May 26, 2016

Clerk of the Board
California Air Resource Board
1001 I Street
P.O. Box 2815
Sacramento, CA 95812-2815

Via: Website Post: http://www.arb.ca.gov/lispub/comm/bclist.php

Subject: Comments on the Air Resources Board April 2016 Proposed Short-Lived Climate Pollutant Reduction Strategy

Dear Chair Nichols and Board Members:

Thank you for the opportunity to review the Air Resources Board's (ARB's) Proposed Short-Lived Climate Pollutant Reduction Strategy (Draft Strategy) and to participate in the various public workshops that ARB has held. The signatories to this letter represent public and private sector composting, recycling, solid waste collection, processing, and disposal interests (Coalition). We own and/or operate and have effectively financed and sited many composting, anaerobic digestion, and organic processing facilities throughout the State.

Reducing methane emissions from the solid waste management sector has been an important component of the California Global Warming Solutions Act of 2006 (AB 32), beginning with an early action measure, the Landfill Methane Control Measure. More recently, the Legislature took steps to increase the diversion of organic materials from landfills with Assembly Bill 341(Chesbro, 2011 - Mandatory Commercial Recycling) that established a state goal of 75percent solid waste diversion by 2020, Assembly Bill 1826 (Chesbro, 2014 - Mandatory Commercial Organics Recycling) that includes a goal to achieve 50 percent diversion of organics from landfills by 2020, and Assembly Bill 1594 (Williams, 2014 – Green Materials Used As Alternative Daily Cover at Landfills) which incentivizes the diversion of green waste from landfills when the diversion credits granted to jurisdictions sunset in 2020. Both public and private stakeholders worked with the authors' offices, CalRecycle, and with ARB's knowledge to craft legislation that was feasible and realistic, and supported the legislation. Once fully implemented, the combined effect of these three measures will be to meet the 50 percent diversion goal of

organics currently disposed at landfills. Their implementation, however, still hinges on development of the necessary organics processing infrastructure, which will take time to site, permit, and construct, and will require billions of dollars in capital expenditures.

The Draft Strategy would ignore this significant infrastructure challenge and instead impose a 90percent diversion requirement of organics from landfills in 2025 (virtual elimination of organics from landfills). Overall, for the reasons explained below, the Coalition recommends that ARB take a phased approach to organics diversion, with Phase I focusing on implementation of AB 341, AB 1826, and AB 1594 before ARB determines what specifically is needed in Phase II. Phase II, which would take place after 2020, would evaluate the implementation of Phase I statutes and determine what steps and time are needed to reach a 90percent organics diversion goal.

Solid Waste Management Industry Overarching Concern

The 90 percent diversion of organics by 2025, as well as any additional regulations in the near term to accomplish these goals is unrealistic and any new regulatory action should not be considered until after the other identified actions in the Draft Strategy have been carried out. The principal focus of ARB, CalRecycle, and the stakeholders in the near term should be on FULL implementation of AB 1826, AB 341, and AB 1594. Further regulation should wait until these measures, and the remaining recommended actions for organics diversion, including aligning financial incentives with organics diversion, collaboration to overcome barriers, and development of markets, are completed. The mechanics to divert organics from landfills is not the problem; the main challenge is the infrastructure needed to process and manage the organics once diverted. The challenge is not only in developing the finances to build the necessary facilities, but also in addressing the regulatory constraints in siting and permitting the facilities.

CalRecycle estimated it will require an additional 100 new or expanded facilities to process the diverted organics from AB 1826. Quite frankly, it is unrealistic to believe that this number of facilities can be built within the next three and one-half years given the challenges of the permitting process. Yet the Draft Strategy proposes to accelerate the existing organic diversion goal before implementation of AB 1826 has even begun.

California has added about 13 active anaerobic digestion (AD) facilities and 169 active composting facilities in the past 20 years. Using CalRecycle's estimate for the 50 percent diversion, at least 165 to180 new facilities must be financed, sited, permitted, and built in the next eight and one-half years to achieve the 90 percent target by 2025.

Additionally, ARB needs to reconsider the necessity to move so quickly on a 90percent mandate that prohibits organic waste disposal (or beneficial use) in landfills. The scientific basis for proceeding as early as 2018 is far from complete. As the ARB itself states in the Short Lived Climate Pollutants (SLCP) on Page 72 - 73:

> "However, quantifying emissions from landfills is difficult, due to their area-wide nature and several landfill-specific factors (size, age, materials deposited, local atmospheric conditions, soils, landfill cover, and gas collection system) . . . Estimates of methane collection efficiency at landfills, both with and without gas

> collection systems, vary widely . . . Continuing evaluation of major sources of methane in the State is necessary, and this includes landfill emissions."

The Coalition believes that the ARB's estimates of emissions of methane from landfills are overestimated (making GHG benefits of organic diversion overstated) and that the ARB and CalRecycle should focus on a more complete scientific understanding of the GHG impacts of the proposed 90percent diversion in consideration of available facilities for managing those materials.

Summary of the Key Issues that Need to be Further Considered

- **AB 341, AB 1826, & AB 1594 will not be fully implemented until 2020 - or later.** AB 1826 requires the diversion of organic waste collected from all large generators of solid waste by 2020 at a likely cost of more than $1 billion. Although CalRecycle is seeking authority to expend as much at $100 million per year between now and 2020, the availability of this funding is uncertain, and a complete plan to site, permit, and finance the necessary facilities has yet to be developed. The results and effectiveness of these programs will not be known until sometime after 2020. It is unclear how the proposed Draft Strategy would overlap or conflict with these existing legislative requirements.

- **To implement the Draft Strategy, what are the costs, who pays and how difficult is it to site new facilities?** Getting to 90 percent diversion of organics by 2025 will require a focus on much more difficult materials to separate and use beneficially – either at the point of generation or after subsequent processing. It is not clear how this will be done for that massive amount of material, nor at what cost. Certainly it will take time. To create sufficient infrastructure to get beyond the existing statutory requirements to 90 percent may involve an additional $1-$2 billion or more. It is not clear how this will be financed, who will pay, and what the true benefits will be in consideration of the full environmental impacts.

- **Energy Recovery Technologies.** Energy recovery and other alternative technologies are currently discouraged, both in law and in practice, in California, although conversion of organic waste streams to fuels can produce very low (or negative) carbon fuels. Beneficially using up to 90percent of the organics in the waste stream may require the use of alternative technologies to process low value, difficult to manage mixed residual solid wastes containing organics to extract energy and/or fuel value.

- **Landfill early action measure.** As stated above, one of the first measures that CARB implemented after the passage of AB 32 was the development of the Landfill Methane Control Measure to reduce the concentration of methane at the surfaces of virtually all California landfills. Approximately 95 percent of all landfills in California now have an active gas collection system operating in compliance with this early action measure. The Draft Strategy does not provide any findings on the success or adequacy of this measure and does not appear to recognize any benefit from this landfill emission control measure. Prior to embarking on an expanded program for organic waste diversion that goes

beyond the new programs referenced above, the efficacy of this early action measure should be thoroughly evaluated in comparison to emissions and environmental impacts under an organics landfill disposal ban.

- **Uncertainty over landfill methane emissions.** The Draft Strategy acknowledges that there is incomplete and uncertain information about actual landfill methane emissions. There has been much recent research performed to try and close this information gap. The Coalition recommends that ARB review these studies and encourages the development of a program to more accurately assess landfill methane capture efficiencies.

These issues are presented in greater detail in Attachment A to this letter.

Recommendations

We believe that the existing 50 percent organics diversion by 2020 established in AB 1826 is a reasonable target. Prior to considering higher goals we must first implement and assess the impacts of the ambitious goals set by AB 1826, as well as the 75 percent recycling and composting goal set by AB 341, and the green material goals set forth in AB 1594.

However, even these goals cannot be achieved without more than just a commitment from agencies to cooperate on permitting and siting issues. We will need concrete policy and financial support at the local and state level to facilitate siting and permitting of the facilities that are needed. This cannot be accomplished without creative input and cooperation from local government, state government, and the solid waste industry. We recommend that CalEPA, in implementing AB 1045 (Irwin), establish a workgroup specifically related to siting issues.

We also believe in a reasonable market based approach as exemplified in AB 1826. We need to focus on fully implementing the mandatory commercial organics program required by that bill. Full implementation will not be accomplished by 2018, when the Draft Strategy calls for additional regulations. Rather, we suggest that the analysis should occur once AB 1826 is fully implemented in 2020. At that point, we will know how effectively the siting and funding strategies outlined in the Draft Strategy have worked and we also will know if the State is on track to site, permit, and build the required organics infrastructure to reach the 50 percent organic waste diversion goal.

We do not believe a 75 percent organic waste diversion goal (or higher) should be set without much more analysis of the available AD and composting capacities. In the near term, available excess digester capacity at municipal wastewater treatment plants should be available. We recommend that ARB and CalRecycle work with the appropriate local agencies on the necessary processing requirements to insure that available food waste streams are compatible with wastewater digester requirements, as well as the funding required for managing this additional waste stream, and both funding needs and barriers that must be lowered for these facilities to effectively utilize the additional biogas to its highest use (e.g., pipeline injection).

We strongly support the conclusion in the Draft Strategy that landfills should not be placed under cap and trade. We also support the reasoned approach recommended in the Draft Strategy that a Phase 2 of the Landfill Methane Rule should not be undertaken without additional technical analysis. We need to know what has been accomplished from Phase 1 before determining if adding additional measures will be effective in reducing methane emissions and whether any new measures would be cost effective. The ARB should form a workgroup to fully evaluate how best to estimate emissions from landfills.

Finally, we need more certainty regarding funding and the availability of State funding to help with capital costs and/or incentive payments. There is concern in the private sector that the rate structures set through contracts and franchise agreements will not be revised to help fund organics infrastructure. Also, funding from the Greenhouse Gas Reduction Fund (GGRF) will be helpful, but only if that amount and more can be assured on an ongoing basis for at least 5 years. These very aggressive organic waste diversion goals set by the Draft Strategy can only be implemented if adequate funding is committed by the State.

Please contact any one of the undersigned if you have any questions or require further information about our comments, recommendations and concerns.

Sincerely,

Jason Schmelzer, Legislative Advocate, Solid Waste Association of North America, California Chapters

Jason Rhine, Legislative Representative, League of California Cities

Cara Martinson, Legislative Representative, California State Association of Counties

Mary Pitto, Regulatory Affairs Advocate, Rural County Representatives of California

Frank Caponi, Division Engineer, Head, Air Quality Engineering, Los Angeles County Sanitation Districts

Alex Oseguera, Vice President & General Manager Northern California-Nevada, Waste Management of California, Inc.

Marek Crabbs, Region Director – Municipal Services & Government Affairs, Republic Services

Eddie Westmoreland, Western Region Vice President of Government Affairs, Waste Connections, Inc.

Bill Zimmerman, P.E., Deputy Executive Director, Western Placer Waste Management Authority

Attachment A

Detailed Comments of the Solid Waste and Recycling Industry: Proposed Short-Lived Climate Pollutant Reduction (SLCP) Strategy May 2016 (Updated from Draft SLCP Comments October 30, 2015)

1. CalRecycle Recent Estimates Regarding Compost and AD Capacity ("State of Recycling in California" - March 2015 and Updated February 2016)

Important information pertinent to the proposed SLCP Strategy for the waste sector is provided in CalRecycle's "State of Recycling in California" report released in March 2015 and Updated February 2016. It does not appear that the proposed Strategy considers several key factors delineated in the CalRecycle report. Several key extracts of the 2015 report with related notations and extracts from the 2016 Update are included below:

Composting and AD Capacity

"If all of the currently disposed organic material were instead recycled, the state's composting, chip and grind, and AD facilities would have to process an additional 12 million tons of organic material each year. As California moves toward greater organics processing, it is critical to consider whether the state has sufficient physical infrastructure to process this additional material. Most organics processing facilities run at levels close to capacity; at most, current facilities could support an additional roughly 1.5 million tons of material per year. Figure 21 shows the estimated available capacity of composting and AD facilities across the state. Not only is capacity limited, but most of the facilities with moderate levels of additional capacity (more than 60,000 tons per year) are not located near population centers." (Page 45)

2016 Update (Table 6): As of February 2016 the capacity crisis persists, as there has been no significant increase in the available capacity of 1.5 million tons per year.

Composting

*"**There are currently 169 active permitted composting facilities in California that process approximately 5.7 million tons of material per year.** Due to updated Department estimates, the throughput of composting facilities is slightly smaller than what is reported in FacIT. The 12 largest composting facilities in California account for 50 percent of the current throughput, while roughly a third of active facilities manage 5,000 tons or less of organic material each year. Most of the high-throughput facilities are located in the Central Valley and are distant from population centers that can generate large amounts of compostable material. It is likely that some of these composting facilities also accept feedstock from agricultural sources." (Page 41)*

"The total number of permitted composting facilities in California has grown substantially from fewer than 10 in 1995 to almost 250 in 2014 (only

161 of these facilities are actively operating). *This growth has been steady except for around 2006 and 2008, when existing facilities were closing at the same rate that new facilities were being added. However, it is difficult to track exactly when the composting facilities closed or to identify the reason behind their closure." (Page 43)*

2016 Update (Table 6): The number of permitted composting facilities has slightly increased to 176. The quantity processed (throughput) has declined to 5,540,000 tons per year.

Anaerobic Digestion

"California currently has 13 permitted, active facilities that process approximately 187,000 tons of material annually (see Figure 19). Another dozen or more AD facilities are planned or in the permitting process. The choice between traditional composting and AD is dependent on local regulations for facilities, type of organic material, and cost." (Page 43)

2016 Update (Table 6): The number of permitted active AD facilities has not changed. The throughput has declined to 146,000 tons/year.

Food Waste

"In contrast to green waste, the handling options for food waste are more constrained. Although 219 jurisdictions reported having active food waste composting programs in their 2013 Electronic Annual Report (EAR) http://www.calrecycle.ca.gov/lgcentral/AnnualReport/Sample/), this number likely overestimates the number of active programs within California. CalRecycle believes that there are between 35 and 40 food waste collection programs for the residential and commercial sectors each, which roughly corresponds to the 71 jurisdictions that reported tonnages associated with food waste collection. The total reported collection for food waste of 0.2 million tons further highlights the limited collection options currently available in California.

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

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

If all of the recoverable organic material that is currently disposed were instead recycled, the state's composting, chip and grind, and in-vessel digestion facilities would have to process an additional 12.7 million tons of organic material each year. As California moves toward greater organics processing, it is critical to consider whether the state has sufficient physical infrastructure to process this

additional material. Most organics processing facilities run at levels close to capacity; current facilities could support at most 1.1 million tons of additional material per year (see Figure 22). As noted above, the current available capacity for food is much lower."(Page 58-59, 2016 Update)

The important takeaway from this information is that 75% of all organics equals about 9 million tons of organics annually. The current infrastructure is woefully inadequate and is operating at near capacity but could manage only an additional 1.5 million tons, unchanged from 2015 to 2016. Nevertheless, much of that additional capacity is located far from urban areas where most organics are generated.

In addition, existing composting and AD capacity processes less than 6 million tons/year. The existing AD and composting capacity has been added primarily since 1995. Therefore, we have added about 13 active AD facilities and 176 active composting facilities in the past 20 years.

Regarding AD facilities, we have roughly 13 facilities processing 146,000 TPY. According to CalRecycle data, there are about 12 more in various stages of siting. If we assume that all of these 12 new facilities are somehow sited, permitted and operating by 2020, we will have 25 AD facilities operating in 2020. The average processing capacity of the 13 existing facilities was about 14,400 TPY in early 2015 but declined to 11,200 TPY by early 2016. If we assume that the average processing capacity will increase by 25% from the 2015 level for these 25 AD facilities by 2020, than the 25 AD facilities would account for only 500,000 TPY of organics processing capacity in 2020. Therefore, by 2020, the vast majority of the 9 million tons of organics will need to be handled by new composting infrastructure.

Highlighting the infrastructure problem is food waste, which is the largest single component of the organics waste stream at 5.6 million tons. However, there is only very limited capacity to process food waste (roughly 0.3 million tons) and this capacity is not significantly increasing. As California moves toward greater organics processing, it is critical to consider whether the state has sufficient physical infrastructure to process this additional material. Clearly the state does not have the infrastructure to process food waste, and permitting,financing, and siting issues for processing food waste persist.

2. Feasibility of Adding Organics AD or Composting Infrastructure

One of North America's largest AD project is in Southern CA. The facility is not yet operating, but currently plans to have a throughput of 300,000 tpy in 2020 and near term 80,000 TPY at a reported cost of roughly $50M.

Another "large" AD facility, ZWED in San Jose, which is operating today, has a planned throughput of 90,000 tpy. These projects, when fully operational, will compose most of the states AD capacity outside of wastewater treatment facilities.

Existing large AD facilities currently operating or under construction represent less than 200,000 TPY in capacity. This is significantly less than the total AD capacity that would be required to handle 75% of the estimated 12 million tons of organic

waste currently disposed in landfills. In fact existing AD and composting capacity only represents about 35% of the total AD or composting capacity that would be required to beneficially use 11 million tons of organic waste per year – necessary to achieve a 90% organic diversion capability. Therefore, the proposed Strategy would, following adoption of regulations in 2018, require the solid waste industry create nearly three times that capacity in just seven years in order to meet the 2025 goal.

Since other conversion technologies or incineration capacity is strongly discouraged in California, there are no other options available right now for organics processing except compost or AD. With no new technologies likely in California, particularly by 2020, the more likely outcome, if compost and AD facilities are not built, will be diversion of organics to direct land application of green materials and export of food waste and other organics for disposal to Nevada and Arizona,. Such leakage will not help achieve CARB's GHG reduction goals.

The one exception to land application and export might be the use of excess municipal wastewater treatment (WWT) anaerobic digestion capacity. With proper investments, these facilities may be utilized to fill that early gap of needed infrastructure for organics management. However, while there is excess capacity at WWT digesters, there are still major hurdles that will need to be overcome in order to provide a high quality and digestible feedstock.

So in order to realistically implement the 75% and 90% targets in the proposed Strategy, we are looking at building on the existing 5.7 million tons/year of compost capacity with some small amount of added AD capacity. Will the final SLCP Strategy be able to demonstrate and explain the feasibility of permitting and siting this level of organics processing infrastructure?

3. What is the cost of adding organics infrastructure?

The proposed Strategy calls for diversion of 75% of organics by 2020, which will require 9 million additional tons of organics diversion capacity statewide by 2020—four years from now. This equates to an additional 135-150 compost operations and 12-15 more AD facilities over the next four years. Using a low-end estimated cost of $10 million per facility, the 135 - 165 composting and AD facilities will require an investment of $1.35 to $1.65 billion in four years. This does not include the substantial additional costs to collect, process and deliver the organics to the facilities. Nor does it include the $100 million-plus in added funding that will be needed to comply with the Compost General Order ($30 M for the current 121 facilities and $30 M for the new capacity plus a doubling for pads.)

CalRecycle has provided grants and loans to support organics diversion projects through its Greenhouse Gas Reduction Fund (GHGRF) funded by AB 32 Cap and Trade auction proceeds. However, this funding so far is an extremely small fraction of the funding needed. The CalRecycle Organics Grant Program provided approximately $15 million in grants in Fiscal Year (FY) 2014-15. For FY 2016-17, $61 million is proposed for organics diversion projects but is subject to a final budget agreement and availability of Cap and Trade auction proceeds.

It is important to note that a vast majority of the costs of expanded organics infrastructure will be funded through rate increases on residential and commercial customers. The process for raising those rates is often dictated by local contracts and franchises and often takes years to accomplish. What will be the source(s) of this funding and how can the money be raised in so short a period of time?

4. SWRCB Compost General Order

Compost General Order: *"The proposed General Waste Discharge Requirements for Composting Operations (Order) will impose (additional) compliance costs on the compost industry that will increase the total cost of operations and decrease net returns**. The proposed Order will require initial capital investments of approximately $25.2 million in retention ponds, monitoring wells, and drains. Annual investment costs will be about $2.2 million, and annual monitoring and maintenance will be an additional $1 million.*** *Although these amounts seem large when expressed in relative terms or in units of production, the effect on compost operators will be manageable. The industry has 121 facilities subject to the proposed Order that processes about 7.8 million cubic yards of compost annually.*

Coalition Letter to SWRCB: Furthermore, the economic analysis assumes "initial capital investment of approximately $25.2 million in retention ponds, monitoring wells, and drains"; this analysis disregards the reality that a significant number of compost facilities will be required to install operating pads in order to meet water quality objectives, at a total cost many multiples higher than the low estimate provided. It is a significant oversight to have concluded that there will be no economic impact from construction of operating pads due to these new standards."

The $28 M assumes 121 impacted existing facilities and it is fair to assume that these new standards will apply to all new facilities as well and actual costs will be significantly higher than the SWRCB analysis. Meeting a 90% reduction in landfill organics will require approximately 100 to 300 new or expanded facilities. How will the proposed Strategy cover these additional costs?

5. Are Suggested Methane Reduction Levels Accurate and Realistic?

The proposed methodology in the SLCP reduction strategy for determining net avoided emissions from landfills relies on a First Order Decay (FOD) model with default assumptions included for landfill gas (LFG) collection efficiency and methane oxidation. To begin with, this is the most inaccurate approach to estimating LFG emissions as it relies on a LFG generation model, with a recognized wide range of uncertainty, as well as default values for LFG collection efficiencies based on studies that do not represent California landfills. It also relies on outdated data for methane oxidation in landfill covers.

The resultant landfill methane emissions are therefore overestimated, which in turn results in overstated benefits for landfill diversion. It is critical that the landfill emission estimates in the SLCP strategy be as accurate as possible because the benefits of the strategy as they relate to solid waste rely heavily on avoided landfill emissions. This methodology is not supported by advancing research and direct measurement studies

which should be reflected in the report. Additionally, the CARB's Landfill Methane Rule (LMR) is resulting in much higher collection efficiencies and lower emissions than predicted under the default FOD models and reflected in the SLCP report.

As commented to CARB in response to the draft SLCP strategy in October 2015, the landfill industry suggests that to avoid flaws inherent in FOD Models, the CALMIM (California Landfill Methane Inventory Model) model should be applied for emissions verification. The California Energy Commission contributed to the development of a new California specific, field tested model by a team of landfill experts led by Dr. Jean Bogner of Landfills+ Inc. CALMIM is an Intergovernmental Panel on Climate Change (IPCC) Tier III methodology for landfill methane emissions and is a freely-available, user-friendly JAVA tool.

Direct Measurement Studies Validate Lower Landfill Methane Emissions than Estimated by FOD Models & Significantly Higher Oxidation Rates than Defaults

FOD models are used to estimate methane generation, and when combined with collection efficiency, can predict landfill methane emissions. They can be applied at levels ranging from global and national down to individual landfills with varying degrees of inaccuracy and uncertainty. Collection efficiencies are determined by calculated the amount of LFG collected and comparing it to the generation quantities predicted by the FOD model. The remaining LFG is assumed to emitted, less the oxidized quantity.

Direct emission measurements, in contrast, are more granular, and may analyze such issues as total site emissions, emissions from particular equipment or processes at a site, and how emissions change by season. In this way, direct emission measurements can be used to validate emission models and quantify emissions.

The most recent direct measurement studies indicate that collection and control efficiencies and methane oxidation rates are, with few exceptions, higher than the calculating when using the FOD models (De La Cruz et. al. 2015) (Walker et. al. 2014) (Shan et. al. 2013) (Green et. al., 2012) (Goldsmith et. al., 2012) (Chanton et. al. 2011) (Green et. al. 2009)). Direct measurement studies have also shown that inventory models used by regulators significantly over-estimate landfill methane therefore GHG emissions (De La Cruz et. al. 2015) (Walker et. al. 2014) (Green et. al. 2012). The following is a brief summary of the results of these studies:

- A comprehensive direct measurement study (Chanton 2011) of 20 landfill sites across the U.S. determined the best assessment of mean oxidation within soil covers was 37.5% ±3.5%. The results were very similar to (SCS, 2009) which based an overall mean of 38% oxidation on a literature search and differentiated oxidation rates based on soil types.
- (Shan et. al. 2013) determined very high collection efficiencies of 91% to >99% based on statistically representative flux chamber measurements at four large California Landfills.

- (De La Cruz et. al. 2013) compared direct measurement of methane emissions from a Southeast U.S. humid landfill of waste aged less than three years to modeled emissions and determined the models predicted 4-17 times high emission rates than measured.
- (MØnster et. al. 2015) showed that for 15 Danish landfills, model-predicted emissions were on an average, a factor of 5 greater than the measured emissions.
- (Green et. al. 2012) compared direct measurement of four closed landfills without gas collection and found that the measured emissions were only 33%, 12%, 44%, and 17% of the emission rate predicted by the federal GHG mandatory reporting rule (MRR) program (GHGRP) (U.S. EPA MRR in table below). The corresponding over-prediction of models was by factors of 2.3 to 8.3 greater than the measured emissions. The Solid Waste Industry for Climate Solutions (SWICS) methodology (SCS 2009) which applies a 30% oxidation rate for soil mixtures likewise predicted much lower emission rates than the GHGRP:

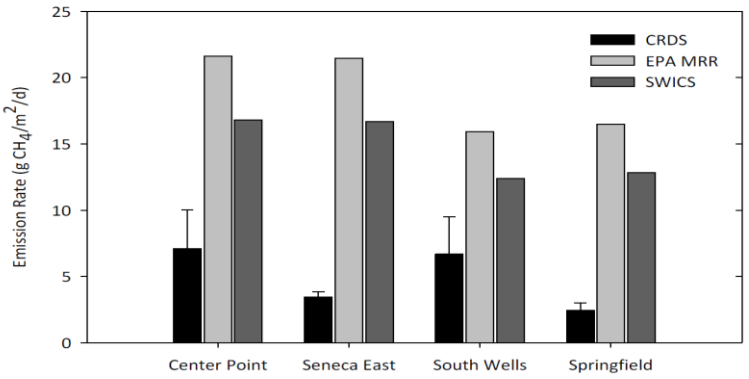

Figure 1. Comparison of Methane Emission Results from CRDS Measurements and Models (error bars represent 1sd)

- (Walker et. al. 2014) applied direct measurement of methane emissions and oxidation from (Goldsmith et. al. 2012) for five California Landfills, four with Mediterranean climates and one with an arid desert climate. Control efficiency for the five landfills was found overall at 85%, ranging from 83-88%. The effects of coverage of the LFG collection system and relative size of the working face and daily cover areas was analyzed and negligible.
- Research aircraft methane measurements were attributed to two large active southern California Landfills (Puente Hills and Olinda Alpha) in (Peischl, J. et. al. 2013). Applying the emission rate to site-specific landfill footprint and methane collected and combusted results in estimated collection efficiencies of 73% and 77%. Applying an oxidation factor at 38% results in control efficiencies of 77% and 80%. These results are considered a lower bound because of limitations in resolution to remove other sources of methane and potential atmospheric

- effects. Note that (Shan et. al. 2013) estimated collection efficiencies at Puente Hills Landfill by two different methods of 93.1% and 95.9%.

The landfill industry recognizes that direct measurement is not possible for calculating avoided GHG emissions; however, they can be used to develop more accurate collection efficiency estimates for California landfills than the default values used in the SLCP report. Therefore, we recommend using the CALMIM model to estimate landfill methane emissions instead. Alternatively, we recommend using the FOD to calculate generation and then adjusting collection efficiencies to reflect the results of actual emissions from landfills rather than an assumed collection efficiency. Further, oxidation rates should be based on the numerous cited studies.

Based on these studies, oxidation rates between 20-55% should be used and collection efficiencies of 85% should be applied over the active life and 95% after closure and capping for emissions estimates for landfills in California subject to the LMR. These collection efficiency values should be immediately applied for all landfill in compliance with the LMR without any phasing in over time.

Assumption of High Landfill Methane Emissions Shortly after Placement of Waste is Unfounded

Methane emissions are not large and unaccounted for during the short term after placement of waste based on factors verified by direct measurement studies. Under the federal landfill New Source Performance Standard and Emission Guidelines (NSPS/EG) requirements, the regulation requires installation of control when the first and oldest waste placed reaches 5 years of age (2 years if the landfill area is at final grade). Therefore, even if landfills wait until the last possible minute for installation of LFG control, the average age of waste in new cells will be younger; an average of less than 2.5 years (less than 1 year for areas at final grade) after placement and not 5 years. In reality, landfills install controls much earlier than 2 or 5 years, and in many cases, controls are installed as the waste is initially placed and activated as soon as gas generation is detected. In arid to semi-arid climates such as almost all of California, LFG generation is negligible within that time period (Walker et. al. 2014) even though FOD models suggest generation is occurring.

Landfills are also progressively developed over the landfill lifetime such that the average coverage of the LFG collection system is very high; approximately 89-97% for an example area fill over the operational life of the landfill (Walker et. al. 2014). Additionally, new landfill cells are commonly developed over existing areas with LFG collection that will in part cover newly deposited waste. LFG collection will also cover newly deposited waste by adjustment of adjacent extraction wells, collection of gas from leachate collection systems, and additional collection from horizontal gas collection system which are installed as the cells are developed. Landfills can use a variety of methods for early collection of LFG, resulting in gas collection from all areas where LFG emissions could occur.

Additionally, a recent study (De La Cruz et. al. 2015) of a humid Southeast U.S. landfill with waste aged less than three years further brings into substantial question assumptions of large unaccounted for methane emissions during short term after placement. The study found very low emission rates, by factors of 4-17 times lower than the emission rate predicted by conventional models.

A related misconception is that methane emissions from landfills are large and unaccounted from the working face and daily cover areas. The facts are that the working face and daily cover areas are a very small fraction of the landfill waste footprint. Industry practices to maximize airspace and regulations governing cover material and working face practices control and limit the size of these areas. Statewide surveys in California verify the average working face is <1% of the landfill footprint (Walker et. al. 2014). The working face is also only present during operations in the day and covered between business hours. Daily cover area is similarly very small, estimated at approximately 2% of the total landfill footprint. Additionally, methane will be generated from waste in the short term regardless of the management alternative during collection and processing whether by composting, anaerobic digestion, or waste to energy (WTE) since each of these methods involve interim storage and processing of waste in an uncontrolled fashion.

Further, surface emissions monitoring (SEM) under the LMR, where SEM is required in all areas of the landfill regardless of age of waste (thus including areas 0 to 2 years), showed no appreciable differences in emissions for the new disposal versus older disposal areas. It appears CARB has not even reviewed data from its own rule in developing the SCLP estimates.

CARB'S Inconsistencies with Landfill Methane Rule

In developing the LMR, CARB has taken credit for GHG reductions associated with promulgating that rule. However, the SLCP does not apply the same amount of methane avoided. CARB incorporated various approaches and assumptions on life-cycle analysis that are inconsistent and not validated which will lead to double counting GHG emissions reductions in CARB's inventory.

In addition, composting, anaerobic digestion, and other organics management technologies' emissions are short term (occur within a year) but landfill emissions are spread out over the long-term (over twenty years) meaning that GHG emissions in the initial years are actually higher with composting. This is completely counter to the goals of the SLCP strategy, which are to achieve near-term reductions of methane and other SLCP pollutants.

For example, CARB used 85% collection efficiency in its LMR rulemaking and justifies the rule, and its projected methane reductions, based on that value. In justification for the LMR, the methane reductions from the LMR were applied immediately upon landfills complying with the regulation and were used to demonstrate progress toward AB 32 goals for GHG reductions by 2020. This was a key reason that the LMR was adopted as

an early action measure under AB 32, because of its ability to create early reductions in GHG.

In the SLCP report, CARB is using default collection efficiency of 75% for landfills until 2030, at which time an increase to 80% occurs; however, the 85% value is not achieved until 2050. This suggests that the LMR does not achieve any reductions in methane until 2030 as the 75% value was actually used as the baseline (pre-regulation) level for the LMR rulemaking. To the best of our knowledge, staff has not presented a scientific basis for an assumption that the LMR will not achieve reductions until 2030, almost 20 years after the regulation took effect, and that it will not reach its full potential until 2050, almost 40 years after the regulation took effect. By completely ignoring the results of valid science based studies and analysis, the sole purpose of delaying the impact of the LMR appears to be to push off any methane reductions from the LMR until after 2025, thereby artificially and inaccurately inflating the benefit of the SLCP. If this is the case, the SLCP strategy will be bad policy based on inaccurate science.

Avoided Renewable Energy Benefit

The SCLP strategy does not account for the loss renewable energy benefits from LFG. In California, the majority of the medium to large landfills, with the highest gas production rates, recover and convert LFG into renewable energy, which has recognized GHG benefits. The SLCP strategy should account for this loss as an impact of any landfill diversion strategy, which does not create an equivalent amount of renewable energy.

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6. CARB Should Provide a Complete Estimate Of Emission Reductions From All New Programs And Fully Reflect Emission Reductions Accounted For The Landfill Methane Rule

CARB estimates emission reductions based on the proposed SCLP waste sector strategy to adopt regulations to effectively ban organics from landfill disposal. The regulations would result in 75% of organics diverted by 2020 and 90% by 2025 (footnotes Page 72 (CARB 2016a)). The estimated emission reductions are 5

MMTCO2e in 2030, increasing to 21 MMTCO2e by 2050 (using the 20-year Global Warming Potential (GWP) for methane which is 3X higher than the 100-year GWP of 25).

CARB provides only very limited backup documentation (CARB 2016b) to support the estimated emission reductions. CARB indicates that the AB 32 Inventory methodology is applied but no detailed input assumptions and calculations are provided. CARB's Business-As-Usual (BAU) baseline for the proposed SLCP Strategy reductions is projected emissions resulting from CARB's Landfill Methane Rule (LMR) promulgated in 2009. However, CARB's SLCP emission reduction estimates do not account fully for emission reductions credited by CARB from the LMR which total 3.6 MMTCO2e (20-year GWP) by 2020 (assumes capture efficiency of 85% by 2020 and converted from 1.0 MMTCO2e (100-year GWP 21; CARB 2008 Scoping Plan Appendix C-160)).

Of significant additional concern is that CARB apparently does not consider emission reductions from mandated commercial organics recycling to achieve 50% reduction in disposal of organics by 2020 from 2014 (AB 1826) and phasing out of diversion credits for green material (GM) alternative daily cover (ADC) by 2020 (AB 1594). Other programs beside the LMR include a 75% statewide goal by 2020 for waste reduction, recycling, and composting (AB 341) and the AB 939 (1989) diversion mandate.

Given the lack of supporting documentation and apparent omission of important programs from CARB's analysis, CARB should provide a complete estimate of emission reductions from all new programs, including emission reductions already accounted for by CARB for the Landfill Methane Rule.

We have conducted a preliminary analysis that we will share with staff. The analyses indicates that the 5 MMTCO2e target can be achieved by effective implementation of the Landfill Methane Rule and by full implementation of the new programs that will be required by AB 1826 (mandatory commercial organics) and AB 1594 (eliminates diversion credit for landfill alternative daily cover.)

<u>Preliminary Analysis And Supporting Documentation:</u>

Table 1. Breakdown of 2014 Disposed Quantities (Tons):

Compost/Mulch Material Types[1]:	Franchised Commercial	Franchised Residential	Self-Hauled	Total
Total Compost/Mulch Material Disposal (Tons) [1]	5,300,000	6,300,000	1,100,000	12,700,000
Compost/Mulch Material Disposal (Food Waste	2,400,000	3,200,000	19,000	5,600,000
Statewide Total Disposal[2]				31,200,000

[1] Rounded from Table 34 of (CalRecycle 2015)

[2] Rounded from CalRecycle DRS (http://www.calrecycle.ca.gov/LGCentral/Reports/DRS/Default.aspx)

Table 2. Tons Disposed and Organics Diverted Based on Diversion Strategy and Business-As-Usual (BAU):

	SLCP New Strategy Total Annual Tons Disposal[1]	SLCP Annual Tons Composted[3]	Existing Strategies (w/o SLCP) Annual Tons Disposal	Existing Strategies Annual Tons Composted[4]
2014	31,200,000	5,700,000[2]	31,200,000	5,700,000
2020	24,500,000	14,500,000	23,500,000	13,400,000
2025	22,200,000	17,400,000	24,700,000	14,100,000
2030	23,300,000	18,300,000	25,600,000	14,800,000
2050	28,500,000	22,300,000	31,700,000	18,100,000

[1] Assume 1% annual increase (growth rate) in tons disposed and composted after 2020.

[2] Year 2014 tons composted is total tons composted + in-vessel anaerobic digestion (AD) from (CalRecycle, 2016) and (CalRecycle, 2015). Note: AD is a very small fraction relative to composting and is therefore not broken out.

[3] SLCP Strategy 75% of organics diverted by 2020 and 90% (80% effective) by 2025 (Page 72 footnote (ARB 2016a). For this analysis it was assumed that total % of organics diverted are based on 2014 total organics disposed, GM ADC, and 2014 existing composting (Total 5.7+1.3+12.7 MT= 19.7 MT).

[4] Mandatory commercial organics recycling (AB 1826) and GM ADC diversion credit ban include a total of 7,700,000 tons organics is diverted by 2020 from 2014 levels: 1. AB 1826 Goal of diverting 50% of organics will be achieved (6,400,000 tons); and 2. An additional 95% of GM ADC and AIC (1,300,000 tons) will be diverted (AB 1594). The AB 1826 goal includes compostable organics from the commercial and multi-family sources (multi-family assumed 1/3 of total franchise residential). Assume 1% growth of waste disposal and composting after 2020. Other existing programs (e.g., AB 341 and AB 939) and synergistic increase in residential organics diversion from AB 1826 may provide additional organics diversion but are not considered in this analysis.

Table 3. CARB Landfill Emission Tool Model Input Parameters (CARB, 2016c):

	SLCP ANDOC%[1]	Existing Strategies ANDOC%[1]	K	SLCP/ Existing Strategies Capture Efficiency[2]
2014	7.52%	7.52%	0.02	77.5%
2020	2.15%	2.96%		77.5%
2025	1.5%	2.96%		77.5%
2030	1.5%	2.96%		80%
2050	1.5%	2.96%		85%

[1] Reduction of Anaerobically Degradable Organic Carbon (ANDOC %) for waste disposed from 2014 baseline is proportional to the reduction in organics disposed from the 7.52% baseline.

[2] Increase applies SLCP which assumes capture efficiency increases to 80% by 2030 and 85% by 2050.

Table 4. Comparison of SCLP Strategy with Existing Strategies Composting Emission Not Considered (Landfill Methane Emission 20-yr GWP ($MMTCO_2e$))[1] :

	SLCP Strategy[1]	Existing Strategies[1]	Reductions SLCP to Existing Strategies
2014	0.2	0.2	0
2020	2.3	2.3	0
2025	2.5	2.7	-0.2
2030	2.6	2.8	-0.2
2050	2.5	3.7	-1.2

[1] Values are from incremental emissions from new waste disposal starting in 2014.

Table 4 does not include the GHG impacts of methane (and N_2O) emission from composting. CARB estimates in its Inventory that there was 0.43 MMTCO2e (100-year Global Warming Potential (GWP)) emission from composting in 2013. The corresponding 20-year SLCP GWP emission would be 1.3 $MMTCO_2e$ or 0.283 $MMTCO_2e$ per million tons composted. Expanding organics recycling to composting will increase GHG emission over the 20-year GWP timeline by up to 6.3 $MMTCO_2e$ per year for the SLCP Strategy assuming current emission factors.

The following summary reflects emission from composting as incorporated in the Inventory (CARB, 2016c):

Table 5. Comparison of SCLP Strategy with Existing Strategies Including Composting Emission (Landfill Methane Emission 20-yr GWP ($MMTCO_2e$)) [1,2]:

	SLCP Strategy	Existing Strategies	Reductions (-) Increases (+) SLCP to Existing Strategies (Composting Emissions Included)
2014	1.6	1.6	0
2020	6.4	6.1	+0.3
2025	7.4	6.7	+0.7
2030	7.8	7.0	+0.8
2050	8.8	8.8	0

[1] Composting emission factor is 0.283 $MMTCO_2e$ per million tons composted (converted for 20-year GWP from 2013 Inventory (ARB, 2016d)).

[2] Values are from incremental emissions from new waste disposal starting in 2014.

Additionally, emission reductions credited by CARB from the LMR total 3.6 MMTCO2e (20-year GWP) by 2020 (assumes capture efficiency of 85% by 2020 and converted from 1.0 MMTCO2e (100-year GWP 21; CARB 2008 Scoping Plan Appendix C-160)). In conclusions, the 5 MMTCO2e emission reduction target by 2030 can clearly be achieved by effective implementation of the Landfill Methane Rule and by full implementation of the new programs that will be required by AB 1826 (mandatory commercial organics) and AB 1594 (eliminates diversion credit for landfill alternative daily cover.)

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