Odor Impact Assessment of Operations at an Organic Waste-to-Energy Facility

Wei Zhou, Ling Jin (presenter), Tin Ho, Nancy J. Brown, Chelsea V. Preble, Randy Maddalena, Michael D. Sohn, Corinne D. Scown, Thomas W. Kirchstetter
Sustainable Energy Systems Group, Lawrence Berkeley National Laboratory

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Problem Statement

Background

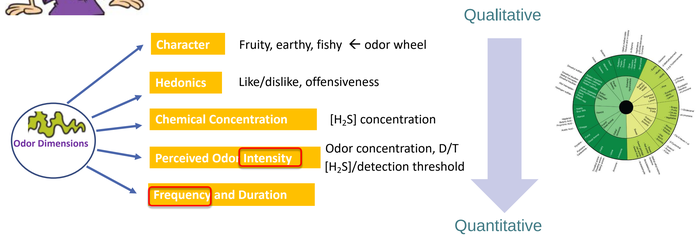
- California's ambitious waste diversion goals: Senate Bill 1383 requires a 75% reduction in organic waste landfilling by 2025.
- Significant growth in organic waste recycling facilities required.
- Anaerobic digestion (AD) of organic municipal solid waste is an important waste diversion strategy.
- Because municipal organic waste is primarily generated in densely-populated areas, these facilities are often sited near cities to reduce hauling distances.

"Failure to control and manage odors is the single biggest cause of adverse publicity, regulatory pressures and facility closures in the organics recycling industry."

— Biocycle (2012)

Odor 101

A sensation our brain generates in response to chemical stimuli.
- Chemical component
- Sensory component



Research Objectives

- Characterize emission sources at various waste processing stages
- Identify influential sources that limit facility scale-up
- Develop mitigation priorities and siting strategies.

https://www.biocycle.net/2014/02/21/the-compost-odor-wheel/

Study Site

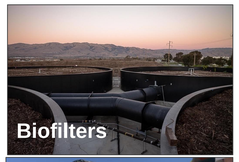
ZWEDC is the largest Dry AD facility and faces scale-up barriers:
- Odor results in public adversity
- Siting and air permitting of new facilities
- High capital and operational costs
- Uncertainty in revenue for power output, compost, and other co-products

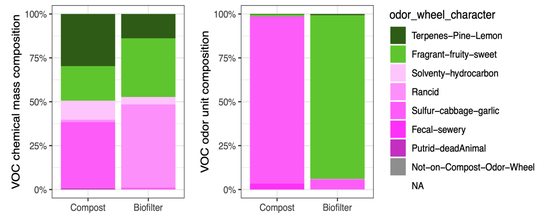
CEC funded study (2015-2019)

* Onsite composting has been relocated.

Measurement and Modeling Approach

Odor Emission Characterization





Chemical concentration (ug/m³)

$$C = \sum_i C_i$$

C_i : chemical concentration of species *i*.

Odor Perception (ou/m³) (~odor activity value, OAV)

$$OAV = \sum_i {C_i}/{OT_i}$$

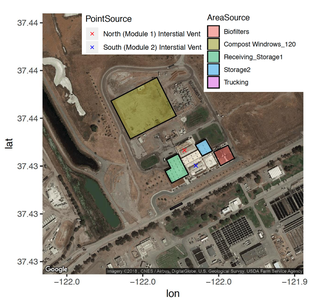
OT_i : odor detection threshold of species *i*.

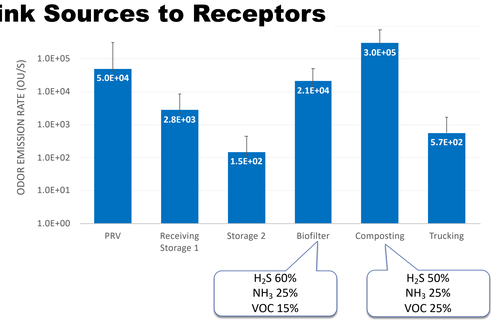
Source	Type	Emitting Frequency	H_2S	NH_3	VOCs	Flow Rate	Literature
Compost	Area	Continuous	●	●	●	●	*
Biofilter	Area	Continuous	●	●	●	●	*
Receiving Storage	Area	Intermittent			●		●
Trucking	Line	Intermittent					●
PRV	Point	Intermittent, unknown schedule				●	●

* For evaluation purpose

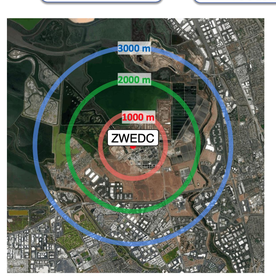
- Spot measurements for large area source.
- Species emissions → odor perception.
- Composting is the leading odor source.
- AERMOD models hourly offsite odor concentrations.

AERMOD to Link Sources to Receptors

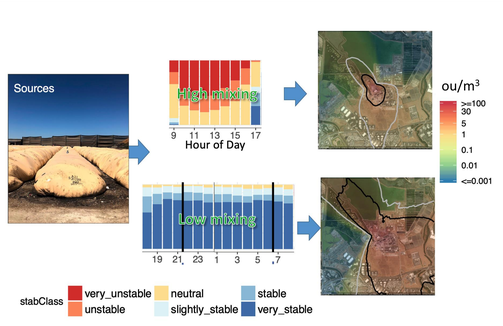




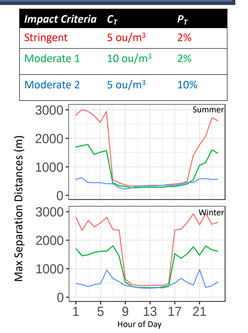
AERMOD
- Prevailing winds
- Atmospheric turbulences
- Building downwash
- Terrain and surface data
- Source data
- Receptor data



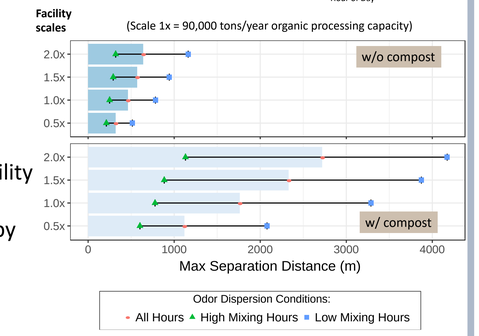
Offsite Odor Impact Assessment



Impact Criteria	C_T	P_T
Stringent	5 ou/m³	2%
Moderate 1	10 ou/m³	2%
Moderate 2	5 ou/m³	10%

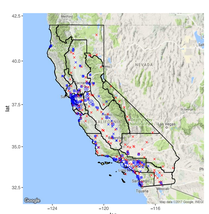


Separation Distance: The minimum distance at which receptor locations begin to no longer affected as determined by odor impact criteria.



- Compost odor dominates offsite impacts and limits facility scale up.
- Time of day matters, driven by atmospheric stability
- Odor impact criteria matters → Key task for regulators.

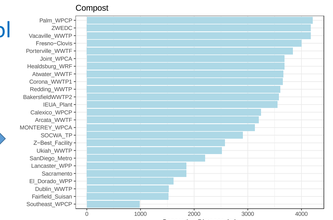
Extrapolation to Entire State

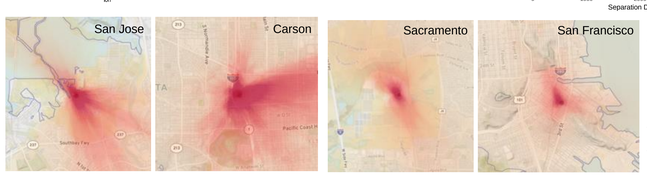


Odor dispersion webtool
Smelly.lbl.gov

25 prototypical sites

By air basin, location, terrain, pop density





Same odor release modeled at 4 locations, difference due to met and terrain.

Conclusions

- Outdoor composting is the dominant odor source; new composting odor management techniques are needed.
- Low mixing hours (early morning/evening and late afternoon) are conducive to greater odor impacts
- Need community monitoring to determine proper odor impact criteria for adequately siting a facility.
- Odor dispersion and assessment tool needed to support AD siting and planning to expand organics recycling at scale.

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