in more compost production.

The policy alternatives identified for this goal were analyzed across four criteria and ordered by priority. Alternatives were inspected and compared with each other on the merits of their effectiveness, efficiency, impacts on equity, and political and administrative feasibility. The resulting recommendation presents the best options for advocates to pursue and for the state to enact, in the following ranked order.

Key Recommendation: Ordered Policy-Making Priorities

1. Invest in Research
2. Prioritize Enforcement of Land Application
3. Nurture Regulatory Reform
4. Secure a Continuous Appropriation for Organics Infrastructure
5. Subsidize Compost Production
6. Establish a Generator Fee
7. Create a Compost Certification Program
8. Raise the State Municipal Solid Waste Disposal Fee (Landfill Tipping Fee)

ACRONYMS

AB: Assembly Bill

AD: Anaerobic Digestion

ADC: Alternative Daily Cover

AQMD: Air Quality Management District

ARB: California Air Resources Board

BACT: Best Available Control Technology

CalRecycle: California Department of Resources Recycling and Recovery

CAFO: Concentrated Animal Feeding Operation

CASP: Covered Aerated Static Pile System

CalEPA: California Environmental Protection Agency

CDFA: California Department of Food and Agriculture

cy: Cubic Yards

GHG: Greenhouse Gas

LEA (or EA): Local Enforcement Agency

MMTCO2E: Million Metric Tons of Carbon Dioxide Equivalents

MSW: Municipal Solid Waste

NOI: Notice of Intent

RWQCB: Regional Water Quality Control Board

SB: Senate Bill

SCAQMD: South Coast Air Quality Management District

SJVUAPCD: San Joaquin Valley Unified Air Pollution Control District

SWRCB: State Water Resources Control Board

VOC: Volatile Organic Compound

WDRs: Waste Discharge Requirements

DEFINITIONS

Alternative Daily Cover: 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.

Agricultural Material: Consists of pre-consumer plant materials coming directly from lands used in the production of farm, agricultural, horticultural, aquacultures, silvicultural, floricultural, vermicultural, or viticultural products, including orchard and vineyard prunings, and crop residues. Per the Water Board, Agricultural material does not include manure, however manure and other materials "of animal origin" are considered an agricultural material by CalRecycle.

Agricultural Material Composting Operations: An operation that produces compost from green or agricultural additives, and/or amendments.

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

Anaerobic Lagoon: A man-made outdoor basin filled with animal waste that undergoes anaerobic respiration as part of a system designed to manage and treat manure created by CAFOs. Also known as a manure lagoon.

Concentrated Animal Feeding Operation (CAFO): An agricultural operation that congregates feed, manure, urine, dead animals, production operations, and at least 1,000 animal units in a confined area; or any size animal feeding operation that discharges manure or wastewater into a natural or man-made ditch, stream or other waterway. (An animal unit is defined as an animal equivalent of 1,000 pounds live weight.)

Chipping and Grinding Facilities and Operations: Facilities or operational areas that do not produce compost, but mechanically reduce the size or otherwise engage in the handling of green material.

Composting: The biological decomposition of organic materials by microorganisms under controlled aerobic conditions to create a product (e.g. soil amendment, fertilizer, soil blend, etc.).

Covered Aerated Static Pile (CASP): a composting process that uses an air distribution system to either blow or draw air through the pile. Little or no pile agitation or turning is performed.

Feedstock: Materials used in the production of compost. Feedstocks are not to be either additives or amendments.

Food Waste: All surplus food scraps. Food waste includes food waste from food facilities, food processing establishments, grocery stores, institutional cafeterias (such as prisons, schools, and hospitals), restaurants, and residential food scrap collection. Food material may include meat and materials incidental to a food scrap collection program.

Green Material: 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. Green material does not include food material, biosolids, material processed from commingled collection, wood containing lead-based paint or wood preservative, mixed construction or mixed demolition debris.

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.

Leachate: Any liquid formed by the drainage of liquids from, or percolation/flow of liquids through any feedstock, additive, amendment, or compost (active, curing, or final product) pile.

Local Enforcement Agencies (LEA or EA): Agencies that are designated by the governing body of a county or city and, upon certification by CalRecycle, are empowered to implement delegated CalRecycle programs and locally designated activities.

Manure: Accumulated excrement (e.g., cattle manure, chicken manure, pig manure), which includes feces and urine, and any bedding material, spilled feed, or soil that is mixed with feces or urine.

Municipal Solid Waste: 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: A wide range of material types including grass, leaves, branches, prunings, stumps, wood waste, agricultural wastes, manure, food, and biosolids.

Organics Recycling: Processing organic material by composting, mulching, (also referred to as chip-and-grind), or anaerobic digestion.

Tipping Fee: The charge levied upon a given quantity of waste received at a waste processing facility.

Tier I Feedstocks: Agricultural materials, green materials, paper materials, vegetative food materials, residentially co-collected food and green materials, anaerobic digestate derived from allowable Tier I feedstocks, and a combination of allowable Tier I feedstocks (per the Water Board's General Order).

Tier II Feedstocks: Non-vegetative food materials, biosolids, manure, anaerobic digestate derived from allowable Tier II feedstocks, and a combination of allowable Tier I and Tier II feedstocks (per the Water Board's General Order).

Tipping Fee: The charge levied upon a given quantity of waste received at a waste processing facility (most commonly a landfill).

Part I: The State of Compost in California

THE PROMISE OF COMPOST

Composting is the biological decomposition of organic materials by microorganisms under controlled aerobic conditions that produce a soil amendment and fertilizer prized by farmers. The State of California currently disposes of an estimated 30.2 million tons of waste annually in landfills, of which food waste—one of the largest material types in the waste stream—accounts for 18 percent.[2] Accounting for other materials like yard waste, compostable paper and lumber, more than 40 percent of the waste which ends up in a landfill is suitable for organics recovery strategies.[i] This amounts to approximately 12.1 million tons of disposed waste that could be composted, mulched, digested, or otherwise processed for reuse on an annual basis.[3] The failure to divert organic compostables from the state's landfills results in anaerobic decomposition of these materials, which causes the release of methane, a greenhouse gas 25 times as potent as CO_2.[4] Because landfills produce 20 percent of the state's methane emissions, decreasing the anaerobic decomposition of organic waste in landfills is an important strategy for reduction of greenhouse gas emissions.

Aside from the reduction in greenhouse gas emissions that result from organics in landfills, there are unrealized social benefits in producing and using compost. Research shows that applying compost to agricultural soils is associated with significant improvements in soil carbon sequestration, microbial activity, gravimetric water, soil water content, water infiltration, and total nitrogen.[5] On rangeland, research is equally promising, indicating that a single application of compost increases forage production by 50 percent and improves soil carbon sequestration by one ton per hectare on average over three years, in addition to increasing the soil's water-holding capacity.[6] If scaled to just five percent of California's rangelands, this could result in major offsets to greenhouse gas emissions, amounting to over 28 million metric tons of carbon dioxide equivalent.[7] This is equal to removing more than 5.9 million passenger vehicles—more than all the cars in the San Francisco bay area—from roadways for a year.[ii] Given the state's ambitious greenhouse gas reduction goals and the agriculture industry's reliance on groundwater during prolonged drought, these benefits are significant.

[i] See Appendix A for more information on the composition and recoverability of California's disposed waste stream.

[ii] There are 7.15 million people in the Bay Area and 797 cars per 1,000 people on average in the U.S.

LEGISLATIVE OVERVIEW

The state legislature has played an active role in setting the stage for widespread compost production.[iii] The passage of the California Global Warming Solutions Act of 2006 (AB 32) required the state to reduce its greenhouse gas emissions to 1990 levels by 2020.[8] Pursuant to AB 32, the Air Resources Board (ARB) has adopted regulations to achieve the maximum greenhouse gas reductions through the adoption of best available technology and cost-effective strategies, part of which include targeting the expansion of the organics recycling sector. Mandatory commercial recycling has been in place under AB 341 since 2012, which establishes a 75 percent overall recycling rate by 2020. AB 1826, passed in 2014, requires the reduction of commercial organics disposal by half of 2014's level by 2020, with phased-in mandatory collection based on the amount of waste generated. With the passage of SB 1383 in 2016, the state committed to diverting 50 percent of the state's organic waste from landfills by 2020, and 75 percent of organic waste by 2025.

AB 1045 was passed in 2015 to promote the use of compost by requiring state agencies to work together to establish a coordinated effort for the development and deployment of compost in order to meet the state's diversion goals.[9] The bill requires that the Secretary of California Environmental Protection Agency (CalEPA) work with the ARB, Department of Resources Recycling and Recovery (CalRecycle), State Water Resources Control Board (Water Board), and California Department of Food and Agriculture (CDFA) to develop and implement policies to aid in diverting organic waste from landfills by promoting composting across the state.[iv,10] More specifically, AB 1045 requires CalRecycle to promote the goal of reducing greenhouse gases by at least 5 million metric tons per year in coordination with the CDFA. An Interagency Waste Working Group for Landfill Diversion (IAWWG) has formed as a result of AB 1045. The IAWWG has created several working groups around permitting, economics and incentives, siting, and the California Environmental Quality Act (CEQA) in order to address some of the barriers to constructing the additional organics infrastructure needed.[11] At this time, it remains unknown what specific steps the IAWWG will recommend to stimulate organics infrastructure.

Municipalities also play an important role in the diversion of organic waste material. The state passed AB 876 in 2015 to require counties and regional agencies to address their long-term planning needs for organics infrastructure. Under 876, counties and regions must report an estimate of the amount of organic waste that will be disposed by the county or region over a 15-year period as well as an estimate of the additional organics recycling facility capacity that will be needed to process the amount of organic waste identified.[12] Counties and regions must also identify locations for new or expanded organic waste recycling facilities capable of safely meeting the necessary additional organic waste capacity. However,

[iii] See Appendix B for an overview of California's legislation relating to organics recycling.

[iv] CalRecycle, the State Water Resources Control Board, and the Air Resources Board are individual branches under the umbrella of the California Environmental Protection Agency.

counties and agencies are not required to report this information until August 1, 2017. Similarly, AB 1594 requires local jurisdictions to addresses the use of green material for alternative daily cover (ADC) on active landfill operations. As of January 1, 2020, ADC will no longer be considered as a diversion strategy and will instead be classified as regular waste.[13] Local jurisdictions will therefore be required to submit plans to divert green waste material that is currently being used as ADC by August 1, 2018. If sufficient capacity at facilities that recycle green material is not expected to be operational by the necessary time, then local jurisdictions must identify and plan for these barriers.

COMPOST'S REGULATORY LANDSCAPE

Compost producers face an extraordinary array of regulations that vary in their specificity and complexity.[v] Composting facilities are subject to regulation by multiple state and regional agencies including CalRecycle, ARB, CDFA, and the Water Board, in addition to 21 regional air quality management districts and nine regional water quality control boards.

CalRecycle permits the facility siting, pathogen destruction, and general operation standards for composting facilities.[14] Under CalRecycle's requirements for composting operations, certain composting activities are excluded from regulation, including composting of agricultural materials, and community composting operations that limit their on-site materials to 100 cubic yards at a given time. On-farm composting regulations are discussed in further detail below. CalRecycle organizes non-excluded composting operations into three regulatory tiers—Enforcement Agency notification, tiered registration permit, and full solid waste facility permit—based on the type and quantity of their feedstocks, or raw material handled in composting.[15] CalRecycle also requires each facility to prepare and implement an odor impact minimization plan that contains a method for assessing and addressing possible odor impacts.

The Water Board oversees facilities' compliance with state water protection rules through the General Waste Discharge Requirements for Composting Operations, adopted in August 2015 and known as the "General Order."[16] These rules are intended to ensure that wastewater from composting facilities is properly handled through siting requirements, implementation of water management plans, and construction of waste containment features. Depending on a composting facility's "potential impacts to water quality," the General Order places most facilities in either Tier I or Tier II, based on the types of feedstocks used, volume of materials received, processed, and stored, and hydrogeologic siting considerations.[vi] Tier I includes smaller facilities and most notably does not allow the processing of

[v] See Appendix C for a detailed overview of CalRecycle and Water Board regulations related to composting operations.

[vi] The Water Board explicitly uses the language of "potential impacts to water quality" to describe the possibility of composting's impacts to the state's waters.

manure, food waste, or biosolids as feedstock. Tier II applies to mid-to-large facilities or those that accept the feedstocks just mentioned, while entailing heightened regulations that necessitate more complex and costly investments in order to protect against threats to groundwater, namely "improved working surfaces and ponds." This requires tamping down of the soil under the composting area, or in many cases laying down a costly barrier like concrete. One exception to these rules is that while Tier I composting operations are not allowed to accept manure as a feedstock, they can accept it as an "additive" comprising up to 10 percent of the total volume in any batch of compost.[vii,17]

Table 1. Feedstock Definitions per the Water Board General Order

Tier I Feedstocks	Tier II Feedstocks
Vegetative food materials	Food materials (non-vegetative)
Agricultural materials	Biosolids
Green materials	Manure
Paper materials	Anaerobic digestate derived from allowable Tier II Feedstocks
Anaerobic digestate derived from allowable Tier I Feedstocks	A combination of allowable Tier I and Tier II Feedstocks
Residentially co-collected or self-hauled food and green materials	

Facility operators cannot stop at interpreting the General Order when it comes to understanding their legal liabilities with respect to water quality as they must contend with regional water regulations and the possibility of rules that apply only to them. In addition to meeting the requirements of the Tier that apply to composters, complexity is added when considering that the nine regional water boards are able to develop region-specific orders or waivers that can apply to compost production at any scale--including on-farm composting--even if they qualify for an exemption under the General Order.[18] Additionally, if a regional water board determines that, due to site-specific conditions, coverage under the Composting General Order does not sufficiently protect water quality, they may issue individual waste discharge requirements (WDRs) for a composting operation.[19]

Compost facilities are regulated locally by 35 regional air pollution control districts that are responsible for controlling air pollution from stationary sources by enforcing their own rules. The San Joaquin Valley

[vii] Although there are many opinions about the best feedstocks and their ideal quantities needed to produce high-quality compost, manure in particular is considered a highly valuable ingredient. Amigo Bob Cantisano, an organic farm advisor and California farmer of over 40 years, estimates that one could conservatively argue for 30 to 50 percent manure content in a batch of compost, although some farmers prefer compost that is comprised entirely of manure.

Unified Air Pollution Control District (SJVUAPCD) and the South Coast Air Quality Management District (SCAQMD) have adopted regulations that require New Source Review (NSR) for the permitting of new or expanded facilities in those districts that are in nonattainment of Clean Air Act[viii] standards for healthy air.[20] NSR determines, based on a calculator developed by the air district, the quantity of volatile organic compounds (VOC) that a facility is likely to produce. As the name indicates, New Source Review treats each new or expanding facility as a new source of emissions and does not account for baseline emissions that the same compostable materials would create in landfills. Where the threshold of significance for VOCs set by the district is exceeded, compost facilities may either employ mitigating measures to decrease emissions, or purchase emission reduction credits (ERCs) to offset emissions.

While the permitting process itself can be cumbersome, the fees or mitigation measures required vary from district to district and depend on the size of the operation. In SJVUAPCD, the smallest facilities would likely not be required to implement mitigation methods beyond best practices for compost production such as maintenance of compost moisture and air content. As operations grow, the mitigation measures become harder to implement and ultimately are not sufficient for the largest facilities, who must purchase ERCs in order to operate.[21] Purchasing ERCs in districts using New Source Review requires one-time costs ranging between $500,000 to $2 million, significantly increasing the cost of establishing a new facility in these districts.[22]

In comparison, CDFA has a minimal role in monitoring the production of compost. The Department administers the Fertilizing Materials Inspection Program, an industry-funded program verifying quality and quantity claims made on fertilizing material product labels. Unlike most fertilizing materials, packaged compost does not require an informational statement of laboratory test results or the maximum levels in parts per million of various chemical elements. CDFA does, however, confirm some claims made on packaged compost regarding quality. Since the majority of compost is used in the agricultural sector and sold in bulk, these packaging requirements are not applicable to most of the compost produced in the state. CDFA also administers the Organic Input Material Program, which verifies that organic fertilizing materials meet organic standards.[23]

Because the various state agencies developed these regulations in isolation from one another, the regulations currently in place are often unclear or in conflict with one another. For instance, different regulating agencies state quantity thresholds and limitations in different units of volume or weight (cubic yards, square feet, or tons) across different time frames—sometimes referring to the quantity on-site at any given time, and sometimes referring to the quantity processed per year. There is also some variation in definitions between the Water Board's General Order and CalRecycle's composting regulations for the same materials. Furthermore, interpretation of the regulations is far from straightforward, often requiring

[viii] The Clean Air Act is a federal regulation designed to control air pollution on a national level.

lengthy correspondence with agency staff to clarify discrepancies or deviations from the rule's text. These issues are discussed further below in *On-Farm Composting Regulations* and *But What About Manure?*

In addition to these differences, the lack of consistency in exemption parameters and regulatory tiers create dozens of unique regulatory categories, shown in the regulatory table in Appendix C. Each of these categories presents unique sets of responsibilities for compost producers, yet it is far from obvious that the regulations need to be this complex and confusing in aggregate. As a result, there are multiple negative outcomes. Producers that are intrepid enough to navigate this regulatory obstacle course do so at increased costs, either in their time and effort, or in payments made to permitting and regulatory consultants. Those that go it alone are quite likely to get things wrong since it is only natural to ignore what you don't understand. At best, this generates acrimony when the producer faces penalties; at worst, it encourages the production and sale of unpermitted or noncompliant compost and may exacerbate the environmental harms regulations are meant to prevent. This is most likely the case with the adoption of the General Order, which at least half of permitted facilities have not yet complied with, in spite of impending compliance requirements.[24] Regulatory confusion is equally detrimental as it may prevent entrepreneurial spirits from even entering the sector. Instead of managing the safety of a vital environmental industry, the cumulative regulatory structure functions as a barrier to entry for an industry in need of rapid expansion, lengthening the amount of time that less socially beneficial organic waste disposal methods will be employed.

Furthermore, a criticism of current compost regulations is that some burdensome rules are not supported by scientific evidence. For instance, the General Order's treatment of manure assumes that it poses the same threat to groundwater as other sources of nitrogen, like synthetic fertilizers, and carries the same dangers of pathogens as food waste. While the Water Board is unable to produce evidence to support its current classification of manure as a Tier II substance, Water Board staff has indicated that declassifying manure will be impossible without clear evidence proving its safety. The implications of this position are discussed below in *But What About Manure?*

On-Farm Composting Regulations

The Water Board's General Order, CalRecycle's composting rules, and some regional air district regulations mentioned above grant exemptions for specific types of agricultural composting. Because the General Order's agricultural exemption disallows feedstock acquired from off-site, if a farm wishes to use agricultural materials from other farms, they can process and store no more than 5,000 cubic yards of feedstock per year in order to remain exempt.[25] This quantity is below the amount of finished compost regularly used by farms between 250 and 500 acres—still considered small according to the U.S. Department of Agriculture's Census.[26] Once a farm exceeds these limits, it falls into either Tier I or

Tier II, depending on its use of manure. While Tier I rules require fewer capital investments and technologies than Tier II, the minimum annual fee from the Water Board for any tier is $2,088 annually, a significant expenditure for a small farm.[27]

Agricultural exemptions from other agency rules are similar. CalRecycle's agricultural exemption also requires that feedstock be derived on the farm where it is composted and must be used on the same site or another belonging to the same owner. Like the General Order, the CalRecycle agricultural exemption allows farmers to sell or give away no more than 1,000 cubic yards annually. In addition to this exemption, there are a few other designations which allow farmers to use additional materials in small quantities, still allowing them to avoid a full permit, but precipitating the need for inspection annually from their local enforcement agency. Regional air districts like SJVUAPCD and SCAQMD have similar exemptions requiring that farms compost only materials from their farm and sell or give away only 1,000 cubic yards per year to qualify for an exemption from their rules.

Because there are small variations in these exemptions and little correlation between rules that apply to non-exempted on-farm composting between regulatory agencies, the resulting regulatory scheme consists of overlapping regulations that confuse and intimidate farmers. Appendix C provides a regulatory grid showing no less than eight different categories that on-farm composters can be assigned to as a result of these intersecting rules. What's more, like the regulations applying to all composters, interpreting these rules can be challenging. One particularly thorny challenge is a discrepancy in the definition of "agricultural material" between CalRecycle and the Water Board. According to CalRecycle's definition, manure is included along with orchard and vineyard prunings and crop residues.[28] In contrast, the Water Board's General Order specifically stipulates that agricultural material does not include manure, indicating that composters exceeding the 5,000 cubic yard limit would have to comply with Tier II regulations in order to handle manure.[29] In spite of this language in the General Order, personal communications with Water Board staff have confirmed that manure does fall under the agricultural exemption as long as it is derived on-farm, a clarification which is very difficult to distinguish from the written rule.[30] Given these contradictions, it's unsurprising that many farmers are unsure about which rules apply to them.

In practice, many farmers fly under the radar of regulators, producing compost with materials from other local agricultural operations acquired through mutually-beneficial trades or sales. The regulatory barriers to sharing feedstock and responsibly managing dairy manure are keeping farmers from acquiring and incorporating different types of feedstock—manure in particular—in their compost, contributing to the negative environmental impacts of current manure management practices and foregone benefits of better quality compost. This abets damaging manure management practices and inhibits the incorporation of greater on-farm composting into the overall organics recycling infrastructure.

But What About Manure?

In addition to the organic waste currently being landfilled, manure is another source of organic waste that is not included in many waste estimates and whose current disposal methods have negative impacts that can be mitigated through composting. As the nation's largest dairy producer, California was home to 1.8 million dairy cows, mostly in the San Joaquin Valley, producing 35 million tons of manure in 2014.[31] Until recently, agricultural sources of air and groundwater pollution in the state were exempt from local air district permit requirements and Water Board rules, but this changed with the passage of SB 700 in 2003, which applied emissions limitations to agricultural operations, and the U.S. Environmental Protection Agency's 2003 "CAFO Rules."[ix] These changes, and the resulting rules and regulations, will make it harder for dairy farmers to legally comply using common manure management practices like anaerobic lagoons, static piles, and the spreading of liquid manure, which recent research indicates have even higher methane and nitrous oxide emissions than previously believed.[32]

Because changing regulations will make dairy farmers unable to use previously widespread manure management methods, California farmers must find a new way to manage this waste product. While anaerobic digesters are feasible for some producers, their cost, location and scale make them impractical for many. A method referred to as scrape manure management is one option to reduce GHG and other harmful gas emissions from dairy cow manure.[33] Combining the resulting manure with agricultural crop residues to produce compost is an economically viable solution to many of the issues currently producing negative environmental and social outcomes. In comparison to raw manure, well-managed composting reduces emissions while destroying pathogens present in manure that make applying it directly to cropland unsafe.[34] Additionally, composting makes manure less expensive to transport by decreasing its weight. These features make composting an important solution to another of the state's manure problems—the concentration of nutrients like nitrogen and phosphorus in unsafe levels on confined animal feeding operations and surrounding areas where raw manure is spread on agricultural land in excess of its nutrient needs.

Compost's relative transportability and safe application to a variety of crops can address many of the current environmental and human health risks posed by manure while generating a beneficial soil amendment. Unfortunately, State Water Board, CalRecycle and regional air district rules disincentivize or

[ix] Pursuant to the Federal Water Pollution Control Act, the US EPA disseminated the National Pollutant Discharge Elimination System (NPDES) permit regulations and effluent limitation guidelines for concentrated animal feeding operations (CAFOs), or "the CAFO rule" in 2003. While its enforcement was limited by legal challenges from the dairy industry, the California Water Board's upcoming Dairy Order is expected to go further to regulate dairy manure management. California Air Resources Board. (2017, April 22). *An Assessment of Technologies for Management and Treatment of Dairy Manure in California's San Joaquin Valley*. Retrieved from https://www.arb.ca.gov/ag/caf/dairypnl/dmtfaprprt.pdf

block the expansion of this important solution. Because exchange of agricultural materials between farmers disqualifies them for agricultural exemptions under these rules, if a farmer without livestock wishes to incorporate more than 10 percent manure into their compost, they are required to comply with the General Order's Tier II stipulations. This is one clear disincentive for farmers to make use of this beneficial feedstock source at precisely the time when we are recognizing the importance of removing manure from lands that are over-burdened by it and move it to land where it can have beneficial effects. Similarly, the air districts' use of New Source Review to evaluate emissions does not account for the significant benefits of composting over other manure management methods, encouraging continuation of the status quo.[35]

Lastly, like the regulations pertaining to on-farm composting more generally, lack of clarity is a significant disincentive to potential compost producers. One source of confusion has to do with the Water Board's General Order on composting and how it interacts with entities already regulated under other Water Board rules, like the Dairy General Order. Dairy farmers and advocates attempted to help the industry improve manure management practices, are unsure whether the more-rigorous Composting General Order will supercede the Dairy General Order, which has more achievable rules regarding compost production on dairy farms.[x] Next, the regional air districts have not provided consistent public information about what mitigation measures composters could implement in order to reduce emissions based on New Source Review.[36]

Like other agricultural and commercial compost producers throughout the state, those wishing to manage manure in the San Joaquin Valley are responding in one of several ways. Many are choosing to ignore the regulations and make compost, hoping to avoid interaction with the state. Others try and fail to establish or expand compliant operations, and some choose not to try in the first place. While ensuring the protection of groundwater and air quality is undoubtedly important, present management methods for the 35 million tons of manure produced annually by the state's dairy industry pose a very serious threat to water and air quality. Composting has the promise not only to mitigate these dangers, but produce significant benefits both for the state's dairy-producing region and California as a whole if composters face a regulatory structure that favors these management practices.[37]

THE ECONOMICS OF THE ORGANICS RECYCLING SECTOR

There are important economic dynamics to note when considering the organics recycling sector that pertain to producers' fixed and variable costs and the anticipated market demand for both organics

[x] Ryan Flaherty of Sustainable Conservation, a non-profit organization promoting environmentally beneficial manure management in the San Joaquin Valley, was told by the Central Valley Regional Water Quality Board that dairy farmers will not need to comply with the Composting Order, but that the Dairy Order rules will likely be heightened to be consistent with the Composting Order.

disposal and finished compost. Moreover, economic considerations cut to the heart of the market failures that justify state action in this area.

To begin with, consider the business model of a stand-alone organics recycler:

Profit = (Disposal Revenue + Compost Revenues) - (Operating Costs + Overhead Costs)

To stay in business, a firm must be able to make up in revenue at least what it loses in costs. Importantly, organics recyclers make money on both organics disposal and their finished product, though the markets from which these two revenue streams come are considerably different. Costs can be thought of as composed of two categories: operating costs (including labor, equipment operations, and interest on operating capital) which are more variable, and overhead costs (including taxes, permits, fees, land costs, and building and equipment) which are more fixed.

As a firm faces increased costs, it seeks to compensate with additional revenue by charging higher prices for the goods and services it provides. This is where the distinction between the disposal and compost markets makes a difference. Organics disposal is more a necessity than the compost, so a one percent increase in the price of disposal will trigger a far smaller decrease in the quantity of disposal demand than a comparable increase in the price of compost. (In technical

Composting Production Technology
Composting has been practiced for thousands of years using low-tech methods that require nothing more than a pitchfork and the raw materials destined for decomposition. Today, there are many techniques and technologies employed in compost production. The technologies most relevant to this report are listed below, in rough order of the fixed costs they impose on the business model of a producer.
Windrow Composting is the most common method for on-farm composting and is still practiced in many commercial operations, although recent changes in regulation will make this method impossible going forward. Windrow composting involves forming organic waste into rows of long piles called “windrows” and aerating them periodically either manually or by mechanically turning the piles.
In-Vessel Composting involves feeding organic materials into a drum, silo, or concrete-lined trench in which environmental conditions can be controlled and materials are mixed to ensure aeration.
Covered Aerated Static Pile (CASP) technology is considered best available control technology (BACT) by California’s air quality management districts. Composting material is covered and forced through the cover for aeration, cleansing the emissions with a biofilter prior to being released. This reduces volatile organic compounds emissions by over 80 percent and minimizes odors.
Anaerobic Digester systems can vary in design, but all rely on a natural process in which microorganisms break down organic materials in enclosed spaces without oxygen. This process results in solid digestive (which can be used as a fertilizer) and a biogas, which is mostly methane (the primary component of natural gas). When these systems process only manure, they are called methane digesters.

terms, compost is more "price elastic" than organics disposal.) Organics recyclers will be able to recoup more revenue on the disposal side of their operations than on the compost sales side.

Consider the details of the market for compost. The current market price for bulk sales of finished compost ranges from $5 to $25 per ton.[38] Certified organic farmers must utilize compost—either purchased or produced on-farm—so their demand for compost remains rather consistent. However, in order for the state to benefit from the potential greenhouse gas reduction, water retention, and soil nutrient benefits of expanded compost use, compost must remain cheap enough so farmers not currently using the product will be enticed to do so. While the reservation price for these farmers is unknown, the current production costs of $25 to $35 per ton for low-technology compost production are doubled when using the best available control technology to $50 to $70 per ton for covered aerated static piles, or $60 to $80 per ton for anaerobic digesters.[39] (See sidebar on Composting Production Technology on the following page.) According to the U.S. Department of Agriculture's Economic Research Service, 69 percent of farms in America are in the operating profit margin "critical zone," indicating that operating profits comprise less than 10 percent of their gross cash farm income. Therefore, the de-facto price limitation on compost not only emerges from the market, but is also key to the social goal of broader compost use.

At this point, it is important to address the distinction between the prices of organics recycling and their true social value. Organics recyclers are involved in transactions with consumers who put a private value on organics disposal because it helps to keep a city clean, or because compost is a valuable soil amendment. But these private benefits do not capture the additional social benefits of greenhouse gas reductions. As long as these market transactions exclude the external benefits to society of compost use, their prices will be but a shadow of the true social value and state intervention will be needed to correct the corresponding underproduction of compost.

Compliance Costs Impact Firm Viability

The construction of compliant facilities under current regulations, particularly the General Order, is estimated to cost in the tens of millions of dollars.[40] Additionally, the fundraising, siting, and construction processes can typically be expected to take from five to seven years, making a continuous stream of funding necessary to reach operational status. These compliance costs are especially challenging for the many smaller scale compost producers distributed across the state, who have smaller budgets in which to absorb these high fixed costs. Furthermore, those farmers that wish to begin producing

compost on-farm—or scale up their current operations—by utilizing feedstock from off-farm may be kept from doing so by regulations such as the General Order.[xi]

Compost producers using low-level technology to produce fairly inexpensive compost must update their facilities to come into compliance with the General Order, or risk going out of business. The approximate cost of compliance with the General Order is as much as $5.19 per ton of compost produced. Additionally, the estimated cost of compliance with regional air district rules is as much as $3.85 per ton of compost produced, leading to approximately $9.04 total in regulatory compliance.[41] Given the per unit price of production, these added regulatory costs may make composting cost prohibitive for small-scale organics recyclers.

Existing State Funding for Organics Infrastructure

Established in 2012, the Greenhouse Gas Reduction Fund (GGRF) utilizes Cap-and-Trade auction proceeds appropriated by the legislature and Governor for programs that help meet the objectives of AB 32, including the reduction of greenhouse gas emissions through increased waste diversion efforts.[42] CalRecycle administers the Greenhouse Gas Reduction Grant and Loan Programs from this fund to provide incentives for capital investments in organics infrastructure.[43] Eligible programs for the Grant Program include the construction, renovation, or expansion of facilities to increase in-state infrastructure for anaerobic digestion or composting of organics, as well as programs to prevent food waste or partner with disadvantaged communities. The Legislature allocated $25 million during the first Grant and Loan cycle in 2014-15, of which $15 million went toward grants for compost and anaerobic digestion projects.[44] The Governor's 2015-16 budget proposed authorizing $60 million in funding for CalRecycle's Grant and Loan programs, yet the Legislature failed to approve the allocation for the Grants Program.[45]

The Legislature appropriated $40 million in fiscal year 2016-17 for waste diversion in the second Grant Program cycle, of which $24 million is earmarked for organics infrastructure ($12 million each for composting and anaerobic digestion facilities).[46] Of the $12 million allocated to composting infrastructure, the maximum grant that will be awarded is $3 million per application, which includes $2.4 million in requested infrastructure costs and $600,000 in performance payments.[xii] These grants are awarded on a competitive basis, and the recipients will likely be announced in August 2017. Approximately $7 million is currently available through the Greenhouse Grant Reduction Loan Program,

[xi] In order to qualify for exemption from compost facility permitting requirements, farms cannot bring any off-farm materials, and are limited from selling or giving away more than 100 cubic yards of compost a year.

[xii] After an application selected to receive a grant, CalRecycle will add an additional amount equaling 25 percent of the amount approved for infrastructure expenses for performance payments. Performance payments are issued for each ton of California-generated green waste, food materials, or ADC diverted from landfills and composted or digested during the term of the grant. Performance payments may be made quarterly on a per ton basis with the dollar amount determined by dividing the amount requested and approved for performance payments by the total number of newly diverted tons by the project during the grant term as stated in the application.

which provides funds for new or expanded organics infrastructure as well as other recycling activities.[47] Because the Legislature allocated funding for the Loan Program in the 2015-16 budget, this funding cycle is currently still open and carries a 4 percent interest rate. CalRecycle anticipates that a greater amount of the loan financing will be utilized once the grants are announced later this year.

Competition from Cheap Substitutes in the Organics Disposal Market

In order to realize the emissions reduction and soil health benefits of organics recycling and compost application, more organic waste must go to better uses while minimizing greenhouse gas emissions. Unfortunately, compost facilities must compete for the raw materials they process. Other destinations for organic waste, including landfills and open land application, have low disposal costs that hide the true negative impacts of these practices. In 1993, AB 1220 set the state municipal solid waste disposal fee (known as the tipping fee) at $1.34 per ton, with provisions to increase the fee to a maximum of $1.40 per ton. This maximum level took effect in July 2001. The tipping fee has not increased since 2001 and currently does not apply to green waste.[48] The 2017 equivalent CPI-adjusted value would be $1.94 per ton, however the tipping fee has not been adjusted for inflation.[49]

Additionally, each landfill charges its own separate tipping fee to waste haulers, which varies depending on each site's location, size, proximity to other landfills, and other operational factors. The median tipping fee collected by landfills for municipal solid waste disposal across the state is $45 per ton, while the average tipping fee for green waste disposal at landfills is $39 per ton.[50] This disparate fee system—making the dumping of green waste in landfills cheaper than dumping other types of waste—contributes to the continued reliance of the waste management industry on landfilling organic waste.

Alternative Daily Cover (ADC) is another way that landfills have been incentivized to dispose of organic waste. ADC is material placed on the surface of a landfill each day to control vectors, fires, odors, airborne litter, and scavenging.[51] Federal regulations require landfill operators to use six inches of earth material as alternative daily cover; up until now, CalRecycle has allowed landfill operators to use compostable materials as ADC. Municipalities currently receive diversion credits for the use of green waste as ADC, counting towards their mandatory waste diversion targets. However, as AB 1594 comes into effect in January 2020, the use of green waste as ADC will no longer count towards diversion, forcing municipalities to find alternatives for disposing of this organic waste.

Another current practice for dealing with organic waste material is the spreading of organic material, sometimes mixed with other non-organic waste, on open land. This practice, referred to as land application, creates multiple problems, including odor, vector control, pathogens, and water contamination concerns for local communities, as well as emissions of greenhouse gases as the material decomposes. In order for land application to be done legally, it must comply with State Water Board regulations on water quality, CalRecycle regulations regarding contaminants, and CDFA

regulations concerning pest and pathogen control. Practitioners of land application must also receive a permit from the appropriate Regional Water Quality Control Board, if required.[52] It should be noted that despite these many regulations, not all land application is illegal. Currently, land application of compostable materials on agricultural lands can be considered a beneficial use of the material, causing the practice to be excluded from other regulatory requirements so long as the compostable material is found to be in accordance with regulations from the CDFA.[53] However, there is little indication that the CDFA is undertaking the actions necessary to ensure this obligation is being met. Land application is especially common in Southern California, where municipalities face very few costs for the practice aside from those incurred in transporting waste to rural areas and spreading it on lands they either own or lease.

PROBLEMS FACED BY CALIFORNIA'S ORGANICS RECYCLING SECTOR

As the preceding discussion illustrates, the compost sector is tasked with ambitious goals amidst a complex regulatory scheme and underdeveloped market. In spite of the state's many legislative commitments, it is not fully realizing the environmental and social benefits of compost. There are currently 145 permitted operations actively involved in composting or digesting organic material, and an additional 162 facilities that chip and grind organic material that may ultimately end up as compost or, more likely, as uncomposted mulch. An inspection of CalRecycle facility data shows that these facilities will process an estimated 12 million tons of organic material in 2017.[xiii] Legislative mandates will require the diversion of an additional 1.1 million tons of organic materials per year by 2020, and 0.66 million tons per year in the five years after that, meaning the industry will need to nearly double what it can accommodate over the next decade. Modest estimates suggest this could avoid the emission of six million metric tons of CO_2 equivalent.[xiv]

Since composting facility capacities vary widely, estimates of how many facilities need to be constructed to handle the state's organic waste range from 30 to 200.[xv,54] Dividing the anticipated throughput increase of 10.8 million tons in 2025 by the average capacity of organics sector facilities from the CalRecycle Database produces a more robust estimate of 169 new facilities.[xvi] However, even this is a rough estimate due to how data on facility capacity is collected. CalRecycle estimated the throughput and capacity figures from various agency sources when initially compiling data for its FacIT database, and has relied on voluntary self-reporting since then. This uncertainty makes it difficult to properly

[xiii] See Appendix D for calculation of estimates. This number does not account for the compost produced and utilized on farms across the state, which is unknown.

[xiv] See Appendix E for details on greenhouse gas mitigation calculations.

[xv] The number of additional facilities needed is reported as a wide range partially due to the variance in estimated capacity and throughput. In addition, multiple sources differ in their assessment of the number of desired facilities.

[xvi] See Appendix D for calculation of estimates.

quantify and plan for future capacity needs—a problem that is especially acute given the predicted scale of necessary state investment.

Moreover, this growth in composting capacity must be distributed across the state so that municipalities (whether in urban or rural settings) are adequately served by composting facilities. For composting to be a feasible greenhouse gas reduction strategy, organic waste cannot be transported long distances to facilities, as the emissions during transport would counteract the reduction of greenhouse gases from compost use. Because of compost's low market price, industry estimates indicate that transportation costs become prohibitive if compost is transported beyond 50 miles.[55] As a result, it simply would not be helpful for the industry at large to only produce compost in a small number of massive facilities, as it is not feasible to expect these facilities to handle the demand from municipalities across the state.

There is also broad concern among producers and users of compost that some commercially produced compost is below optimum quality.[56] CalRecycle regulations require that compost contain no more than 1.0 percent by dry weight of physical contaminants greater than 4 millimeters; this limit will become more stringent in January 2018 when contamination requirements decrease to 0.5 percent by dry weight.[57] Nonetheless, compost consumers still complain about the presence of plastics in some of the compost available in the market. Furthermore, compost can vary in its nutrients, water content, particle size, organic matter, and the weed seed and pathogens present, among other parameters. Organic farmers, who currently comprise the largest segment of compost consumers, rely on their relationships with compost producers they trust. Maximizing the environmental benefits of compost use, however, means attracting and retaining a much larger number of conventional farmers as compost consumers. Unreliable quality can therefore be a major hindrance to widespread adoption.

Finally, the multiple agencies responsible for regulating compost producers across California have contributed to a disjointed regulatory scheme in which each entity focuses on enforcement of the regulations they are solely responsible for, overlooking the net environmental benefits possible from a thriving organics recycling sector. Given these obstacles, state agencies and advocacy groups acknowledge that is extremely unlikely that the state will meet its organic waste diversion goals in the timeline specified by legislation.

Table 2. Problem Summary

Problem	Definition
Imperfect Information	The benefits and harms of compost production and use are not fully quantified. Compost consumers face imperfect information regarding the quality of finished compost. An accurate, timely assessment of throughput and capacity is lacking.

Problem	Definition
Regulatory Conflict	Regulations are extremely complex and lack clarity. Regulatory statutes have conflicting definitions and parameters, were developed without sufficient collaboration between agencies or input from farmers, and some are not informed by sufficient scientific evidence. Current rules disincentivize the diversion of organic waste from harmful management practices towards compost production.
Underproduction of Compost	The market price for compost does not reflect its true social value. Demand among municipalities for organic waste hauling is not sufficient to drive production.
Underinvestment by the State	Compost producers face high fixed costs and cannot raise compost prices without disproportionately driving down the quantity of compost demanded. State investment thus far is inconsistent and insufficient.
Overuse of Landfills	Landfilling is too cheap in comparison to organics recycling. Laws against land application are not enforced, making this an even cheaper option for organic waste disposal than landfilling. This makes it difficult for existing compost facilities to compete for feedstock.

Part II: Criteria

This report identifies various policy solutions to the problems present in the current state of composting in California. They will be assessed using the following criteria where applicable:

Effectiveness

Effectiveness will be assessed by the degree to which a policy alternative will result in the production of abundant, affordable, high quality compost throughout the state. A secondary question to be answered in this analysis is: Will this policy be effective at diverting organic waste in the timeframe stipulated by the Legislature? In other words, will this aid in achieving the state's organic waste diversion goal of 75 percent by 2025? Considerations of where compost production physically occurs in the state, and the scale at which it occurs, will also be examined.

Efficiency

Because many of the proposed policy alternatives involve monetary costs, a comparative sense of the impact of state investment will be considered. Efficiency will accordingly be conceived as a straightforward cost-effectiveness assessment: Given the cost to the state, what is the magnitude of the alternative's impact in generating quality, abundant, and affordable compost?

Equity

Three dimensions of equity will be considered: process and distributional equity, and environmental justice. Process equity will weigh whether the policy alternative helps or hinders the participation of smaller composters in the market and encourages compost production by farmers. In addition, the distributional implications of cost incidence will be assessed based on how these costs are shared amongst California residents, compost processors, and farmers. Environmental justice concerns associated with a particular alternative are identified as well.

Feasibility

Many of the policy alternatives identified in this report involve creating new taxes or subsidies, raising fees, or changing regulations. Comparing these options requires analyzing their projected political feasibility and likely implementation outcomes by examining the actors, events, and environments involved in all stages of passing and implementing the proposed alternatives. Questions to be considered are as follows: Can the distribution of costs and benefits help predict what sort of political dynamics are involved? Does this alternative require changing law or agency rules? Once passed or formalized, how easily can the alternative be implemented administratively?

Part III: Policy Alternatives

RESEARCH AND CERTIFICATION

This alternative would address the information deficits which currently exist in the compost market, ensuring that regulatory decision-making is informed by sound scientific evidence and consumers of compost have some assurance of quality. First, the state could fund research to better quantify compost's environmental benefits, particularly its carbon sequestering capacity. Additionally, research could examine the environmental impacts of compost production—especially the impact of manure and food waste composting on water quality and the emission of greenhouse gases and other air pollutants—in order to inform further development of best management practices for compost production. This research could be deployed through education efforts aimed at improving the compost production process and articulating the benefits of compost application to farmers and ranchers, along with clarity about how the regulatory scheme applies to them. Lastly, the state can address the problem of the availability of data on compost facility capacity by requiring mandatory reporting of the quantity of compost produced at the state's facilities. This would allow the state to better ascertain the true capacity shortfall and identify opportunities to develop capacity and incentivize expansion.

Second, the state could create a certification program that would aim to address the lack of information that compost consumers face when purchasing commercially produced compost. One option is to certify the quality of the finished compost product itself. Because compost can vary in its nutrient composition, water content, particle size, organic matter, weed seed and pathogen content, and other factors, a certification program for compost could ensure that compost users are better informed about the makeup and quality of the compost they purchase. This alternative could also take the form of a certification achieved by producers of compost after completing a training program on best practices in the industry. A certification program could be administered by the CDFA or through regional conservation districts or local enforcement agencies.

REGULATORY REFORM

This alternative is comprised of several components that seek to streamline compost regulations to ensure that compost producers have clear rules that are consistent across regulatory agencies and reflect compost's known benefits and hazards, as well as the state's commitment to expansion of the organics recycling industry. Suggested changes include:

1. Changing regional air boards' rules to take a lifecycle view of emissions from composting facilities, recognizing that producers who expand composting capacity are diverting waste from other streams—like static piles, landfills, manure lagoons, or burning—that have more harmful impacts on air quality. Rather than worsening regional air quality, diversion of waste into composting facilities employing BACT are mitigating fugitive emissions from current management practices and reducing overall regional emissions. This recalculation would decrease the mitigation measures needed or ERCs that new or expanding facilities would be required to purchase based on New Source Review in many air districts, decreasing the fixed costs involved in establishing a new facility or increasing production capacity at existing sites.

2. Reclassifying manure as a Tier I rather than Tier II feedstock according to the Water Board's General Order, recognizing that there is no evidence that composting of manure poses the same threat to groundwater as synthetic sources of nitrogen or municipal food waste. Furthermore, this acknowledges that current manure management practices are far worse for water quality than composting, which mitigates many of the dangers posed by animal waste.

3. Aligning agricultural exemptions in the Water Board's General Order and CalRecycle's regulations on composting. This should include standardization of the agricultural material definitions between these two regulating agencies, and expansion of exemptions to allow farms to import materials from other agricultural sources for use in making compost in order to allow farms to make best use of available feedstocks in their area.

4. Establishing a concurrent permitting process for the approval of new composting facilities. This would require coordination and cooperation between state and regional regulatory agencies to establish one streamlined permitting process for new or expanded organics processors.

SUBSIDIZE COMPOST

Subsidies are a policy instrument often employed when a market fails to produce enough of a socially desirable good as is true in organics recycling currently. In light of this, this alternative proposes a $10 per ton subsidy be offered to qualified producers for compost produced from newly diverted feedstock between now and the target year of 2025, at a cost of approximately $57 million over 10 years.[xvii] The rationale and specification for such a proposal is discussed below.

There are at least two arguments for a subsidy, and both suggest a dollar figure in the territory of $10 per ton. On the one hand, relative to its true environmental benefit as a climate change mitigator, compost is undervalued at the market-clearing price. Despite the fact that compost production prevents

[xvii] See Table 3 for calculations.

greenhouse gas emissions, this is not captured in the current price organics recyclers can charge for their organics waste disposal services or compost product itself. The social benefits of compost are simply not what anyone is paying for. Nonetheless, it is estimated that a ton of compost mitigates about one $MMTCO_2E$.[xviii] The allowance to emit that amount of greenhouse gas was auctioned most recently in the state's Cap-and-Trade market for $13.57,[58] and most estimates of the social cost of carbon are between two and two hundred times this dollar figure.[59] On the other hand, industry experts estimate that compliance costs for air and water regulations amount to about $9 per ton of compost. Whether the purpose is to credit producers for their contributions toward greenhouse gas reduction or give them a boost over regulatory hurdles, $10 per ton is a reasonable figure.

In order to make the proposal fiscally plausible, the tons eligible for the subsidy should be restricted to those that would be produced from the material diverted out of landfills and into the organics recycling sector by the AB 1826 and SB 1383 policy drivers in a given year. So if the industry as a whole is expected to convert formerly landfilled feedstock into 934,000 additional tons of compost in 2018 as compared to 2017, the subsidy is offered only on those new tons of compost. The proposal is currently presented without specifying a funding stream, though it could be conceived of as a reallocation of some existing GGRF money received by CalRecycle and is also compatible with other funding options considered in this report.

Table 3. Proposed Subsidy Calculations

	2015-2020	2021-2025	Totals
Feedstock from mandatory diversions added each year	+ 1.1 million tons/year	+ 0.66 million tons/year	9.9 million tons
Resulting Compost	+ 636,000 tons/year	+ 369,000 tons/year	5.7 million tons
Annual Subsidy	~ $6.4 million/year	~ $3.8 million/year	**~ $57 million total**

The subsidy could be administered through a mechanism similar to CalRecycle's design for the GGRF Grant performance payment mechanism included in the 2016-17 grant cycle awards, which will issue payments for each ton of green waste, food materials, or ADC newly diverted from landfills on a quarterly basis.[60] To target the funds geographically, the subsidy would be available to producers up to a yearly quantity proportional to the mandated increase in diverted organics of the county they service, as estimated by AB 876 reporting requirements. In order to support quality assurances, producers would need to prove their product or staff meet minimum standards of quality or professionalism.

[xviii] See Appendix E for calculations that arrive at this claim.

ESTABLISH SUSTAINABLE FUNDING SOURCES

This alternative proposes the establishment of a multi-year appropriation by the state Legislature for the development of the organics recycling sector. This funding would be a separate appropriation from the CalRecycle Greenhouse Gas Reduction Grant and Loan Programs, and would not be tied to Cap-and-Trade auction proceeds. Per CalRecycle's estimates of the financial incentives necessary to develop the compost sector, a maximum appropriation of $100 million per year for five years is proposed to fully support the implementation of AB 1826 and SB 1383.[61] A lesser annual appropriation could also be considered. This appropriation could be administered in several ways: 1) the funding could augment or replace the Greenhouse Gas Reduction Grant and Loan Program funding, 2) the funding could be used for an incentive payment program by subsidizing the production of compost on a per ton basis, 3) the funding could be used to support research, or 4) a combination of these mechanisms.

Another mechanism that could provide a sustainable source of funding for organics recycling is the introduction of a fee, commonly referred to as a generator charge, that could be added to ratepayers' monthly disposal bills as municipal organics recycling goes into effect. Similar to generator charges that are added to other utility bills such as electricity and recycling of hazardous substances, this charge would be added to every Californian's household bill.[62] The recommended amount of the generator charge is $0.10 to $0.20 per month. This modest increase to ratepayers' utility bills would contribute approximately $15.3 million to $30.5 million on an annual basis.[63] The money raised from the addition of the generator charge would be a predictable, sustainable source of funding that could be directly utilized for organics recycling efforts for as long as the state determines is necessary.

PENALIZE SUBSTITUTES

This alternative proposes two options for penalizing the substitutes for composting organic material that would make these substitutes less financially appealing to waste haulers.

The first option includes raising the state waste disposal fee (also referred to as the tipping fee) charged for landfilling waste. Given that the current state disposal fee is currently a low $1.40 per ton, has not been raised since 2001, and does not apply to green materials, there is ample opportunity for the state to increase its revenue from this action. Raising the state disposal fee for landfills as well as requiring this fee be charged for organic materials would help make landfilling a more expensive and less attractive option for waste haulers. Like municipal recycling programs, which have been partially funded through the state disposal fee, the revenue earned from raising the state disposal fee could be used to fund the expansion of the compost sector.

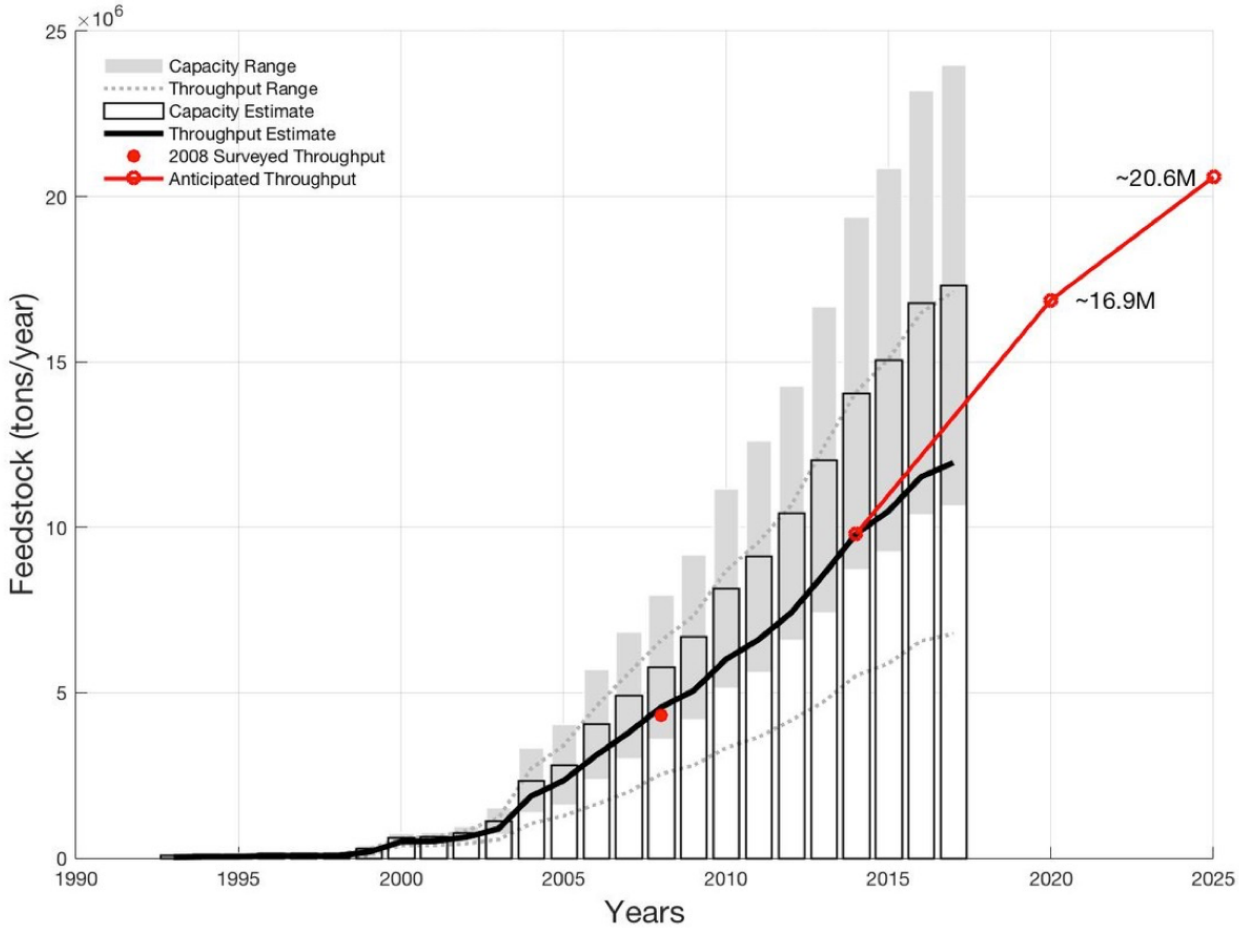
The second option for penalizing the substitutes to organics recycling requires the state to take swift measures to properly enforce the laws pertaining to land application of organic materials. This alternative proposes strict enforcement of permitted land application and existing regulations against illegal land application so that more compostable materials are diverted from being illegally applied to lands, thereby providing more available feedstock to composting operations.

Part IV: Analysis & Discussion

STATUS QUO

Under the current regulatory scheme and given existing infrastructure, it is highly unlikely that the necessary infrastructure will be in place to process the anticipated throughput of organic waste and meet the state's 75 percent organics diversion goal by 2025. The figure below illustrates the capacity challenge facing the state.

Figure 1. California Organics Recycling Industry Capacity, Throughput & Projections[xix]



[xix] The data used to create these estimates is sourced from CalRecycle's FacIT and SWIS databases; 2010 Infrastructure Study; AB 1826/SB 1383 text; and Department of Finance population projections. See Appendix D for details on data sources, computations, and estimates.

Depicted is the cumulative growth of the industry's overall capacity as well as estimates of its throughput (the tonnage of feedstock facilities are handling in a given year). For every given year, the midpoints of both throughput (black line) and capacity (bars) are illustrated, with the corresponding ranges incapacity as given by CalRecycle depicted in gray. The red line projects the throughput needs to 2025, capturing both the anticipated diversion of formerly-landfilled feedstock as well as the increase in the baseline of organic waste generation attributable to population growth. While the growth of the organics recycling sector since the early 1990s is striking, this chart also makes clear the key dubious assumption in the status quo: that the industry's aggressive growth can continue in a linear fashion for another decade. There is an abundance of reasons to believe the next decade will be characterized by far more growing pains than the previous few.

One of the primary barriers to the growth of the organics recycling sector is the regulatory burden faced by composting facilities. The regulations established by CalRecycle and the Water Board are difficult to understand and contain conflicting language around definitions of allowable feedstocks. Appendix C illustrates the complexity of complying with CalRecycle and the Water Board's regulations. Larger firms can hire a consultant to help interpret and comply with the regulatory language, whereas small- and mid-size composters may not have the resources to do so. Unlike large, established waste haulers, small-scale producers and farmers do not have easy access to additional capital to come into compliance with various state agency regulations. As a result, the status quo will only further solidify the disadvantage that small-scale and on-farm compost producers operate under due to the costs associated with regulatory compliance.

Furthermore, the lack of regulatory clarity around agricultural composting will continue to hinder the widespread production of on-farm compost. Without clarification from the Water Board regarding whether manure is or is not an agricultural material, it will be difficult for farms to ensure they are composting in accordance with regulations. Since compliance with Tier II rules requires substantial technical and financial investments, farmers are likely to avoid composting altogether if they believe they fall under this categorization. Additionally, disallowing the exchange of agricultural materials between farms for use in composting—which is allowed in small quantities in the CalRecycle rules for farms but prohibited by the General Order—further hinders the expansion of one potential method for responsible management of this plentiful feedstock.

While organic farmers are already required to utilize compost, many conventional farmers do not view compost as a necessary input in production. Farmer's marginal revenues are so slim that it will be difficult to convince them to add compost to their lands if they are not convinced that the compost they purchase is of the highest quality and will have positive impacts on yield. Because a certification program for compost does not exist, there is no standard of assurance to farmers that the compost they purchase will be high quality. Due to the costs associated with compliance, there is no reason to

suspect that compost will become more affordable and therefore attractive to farmers currently not using it.

An additional obstacle prohibiting the growth of the market for compost is the inadequacy of state investment in the sector. If the funding mechanisms currently in place remain unchanged, they are not likely to compel new investors to enter the market because funding is not widely provided nor guaranteed on a year-to-year basis. There are immense fixed costs associated with compliance and construction of the average composting facility. Given this large capital investment and the lengthy timeline associated with siting, permitting and building such a facility, the lack of state funding is not sufficient to attract the private investment in compost production needed in the near term. While $15 million in competitive organics grants was awarded in 2014-15, over $118 million in grant requests were submitted for this period.[64] This demonstrates a massive demand for state funding that is not being met. Additionally, the Legislature's failure to appropriate funding in the 2015-16 budget for the GGRF Grant Program shows the uncertainty that currently plagues the state funding mechanisms for organics infrastructure development.

Only four new or expanding composting facilities can be expected to receive grants in the 2016-17 Greenhouse Gas Reduction Grant Program cycle if the grants are again administered in $3 million blocks. CalRecycle received 46 grant applications totaling $97 million in requests for this cycle.[65] The amount of funding being offered stands in sharp contrast to the $100 million that CalRecycle estimates is needed annually to support the development of compost infrastructure over the next five years—an amount that is much more similar to the total funding requested in grant applications.[66] Due to the restrictions placed on the GGRF Grant program, any funds allocated by the Legislature must be encumbered within two years. However, the design, siting, environmental review, and permitting process for new composting facilities often takes multiple years, so grants can feasibly only go toward projects that are "shovel ready," otherwise the money will be returned to the GGRF general fund.

Without more significant investment in organics recycling in the longer-run, municipalities will necessarily take a leading role in ensuring organic waste is diverted from landfills as AB 1826 and SB 1383 are enforced. This process will require municipalities to solicit bids for waste disposal that include separate organics recycling. Bidding firms will offer organics recycling services at no less than their minimum average costs, which includes most of the fixed costs of their composting operation. As municipalities begin to pay haulers for the costs of mandatory organics recycling, they will ultimately pass on the increased costs of waste collection to their ratepayers. This may have a disproportionate impact on low-income ratepayers for whom the increase will be more burdensome.

There is also an environmental justice concern with siting facilities in the status quo scenario. While well-managed composting facilities pose minimal environmental hazards and present net benefits to regional

air quality, low-income communities and communities of color are frequently the neighbors of such waste management sites, and even the best-managed operations are likely to increase vehicle traffic and and result in some VOC emissions.

Maintaining the status quo requires no action by the state and is therefore a politically attractive alternative for state agencies and legislators. A common perception of the development of the compost market holds that while the state's diversion goals will not be met by 2025, there is not an imperative need to interfere any further in encouraging the expansion of the market. However, failing to meet the state's diversion goals in a timely manner may have negative consequences for the responsible enforcement agencies and proponents of the relevant legislation. While AB 1045 was passed in 2015 to require coordination among regulatory agencies, the resulting working groups have not yet produced any fundamental reconciliation of the conflicting regulations or definitions. Given CalRecycle's authority to lead this coordinated effort, the agency may come under greater scrutiny if it fails to meet the statewide organics diversion goals.

In addition, it is likely that ratepayers will direct their disapproval of waste collection fee hikes at the entity they view as responsible. If the state does not intervene by providing greater financial support to municipalities for developing organics recycling infrastructure, ratepayers may solely blame municipalities for increased waste collection rates. This outcome may be politically unattractive due to the tension that could arise between municipalities and the state over pressure from upset ratepayers.

As a whole, the status quo has major drawbacks due to is its lack of timeliness, effectiveness, efficiency, and equity; the state's 75 percent waste diversion goal may be met without intervention eventually, yet it is highly unlikely to be met by 2025. Moreover, the status quo does little to ensure that quality compost will become more abundant and affordable, or that the financial burden of mandatory organics recycling will not fall more heavily on disadvantaged Californians. Finally, the status quo is inefficient because it does not provide the necessary increase in capacity for the anticipated quantity of organic waste that will need to be processed. Without further policy intervention, it is not likely that the state will achieve its organics diversion goals and reach the socially optimal level of compost production on the desired time scale, sustaining net overall costs to society.

RESEARCH AND CERTIFICATION

Research

The primary objective achieved by this alternative is an alleviation of the information deficits that currently plague the composting industry by ensuring regulatory decision-making is backed by scientific data and

compost consumers can be more confident about the quality of compost. Investment in research by the state would help clarify the potential environmental harms that different types of compost production realistically pose, providing the evidence needed to form regulations that ensure environmental protection without treating compost as though it has the same hazards as landfilling or synthetic fertilizer use. Furthermore, understanding the realistic water and air quality implications of compost production will inform better development of regulations. In addition, quantifying compost's benefits to soil quality and health would help encourage farmers and ranchers to begin utilizing compost on their lands. Research can also inform comprehensive education campaigns on the ecosystem benefits associated with widespread compost use, which would theoretically encourage broader adoption of compost use among conventional farmers and ranchers.

Collecting accurate data on existing organics recycling capacity will be essential to the planning efforts of municipalities as the state's diversion goals come into effect. Without a mandatory reporting scheme, the state's throughput capacity may continue to be over- or under-estimated, which will impede the achievement of its long-term organics recycling goals. This lack of data on capacity also has broad repercussions for properly quantifying the state investment needed to subsidize the growth of the composting sector.

Research has strong potential to increase consumer demand for finished compost as its benefits become more widely appreciated, which is anticipated to further drive production. However, it is unclear whether this proposal would ensure compost production becomes more widely distributed across the state. Because the state's investment in research is relatively inexpensive, but will have long-term benefits for the industry, this alternative is exceptionally efficient. Publicly funded research is a highly equitable option because it can equally inform both small- and large-scale producers of the benefits of compost. The human resources needed for research already exist in state agencies and universities, making this a highly feasible alternative. There are a number of talented researchers doing work in this area that have existing relationships with state agencies, but require state funding to conduct further analysis.

Certification

A certification program would help to eliminate the information asymmetry that farmers face when buying commercially produced compost. Like research and education on the benefits of compost use for farmers, the certification of quality would drive demand and therefore stimulate further production. Certifying the quality of finished compost would give producers, assuming that standards are rigorous, the most information about the compost they purchase. Establishing a new certification program could have significant, ongoing costs to the state required to hire new staff, develop standards, and conduct inspections. As with many other certification schemes, it is much easier for larger composters to absorb

the costs associated with meeting certification standards. While this would be the most effective way of ensuring the quality of commercially produced compost, its high fiscal and administrative costs make this option infeasible.

A training certification for producers would give less specific information about the composition of compost, but would be easier and more affordable to implement from the state's perspective in comparison to certifying compost's quality. Because of its lower costs, this option has the potential to be less burdensome for small compost producers.

REGULATORY REFORM

Regulatory reform can help overcome the complex and unclear regulatory landscape that currently exists for composters. By aligning the rules developed by multiple regulatory agencies with current scientific knowledge and the state's commitment to organic waste diversion, this alternative could aid in the development of the compost sector.

Changing the way that regional air boards assess emissions will ease the burden for new composting facilities that are currently viewed as new sources of emissions. Along with concurrent permitting, this change will make the establishment and permitting of new facilities more straightforward, speedy, and less expensive. This will expand the availability of compost and may marginally deflate the price of organics recycling since there will be a lower cost to establishing new facilities.

Reclassifying manure in the Water Board's General Order will help small and mid-size facilities in regions with large quantities of dairy manure to continue operating close to both the source of their main feedstock and in proximity to agricultural consumers of compost. This would also benefit agricultural compost producers that currently are not allowed to import agricultural materials (including manure) onto their farms without foregoing their exemption. If this is not changed, declassification of manure will at least mean that they do not need to meet the prohibitive requirements entailed with Tier II status in order to use manure in their compost piles. Changes to the classification of manure and expansion of agricultural exemptions may improve the quality of compost produced, since farmers who can access diverse feedstocks are likely to make better compost than that available commercially.[xx] Furthermore, if farmers and commercial composters were not confused or worried about the use of manure, the resulting increase in composted manure would have a significant role in ameliorating the dairy industry's current manure problems. It would also contribute to the feedstock available to commercial composters in dairy-producing regions, driving demand for organics recycling and increasing the financial viability of the sector.

[xx] See Footnote vii for a brief explanation of opinions on manure use in compost.

Regulatory changes as a whole are anticipated to be effective in making more compost available on a faster timeline than the status quo. In addition, these changes can contribute to maintaining the affordability of compost and its wider distribution throughout the state. Costs to implement regulatory reform are minimal, as the infrastructure and staffing already exist to carry out regulatory changes. In spite of the low price tag, these reforms could have major positive impacts on the operating costs for compost producers by reducing the costs of compliance. Regulatory reforms present a good opportunity to address equity amongst compost producers of different sizes. The labor and financial outlays involved in meeting regulations and permitting requirements are particularly burdensome for smaller producers who are less able to divert resources to compliance. Similar to the status quo, placement of new composting facilities has additional equity implications for communities disproportionately impacted by air and water quality contaminants and should be taken into consideration in siting decisions. Simultaneously, the potential increase in composting of dairy manure will benefit farmers and rural communities that currently are not managing their dairy manure using best management practices with detrimental environmental and human health results.

It is difficult to change agency regulations developed through long, multi-stakeholder processes. In particular, the Water Board has indicated that although some rules were developed without data, scientific evidence will be required to change them.[67] However, the legislative mandate from AB 1045 requires state agencies to collaborate in development of coordinated permitting and regulation of composting facilities. Although significant progress has not yet been made towards streamlining efforts as a result of 1045, this vehicle could be leveraged to improve agency collaboration. In addition, while implementation is difficult, as because these changes require minimal financial outlays and no further legislative action, the necessary mechanisms for implementation of this alternative already exist.

SUBSIDIZE COMPOST

Looking forward, a short-term and geographically targeted compost subsidy could inject enough money to prime the pump of the organics recycling sector, though this mechanism may need to be broadened to have the desired effect.

A subsidy supplements the willingness to pay of private compost consumers, and we can reasonably expect that producers would respond by producing more quantity. Compost producers who receive a $10 per-ton subsidy will receive a price for each qualifying ton of compost that is between 30 and 100 percent of what they could charge for that product, so this revenue supplement could be quite substantial. Firms can then do one of three things with the additional money, all of which are desirable to an extent. Firms can reduce the prices they charge businesses and municipalities for taking their organic waste, easing the transition to overall higher waste disposal rates. They can invest the money in

additional infrastructure, further addressing the infrastructure capacity shortfall. Or they can return the money to investors, potentially drawing additional investment into the sector. Stipulating that the number of tons that qualify is proportional to the regional change in organics diversion would result in the subsidy dollars being directed to the parts of the state where organics recycling is furthest behind, and we anticipate that the additional funds could help to stabilize existing producers who are working to meet regulatory demands and potentially also spur additional infrastructure development.

The chief advantages of this alternative are its ability to efficiently support distributed compost production, and provide some support for a minimum quality standard. Priming the pump through this sort of investment directly incentivizes the thing that we want more of: compost. As such, it is arguably more efficient than an infrastructure investment because facility investments carry comparatively greater risk and production uncertainties (all those involved in starting and running a business). And from the standpoint of the state's greenhouse gas mitigation goals, $10 per ton of MMT$CO_2E$ mitigated is a steal! By requiring that a ton of compost meet a quality standard to be eligible, the state could leverage the incentive to build more consumer confidence around quality. Stabilizing the profitability of firms in underinvested regions, a subsidy can also correct against urban bias in resource allocation. Insofar as firms moderate their charges to municipalities, this may also be a benefit to ratepayers in these communities. Because it is agnostic as to production type or scale, the subsidy is equitable in a procedural sense, as well. And since CalRecycle doesn't have to be an arbiter of good or bad business-plans, there are some administrative efficiencies, too.

That said, a subsidy is unlikely to bring in new firms and may be either difficult to administer or too costly to be politically feasible. In the restricted specification (only tons of compost produced from formerly landfilled feedstock, proportional to the anticipated diversion in that region) it would be hard for producers to anticipate what subsidy dollars would be available once they have gone through the five to seven years of new facility permitting. It might be difficult for CalRecycle to predict those numbers, for that matter. Moreover, since organics recyclers are currently not subject to any production reporting requirements, an entirely new mechanism would have to be developed to accurately measure tons and dole out subsidy dollars. Expanding the scope of what tons qualify for the subsidy could result in a greater stimulus to the sector and would also simplify the program's administration, but this comes at a potential tradeoff of political feasibility, since it would come with a larger budgetary cost. While this would be money well spent, it might mean the most effective version of this alternative would require substantially greater political capital than the more narrowly specified but somewhat cumbersome version.

SECURE SUSTAINABLE FUNDING SOURCES

Cap-and-Trade auctions have shown great volatility in the last year and therefore cannot be relied upon for encouraging the expansion of composting to the level needed to meet legislative mandates. While the auctions generated over $1 billion in the state during fiscal years 2014-15 and 2016-17, the last several quarters paint a different picture: over $8 million in proceeds were generated in the third quarter of 2016, $364 million in proceeds were generated in the fourth quarter of 2016, and around $8 million in proceeds were generated in the first quarter of 2017.[68] Furthermore, the prospect of Cap-and-Trade beyond 2020 is presently uncertain and will require the Legislature to confirm the Air Board's authority to administer the auctions through a two-thirds urgency vote when it approves the Governor's 2017-18 budget in June.[69]

The dramatic fluctuation in auction proceeds illustrates the problem with the present funding of the GGRF Grant and Loan programs from the Cap-and-Trade program. Because funding is not appropriated by the Legislature to CalRecycle on a predictable year-to-year basis, potential investors in expanded or newly constructed composting facilities are dissuaded from entering the market. Given the average timeframe of five to seven years needed to fully design, site, permit, and construct a new facility, knowledge of a continuous available funding source would attract more investors to composting projects.

Establish a Continuous Appropriation

By establishing a continuous appropriation through the Legislature for the development of the composting sector, this alternative would help alleviate the current uncertainty in funding for organics recycling. The recommended amount of $100 million a year for five years is based on CalRecycle's estimate of the state assistance required to leverage private sector funding and local rate structure changes to support the financing of organics infrastructure and market development.[xxi] This appropriation could be administered by CalRecycle through either a grant and loan program similar to the current GGRF Grant and Loan Programs, through a per-unit subsidy on compost produced, or through a combination of these payment mechanisms. However this funding is utilized, it would eliminate considerable uncertainty, allowing compost producers to build this potential revenue stream into their long-term funding models and use it to secure greater private investment. Additionally, this substantial investment would better meet the demand for state grants demonstrated by the requests CalRecycle has received for the 2016-17 grant cycle.[70]

[xxi] CalRecycle arrives at this number through the following calculation: the estimated cost of the number of new or expanded facilities needed to comply with AB 341 and SB 1383 is $2-3 billion over the next ten years. Assuming the necessary leveraging of private investment may be achieved if the state provides 20% of the mid-point of this funding over a five-year period, the state's investment would total $500 million, or $100 million per year over five years. Levenson, H. (2017, April 28). Email correspondence.

This alternative would also help address questions of process equity, as more compost producers could take advantage of increased state funding for composting projects. CalRecycle is presently confronted with the task of "picking winners and losers" due to the competitive nature for grant money and the implicit requirement that projects must be "shovel ready" at the time the grant is awarded. By expanding the amount of funding, smaller projects will face a better chance of receiving state support, and projects that are not yet ready for construction can be given assistance for pre-construction activities such as siting and permitting costs. Promoting the participation of small and mid-size composters is an essential component of ensuring compost facilities are widely distributed across the state so that capacity is available where organic waste is collected.

In addition, this alternative would lessen the burden on ratepayers by increasing the amount of state funding available to comply with AB 1826 and SB 1383. By making organics recycling more financially feasible for municipalities and composters through greater access to grants and/or incentive payments, less of the cost of compliance will fall on ratepayers. Therefore, distributional equity concerns are attenuated by lessening the potential increase ratepayers can expect to face as municipalities begin mandatory organics collection.

Convincing the Legislature of the necessity of continuously appropriating funds for the development of the composting sector will require significant political will and an acknowledgement of the obstacles preventing the state from reaching its organic waste diversion goals. As is the case with much legislation, AB 1826 and SB 1383 were passed without any appropriations. However, the lack of progress in expanding the capacity of composing operations as well as CalRecycle's estimates for required funding are red flags indicating a serious underinvestment in the sector. This alternative would help ensure that the costs of organics recycling are not entirely borne by ratepayers as a result of municipalities raising waste collection fees. By offering a greater amount of funding for CalRecycle to administer, subsequent municipal and private sector investment in organics recycling will lessen the direct impact on ratepayers through localized rate increases. This source of appropriations should end once the sector is no longer reacting to changes that are a result of statutorily mandated diversion and has stabilized.

AB 1342 has been introduced by Assemblyman Heath Flora for consideration in the current legislative session. This bill would continuously appropriate $100 million from the Greenhouse Gas Reduction Fund to CalRecycle for in-state organic waste and recycling projects that reduce GHGs.[71] Although this bill is a promising indication of movement by the legislature toward appropriating funding for the compost sector, there is apparently very little political will behind this bill, and it is not expected to pass.[72] However, the Governor's strong commitment to GHG reductions indicates this may still be a strategic moment to capitalize on. One of the Governor's climate change pillars calls for enhancing the carbon sequestration of forests, rangelands, farms, and soils to achieve GHG reductions.[73] Because of the

critical role compost plays in carbon sequestration, there is a strong case to be made for increasing the state's commitment to adequately financing the growth of the compost sector.

Introduce a Generator Fee

Introducing a generator charge on ratepayers' monthly disposal fee would also provide a sustainable source of funding for organics recycling by installing a continuous funding stream. There are currently no additional fees associated with waste disposal (excluding hazardous waste) that are charged to ratepayers. Given California's broad ratepayer base, between $15.3 million to $30.5 million could be raised if a charge of $0.10 to $0.20 per month were established.[74] This range is comparable to the approximately $0.17 monthly generator fee charged to residential ratepayers on their electricity bills.[xxii] The funds raised by a generator fee could be administered by CalRecycle for organics recycling or other projects that help the state meet its waste diversion goals, at which time the fee could be reassessed or removed. While the estimated upper limit of $30.5 million in revenue would greatly help address the need for funding of organics recycling, this amount still pales in comparison to the funding projected by CalRecycle to propel organics recycling past the "hump" it is at now.

Because the increase to ratepayers' monthly disposal bills would be quite modest, it is likely that many ratepayers would not be highly attuned to the introduction of a generator fee. However, unlike an appropriation based on the California tax base, a generator fee would be more explicitly known to ratepayers. Therefore, the new costs to ratepayers are more directly traceable than an appropriation. A generator fee can also be considered as a regressive tax on ratepayers, as the fee would not be proportional to individual ratepayers' income. This would therefore be a less equitable option than an appropriation from the state's general revenue, which leverages the progressivity of the California tax code.

Passing legislation to introduce a generator fee may prove politically challenging as legislators may be hesitant to associate themselves with "taxing" ratepayers. However, other utility bills, such as electricity bill, already have a generator fee, so there is political precedent for this type of policy.[75] As a whole, the proposal of a generator fee would be effective at providing organics infrastructure with some stable source of funding, yet it would require significant political fortitude to pass with a two-thirds vote of the Legislature.

[xxii] Californian residents use an average of 573 kilowatt hours of electricity per month, while the surcharge on electricity is $0.00029 per kilowatt hour, giving a month average of $0.166. Data from: Electricity Local. (n.d.) California Electricity Rates and Consumption. Retrieved from http://www.electricitylocal.com/states/california/

PENALIZE SUBSTITUTES

Raise the State Municipal Solid Waste Disposal Fee (Tipping Fee)

The low state disposal tipping fee California charges to waste haulers does little to drive organic materials to better uses. This alternative recommends increasing the state disposal fee to $4.00, which is an amount supported by current legislative efforts.

Because California has not successfully increased the state disposal tipping fee since 2001 or adjusted the price for inflation, California's cost of landfilling likely presents the lowest cost option to municipalities for the disposal of organic material. According to CalRecycle, more than half of landfills charge less to accept green waste, which only adds to the incentives municipalities have to send their organic waste to landfills.[76] While there is a great deal of complexity in how landfills set their own tipping fees for accepting waste, landfills might charge less for taking organic waste than for municipal solid waste. This may be due to the fact that organic waste is less hazardous and easier to handle, or because landfills can utilize the organic waste as ADC until AB 1594 goes into effect in 2020. CalRecycle further reports that negotiation for discounted landfill tipping fees is common, indicating the need for the state disposal fee to be increased so that landfilling becomes more expensive.[77]

Requiring a higher state disposal fee would help remove the present lack of financial incentives to divert organic waste from landfills, thereby helping California achieve its statewide recycling goals. Increasing the state disposal tipping fee would not only discourage the disposal of organics in landfills, but also raise needed revenue for the state. Therefore, this policy alternative would be effective at indirectly meeting the objective of encouraging the production of compost throughout the state by directing more feedstock material to compost facilities. Raising the state disposal tipping fee at landfills also raises concerns regarding the distribution of who pays for the increased costs of landfilling. If the responsibility of paying for landfilling falls equally on California residents, concerns regarding how low-income residents will be able to adjust to the new prices must be considered.

Previous attempts to raise the tipping fee have been defeated in the Legislature. Most recently, AB 1063 was introduced in 2015, which included an increase in the state's solid waste disposal fee from $1.40 per ton to $4.00 per ton beginning in January 2017. This year, Assemblymember Susan Eggman introduced AB 1288, which proposes the same state disposal fee increase and will require a two-thirds vote of the legislature to pass.[78] The political feasibility of this bill passing has been compared to SB1, commonly referred to as the gas tax bill, as it involves a new fee for ratepayers.[79] SB1 required over a year and a half of thorough negotiations, and it still passed with a very close vote. It is expected that AB 1288 will face a similar battle, which calls into question the feasibility of this alternative.

Enforce Existing Laws Regarding Land Application

The issue of land application has only been widely recognized at the state agency level in the last two years, making this a relatively new concern for the state.[80] Despite the illegality of most land application, many LEAs are not enforcing existing laws against the practice, making this an important problem for the state to address. Enforcing the current permitting process and regulations regarding land application would be effective at directing more feedstock to composting facilities, thereby encouraging the production of compost.

In addition, enforcing compliance with regulations related to land application would be a cost-effective method of making this substitute for composting less attractive. The agency infrastructure needed for enforcement against land application already exists, so no new enforcement structures, policies, or regulations are necessary. Therefore, very few additional costs are expected to be needed to implement this alternative, making enforcement an efficient use of agency resources.

This alternative has multiple environmental justice implications given the water quality, vector, and odor problems that result from land application. Enforcing regulations against illegal land application is fundamental to ensuring communities are not subject to harmful environmental conditions. Given that much of the land application is occurring in areas with a concentration of low-income residents, enforcing illegal land application will help safeguard the interests of these communities.

Because enforcement of land application regulations should be easily administered, there is no reason to suspect that this alternative will come under political scrutiny. In fact, as the issues associated with land application become more widely known, it is likely that responsible regulatory agencies and elected officials will face public pressure to do something. As a result, this alternative can be seen as a highly feasible and essential undertaking to protect the health and safety of Californians.

Part V: Recommendation

To begin with, it is apparent that the state of California ought to do something. While clearly the most feasible option, the status quo is insufficient to produce the socially desirable quantity of compost and it generates inefficient, inequitable, and untimely outcomes. The recommendations that follow give high priority to political feasibility, as strong political will is required to take the steps necessary to propel the state toward reaching its diversion goals.

Research is given top priority in this recommendation as it interacts with and enhances all of the other policy options. For instance, if regulators and producers alike understand the realistic threat that compost poses to air and water quality, regulations can protect precious natural resources and human health without unnecessarily hindering practices that will result in net environmental benefits. This will be especially instrumental in forming rules that allow farmers and commercial composters to manage manure responsibly in the production of high-quality compost. Furthermore, knowledge gleaned through waste characterization and capacity studies is uncertain, which has ramifications for the organics recycling sector as a whole. Effective capacity planning among municipalities can only be conducted if state agencies have better information on existing composting capacity. Furthermore, while the benefits of compost as a soil amendment are well known, they are not necessarily well quantified and in order for agricultural demand to provide needed revenues for a growing industry—and for the state to garner the environmental benefits from widespread compost use—it will need to be measured as rigorously as other precisely controlled agricultural inputs. While research does require modest state funds, they are incurred initially and will continue to pay dividends as publicly-funded research can inform science, agricultural technologies, and policy for decades to come.

Second, enforcement of existing laws and regulations that restrict the legal application of organic waste on open land will effectively drive organic waste towards organics recycling and away from its harmful alternative uses. Because enforcement agencies have only recently become aware of this problem, the state should ensure they have the necessary resources to enforce proper land application practices. With ADC no longer counting toward diversion goals by 2020, it will be even more important to prioritize enforcement so that firms and municipalities do not turn to land application as a cheap option for organic waste disposal. More available feedstock introduced into the organic recycling sector will in turn help drive the composting industry in areas where land application is occurring.

Research plays a role in enforcement of land application regulations, as this practice is largely undocumented and anecdotal. A systematic study should be conducted to understand the impact land application is having on both the environment and adjacent communities. Addressing illegal land

application is undoubtedly the duty of the state, and the existing regulations in place make this effort both politically feasible and necessary.

Next, regulatory reform should be a high priority because of its potential to lower the costs of infrastructure development and provide greater clarity and ease for on-farm and commercial composters. While state investment in the industry is likely to continue to be inconsistently and insufficiently spread across the whole industry, shaping air and water regulations to better accommodate compost producers is among the best alternatives to ensure a healthy, thriving, and dispersed industry in the short-term. Current regulatory confusion is undeniable and will continue to constrain the development of small-scale and on-farm composting, in addition to slowing the construction of larger, better-funded commercial facilities. AB 1045 already exists as a vehicle to encourage agency cooperation on the permitting and siting of compost facilities, which should be leveraged to address the current dysfunction resulting from agencies' focus on developing rules according to their individual mandates.

Beyond adopting reasonable regulatory reform, the state should take bold action by injecting additional money into the composting industry. First, an appropriation of $100 million over five years should be strongly considered, as the magnitude of this investment would be the most effective at accelerating the organics recycling market in order to meet the state's legislative mandates. A sustainable appropriation of this size has the advantages of being certain enough to allow the industry to grow at an aggressive pace. This appropriation could be used to fund any of the other policy alternatives with fiscal requirements, so long as they serve the organics diversion goals.

Administratively, an appropriation is a straightforward alternative because it allows state agencies to determine the best use of funding without needing to create new structures or programs. However, an appropriation of $100 million per year over five years will face a tough political landscape, yet this political reality does not diminish the impact such a large investment would have in propelling the compost sector forward.

The next step the state should take to introduce additional resources into the industry is the assessment of a per-unit subsidy of compost production. While there are risks involved in not getting the amount right, this alternative addresses the need to prime the pump of a growing economic sector. A per ton subsidy to new compost production can do this in a targeted way that supports access for producers of all sizes and would infuse investment into geographic areas where organics diversion represents the biggest change from "business as usual."

Unless the subsidy is funded from a continuous appropriation as recommended above, it still faces the problem of instability. To have the greatest effect at stabilizing distributed infrastructure and helping the industry overcome regulatory compliance costs, the subsidy should be funded from an appropriation,

rather than from Greenhouse Gas Reduction Funds. There are also costs associated with the implementation of a per-unit subsidy, as CalRecycle would likely have to increase their staffing to effectively administer the subsidy, and current information deficits make accurately tracking new and expanding production difficult.

Because the proposed generator fee would contribute a smaller amount of funding than the recommended appropriation, and because it would be collected from ratepayers rather than the entire California tax base, it is given less priority. With this option, the burden of financing the growth of the organics recycling sector would be less equitable than an appropriation and the benefits would be less dispersed. Furthermore, because the costs to ratepayers are more direct, it is likely to face a tougher political battle than an appropriation from the general state fund.

Certification is one of the final measures to be recommended as it is administratively complex and would require the creation and implementation of an entirely new program. First, a robust certification program is implausible without the necessary research to support minimum quality standards. Certification can arguably be seen as another layer of regulatory burden, which could result in an additional barrier to small-scale composters, while large-scale producers might be better able to marshal the resources needed to comply with set standards. The gains in quality that certification seeks to achieve could more easily be secured through less formal mechanisms (such as market pressure or eligibility requirements to receive a subsidy or infrastructure grant). Moreover, consumer interest in a certification program is mixed and unpopular amongst producers, making this policy alternative somewhat beyond the scope of what is currently needed to move composting forward in California.

Finally, raising the state municipal solid waste disposal fee (tipping fee) is ranked lowest because previous attempts to do so have failed in the Legislature. Furthermore, it is unknown how high the fee would have to be raised in order to make organic recycling more competitive with landfilling. This approach is also somewhat duplicative in its efforts, as California's waste diversion laws are already intended to redirect organic waste from landfills toward better uses. Attempting to dissuade waste haulers from landfilling organics waste through raising the disposal tipping fee is a circuitous attempt at best, and an unnecessary political fight at worst.

Part VI: Limitations & Further Steps

Though this report is intended to give a comprehensive perspective on the market and regulatory challenges facing the compost industry in California, there are additional aspects of the sector that require further analysis. The effectiveness of existing legislative policy drivers remains to be seen; their collective influence must be carefully and continuously studied to determine the most critical and impactful areas for the state to intervene.

As AB 876 comes into effect and counties begin to report on their progress toward meeting organics diversion goals, the state will have a much more thorough picture of the capacity shortfalls that exist across the state. The distributive aspect of organics processing capacity was not well quantified in this report since making such spatially explicit estimates would require many assumptions and extrapolations from existing data. While CalRecycle does report on the geographic distribution of the throughput of composting and anaerobic digestion facilities in its 2015 "State of Recycling" report, this data is composed of estimates that are not corroborated by more precise survey methods. The way that shortfalls are distributed across the state, however, are key to the viability of the status quo.

How the status quo unfolds depends chiefly on how municipalities enact their responsibilities under the state's organics diversion goals. Municipalities will need to contract with organics recyclers or establish city-run composting facilities as state mandates come into effect, if they have not done so already. It is anticipated that municipalities in different areas of the state will face diverse challenges in meeting these goals, as current infrastructure varies widely across the state. However, given the time and data constraints of this report, the nuance in response of municipalities to the diversion goals could not be captured. Additional analysis should be done to project in greater detail whether municipalities will feasibly be able to meet the state's goals, particularly without financial support from the state.

An additional area in need of exploration is the impact that physical contamination requirements will have on the quality of and demand for compost. While CalRecycle regulations will require that compost contain no more than 0.5 percent of physical contaminants greater than 4 millimeters beginning next year, this report does not address whether this requirement will improve the quality of compost to stimulate further demand. Though this is presumably a positive step toward reducing the presence of plastics and other contaminants in commercial compost, it is unknown whether this requirement will be stringent enough to have an impact on demand for commercially produced compost by farmers. The effect this regulation will have on the production techniques and costs of commercial composters was also outside the scope of this report.

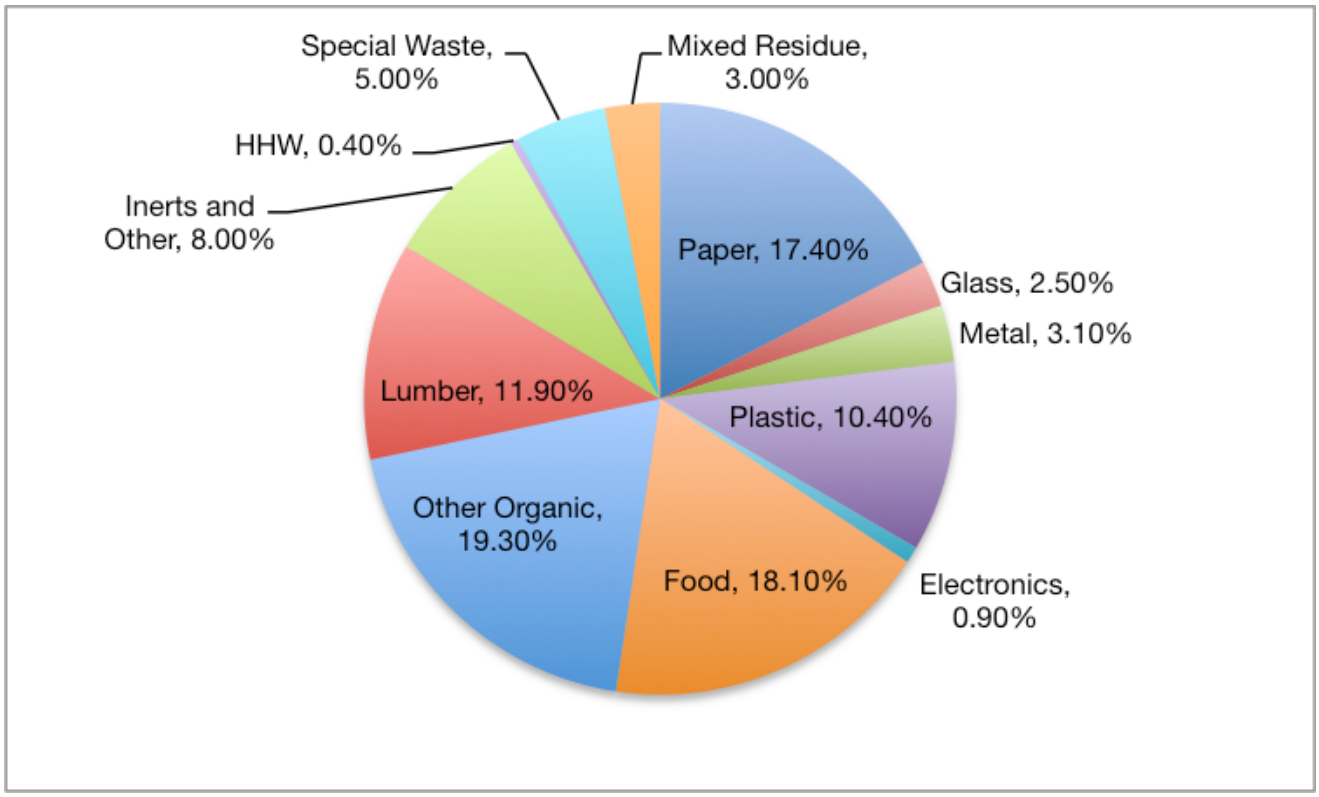
Further uncertainty surrounds the issue of illegal land application and the magnitude of this problem. Given the recent attention this issue has garnered, the state has yet to fully determine the extent of illegal land application, making the potential impacts of this practice extremely hard to quantify. If illegal land application proves to be a widespread problem—as is suspected—it is likely resulting in a less-than-ideal supply of feedstock for the organics recycling industry. Better quantification of this issue at the state level will help facilitate adequate policy responses.

As this report illustrates, one of the most fundamental challenges the compost industry in California faces is a lack of data, both on the quantitative aspects of compost use and the estimated capacity needs municipalities will require to meet state diversion mandates. As more of this information is collected under AB 876 and other reporting structures, the state will be able to form a better strategy for moving the composting sector forward. Until such data is available, the organics recycling sector will continue to suffer from unpredictability and uncorroborated assessment.

Lastly, the stakeholders involved in this complex issue are wide ranging and diverse and the impacts of recent legislative and regulatory changes on these individuals and entities can be harder to predict for some than others. In particular, the full implementation and enforcement of rules for certain sectors of the industry and the degree of noncompliance has yet to be seen, especially amongst small and mid-size compost operations, which is still largely unknown. Anecdotal accounts verify that some smaller producers whom local farmers rely on for their high-quality compost are going out of business, at least in part due to Water Board rules that make composting manure infeasible without enormous economic outlays. Furthermore, it is likely that some on-farm composters are not following the rules surrounding agricultural exemptions by importing materials from other farms. If local enforcement agencies choose to focus their attention on this practice, it could have devastating impacts on organic farmers throughout the state. On-farm composting is vital to the maintenance of current compost production levels, and its persistence and expansion will require that state officials and advocates alike continue to elicit input from and analyze the vitality of these compost producers.

APPENDIX A: CALIFORNIA'S DISPOSED WASTE STREAM

Figure 2: Composition of California's Overall Disposed Waste Stream (2014)

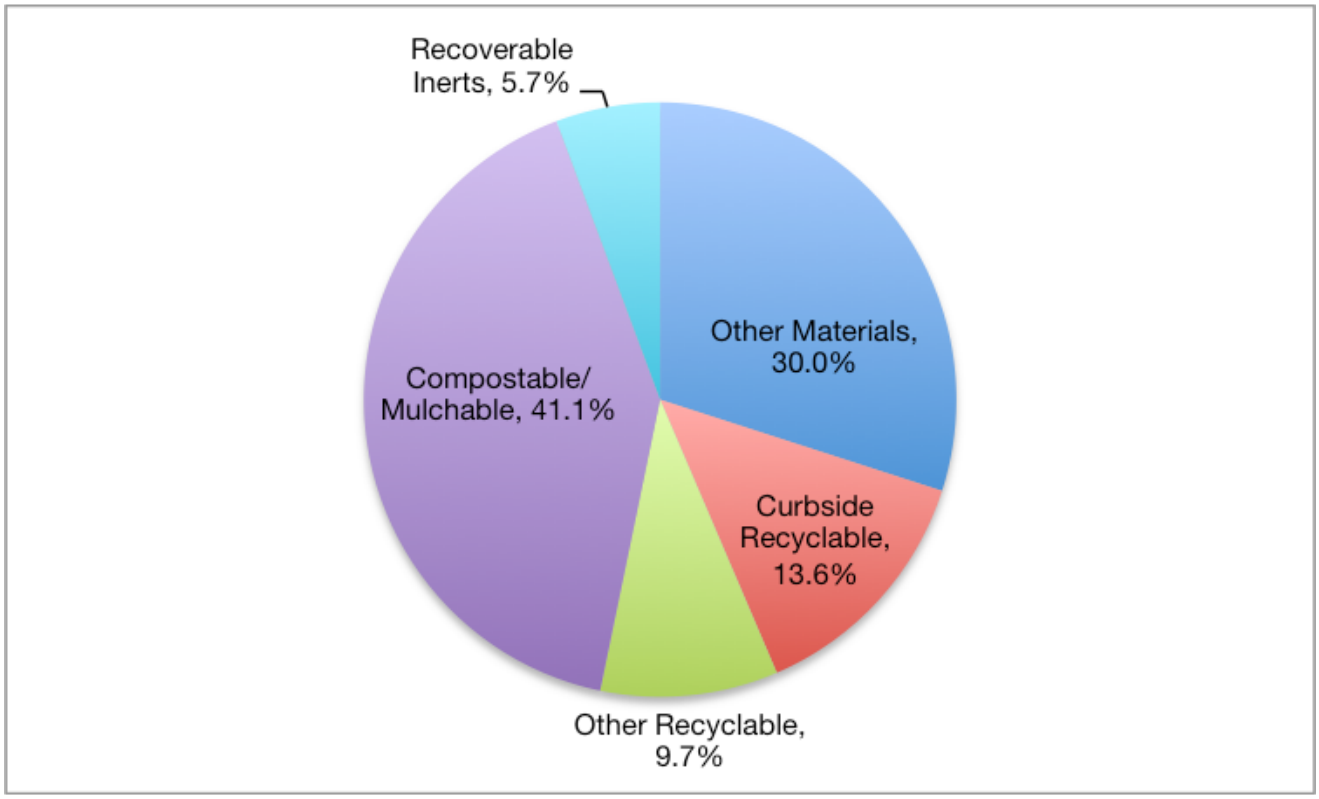


Data Source: CalRecycle. (February 2016). *State of Recycling in California.*

This chart represents the composition of the 74.9 million tons of disposed waste that was collected in 2014, when CalRecycle last conducted a waste characterization study. Approximately 42 percent of the waste stream was landfilled, despite the fact that much more of the waste stream is recyclable. Looking at only food and organic waste, an astonishing 37.4 percent of the overall disposed waste stream could be composted, revealing the opportunity for growth of the organics recycling sector in California.

APPENDIX A: CALIFORNIA'S DISPOSED WASTE STREAM

Figure 3: Recoverability of California's Overall Disposed Waste Stream (2014)



Data Source: CalRecycle. (February 2016). *State of Recycling in California.*

This chart represents the recoverability of the materials disposed of in 2014, according to CalRecycle's waste characterization study. This analysis suggests that there is significant potential to divert material away from landfills toward better uses, particularly among food and other organic material. (Note: "Other Materials" includes any material that does not currently have a recycling market in California.)

APPENDIX B: LEGISLATIVE TIMELINE

Legislation	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030
AB 32 *(Global Warming Solutions Act)*		Updated target scoping plan			***Goal:*** 25% reduction in GHG emissions						***Goal:*** 40% reduction in GHG emissions
AB 341 *(Mandatory Commercial Recycling)*	Starting in 2012, commercial generators with 4 cubic yards/week of municipal solid waste must have a mandatory recycling program				***Goal:*** 75% Statewide Recycling Rate						
AB 1826 *(Mandatory Commercial Organics Recycling)*	Mandatory recycling if organic waste = 8 cy/week		Mandatory recycling if organic waste = 4 cy/week	Mandatory recycling if MSW = 4 cy/week	Mandatory recycling if MSW = 2 cy/week, if 50% of all organics are not diverted by 2020 CalRecycle to conduct waste characterization study in 2018 with a 2019 determination						
AB 1594 *(ADC)*			Jurisdictions must submit green waste Alternative Daily Cover plans		No diversion credit given for green waste used as Alternative Daily Cover						
AB 876 *(Organics Waste and Capacity Estimates)*		Counties estimate 15-year capacity	Counties report annually on organics capacity and progress of AB 1826			Counties continue to update report on organics processing capacity					
SB 498, AB 901 & AB 1103 *(Reporting)*	Wood chips to bioenergy reported	Regs on reporting system adopted	Food waste, compost, and wood commodities are reported annually								
SB 1383 *(Methane Mitigation)*		CalRecycle to develop regulations	CalRecycle to adopt regulations in 2018 based on targets		***Goal:*** 50% reduction in the level of organic waste from 2014 baseline				Penalties for non-compliance effective	***Goal:*** 75% reduction in the level of organics waste from 2014 baseline	
AB 1045 *(Infrastructure)*	CalEPA to promote compost use and coordinate regulations	CalEPA to post recommended actions	CalEPA to hold state meetings, annual public meeting, and annual CalEPA update of recommendations								

APPENDIX C: CALRECYCLE & WATER BOARD REGULATORY MATRIX

This regulatory grid is intended to capture the regulations for composting operations under CalRecycle (Title 14, California Code of Regulations, Division 7, Chapter 5.0, Article 3.0) and the State Water Resources Control Board (Order WQ 2015-0121-DWQ). Because many of the thresholds for type and quantity of feedstock do not directly align between the agencies, as many as 14 different "categories" of composters can be identified. Based on these various thresholds and feedstock types, it gets rather confusing as to whether a composter is excluded from the requirements of the agencies. It is likely that this is not a complete picture of the different "categories" given the challenge of interpreting and understanding the agencies' regulations, particularly for on-farm composters.

Composting Type	Feedstock	Volume On-Site at One Time	Max Feedstock On-Site Per Year	Allowable Product Sales	CalRecycle	SWRCB
Community Composter	Generated on-site and off-site; Includes food waste & manure	<100 cy <750 sq ft	No Max	Unlimited	Excluded	Excluded*
Very Small On-Farm Composter	Ag material generated on-site and off-site; Includes food waste & manure	<500 cy	No Max	Undefined	Excluded	Excluded*
Small On-Farm Composter	Ag material all generated on-site	No Max	No Max	<1,000 cy/yr	Excluded	Excluded*
Small On-Farm Composter	Ag material all generated on-site; Includes food waste & manure	No Max	<5,000 cy/yr	<1,000 cy/yr	LEA Notification	Excluded*
Mid-Size On-Farm Composter	Ag material all generated on-site; Excludes food waste & manure	No Max	>5,000 cy/yr	Unlimited	LEA Notification	Tier I**
Mid-Size On-Farm Composter	Ag material all generated on-site; Includes food waste & manure	No Max	>5,000 cy/yr	Unlimited	LEA Notification	Tier II

Composting Type	Feedstock	Volume On-Site at One Time	Max Feedstock On-Site Per Year	Allowable Product Sales	CalRecycle	SWRCB
Mid-Size On-Farm Composter	Ag & green material generated on-site and off-site; Excludes food waste	<12,500 cy	<5,000 cy/yr	<1,000 cy/yr	LEA Notification	Excluded*
Mid-Size On-Farm Composter	Ag & green material generated on-site and off-site; Excludes food waste & manure	<12,500 cy	>5,000 cy/yr	Unlimited	LEA Notification	Tier I**
Mid-Size On-Farm Composter	Ag & green material generated on-site and off-site; Includes food waste & manure	<12,500 cy	>5,000 cy/yr	Unlimited	LEA Notification	Tier II
Any Size On-Farm Composter	Ag & green material generated on-site and off-site; Excludes food waste & manure	<25,000 cy	No Max	Unlimited	Full Permit	Tier I**
Any Size On-Farm Composter	Ag & green material generated on-site and off-site; Includes food waste & manure	No Max	No Max	Unlimited	Full Permit	Tier II
Small Commercial Composter	Allowable Tier I Feedstocks	<25,000 cy	N/A	Unlimited	Full Permit	Tier I**
Commercial Composter	Allowable Tier I & Tier II Feedstocks	>25,000 cy	N/A	Unlimited	Full Permit	Tier II

Notes:

cy/yr = cubic yards per year

*Requires covering compost during rain events and management of the application of water

**Tier I Facilities must also meet specifications regarding percolation rate and groundwater level

APPENDIX D: CAPACITY AND THROUGHPUT COMPUTATION

Capacity and throughput estimates over time were reconstructed using a set of CalRecycle databases and publications. Projections were done using population growth estimates from the California Department of Finance and the text of statutory diversion mandates.

CalRecycle's Knowledge Integration Section, Policy Development and Analysis Office provided a spreadsheet of information on 385 facilities that handle organics and have data in the FacIT database on April 20, 2017. To protect proprietary firm information, capacity and throughput figures were given in ranges of tons per year.

The following method was then used to illustrate that data and relate it to future projections.

1. Capacity and throughput ranges were split into low and high figures. Where high figures were listed as 'above', it was replaced by a numerical value equal to the low value + 1.

2. Since the provided data omitted operational status, it was checked against an April 8th, 2017 download of the Solid Waste Information System (SWIS) data. Using unique identifying numbers, 5 facilities in the FacIT database were identified as closed. These facilities had no closure dates listed, so closure dates were estimated by calculating the average lifespan of a facility in the SWIS database for whom permit date and closure date was known, about 3.4 years, then assigning a closure date that length of time after the listed permit date.

3. Cumulative figures for capacity and throughput were then calculated by adding the capacity and throughput estimates for each facility permitted in that year or previously, subtracting facilities capacity and throughput from the year in which that facilities was thought to have closed.

4. As a check on the accuracy of this method, the 2010 CalRecycle infrastructure survey was used. That publication estimates that 4,162,265 cubic yards of compost was produced in 2008. The following conversions were used to translate that number into an estimate of the throughput the industry handled in that year: 1 cubic yard compost = 1200 lbs; 2000 lbs = 1 ton; .58 tons compost = 1 ton feedstock. This results in an estimated 2008 throughput of 4.3 million tons, which is roughly in line with the midpoint of the cumulative range of throughput for that year as estimated by FacIT: 4.6 million tons.

5. Projection estimates of the throughput that the industry will need to handle in the future were completed in the following way:

A. Calculate the total organics disposal in 2014 from CalRecycle Data: approximately 13.1 million tons.

B. Calculate the total commercial organics disposal in 2014, using the unbiased 2008 sector breakdowns: approximately 6.5 million tons.

C. Calculate the 2020 and 2025 diversion goals from these numbers, which are 50% of commercial and 75% of total, respectively, or 6.6 million tons per year and 9.9 tons per year.

D. Assume linear infrastructure development to derive the additional throughput for each year: about 1.1 million per year until 2020 and .66 million per year between then and 2025.

E. Use demographic data projections to set a baseline of projected throughput by taking the midpoint of the range of throughput estimated in 2014 and dividing it by the population estimate in 2014 to derive an organic waste per person figure. Then multiply demographic projections by this per-person figure over the year range in question. This results in an estimated increase of ~10.8 million tons / year over the 2014 throughput.

F. Finally, add the diversion target quantity to the baseline in 2020 and 2025 to get the anticipated feedstock throughput.

APPENDIX E: GREENHOUSE GAS EMISSIONS REDUCTION CALCULATION

How much greenhouse gas emissions are mitigated by the production of one ton of compost? The following method draws heavily from analysis done by the California Air Resources Board.

CARB's method provides an estimate of the Carbon Emissions Reduction Factor (CERF) by calculating emissions reductions resulting from avoidance of methane emissions at landfills, emission reduction resulting from decreased soil erosion, reductions of fertilizer use and reductions of herbicide use. For this analysis, a single value (CERF_average) is derived for the typical ton of compost produced in 2014.

The CERF_average calculation is a weighted average where CERF values estimated for Food Waste, Yard Trimmings, and Mixed Organics are weighted by the proportion of those feedstocks in the 2014 CalRecycle waste characterization study, which is the most recent. CARB's conversion factor of .58 tons of compost for every ton of feedstock is then used to translate between tons of feedstock and tons of finished compost.

Table 4. Estimated Tons of Waste and Corresponding CERF Values

Waste Type in CERF Estimation Method	Corresponding Materials from Waste Characterization Study	CERF	Estimated Tons (%)
Food Waste	Food	0.62	5,591,179 (57%)
Yard Trimmings	Leaves and Grass Prunings and Trimmings, Branches and Stumps	0.44	2,663,680 (27%)
Mixed Organics	Remainder/Composite Organic, Manures	0.56	1,498,273 (15%)
Total Waste	*(Omitted: Textiles, Carpet)*		**9,753,132 (100%)**

Data Source: Air Resources Board. (2016, March). *Method for Estimating Greenhouse Gas Emission Reductions From Diversion of Organic Waste From Landfills to Compost Facilities*. Retrieved from https://www.arb.ca.gov/cc/waste/cerffinal.pdf

CERF_average = (.62(.57)+.44(.27)+.56(.15))/.58 = .57 MTCO2e / ton of feedstock

CERF_average_compost = .57 MTCO2e / ton of feedstock * 1 ton of feedstock / .58 tons compost ≈ 1

APPENDIX F: EXPERT INTERVIEWS

Will Bakx, West Marin Compost Soil Scientist

Gowan Batist, Farm Manager, Fortunate Farm

Joseph Button, Sustainability Director, Straus Family Creamery

Paul Bernier, Owner, Bernier Zinyards

Amigo Bob Cantisano, Organic agriculture advisor

Grant Cope, Deputy Secretary for Environmental Policy, CalEPA

Scott Couch, Supervising Engineering Geologist, Division of Water Quality, State Water Resources Control Board

Al Courchesne, Owner, Frog Hollow Farm

Ember Christensen, Division of Water Quality, State Water Resources Control Board

Neil Edgar, Executive Director, California Compost Coalition

Torri Estrada, Director of Policy, Marin Carbon Project

Ryan Flaherty, Director of Business Partnerships, Sustainable Conservation

Phil Foster, Owner, Pinnacle Produce

Evan Johnson, Senior Environmental Scientist, CalRecycle Policy Development and Analysis Office

Elizabeth Kaiser, Owner, Singing Frog Farm

Nick Lapis, Director of Advocacy, Californians Against Waste

Howard Levenson, Deputy Director, CalRecycle Materials Management and Local Assistance Division

Justin Malan, Principal, Ecoconsult

Jenny Lester Moffitt, Deputy Secretary, California Department of Food and Agriculture

Calla Rose Ostrander, Climate Change Consultant and Compost Lobbyist

Pete Price, Board Member, Community Alliance with Family Farmers

Dave Runsten, Policy Director, Community Alliance with Family Farmers

Whendee Silver, Professor of Ecosystem Ecology, Department of Environmental Science, Policy and Management, University of California, Berkeley

Cole Smith, Compost Program Coordinator, UC Cooperative Extension

Albert Straus, Founder and CEO, Straus Family Creamery

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