

**From:** [Ken Eklund](#)  
**To:** [Coffin Butte Landfill Appeals](#)  
**Subject:** ENRAC recommends denial of LU-24-027  
**Date:** Friday, August 29, 2025 10:59:23 PM  
**Attachments:** [ENRAC Recommendation to Deny LU24027.pdf](#)  
[Turning Down the Heat.pdf](#)  
[EPA inspection uncovered methane leaks at Benton County landfill - OPB.pdf](#)

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Dear Commissioners:

On April 9, 2025, after substantial research and evidence-gathering and lengthy deliberation, Benton County's Environment and Natural Resources Advisory Committee (ENRAC) voted to recommend denial of Republic's land use application to expand the landfill, LU-24-027. ENRAC was given the charter to make this official recommendation on this application by the Board of Commissioners. I'm attaching their official Decision and Rationale for the Commissioners' Record, as a PDF.

The Committee's letter on their Decision (pp. 1-2) lists concerns about air pollution, methane emissions, water pollution, toxicants in leachate, impacts to local residents and community, impacts to economics, and regional impacts as factors in their decision. They refer the Commissioners to their tranche of evidence, which includes EPA inspections reports and a timeline of EPA monitoring and enforcement actions on Coffin Butte Landfill, and to further environmental reports and news articles (two of which follow the Recommendation to Deny as further pages of this email).

In July, as you know, the Planning Commission did deny the application to expand the landfill, in a unanimous vote. I join with ENRAC in urging the Board of Commissioners to deny LU-24-027 and affirm the Planning Commission and ENRAC, because the many concerns they list still pertain and even more economic and environmental hazards have come to light since they gathered evidence and made their overwhelming decisions to deny.

All best,

Ken Eklund

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April 16, 2025

**To:** Benton County Planning Commission

**From:** Benton County Environment and Natural Resources Advisory Committee

The members of the Benton County Environment and Natural Resources Advisory Committee (ENRAC) voted on April 9, 2025, to recommend to the Benton County Planning Commission to **deny** the Conditional Use Permit requested by Republic Services to expand Coffin Butte Landfill (CBL).

The following major topics, which are discussed in greater detail in the accompanying Report, were key considerations that informed ENRAC's recommendation. Each reflects a significant impact that was identified and assessed in whatever event of the Planning Commission's final landfill expansion decision.

- Air Pollution
  - Volatile organic compounds and odor contaminants still cause unknown issues; air quality permitting has not been consistent and CBL is currently on a DEQ Title V expired permit.
- Methane Emissions
  - Methane emissions have resulted in several EPA inspection infractions. Ongoing state and legislative efforts towards monitoring and an EPA subpoena recommend denial of the CUP to allow full analysis of what is happening with methane emissions.
- Water Pollution
  - Arsenic, other heavy metals, and organic pollutants (especially Polyfluorinated Alkyl Substances (PFAs)) have been problematic and remain unsettled; further comprehensive groundwater and toxicological analysis should be conducted.
- Leachate
  - Leachate has further complex toxicants that may be leaking, but primarily a more clear plan of how leachate is remediated and delocalized must be considered.
- Impact to Local Residents and Community
  - Residents near landfills experience higher rates of health issues, such as birth defects and cancers. New construction introduces new opportunities for contaminant spread and destruction of local wetland ecology. Environmental justice asks that those impacted have a significant voice.

- Economics
  - Denial for CUP will likely increase rates for local rate-payers.
  - Removal of the intake cap means CBL can increase waste intake coming from other municipalities, thus shortening the longevity of the CBL.
  - Low-income communities are targeted for landfill locations, or become so due to their location, driving housing & land value down by around 13%.
- Regional Impacts and Coordination
  - Impacts to road wear and increased traffic, need for increased consolidation of waste and to minimize the use of trucks requires infrastructure investment.
  - With its lifespan already overestimated by 30-50 years, considerations of CBL end-of-life & closing should be clearly stated.

For more detailed reporting, referenced documentation, and individual member statements and comments, please see the further Report below.

Thank you,

Jason Schindler, ENRAC Chair



## ENRAC Deliberations on CUP Expansion Application

FINAL REPORT – April 16, 2025

The following Report was created by ENRAC based on a worksheet that each member completed. Topics were identified at the March 12 meeting, and each row within the “Topic/Issue” is from an individual ENRAC member. No effort was made to aggregate language or find consensus per topic.

### Overview

The following are resources, considerations, potential impacts to consider, and a general framework for ENRAC Members to evaluate Republic Services’ application for a Conditional Use Permit (CUP) to expand the Coffin Butte landfill. ENRAC will develop a recommendation to be submitted to the Benton County Planning Commission to reject, accept, or accept the application with conditions. There is no legal or formal required length, content, or structure for the recommendation. The recommendation must be voted on and approved by ENRAC by April 22.

### CUP Application Materials

The following are links to the CUP application & related materials:

- [Landfill expansion application](#) (submitted July 19, 2024)
- [Revised application](#) (submitted Oct. 30, 2024)
- [Additional information](#) (submitted Jan. 15, 2025)
- [First Addendum to Burden of Proof](#) (submitted March 14, 2025)
- To learn more about the decision process visit [bentoncountyor.gov/coffin-butte-landfill](https://bentoncountyor.gov/coffin-butte-landfill)

### What to Consider Per Code

Per Code [53.215](#), the following are the considerations, but not limited to, when evaluating the CUP:

*The decision to approve a conditional use permit shall be based on findings that:*

- (1) The proposed use does not seriously interfere with uses on adjacent property, with the character of the area, or with the purpose of the zone;*
- (2) The proposed use does not impose an undue burden on any public improvements, facilities, utilities, or services available to the area; and*
- (3) The proposed use complies with any additional criteria which may be required for the specific use by [Benton County Development Code](#). [Ord 90-0069]*

The following are additional Codes as reference:

- [Chapter 23 – Solid Waste Management](#)
- [Chapter 77 – Landfill Site \(LS\)](#)

The following should be kept in mind when evaluating the application:

- Your analysis must focus only on the expansion area, NOT the landfill itself or its history
- The definition of “area” can be interpreted by you and/or by issue; such as, impacts to neighboring communities, impacts that go beyond the landfill, impacts on other jurisdictions, etc.
- You can consider & evaluate short-, mid- &/or long-term Impacts
- Benton County cannot control where the waste that is received at the landfill originates
- If the application is approved, the current cap of 1.1 million tons accepted per year will cease
- If the application is approved, Metro (Portland area’s disposal district) will not be able to send materials to Coffin Butte per existing policy



## ENRAC Deliberations Framework for CUP Application

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The following is a framework to organize topics to be analyzed and feedback to be captured. The objective is for ENRAC Members to agree on a recommendation to the Planning Commission via either consensus or by majority vote. The 'Topics & Issues' were captured from the March 12 ENRAC meeting. For 'Potential Impacts', include your thoughts, research links, and/or any items for ENRAC to consider. For 'Thoughts on Recommendation', include your positions or perspectives on whether the Topic/Issue leans you to recommend approval, denial, or approval with conditions for the application. Staff will compile all comments as sent for discussion at the next ENRAC meeting. Lastly, please identify any additional topics you want included and/or thoughts on reorganizing the current framework.

Abbreviations noted, if not extensive:

- BC                   Benton County (though usually as Benton County Governance)
- BCC                Benton County Commission (& Commissioners)
- BC PC             Benton County Planning Commission
- CUP                Conditional Use Permit (application in consideration; assumed to be most recent unless noted)
- CBL & CB        Coffin Butte Landfill, also Coffin Butte, but implies and implicates ownership by Valley Landfills, Inc. and Republic Services Operations
- EPA                Federal Environmental Protection Agency
- DEQ               Oregon Department of Environmental Quality, assumed to be Oregon chapter unless otherwise noted
- GHG               Greenhouse Gas Emissions, typically CO2 and methane, though others exist
- ENRAC            Environmental and Natural Resources Advisory Committee
- DSAC             Disposal Site Advisory Committee
- SWAC             Solid Waste Advisory Committee
- VOC               Volatile Organic Compound

All recommendations and documentation below assumes the inclusion of the above CUP Application documents already outlined in this letter.

All documents cited in this letter are shared here: [https://drive.google.com/drive/folders/1K2eYDx56-TTG-xx\\_LOCHjr0iOagkuwSV?usp=sharing](https://drive.google.com/drive/folders/1K2eYDx56-TTG-xx_LOCHjr0iOagkuwSV?usp=sharing)

## ENVIRONMENTAL IMPACTS

| Topic/Issue   | Potential Impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Air Pollution |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Methane is released from landfills, so if expanded there is potential for increased methane GHG emissions. On the other hand, if the landfill were to not expand, there will be increased air pollution elsewhere as the region may have to truck our waste further to dispose of it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Approve with conditions, such as increased monitoring and stronger sorting of organics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|               | Increased particulate matter and odor emissions during construction and expanded landfill operations. Possible worsening of local air quality for nearby communities                                                                                                                                                                                                                                                                                                                            | approval with conditions: Require air quality monitoring stations and dust suppression strategies during construction and operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|               | local smell; methane leaks                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|               | ❖ Odor Issues – see below Odor section<br>❖ VOC Emissions                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|               | <ul style="list-style-type: none"> <li>• <a href="#">Oregon warns Coffin Butte Landfill over methane emissions</a></li> <li>• <a href="#">DEQ - Landfill Methane Emissions Reduction</a></li> <li>• <a href="#">Oregon regulators pause Coffin Butte Landfill air quality permit process</a></li> <li>• <a href="#">Coffin Butte Landfill</a></li> <li>• <a href="#">EPA Coffin Butte Inspection Report Summary – Beyond Toxics</a></li> <li>• <a href="#">EPA Inspection Report</a></li> </ul> | Methane leaks seem to be a continuous issue for the landfill. After DEQ and EPA inspections, CB did not meet the guidelines for a methane flare, for methane leaks, and for methane reduction. As of Jan 2025, the DEQ had to pause its air quality public comment period and permitting review process for the landfill. CB's air quality permit has not been updated since 2009. This update has not happened yet because Republic Services claims to not be able to find their paperwork. The DEQ is currently letting them run the landfill with an expired permit until they can find this paperwork. This seems suspicious to me, especially because the EPA announced how CB was violating limits for as how much methane is leaking from the landfill. <b>Application should be denied, as their air quality permit is not up to date and CB is violating federal methane regulations.</b> |

## ENVIRONMENTAL IMPACTS

| Topic/Issue                     | Potential Impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Greenhouse Gas Emissions</b> | Methane emissions are a huge concern.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Recommend requiring the most stringent applicable standards for monitoring and ameliorating, with independent monitoring of that monitoring.<br><br>See Row 2 above.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                 | Additional methane and CO <sub>2</sub> emissions from increased waste volume                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | approval with conditions: Ensure strong GHG mitigation plans (e.g., expanded gas capture system, renewable energy utilization) and regular reporting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                 | methane no smell, but cited for leaks in June 2024 with ruptured plastic covers full report 8/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                 | <ul style="list-style-type: none"> <li>• Methane Emissions</li> </ul> <p>Considering the extensive documentation below, with some focus on the “CBL and EPA - timeline.pdf,” and its supporting documents.</p> <p>See <a href="#">documents available</a>:</p> <ul style="list-style-type: none"> <li>• CBL and EPA - timeline.pdf</li> <li>• ENRAC - EPA Jun 2022 CBL Inspection Report - Heinz.pdf</li> <li>• ENRAC - EPA Jun 2024 CBL Inspection Report - Conley.pdf</li> <li>• ENRAC - EPA Subpoena CBL January 2025.pdf</li> <li>• ENRAC - Planning Commission Findings and Decision 2021.pdf</li> <li>• EPA landfill area demographics 1 mile radius exp.png</li> <li>• EPA landfill area demographics 3 mile radius exp.png</li> <li>• EPA landfill area demographics 5 mile radius exp.png</li> <li>• The Hidden Costs of Landfills.pdf</li> <li>• 5.3 Delegation of BCC 77 Duties from SWAC to ENRAC - 240702 - Order D2024-048.pdf</li> <li>• 133902.pdf</li> <li>• A huge landfill in Oregon is spewing methane. Its... _ Canary Media.pdf</li> <li>• Benton County News July 112024.pdf</li> <li>• Benton Cty Land Use Appl Process Map.pdf</li> </ul> | <ul style="list-style-type: none"> <li>• Methane Emissions</li> </ul> <p>Considering the extensive documentation provided, with some focus on the “CBL and EPA - timeline.pdf,” and supporting documents, a general pattern of institutional negligence is observed that needs important inculcation.</p> <p>CBL was monitored by the EPA on at least two separate occasions, 2022 and 2024, both times finding significant methane emission events at various sites at the CBL site inspected. It is noted in the CUP that the events from 2022 inspection events were deemed addressed. The 2024 inspection, to my reading, did not include official DEQ or EPA action items merely from their reporting, so no action was required from CBL.</p> <p>However, within the further documentation provided, between a faulty and slow regulation and observation process between OR DEQ and EPA (my reading on jurisdictions are complicated and not always fully understood), a narrative suggesting that methane is not adequately and immediately addressed on site still remains. By my reading, had the spot inspection in 2024 been more successful and redress of previous infractions were more consistent, the need for Sen. Merkley, state officials, and local efforts by SGB to suggest further institutional and regulatory oversight may have been unnecessary. Instead, it can be observed that an incomplete and inadequate regulatory framework has led to at least a learned and</p> |

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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• CB Aerial Map.pdf</li> <li>• CB Basic Facts.pdf</li> <li>• CB CUP Process Flow Chart.pdf</li> <li>• CB Ex. Summary.pdf</li> <li>• CB Expansion Overview.pdf</li> <li>• Coffin Butte Online Resources.docx</li> <li>• Email August 2024 Wyden Merkley Hoyle Urge EPA to Investigate Landfill Concerns in Benton County.pdf</li> <li>• Email June 2024 - URGENT Methane Leaks at Coffin Butte What You Need to Know.pdf</li> <li>• ENRAC Collab OneNote.pdf</li> <li>• EPA Inspection of Coffin Butte Landfill Accumulation of Flammable Methane.pdf</li> <li>• FAQs Benton Cty. June26.pdf</li> <li>• FAQs Coffin Butte.pdf</li> <li>• FINAL SGB Letter to Sen. Merkley - Coffin Butte Landfill.pdf</li> <li>• Gmail - Coffin Butte Resubmits 2023 Annual Landfill Report.pdf</li> <li>• July 10 ENRAC Meeting Video Recording.pdf</li> <li>• OPB Interview How much methane seeps out of Oregon landfills.pdf</li> <li>• SWACRecommendation.pdf</li> <li>• Testimony in support of SB 726 133902.pdf</li> <li>• Landfill Methane - Moms Clean Air Force.pdf</li> <li>• <a href="#">Benton County Talks Trash Final Report: bctt final report 4-11-2023.pdf</a></li> <li>• ENRAC Section 114 Info Request subpoena memo.pdf</li> <li>• Carbon Mapper explainer 3.pdf</li> <li>• Corvallis to stop accepting leachate from Republic Services.pdf</li> </ul> | <p>institutional lack of a culture of caring for the landfill and assuring methane security has been consistently met. Other details in the supporting documents (business info subpoena, resignations at CBL environmental lead) lend shade, if not fully realized or corroborated, that the system is not stable. The very recent activity of the EPA and DEQ suggest they are still in the process of understanding what to do about recent inspections and how to approach CBL in their infractions. As such, this is clearly an in-progress issue.</p> <p>Other details in the supporting documents and encapsulated in the “ENRAC Section 114 Info Request subpoena memo.pdf” timeline suggest that an ongoing legal and regulatory activity may be in progress (business info subpoena, resignations at CBL environmental lead) and lend shade, if not fully realized or corroborated, that the more information, insight, and response from EPA is forthcoming. The very recent activity of the EPA and DEQ suggest they are still in the process of understanding what to do about recent inspections and how to approach CBL in their infractions. As such, this is clearly an in-progress issue—and then timing is still key to understand whether the CUP should be approved as written and at present.</p> <p>Further, that the State of Oregon is currently considering SB 729 (with further supporting documentation included), suggests that a further need for improved and increased monitoring and regulation is required before the current institution of methane security can be achieved.</p> <p>It is also noted that methane is the largest factor in consideration here for GHG emissions, and while power co-generation and plume burning is present, the emissions from leakage is the biggest problematic part of that.</p> <p>It is also noted that methane leaks should also be associated with odor, VOC, and other volatile pollution emission as methane itself acts as increased carrier gas for those pollutants. Monitoring and testing of those leaks should be better understood.</p> <p>Further testimony and reporting in the Benton County Talks Trash documentation should be fully considered, of course. The history of</p> |
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|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                                                                                                                                                                                                                                                                                                        | <p>SWAC, DSAC, ENRAC, BC PC, and BCC are all complicated in the assessment of methane emissions alone.</p> <p><b>Therefore</b>, it is recommended that until further and fully demonstrable progress can be made to have site inspections be more successful and consistent, that methane can be assured to be secure upon random inspection, in-progress EPA considerations fully resolved, and the case for SB 729 and improved methane regulation and monitoring is resolved, <b>the present CUP application should be denied.</b></p> <p>These progressions may constitute need for further consideration and redress in a further CUP, but because of the lack of real enforcement within a “recommendation with conditions,” at this time, a full denial is the safest route.</p>                                                                                                                              |
| Leachate | Leachate is quite dangerous and after learning from Beyond Toxics that landfills liners do not last forever, it is scary to know that toxins are leaking into the soil and groundwater.                                                                                                                                | Approve with conditions, such as increased groundwater and river monitoring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|          | Increased waste volume could produce more leachate, potentially posing risk to groundwater and surface water if not managed properly                                                                                                                                                                                   | approval with conditions: Strengthen leachate collection and treatment infrastructure; require third-party audits of system capacity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|          | will never be free of PFAS, endocrine disruptors in humans (and likely other creatures)                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          | <ul style="list-style-type: none"> <li><a href="#">Potential toxicity of leachate from the municipal landfill in view of the possibility of their migration to the environment through infiltration into groundwater</a></li> <li><a href="#">Requirements for Municipal Solid Waste Landfills (MSWLFs)</a></li> </ul> | <p>According to Benton County’s Environmental Assessment for 2022-2023, CB released about 30 billion gallons of leachate. CBL is alongside Soap Creek, a tributary of the Luckiamute River that flows directly into the Willamette. This means that toxins are flowing into our water. The Environmental Assessment claims that all this leachate is within drinking water standards but that does not necessarily mean that this isn’t harmful to the ecosystem. The landfill is also built on previous wetlands, meaning there is a direct connection to the ground water. The plan for the expansion also shows the creation of new wetlands right beside the landfill. The EPA has requirements against siting and expanding landfills on or near wetlands. <b>Expansion of the landfill should be denied so we are not supporting further environmental degradation and pollution from leachate toxins.</b></p> |

## ENVIRONMENTAL IMPACTS

| Topic/Issue | Potential Impacts                                                                                                               | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soil        | Risk of contamination from accidental leachate release                                                                          | approval with conditions: Require soil testing and protective barriers; implement best practices for soil erosion control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|             | possible toxins on site, soil contents will leach into local wetlands and eventually our waterways, which all connect to oceans |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Toxicology  | Potential long-term exposure to hazardous materials or pollutants through air, water, or soil pathways if not properly managed  | Require a toxicological risk assessment and mitigation plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | arsenic, heavy metals                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | Comprehensive toxicological analysis of leachate, groundwater, airspace, plume, flaring, and network effects is complex.        | <p>With the complexity of all of the environmental testing posted elsewhere, merely taking any one of the signs of environmental and human impact may yet still paint an incomplete picture.</p> <p>Toxicological effects may not actually be seen unless comprehensive testing within the ecological matrix is observed, as synergistic effects from various pollutants may not be observed from individual contaminants observed. This is a difficult testing space to evaluate, but current technology is building to accommodate air and water combined testing. Some effort should be made to consider that toxicological space as that effort has not been adequately seen in the CUP.</p> <p><b>Therefore</b>, it is strongly recommended that a vetted, comprehensive toxicological analysis approach become a requirement for any approved CUP and indeed continued monitoring at CBL. Without systemic understanding of the toxicological effects, individually considered contaminants may not show the full impact of the proposed changes.</p> |

## ENVIRONMENTAL IMPACTS

| Topic/Issue                                     | Potential Impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Water Pollution</b><br>(surface &/or ground) | Huge concern. Not sure how to separate out leachate, soil, toxicology that all seem to relate to the nasty stuff in the water coming from the landfill.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Recommend requiring the most stringent applicable standards for monitoring and ameliorating, with independent monitoring of that monitoring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                 | Leachate seepage could contaminate groundwater or nearby surface water bodies, especially during extreme weather events                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | approval with conditions: Strengthen barriers and conduct hydrogeologic studies to guide water protection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                 | <p>post waste water treatment of leachate, it will go into our waterways with unfilterable PFAs and other potential toxins. This will eventually be in our oceans. Landfills are not allowed to be built currently on wetlands. Coffin Butte was sited well before EPA developed guidelines for safer siting of landfills, see attached guidelines. It is sited on wetlands and a tributary of? Soap Creek runs right by it.</p> <ul style="list-style-type: none"> <li>• <a href="#">EPA landfill siting recommendations:</a></li> <li>• <a href="#">Oregon Wetlands Map</a></li> <li>• <a href="#">Oregon USA Water/Wetlands</a></li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                 | <ul style="list-style-type: none"> <li>• See also Leachate discussion</li> <li>• Arsenic Issues &amp; Groundwater</li> <li>• PFAS pollution</li> </ul> <p><u>Documents available:</u></p> <ul style="list-style-type: none"> <li>❖ LandfillRelatedWaterQualityIssues.pdf</li> <li>❖ J Geier to BoC groundwater arsenic Aug 2024.pdf</li> </ul>                                                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>• Arsenic Issues &amp; Groundwater</li> </ul> <p>Numerous documents, with focus on the “LandfillRelatedWaterQualityIssues.pdf” report suggest that the situation with Arsenic contamination is not fully settled. My reading of the material suggests that there could be potential leak issues or contamination from the landfill infrastructure, though indeed better evidence is needed and evidence to the contrary is presented.</p> <p><b>Therefore</b>, without additional evidence, the BC PC is recommended to take particularly close look at whether combined evidence here or elsewhere can constitute a clear and present danger to local environment and groundwater. <b>It is not currently clear that the CUP presents a danger to environmental impact and several important gaps in testing and knowledge seem to remain.</b></p> |
|                                                 | Those who rely on well water and live around the landfill or Soap Creek may be exposed to the leachate toxins.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| ENVIRONMENTAL IMPACTS                                    |                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic/Issue                                              | Potential Impacts                                                                                                                                                                                             | Thoughts on Recommendation                                                                                                                                                                                                                                                                         |
| <b>Monitoring</b><br><i>(general &amp;/or specific)</i>  | Huge concern. Based on press reports, Republic has been less than stellar in monitoring and ameliorating methane emissions                                                                                    | I think strong monitoring is super important.                                                                                                                                                                                                                                                      |
|                                                          | Need for expanded and more frequent monitoring of air, water, and soil quality due to the scale of the proposed expansion                                                                                     | approval with conditions: Set mandatory monitoring frequency, real-time data access for the public, and independent oversight of monitoring results                                                                                                                                                |
|                                                          |                                                                                                                                                                                                               | There has clearly been issues with CBL's monitoring standards as the EPA and DEQ continue to show CB's violations. <b>Due to these violations, the expansion request should be denied because there CB is not showing trustworthy information or sharing about the air and water quality data.</b> |
| <b>Regulations</b><br><i>(general &amp;/or specific)</i> | Expansion must comply with state and federal regulations regarding landfill operation, emissions, water protection, etc.                                                                                      | CUP approval contingent upon full regulatory compliance with DEQ, EPA, and county requirements, and routine compliance verification                                                                                                                                                                |
| <b>Other?</b>                                            | Climate resilience concerns                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                    |
|                                                          | My understanding is that Coffin Butte, because of local geology/soil, is not a sight that would be selected for a start-from-scratch landfill. The landfill is there only because of the old Camp Adair dump. | If the expansion is granted, specify that no further expansion will be allowed. After the 5 or 6 years "bought" by the expansion, shut the place down. Permanently. Begin planning now for a new appropriate site.                                                                                 |
|                                                          | Consideration of the "natural" ecology of the landscape to have its own voice.                                                                                                                                | See below comments within Network/Systemic effects.                                                                                                                                                                                                                                                |

Links to be included above under "Air Pollution" & "Greenhouse Gas Emissions":

<https://cdn.sanity.io/files/xdjws328/production/657706be7f29a20fe54692a03dbedce8809721e8.pdf>

<https://www.opb.org/article/2025/01/18/epa-inspection-coffin-butte-methane-leak/#:~:text=An%20Environmental%20Protection%20Agency%20inspection,the%20town%20of%20Adair%20Village.>

Recent report that includes CB. Methane emissions are an issue here:

<https://cdn.sanity.io/files/xdjws328/production/b562620948374268b8c6da61ec1c44960a8d5879.pdf>

| HUMAN IMPACTS               |                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Topic/Issue                 | Potential Impacts                                                                                                                                                                                                      | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Local Residents / Community |                                                                                                                                                                                                                        | Vocal residents are quite opposed to the expansion. If we do not expand, the county is yet to come up with options for where our waste will go.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                             | Increased traffic, noise, and perceived risks may affect quality of life. Expansion could raise long-term concerns about property values and environmental health                                                      | approval with strong community engagement: Require a community liaison, grievance mechanism, and public outreach before and after expansion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                             | local smell complaints are common among local residents                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                             | <p>Local Residents &amp; Community <a href="#">documents available</a></p> <ul style="list-style-type: none"> <li><a href="#">Benton County Talks Trash Final Report: bctt final report 4-11-2023.pdf</a> -</li> </ul> | <ul style="list-style-type: none"> <li>Local Residents &amp; Community</li> </ul> <p>The Benton County Talks Trash initiative, spurred by the original 2021 CBL CUP and general public outcry, is an important summary of the local, historic, and community perspectives related to this CUP.</p> <p>As public comment will likely corroborate, there is a very mixed and vocal community, especially those within close proximity to the landfill, that have concerns. NIMBYism is a constant issue with any large project, though indeed the backyard being a landfill is more dramatic than many.</p> <p>There is important consideration and network effects with the consideration of local residents. Shall the concerns of a vocal minority lead the discussion, even when they are the ones most impacted by those changes? Generally, it would be the assumption from the ENRAC Board that this is true—externalized pollution has been a classical and on-going environmental justice issue, especially when that minority, however vocal, is denied its rights and due process—and even then—to resist a distant majority willing to sacrifice a portion of health and well being elsewhere.</p> <p><b>Therefore, it is extremely important</b> that any evidence that the above environmental impacts to local residents be considered with the greatest of weight towards the recommendation or denial of this present CUP. The planning commission needs to carefully incorporate all those voices, views, and evidences of impact.</p> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                             |
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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Therefore</b> , due to numerous concerns within the BCTT report and issues raised about further expansion of the CBL, <b>the present CUP application should be denied.</b>                               |
| <b>Odor</b> | Landfill expansion may lead to intensified odors, particularly during warmer months or operational changes                                                                                                                                                                                                                                                                                                                           | approval with conditions: Install additional odor control systems and require real-time odor monitoring with public reporting                                                                               |
|             | <ul style="list-style-type: none"><li>• Odor Issues</li></ul> <p>Odor is a complex metric. What can be smelt by humans is not linearly associated with what may be present in air and air samples, even if testing were possible at every instance.</p> <p>Perhaps similarly, a variety of VOCs and various airborne pollutants are not detectable at all by scent and constitute a difficult monitoring and regulation problem.</p> | <ul style="list-style-type: none"><li>• Odor Issues</li></ul> <p>Odors may be considered a carrier metric for various other pollutants, VOCs, and quality of life around an undesirable infrastructure.</p> |

| HUMAN IMPACTS   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Topic/Issue     | Potential Impacts                                                                                                                                                                                                                                                                                                                                                                                                                                               | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Social/Societal | I am curious about the future impacts of the landfill on society. 10, 25, 50 years from now?                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                 | Risk of inequitable burden on low-income or marginalized communities; perception of being a 'dumping ground.'                                                                                                                                                                                                                                                                                                                                                   | approval with equity assessment: Conduct a social equity impact analysis and engage directly with impacted residents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                 | <ul style="list-style-type: none"> <li>• <a href="#">Targeting minority, low-income neighborhoods for hazardous waste sites</a></li> <li>• <a href="#">Environmental and socio-economic impacts of landfills</a></li> <li>• <a href="#">The Hidden Damage of Landfills</a></li> <li>• <a href="#">Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice</a></li> </ul> | <p>Those living around landfills are seen to experience high rates of cancers, birth defects, and other health issues due to the toxins released into the soil, air, and water. Aside from health issues, landfills also decrease property values which could make it difficult or near impossible for residents near the landfill to sell their homes and move away. In addition, all the news and controversy surrounding CBL may lower home values even more and even deter people from moving to the area.</p> <p>Landfill siting and regulating processes seem to follow “the path of least resistance” (Mohai and Saha 2015) which is how CBL and Republic Services has been exerting its power. This means that when there are little resources being dedicated to the opposition, the landfill owners have a stronger voice in the matter. Low income and communities of color have been seen to be targeted for landfills and other toxic sites. Rural landowners near CB are being targeted here. <b>The landfill expansion request should be denied, as it is causing many harmful impacts to Benton County residents and has the possibility to cause health issues like cancer and birth defects.</b></p> |
| Other?          | Mental well-being concerns among community members                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                 | <ul style="list-style-type: none"> <li>• <a href="#">Chronic stress puts your health at risk</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                     | The stress of this toxic landfill is not doing good for community members and residents around CBL. Stress in combination with the other issues of the landfill can drive health problems for our locals.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| ECONOMIC IMPACTS |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic/Issue      | Potential Impacts                                                                                                                                                                                                                                                                                                                                                                         | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Economics        |                                                                                                                                                                                                                                                                                                                                                                                           | If the landfill does expand, it can help to maintain the jobs that are already employing those who work at the landfill and the waste haulers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                  | Could result in job creation, increased tax revenue, and economic growth locally, but also pose long-term infrastructure costs                                                                                                                                                                                                                                                            | approval with conditions: Request an economic cost-benefit analysis and transparent budgeting for public infrastructure use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                  | county will have decreased income if landfill does not expand<br>Human health value must be considered.                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  | <ul style="list-style-type: none"> <li>Benton County Economics <a href="#">documents available:</a></li> </ul> <p>Supporting Documents:</p> <ul style="list-style-type: none"> <li>❖ Basic_Economics_of_Coffin_Butte_Landfill.pdf</li> <li>❖ <a href="#">Benton County Talks Trash Final Report: bctt final report 4-11-2023.pdf</a></li> <li>❖ <a href="#">SPLG Waste.pdf</a></li> </ul> | <ul style="list-style-type: none"> <li>Benton County Economics</li> </ul> <p>Of note in the provided report, BC stands to continue and increase benefit fairly significantly in the associated costs and use fees of hosting CBL within Benton County. While there is nothing necessarily wrong with that, it is important to make clear and transparent that this is happening. Economics and politics always make corroborations, but to understand them and their implications is key.</p> <p>However, of greater note in this report and as raised in BCTT reports and commentary, the elimination of intake caps is most concerning. With a noted recent pattern from 2019 onward and changes in the regional landfill options, CBL has increased to near present intake capacity. The CUP, if approved, would eliminate any cap on intake, allowing significant increases in waste intake from regional outlets. While it is acceptable to assess the longevity of the present intake and fill rates as stated in the CUP, my reading is that it is not mandated or regulated how long that capacity need remain as stated.</p> <p>The pending SMMP and further changes in local and regional solid waste and material processing is encouraging. However, it is consistently noted that Republic and other waste management corporations have consistently dragged and prevented in providing actionable alternatives to landfill use—it being cheaper and easier to continue with old practices than spurn new activity, collaborations,</p> |

|                   |                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|                   |                                                                                                                                                                          | <p>real and demonstrable recycling and composting options, and creative solutions within the current system of waste management.</p> <p>As such, extending the CBL and approving the CUP does not put due economic pressure on BC, infrastructure, and cultural practices in order to instigate better SMMP and waste management practices. It only extends the inevitable need to do so, and worryingly so.</p> <p>It bears repeating, Republic Services is a for-profit, publicly traded corporation. They stand to continue to extract wealth from our local trash infrastructure and culture.</p> <p><b>Therefore</b>, without better consideration, coordination, and pressure to change current waste management practices, <b>the present CUP application should be denied.</b></p> |
| Ratepayers & Fees |                                                                                                                                                                          | If the landfill does expand, fees may not change. Maybe a different rate style could help to alter how much waste is entering the landfill.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                   | may increase if landfill is farther away                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                   | Residents in Benton County do not have an equitable choice in its decision for waste disposal. The provided options constitute a local monopoly and should be redressed. | Changes to the CUP and CBL functioning will likely change operation rates as expected in future system management. That said, creative solutions to equitable and sustainable distributions of the costs of CBL and CUP activity is recommended. E.g., income based cost burden, community, city, and county partnership and subsidy in that cost, and other environmental justice based solutions should be included. As Republic Services is a for-profit corporation, Benton County, City of Corvallis, and the residents should not merely be supporting the profits of said corporation when there is little to no competition for residents to choose from for waste and recycling options.                                                                                          |
| Other?            | City of Corvallis already stopped taking leachate for wastewater treatment, which was financial loss                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| SYSTEMIC/NETWORK EFFECTS |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| Topic/Issue              | Potential Impacts                                                                                                                                                                                                                                   | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Regional Impacts         |                                                                                                                                                                                                                                                     | If the landfill doesn't expand, I am not sure where our trash will go.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                          | Could shift regional waste dynamics; some counties may become more reliant on Benton County for disposal (?)                                                                                                                                        | approval with regional coordination: Encourage regional waste planning and develop an inter-jurisdictional framework for impact management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                          | <ul style="list-style-type: none"> <li>• <a href="#">History of Coffin Butte</a></li> <li>• <a href="#">What is the Typical Lifecycle of a Sanitary Landfill?</a></li> <li>• <a href="#">Coffin Butte Site Life Working Group Report</a></li> </ul> | <p>With the SMMP and future mandated task force, the region is trying to scramble to create a waste reduction plan in preparation for the closure of CBL. While the expansion may provide more time for a stronger material management plan, it comes at the detriment to the community and the environment.</p> <p>There are already major impacts to the region, since the landfill is set to close in the near future, with and without the expansion. A normal lifespan of a landfill is 30 to 50 years and CB has been used since the 1940s with Camp Adair. Benton County shares that the lifespan of CB has been "historically overestimated".</p> <p><b>The expansion should be denied so the landfill can close at its expected date in 2038. It is well past the average lifespan of landfills, and we have other options instead of expanding.</b></p> |
|                          |                                                                                                                                                                                                                                                     | As with other mentions in the document (see waste transport below), the coordination of waste management and options therein should be led more at the state and industry level to come into accord with the needs and desires of residents. While jurisdictions are in place, further state and local mandates for that sharing of the load and buy-in from regional interests for better outlets (see Eugene/Springfield recycling efforts) would be important to see.                                                                                                                                                                                                                                                                                                                                                                                          |

| SYSTEMIC/NETWORK EFFECTS                                                                   |                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Topic/Issue                                                                                | Potential Impacts                                                                                                                                                                                                                                            | Thoughts on Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Sustainable Materials Mngt.</b>                                                         |                                                                                                                                                                                                                                                              | This section is crucial to consider.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                                            | Expansion may disincentivize upstream waste reduction, reuse, and recycling if capacity is too easily available                                                                                                                                              | approval with conditions: Require landfill operator to invest in or support waste diversion programs and tracking of material flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                            | “Recycling” has long been touted as a solution to waste management, but between industry producers and waste-handlers, has been a façade of disinformation from many angles.                                                                                 | Real recycling options would be encouraging, and the new Eugene/Springfield management system access agreement or similar proposed local deployment would go a long way to encourage and engender confidence in Republic Services / CBL waste streams, and in consideration with the SMMP. Since Republic is a for profit corporation, I think increased investment would improve their image dramatically. That’s outside of the realm of this CUP directly, but as systems connect, it would be nice to see those. Without seeing those examples of industry led improvements, the status quo operations are not recommended.                           |
| <b>Waste Transport</b><br><i>(additional mileage, GHG emissions, traffic, roads, etc.)</i> |                                                                                                                                                                                                                                                              | I think this is important to consider. The landfill is already here, so expanding means that another one will not have to be built yet. If it is not expanded, we will have to truck our waste further. Is there potential to use the trains?                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                            | Increased truck traffic could worsen road conditions and contribute to emissions, especially if haul distances increase                                                                                                                                      | approval with conditions: Include traffic impact analysis, road maintenance agreements, and transportation-related emission offset programs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                            | It seems like this is something that Benton County is currently working out and they have more details than ENRAC.                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                                                            | Some kind of waste transport is guaranteed; minimizing that with more efficient and lower carbon options is helpful. Consolidation and shipping is often a better solution than pick-up truck transport. All of which depends on where trash is coming from. | While GHG emissions from carbon based transport are key, consolidation and location of waste pick-up is a large portion of that calculus. Corvallis and Benton County are relatively close, but if more trash (without a intake cap) comes from further away, there may be less of a conservation of carbon footprint unless those further waste regions are consolidating their transport.<br><br>This is a tricky analysis, and further examination is warranted depending on variables of intake cap, locations of accepted waste-streams, impacts of other waste disposal opening and closing, improved recycling, composting, and SMMP efforts, etc. |

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| <b>Other?</b> | Risk of future inter-county political tensions or resistance to further expansion proposals                                          | approval with planning safeguards: Establish a landfill lifecycle strategy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|               | <p>Exit Strategies</p> <p>Rights of land spaces and ecologies to exist.</p> <p>See Toxicology above as a Systemic/Network Effect</p> | <p>Agreed, in any future solution, a clear and public CBL exit strategy seems vital and necessary. Even if this CUP is approved, that approval will likely continue to wane, and everyone wants a better solution with more options and SMMP solutions to prevent need for landfill at any location. Idealistic, but still important to consider in the long term.</p> <p>While an “environmental” consideration, I put this consideration of the rights of ecologies to exist without the direct need for human utilization. Indeed, a nod towards the proposed land use within the CUP will change the ecology of that land significantly and there is both building if nascent recognition and understanding that ecologies should have their own voice and independence in that relationship to humans and the built environment.</p> <p>That said, a stewardship model of the landscape would be an important consideration of the wetlands that will be destroyed in the current CUP. Is stewardship of our lands, respectful of those lands, consider the CUP a good use case for its destruction?</p> <p>See Toxicology comments above; noted that they are systemic issues.</p> |

## Additional Comments from ENRAC Members

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As ENRAC members, our voices are diverse and intend to hold the follow space for our individual comment. That said, not all ENRAC members will fully agree with these personal statements, but agree that they should have that space here over individually submitted commentary.

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From Charlene Carroll, M.D. – March 21, 2025

Overall recommend not expanding landfill. it was a poor initial siting, and there are local wetlands that cannot be protected from the leaching toxins and PFAS due to landfill contents. The landfill and repercussions that result will effect the area and our water for a long time, possible forever. (PFAS are considered forever chemicals). Expanding the landfill will only worsen this issue.

Yes, this will increase the cost of getting rid of garbage, and decrease income to the county. Human health is invaluable, and this cost cannot be overstated.

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From Jason Schindler, current ENRAC chair – 2025-04-14

Dear Planning Commission, Benton County Commissioners, Staff, et al.,

I have to write this piece because our process necessitated its reflection. It is not complete, though it would be difficult to say any part of this decision-making process could or would be, even at time of writing.

As with most things, what most of environmental action and consideration really requires is a good story that can conceptualize and narrativize the data, facts, experiences, and influences that play upon the complicated task at hand. Our process in ENRAC does not encourage that well, in fact eludes it quite intentionally I believe. But as I have been appointed its chair and have the background to accommodate this task, it is also my need to encapsulate and present what I have experienced.

Therefore, our mission, from the Benton County Commissioners (BC PC) and BC Planning Commission:

From: "5.3 Delegation of BCC 77 Duties from SWAC to ENRAC - 240702 - Order D2024-048.pdf"

*NOW THEREFORE IT IS HEREBY ORDERED, the Environment & Natural Resources Advisory Committee is delegated the duties and responsibilities formerly assigned to SWAC in BCC 77.305 without further action by the Board. This delegation is limited to "review and make recommendations through the Planning Official to the Planning Commission regarding the Site Development Map Plan and narrative."*

But this mandate has taken on a variety of articulated forms, largely from BC staff, from apparently needing to assess the CUP on ENRAC's base of expertise, to considering what documents and resources we were interested and willing to find (many included above), to a consensual and binding vote, to merely providing

some commentary and recommended reviews to the BC PC, many overlapping with varying degrees of clarity. To point, we are all variously qualified volunteers with extremely limited direct expertise and available time to do so, nor was much time given for such a task.

While every opportunity to allow ENRAC to make its own decisions and assessments has been voiced by BC staff, and they have taken every opportunity to be supportive and helpful, additional concerns are noted below. They are noted in difference to the voicing of BC staff since the functionality of meetings, conducting our meetings, and patterns of interaction constitute a different and indirect level of interference and BC preference.

Relationship to VNEQS (<https://www.coffinbuttefacts.org/>), the online portal and vocal discussion community to deny the landfill expansion, has understandably been straining between BC. However, VNEQS activists have been directly vilified by staff in meetings (e.g., “they’re not good people”). Similar sentiment was levied against the outgoing and dissolved SWAC board as well. While this is taken with a grain of salt, as well as an obfuscation about what exactly happened within SWAC and the complicated history (some of which is piecable by BC Talks Trash reporting), it is still clear that BC staff have a clear and present preference and some chips that may not evidence a level playing field.

Most recently, and demonstrably to the operation of the ENRAC board, only now, under more direct scrutiny, are public meetings laws and regulations, active and enforceable for over a year, being clearly articulated and enforced to ENRAC meetings and practices (though, indeed, other boards seem similarly complicated and confused in how they carry their activity and public meetings practices, e.g., DSAC). The laid-back culture of ENRAC has generally allowed for a sense, if underutilized, that collaboration and communication was easily allowable. Understandably and problematically, present public meeting laws, as articulated by BC staff, were articulated to **not allow** for direct communication between board members on any aspect of deliberation, most communications synchronous or asynchronous assumed to contain deliberative aspects, resulting in communications being constantly filtered, documentation sharing constrained, and all meetings and contents required to be made public while the process of making them public has been curtailed or impossible. While this has not been the functional operation of ENRAC since its reformulation in 2020, the recent scrutiny with the CUP mandate has activated this application of public meeting laws and made our process even more onerous, especially that we do not have the processes or practices in place before needed to allow good board functioning. Nor do these public meeting laws seem applied regularly or accurately as I don’t believe that this is fully true in every case. It is recognized that the legislative thrust for these public meetings laws engender transparent and accountable deliberations, and that is important, but the ability to function as ENRAC desired or was led to believe seems curtailed by both the mandate to now abide by those rules and few practiced solutions to allow for that activity.

Additionally, in the process of ENRAC’s deliberations as the CUP has been approved and deemed complete for ENRAC’s assessment, with the above changes to process, the expedited nature of that assessment has been further encouraged by BC staff, suggesting too numerous in options that a simple vote, whatever assessment of documents and process ENRAC desired, could be done quickly and easily—moving on to next projects of the ENRAC board. This has generated a deleterious function of ENRAC to serve the original mandate above, devaluing and expediting our perspective, however distributed in the Planning Commission’s purview. While it is understandable that our timeframe was short, a certain amount of rushing the process and lip service paid to our important role in assessing the CUP is noted. The additional speediness and willingness to skip the

laborious part of assessing the entirety of the CUP (1200+ pages) and any amount of introduced documentation, has been notably present.

As such, it is difficult to get a sense that ENRAC is particularly enabled or empowered to do the best job it can do to assess the particularly important activity we have been tasked with. Perhaps this is by a certain kind of bureaucratic design, and while no sense of that is directly perceivable from BC staff—there remains a bureaucratic and institutional inertia against a sense of ideal functioning, adequate review, and democratic thriving.

At time of writing, ENRAC has made their decision and done the best it could to provide a summary and detailed assessment of the CUP and important concerns for that recommendation. I hope that the Planning Commission considers closely what level of actionable precaution and consideration of data should be included to assess the CUP Application. There will always be more data and more opinions, more arguments and important vital considerations to every aspect of BC, community, residents, region, and environment. ENRAC understands the BC PC to have a more regimented and policy angle on its approval process, will be assessing and accumulating copious public comment and existing documentation, and we hope to support that endeavor. But, to point, ENRAC makes its assessment without those regimented needs and hopes to encapsulate a different and environmentally driven perspective herein.

Thank you for considering our recommendation,  
Jason Schindler

# EPA inspection uncovered methane leaks at Benton County landfill

*Nathan Wilk*



FILE - Work at the Coffin Butte landfill, as seen on July 31, 2024.

*Nathan Wilk / KLCC*

An Environmental Protection Agency inspection last summer found dozens of methane leaks at the Coffin Butte landfill in Benton County, Oregon.

The site accepts more than 1 million tons of garbage annually. It's located about eight miles north of Corvallis, near the town of Adair Village. Residents living there [have shared concerns](#) about odor and fire hazards.

EPA inspectors did a partial walkthrough of the site on June 21. This month, the environmental watchdog group Industrious Labs obtained the report through a public records request.

During their visit, inspectors noted tearing in Coffin Butte's covering, and plants growing through the tarp. They recorded 41 places where methane emissions exceeded the legal maximum of 500 parts-

per-million.

In one area, a gas extraction well was missing its cap, and yielded a methane reading of more than 100,000 parts-per-million. Methane is explosive at around half that concentration, according to the National Oceanic and Atmospheric Administration.

“That is an enormous oversight,” said Mason Leavitt, a Data Analytics Specialist with Beyond Toxics, a Eugene-based nonprofit that’s been monitoring the situation at Coffin Butte. “At landfills, there are a variety of sources that can start fires, including lithium batteries, operating equipment, and the flare.”

In an email to KLCC, Melissa Quillard — a spokesperson for Republic Services, which owns and operates the landfill — said the company shares the community’s concern about methane emissions.

Following the inspection, she said the landfill’s ownership has taken steps to address the EPA’s findings: patching tears, upgrading its flare, and expanding the gas control and collection system.

However, Mark Yeager — who lives about five miles from the landfill — said conditions for neighbors haven’t improved since last summer. He said acrid odors still carry as far as northern Corvallis, and sometimes for multiple days in a row.

Methane itself is odorless, but not all of the gasses produced in a landfill are.

“There are so many aspects of the landfill operations that need to change, and that’s not going to come from Republic just deciding they want to do a better job,” said Yeager. “There’s going to need to be some degree of enforcement.”

Quillard said the EPA has not notified Republic Services of any impending enforcement action.

“Coffin Butte Landfill provides essential waste disposal services to the community and is highly engineered with multiple safety measures in place,” she said. “The landfill meets or exceeds all regulatory requirements.”

## **Application to Expand**

Meanwhile, Republic Services is [looking to expand](#) the Coffin Butte landfill. On Jan. 15, Benton County received additional documents as part of the company’s application.

If staff determine the application to be complete, they will schedule a public comment period and a hearing with the Benton County Planning Commission. The county estimates that this application process will be complete in June of this year.

At the same time, the state has paused work on Republic Services’ air quality permit process until it gets additional documents. The permit was last renewed in 2009, and expired in 2014 — but has

received administrative extensions since then.

**Correction:** *An earlier version of this story misidentified the area that Republic Services has applied to expand into. KLCC and OPB regret the error.*

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# TURNING DOWN THE HEAT

How the U.S. EPA Can Fight Climate Change by Cutting Landfill Emissions



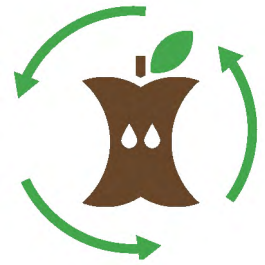
This report was researched and written by Kim Finlay of Industrious Labs. Kim Finlay and Heijo Schraff conducted the data analysis. Design by Big Think Studios.

### **Acknowledgements**

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### **About Industrious Labs**

Industrious Labs exists to deliver unstoppable policies, people power, and analysis to drastically reduce dangerous emissions, hold industry accountable to communities and workers, and develop a circular economy.



**Waste**

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# Executive Summary

Reducing methane emissions is the most impactful way to slow global warming in the next twenty years—years that we know are pivotal in efforts to meet ambitious climate targets. One straightforward path to dramatic methane reduction is addressing emissions from our country's more than 2,600 municipal solid waste (MSW) landfills. According to estimates reported to the U.S. Environmental Protection Agency (EPA)'s Greenhouse Gas Reporting Program (GHGRP), MSW landfills are the country's third-largest source of methane emissions. Compounding research reveals that the reality is likely much more severe, with unchecked levels of methane hiding in plain sight. Despite being unseen and often under the radar of policymakers, trash and the greenhouse gas emissions it generates represent an enormous opportunity to press the emergency brake on climate change.

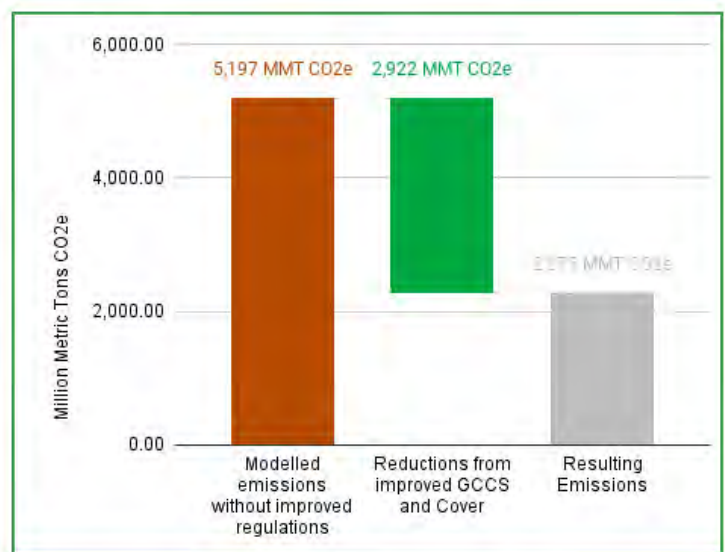
Mitigating emissions from MSW landfills will require a full-circle approach. Policy solutions to reduce and divert organic waste have a vital role to play in limiting future new emissions; however, waste diversion and prevention only address new emissions. To mitigate emissions from previously landfilled waste, strong, effective and comprehensive federal air emissions regulations for MSW landfills are vital. In July 2024, the EPA committed to updating the Clean Air Act standards for how landfills monitor, capture, and control methane—the New Source Performance Standards (NSPS) and Emission Guidelines (EG)—in 2025.<sup>1</sup> The EPA is to be commended for this commitment, and its acknowledgement of the waste sector's outsized role in driving potent methane emissions.

There is a broad suite of available technology and best practices to lower methane emissions that the EPA can and should consider as it works to draft updated NSPS/EG standards. To inform policymakers as they work to put in place strategies and policies to meet global climate commitments and to support the EPA in its work to update the standards, Industrious Labs modeled a number of

improvements to landfill operations. In our analysis, we employed the Afvalzorg Multiphase model, which is designed to account for varying waste degradation rates and provides detailed estimates of landfill gas generation, recovery, oxidation, and emissions over time. **The model results reveal that embracing two categories of solutions – improved landfill cover requirements and gas collection and control systems (GCCS) – would yield a methane emissions reduction of 56% cumulatively through 2050. These emissions reduction total 104 million metric tons (MMT) of methane, which equal:**

- **2,922 MMT of carbon dioxide equivalent** on a global warming potential of 100 years
- **8,289 MMT of carbon dioxide equivalent** on a global warming potential of 20 years<sup>2</sup>

**Figure 1: 2025-2050 Cumulative Emissions and Reduction Potential from Model Results**



The modeling used is based on a validated, data-informed baseline of landfill gas recovery rates of 43%, termed “Updated Assumption Baseline.” EPA assumptions in the GHGRP have relied on an assumed national landfill gas recovery rate of 75%, recently downgraded to 65%.<sup>3</sup> While studies have demonstrated that this recovery rate is achievable, it requires stringent landfill



management practices that aren't reflected in current federal regulations. Additionally, a significant proportion of landfills in the United States remain unregulated. However, even using EPA's baseline assumption of 75% gas recovery rate as a starting point, the emission reduction potential by adopting these two categories of improvements to the NSPS/EG is highly significant, totaling 47.9 MMT of methane (1,341.2 MMT CO<sub>2</sub>e) at an overall reduction of 42% cumulatively between 2025 and 2050. It is also important to note that there are additional measures, such as more effective and comprehensive monitoring to quickly find methane leaks, that were not modeled and thus represent even more potential emissions reductions.

While improving gas collection and landfill cover practices would yield significant emissions reductions, especially when paired with a robust organics diversion strategy, they are not an exhaustive representation of readily available solutions that should be considered by the EPA as they update their NSPS/EG standards.

Timely and accurate emission detection is also crucial. Advanced technologies such as airborne imaging spectrometers have been utilized to conduct extensive surveys of active landfills, revealing substantial sources of methane emissions that often go undetected by traditional methods.

Curbing polluting emissions from landfills requires a two-pronged approach. First, we must address the waste already buried in the ground. Despite broad availability, proven results, and cost-effectiveness, many municipal landfills do not use established strategies to control methane emissions, necessitating action to update federal landfill emissions standards. Second, policymakers must prioritize solutions to keep organic waste out of landfills in the first place. In order to illuminate the emissions potential of at-scale organics diversion, Industrious Labs modeled zero organic waste landfilled by 2050.

The implementation of zero organic waste landfilled by 2050 combined with earlier installation and expansion of gas collection and control systems is projected to achieve a substantial cumulative emissions reduction of 100 MMT of methane, representing a 54% decrease from the Updated Assumptions Baseline. This reduction equates to 2,801 MMT CO<sub>2</sub>e, calculated using a Global Warming Potential (GWP) of 28.

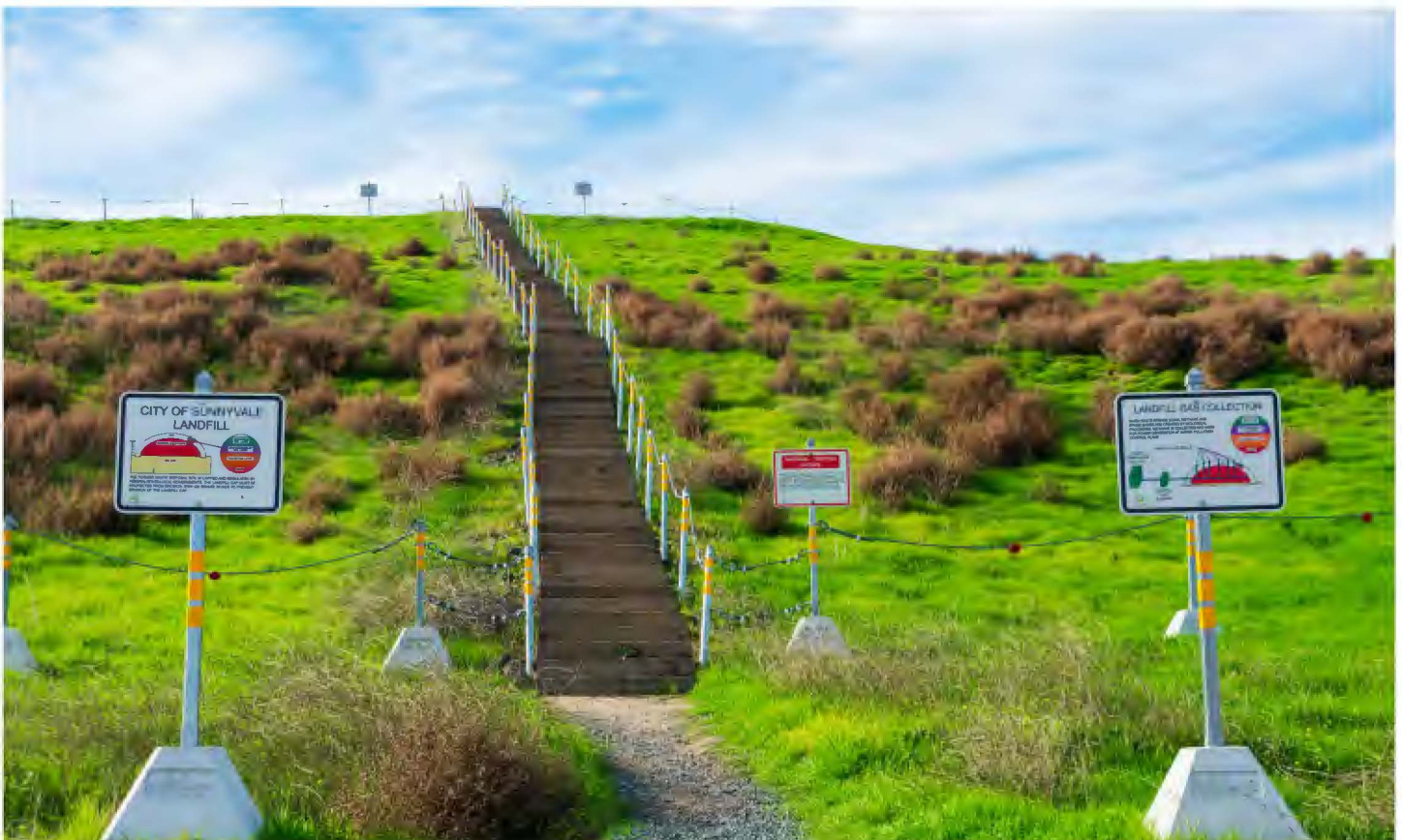
# Key Improvements to New Source Performance Standards/Emission Guidelines Standards (NSPS/EG)

In June 2023, a coalition of 14 environmental and community advocacy groups petitioned the EPA for more effective regulations to better control methane pollution from municipal landfills.<sup>4</sup> The petition outlines a number of improvements to the NSPS and EGs for MSW landfills that would improve methane mitigation. This analysis focuses on several key categories of improvements and models their impact on methane emissions. The categories are as follows:

- Gas Collection and Control Systems (GCCS):
  - » Lowering size and emission rate thresholds for GCCS Installation.
  - » Earlier installation and expansion of GCCS.
  - » Improving GCCS design and operation.
- Enhanced cover systems.

This section will provide basic information on the current federal regulatory parameter and the proposed key improvements to that parameter. Recognizing that there is a plethora of evidence and information supporting each of these improvements, we provide citations to resources rather than reproducing here.

**Beginning on the next page, we outline current NSPS and EG standards for each practice, as well as proposed improvements to yield significant methane emissions reductions.**



# Gas Collection and Control Systems (GCCS)

There are several key improvements needed for the installation and operation of GCCS in municipal solid waste landfills.

## Lowering Size and Emission Rate Thresholds for GCCS Installation

### Current EPA Standards

The current EPA regulations require GCCS if an active landfill has:

- A design capacity greater than or equal to 2.5 million megagrams (Mg) and 2.5 million cubic meters (m<sup>3</sup>).
- A Non-Methane Organic Compounds (NMOC) emission rate of 34 Mg/year or more.<sup>5</sup>

### Proposed Improvements

The proposed improvements to the standards involve adopting lower size and emission rate thresholds to install GCCS, as follows:

- 200,000 tons of waste-in-place.
- Greater than 664 tons/year methane generation rate.<sup>6</sup>

## Earlier Installation and Expansion of GCCS

### Current EPA Standards

Current landfill GCCS expansion practices are not aligned with EPA's own research findings.

Current EPA standards require that an active gas collection system must “(ii) Collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of 5 years or more if active; or 2 years or more if closed or at final grade.”<sup>9</sup> Yet EPA research indicates that half of the carbon in food waste degrades into methane within just 3.6 years and food waste is the largest input to landfills. This discrepancy in timelines leads to significant methane escape, with EPA estimating that 61% of methane is released before gas collection systems are in place—highlighting the urgent need to adjust regulatory timelines to better match the rapid degradation rate of food waste and mitigate methane emissions.<sup>10</sup>

### Proposed Improvements

The proposed change would require the installation and expansion of GCCS within one year after waste is placed.<sup>11</sup> Implementing earlier installation and expansion of GCCS captures methane emissions from earlier in the life cycle waste disposal, preventing large amounts of methane from escaping into the atmosphere in the initial years. Early installation also increases the efficiency potential of the GCCS, improving overall methane reduction outcomes. Finally, by capturing methane and other harmful air pollutants sooner, the overall environmental impact of the landfill can be significantly reduced.

## Earlier Installation and Expansion of GCCS (cont.)

### Current EPA Standards

The design and operation standards for GCCS in the EPA NSPS/EG standards are not stringent, leading to variations in effectiveness and efficiency across different landfills.

### Proposed Improvements

Strong landfill management practices such as advancements in landfill gas collection systems significantly improve gas recovery rates, thus yielding emissions reductions. For instance, a study by the American Institute of Physics highlights effective landfill gas management strategies that optimize methane control and enhance gas recovery efficiency.<sup>12</sup> Enhanced systems, such as those incorporating more efficient gas collection wells, advanced flaring systems, and improved leachate management, have been shown to significantly reduce methane emissions and increase the volume of gas captured for energy production. The proposed change involves the development and implementation of more robust and comprehensive GCCS design plans. This includes:

- **Horizontal gas collection systems:** Implement horizontal gas collection systems in cells with larger footprints to ensure more efficient gas collection.<sup>13</sup>
- **Integration with leachate collection systems:** Integrate gas collection systems into leachate collection systems to enhance overall performance.<sup>14</sup>
- **Updating the GCCS design and realization of GCCS improvements in the field** if necessary to achieve higher gas recovery rates.<sup>15</sup>

### States Leading the Way

Various states have reported positive outcomes from adopting improved regulations, from landfills that previously lacked GCCS subject to minimum federal performance and operations standards.

**California:** The California Air Resources Board (CARB) noted in its state plan that the new landfill methane rule (LMR) mandates regulated GCCS at 30 landfills that were not previously covered under the existing guidelines. This is in addition to the 105 landfills already regulated under the existing guidelines.<sup>7</sup>

**Oregon:** The Oregon Department of Environmental Quality estimated that lowering the waste-in-place threshold to 200,000 MT and the methane generation threshold to 664 MT of methane per year could potentially require

eight additional landfills to install GCCS, on top of 15 landfills already regulated.

**Maryland:** The Maryland Department of the Environment projected that nine landfills with existing GCCS would fall under the new landfill methane regulation, with an additional thirteen landfills potentially needing to install GCCS.<sup>8</sup>

Lowering these thresholds would require more landfills to implement GCCS, significantly increasing overall methane capture and reducing emissions. Aligning federal regulations with the successful state practices outlined above ensures a more uniform approach to methane reduction across the country, enhancing the overall effectiveness of environmental protection measures.

# Enhanced Cover Systems

## Current EPA Standards

Despite the ability of effective landfill cover to dramatically reduce emissions, the current EPA NSPS/EG standards do not contain any requirements related to type and timing of landfill cover. Federal regulations around landfill cover are found in solid waste regulations issued under the Resource Conservation and Recovery Act, but they are not crafted to limit methane emissions.

Traditional landfill covers typically consist of a layer of soil or synthetic material primarily designed to contain waste and minimize water infiltration. However, these covers may not be optimized for methane oxidation, as EPA air emissions regulations currently omit this parameter. Instead, the primary function of these covers has been to prevent leachate formation and control odor rather than address methane mitigation comprehensively. Consequently, methane produced from anaerobic decomposition of organic waste within landfills can escape into the atmosphere, contributing to greenhouse gas emissions. Methane leakage through landfill covers is a well-documented problem. Soils are prone to cracking due to desiccation, especially during dry periods. These cracks create pathways for methane to escape, compromising the effectiveness of the cover as a gas barrier.<sup>16,17</sup> Even though microbial methane oxidation can occur, it may only mitigate a small portion of these emissions without additional gas distribution layers.<sup>18</sup> Aerial surveys conducted by CARB in 2021 and 2023 identified leaks through the cover materials as a recurring problem.<sup>19</sup> This issue is widely recognized in landfill management and underscores the need for improved cover design and ongoing monitoring to minimize methane leakage.

## Proposed Improvements

- **Optimized design and implementation standards:** Ensure in each individual case that climate conditions (soil moisture and soil temperature) allow microbial organisms to substantially oxidize methane over most of the year. Develop and enforce more robust design standards for landfill covers, specifying the thickness and composition of cover materials to ensure effective gas containment and oxidation.
- **Use of biocovers for remote landfill areas:** Biocovers are an engineered system that can achieve much higher methane oxidation rates, but they use materials with more permeability than traditional landfill covers and they work best under specific environmental and operating conditions such as requiring biocovers in areas where the GCCS cannot be extended, such as on steep slopes. Ensure biocovers have greater porosity and thermal insulation than traditional landfill covers to promote methane oxidation. The design should incorporate features that maintain soil moisture and temperature, enhancing microbial activity year-round. The biocover should consist of two layers:
  - » A gas distribution layer made of gravel, broken glass, sand, or similar coarse material.
  - » An oxidation layer made of soil, compost, mulch, peat, or other organic material with demonstrated oxidizing capacity.

The oxidation layer should be stabilized with vegetation to prevent erosion and control moisture. Enhanced biocovers can significantly increase methane oxidation by providing an optimal environment for methanotrophic bacteria, ensuring a high rate of methane conversion to carbon dioxide.

## Proposed Improvements (cont.)

- **Oxidizing materials for intermediate cover:** Use materials with demonstrated oxidizing capacity for intermediate cover and establish requirements related to permeability, including the compaction of soil. This practice ensures that even temporary covers contribute to methane oxidation, reducing emissions during periods between waste deposits.
- **Earlier installation of immediate/final cover:** Implement the earlier installation of intermediate and final cover systems to enhance methane oxidation and reduce emissions. This practice should include specifications for cover thickness and material composition to optimize conditions for methanotrophic bacteria, which convert methane into carbon dioxide and water vapor. By advancing the timing of cover installation, landfills can significantly lower methane flux at the surface, preventing gas escape and improving the efficiency of GCCS.
- **Maintenance and monitoring:** Implement rigorous maintenance and monitoring protocols for biocovers. Regular inspections and maintenance activities, such as moisture control and vegetation management, are critical to sustaining the oxidizing capacity of the cover material. Monitoring should include periodic measurements of methane flux to assess the effectiveness of biocovers in reducing emissions.

## How Cover Materials and Practices Influence Methane Emissions

Research indicates that the type and application of cover materials significantly influence landfill methane emissions. The CARB demonstrated that intermediate covers applied within days, using oxidizing materials, effectively control methane emissions.<sup>21</sup> Properly compacted daily covers in areas with GCCS reduce permeability and improve efficiency. Studies show that well-designed final covers, liners, and GCCS can achieve collection efficiencies as high as 90%.<sup>22</sup> In a pilot-scale study conducted at the AV Miljø Landfill in Denmark, the biocover system achieved methane oxidation efficiencies ranging from 81% to 100%, with methane oxidation rates reaching up to 124 g/m<sup>2</sup>/day under optimal conditions. Similarly, research indicates that modifying landfill cover soils with aged refuse

significantly enhances their methane oxidation potential, achieving high rates of methane conversion, especially when the cover is maintained at optimal moisture and temperature levels.

Research has shown that the earlier installation of intermediate and final cover systems on landfills can substantially reduce methane emissions.<sup>25,26,27</sup> These covers enhance the conditions for methane oxidation by methanotrophic bacteria, which helps in converting methane into less harmful gasses such as carbon dioxide and water vapor. Moreover, early and thick cover installations prevent methane from escaping into the atmosphere, improving the overall efficiency of GCCS.

### Recommended Changes That Are Out of Scope for this Analysis

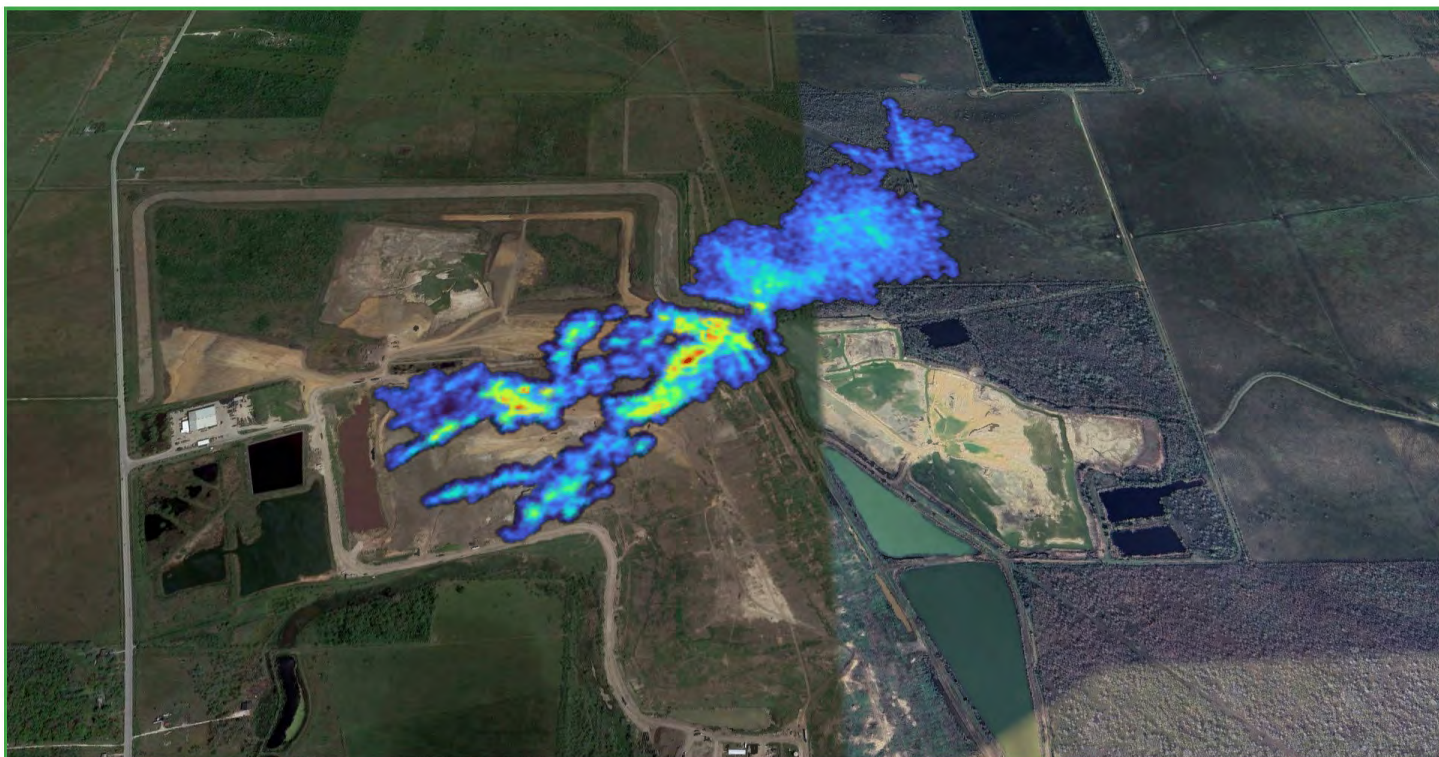
While improving gas collection and landfill cover practices would yield significant emissions reductions, especially when paired with a robust organics diversion strategy, they are not an exhaustive representation of readily available solutions that should be considered by the EPA as they update their NSPS/EG standards.

Timely and accurate emission detection is also crucial. Advanced technologies such as airborne imaging spectrometers have been utilized to conduct extensive surveys of active landfills, revealing substantial sources of methane emissions that often go undetected by traditional methods. For instance, a study led by Carbon Mapper, U.S. EPA and its partners found that 52% of surveyed landfills had significant methane emissions, with many plumes persisting over months or years.<sup>28</sup>

The use of available remote measurement technology to detect methane emissions has been embraced by state and federal policymakers, in addition to the scientific community. For example,

the state of Pennsylvania sponsored overflights over voluntarily participating methane emitters like oil and gas and landfills, and then they gave the results of methane emissions they found to the landfill operators. The overflights resulted in a 37% emissions reduction from the landfills that were super emitters—the largest percentage reduction out of any of the surveyed sectors.<sup>29</sup> In July 2024, EPA awarded Climate Pollution Reduction Grant funding to the state of Colorado to “deploy advanced methane monitoring technology that will inform regulatory policy with a focus on measuring and addressing methane emissions in low-income and disadvantaged communities.”<sup>30</sup>

While these detection methods have been highly effective at identifying super emitter events,<sup>31</sup> there is currently insufficient data to accurately model the impact of fixing methane leaks. Consequently, this analysis does not incorporate more accurate emissions detection methods.



Methane plume observed by Carbon Mapper during aerial monitoring at a landfill in Texas.

Image Credit: Carbon Mapper

# Methodology Overview

This section outlines our methodology, detailing the approaches and techniques employed in our analysis. We used a comprehensive approach to model landfill methane emissions, incorporating multiple baselines and data sources to ensure accuracy and completeness.

First, we established baselines using both the EPA's default assumptions and direct measurement evidence from recent research. This dual-baseline approach allows us to cross-validate our results and improve reliability.

To account for all landfills nationally, particularly those not covered by the GHGRP, we utilized waste-in-place data from the National Inventory Report (NIR) covering the years 1990 to 2021.<sup>32</sup> This data helps bridge gaps where GHGRP data is unavailable, ensuring a more accurate and inclusive national estimate of landfill methane emissions.

We simulated different policy scenarios, such as enhanced GCCS and improved cover techniques, to estimate their impact on methane reductions. Our scenarios have been adjusted based on gas recovery rates and oxidation rates aligned with proposed regulatory changes. Each scenario's effectiveness is evaluated based on its ability to capture and oxidize methane, taking into account variables like cover type and oxidation rates. This methodology allows us to project future emissions and assess the potential of various mitigation strategies.

For this analysis, the reported waste-in-place was treated as one collective landfill, and a multiphase model was employed to simulate methane production across the country. A blended decay value was used to represent all climatic zones, ensuring a comprehensive national estimate. Although more granular models and approaches exist, they require extensive data for each landfill, which is currently unavailable due to gaps in available public datasets. Consequently, waste-in-place was used as the best proxy for estimation and to evaluate the impact of these policies nationwide.

The simulated emissions from this model closely replicate the data reported in the NIR,<sup>33</sup> utilizing the EPA's parameters for calculation. For the year 2009, the NIR estimated methane emissions at 4,928,910 metric tons, while the EPA Assumptions Baseline in this analysis was 4,930,504 metric tons. This strong correlation between the simulated data and the reported figures provides confidence that the results presented in this report accurately reflect the current state and offer realistic projections for the impact of various landfill management adjustments.

## Modeling Approach Incorporates Lower Gas Collection Efficiencies, Reflecting Latest Research

In our modeling we utilize two baselines: 1) EPA Assumptions Baseline and; 2) Updated Assumptions Baseline. In this section we describe our rationale. The EPA Assumptions Baseline reflects the EPA's use of a 75% default gas recovery rate for landfills, which it substantiates through research and modeling, primarily using the Landfill Gas Emissions Model (LandGEM).<sup>34</sup> LandGEM, developed by the EPA's Office of Research and Development, utilizes both site-specific data and default parameters from the Clean Air Act and AP-42 emission factors to estimate gas recovery. The EPA's method for estimating landfill methane emissions assumes that well-managed landfills can achieve a 75% recovery rate, based on limited empirical data and performance benchmarks from various landfill sites. While there have been studies that show effective gas collection can be achieved at a 75% recovery rate, this is only true for well-managed landfills with gas collection systems and requires sustained effort to reach this high recovery rate.<sup>35</sup>

Landfill gas collection systems are less common and less effective than anticipated: A study on landfills in Maryland<sup>36</sup> demonstrates that landfill gas collection systems are less common than expected. Of the 40 landfills in Maryland that produce gas, only 21 have gas collection systems in place. Of

these, 10 landfills use systems that only flare the gas, while the remaining 11 landfills have devices that convert some or all of the collected gas into heat or electricity. It's important to note that gas collection systems are not capable of capturing and combusting all the gas produced by a landfill. In Maryland, reported collection efficiencies in 2017 ranged from 5% to 95%, with an average efficiency of 59%—much lower than 75%.

Nesser et al. (2024) compared LMOP<sup>26</sup> and GHGRP data with satellite methane observations for 38 landfills, revealing an average gas recovery efficiency of 50% (ranging from 33% to 54%).<sup>37</sup> At the six facilities among the top 10 methane-producing landfills, the study found a mean gas recovery efficiency of 33%. The report utilized observations from the TROPOMI satellite instrument to quantify methane emissions from 70 landfills across the contiguous United States that report to the EPA's Greenhouse Gas GHGRP. The authors observed a median 77% increase in emissions (13 Gg/a) compared to reported emissions (7.2 Gg/a), indicating significant underreporting. For the 38 facilities that recover gas, the authors observed an average gas recovery efficiency of 50% (ranging from 33% to 54%). The discrepancies were attributed to overestimated recovery efficiencies and the failure to account for site-specific operational changes.<sup>38,39</sup>

In an analysis of Maryland MSW landfills, the Environmental Integrity Project (EIP) found data on system efficiency for 16 out of the 17 unregulated systems. These gas collection systems at the 16 unregulated landfills had a reported collection efficiency of 55%.

Regulated landfills are required to adhere to certain standards and best practices, which significantly enhance the performance and efficiency of their GCCS. These practices include proper design, construction, and ongoing monitoring and maintenance, aimed at ensuring optimal gas capture and reduced emissions. In contrast, unregulated landfills often lack these rigorous standards and oversight, leading to less effective gas collection and higher emissions. This

disparity underscores the importance of regulatory frameworks in ensuring the effectiveness of GCCS in reducing landfill gas emissions.<sup>40,41</sup>

Another study evaluated five to eight years of annual methane collection data from 114 closed landfills nationwide and determined that MSW landfills emit more methane than estimated using EPA's AP-42 factors and GHGRP methods.<sup>42</sup> Additionally, research by CARB/CalRecycle and California Polytechnic State University observed real-world collection efficiencies at landfills ranging from as low as 23% to above 99%.<sup>43,44,45</sup>

In 2024, the EPA downgraded the default landfill gas collection efficiencies within the GHGRP formulas by ten percentage points to better reflect real-world conditions and operational variabilities observed in landfill gas collection systems.<sup>46</sup> This adjustment aimed to improve the accuracy of reported methane emissions from landfills, ensuring that the data collected under the GHGRP more accurately represents actual emissions. Since this adjustment, more measurement data from satellite detection from Nesser et al.<sup>47</sup> that found that the actual methane recovery rates at U.S. landfills are significantly lower than previously estimated. On average, methane emissions from the 70 high-emitting landfills analyzed were 77% higher than the values reported to the EPA, with some landfills showing emissions up to 200% greater than reported when considering gas recovery. This suggests that the assumed gas recovery efficiencies used in official estimates are often overly optimistic, particularly for these high-emitting sites.

### Updated Assumptions Baseline

As described previously, there is increasing evidence that the default value of 75% gas recovery rate assumed by the EPA is too high, resulting in an underestimation of methane emissions from landfills. This analysis aims to determine a more accurate baseline using a gas collection recovery rate that has been validated by independent studies and direct measurements of methane emissions from landfills.

The EPA’s NIRs indicate that waste landfilled over 30 years ago continues to contribute approximately 10% to overall methane emissions from landfills. This 10% of emissions largely come from unregulated landfills without GCCS, therefore a small if not existent gas recovery rate. Meanwhile, NIRs from European nations suggest that recovery rates average around 29%.

Comparison of tracer plume measurement data with methane generation data from Danish landfills with operational gas recovery systems showed that actual recovery efficiencies ranged between 13% and 86%, with an average of 50%.<sup>48</sup> Similarly, an analysis of gas recovery monitoring data from 56 Dutch landfills with operational GCCS suggests an average recovery rate of 25%.

Considering the European experience, the observed recovery efficiency of approximately 400 LMOP landfills,<sup>49</sup> and the likelihood that the remaining 1,200 landfills perform less efficiently, along with emissions from unregulated landfills, a more realistic overall gas recovery efficiency for the entire USA is estimated at 43%. The derivation of this recovery rate started with a baseline of 50% gas recovery efficiency (from Themelis et al.),<sup>49</sup> subtract 5% to account for decreased efficiency in landfills with waste older than 30 years, and then subtract an additional 2% to account for landfills that don’t participate in the LMOP, which likely have lower recovery rates. This results in our Updated Assumptions Baseline of an estimated 43% gas recovery efficiency for U.S. landfills.

Additionally, the Greenhouse Gas Inventory (GHGI) scales up reported emissions from the GHGRP, which only covers larger landfills, to account for smaller, non-reporting landfills. This further supports the 43% estimated overall recovery efficiency for U.S. landfills.

**Validating Our Baseline On Direct Measurements**

An analysis of satellite methane observations by Nesser et al.<sup>50</sup> estimated that nationally, 6.9 MMT of methane were emitted by MSW landfills in the US in 2019. In contrast, the EPA NIR reported 4.6 MMT of landfill methane emissions for the same year. The Updated Assumptions Baseline scenario calculates 6.6 MMT of landfill methane emissions in 2019. Despite uncertainties inherent in all three approaches, the close agreement between the satellite observations and the Updated Assumptions Baseline scenario suggests that the latter is more plausible than the NIR submissions. This results in an underestimation of emissions in 2024 of over 62% when the Updated Assumptions Baseline is compared with the EPA Assumptions Baseline and reported figures.

Given the stronger alignment of the Updated Assumptions Baseline with independent satellite observations, we have chosen the Updated Assumptions Baseline as the foundation for all subsequent scenarios.

**Table 1: Assumptions for Gas Recovery, Organics Diversion, and Methane Oxidation Rates Across Different Baselines**

| Description                                    | Assumed Gas Recovery Rate                                      | Assumed Organics Diversion | Assumed Methane Oxidation Rate |
|------------------------------------------------|----------------------------------------------------------------|----------------------------|--------------------------------|
| EPA Assumptions Baseline                       | 1% in 1986 increasing to 65% in 2021                           | None                       | 10%-20%                        |
| Updated Assumptions Baseline                   | 1% in 1986 increasing to 43% in 2021                           | None                       | 10%-20%                        |
| Proposed Gas Collection and Cover Improvements | 1% in 1986 increasing to 43% in 2021 increasing to 80% in 2040 | None                       | 20% increasing to 35% in 2040  |

To align EPA Assumptions Baseline with the NIR data, no excessive assumptions were needed. The average values used were:

- **DOCf (Degradable Organic Carbon fraction): 0.5**

DOCf represents the fraction of Degradable Organic Carbon (DOC) in the waste that will eventually degrade and generate methane. A value of 0.5 means that 50% of the organic carbon present in the waste is expected to break down into methane and carbon dioxide under anaerobic conditions in a landfill. This value is essential for estimating the potential methane generation from the waste.

- » **k (Decay Rate Constant): 0.045 per year**

The decay rate constant, denoted as “k,” is a measure of how quickly the organic material in the waste decomposes over time. A value of 0.045 per year indicates that 4.5% of the degradable organic carbon in the waste will degrade each year under landfill conditions. This constant is critical for predicting the rate at which methane is produced over time, influencing the shape of the methane generation curve.

- » **MCF (Methane Correction Factor): 1.0**

The Methane Correction Factor (MCF) accounts for the efficiency of methane capture in a landfill environment. An MCF of 1.0 indicates that the landfill operates under fully anaerobic conditions, meaning that the entire DOCf has the potential to produce methane. This value assumes optimal conditions for methane generation, with no aerobic degradation processes reducing methane production.

We assumed that the gas recovery rate in the EPA Assumptions Baseline gradually increased from 1% in 1986 to 65% in 2021. Methane oxidation rates were set at 10% from 1960 and increased gradually to 20% by 2010, remaining constant thereafter. The NIRs do not provide detailed fluctuations in these parameters over the years, so gradual increases or decreases were assumed in the model. After 2021, the parameters in EPA Assumptions Baseline remain unchanged, resulting in no further reductions in methane emissions. Instead, emissions grow due to the increasing total amount

of waste-in-place. Waste-in-place takes on linear growth as an average of the previous 11 years of waste-in-place.

## Model

In our analysis, we employed the Afvalzorg Multiphase model<sup>51</sup> to estimate landfill gas generation, recovery, methane oxidation, and emissions. This advanced tool is particularly advantageous for providing a national estimate for emissions from landfills, especially when evaluating the impacts of various policy changes such as gas collection efficiency improvements, enhanced cover systems, and organics diversion.

The Afvalzorg Multiphase model is appropriate for detailed analysis of landfill gas dynamics at landfill sites with diverse waste streams and comprehensive waste registers. It accounts for multiple phases of waste degradation, allowing for precise estimations of landfill gas generation and recovery. A multiphase model is a sophisticated tool that simulates the generation, collection, oxidation, and emissions of landfill gas over time. The most important difference between multiphase and single-phase models is that multiphase models account for the varying degradation rates of organic carbon types—easily degradable (like food waste), moderately degradable, and less degradable (like wood). Food waste decays quickly and almost completely, while wood decomposes slowly and incompletely. This distinction was introduced by the Intergovernmental Panel on Climate Change (IPCC) in their 2019 update for landfill methane generation modeling. A multiphase model is more appropriate for detailed organics diversion policies, particularly when focusing on food waste diversion. These stages each produce different gasses, and the model estimates gas generation based on factors like waste composition and environmental conditions. It also simulates the efficiency of GCCS and accounts for methane oxidation in the cover soil, reducing surface emissions. The advantage of using a multiphase model lies in its ability to provide more accurate and detailed projections of emissions. By considering the distinct decomposition phases, it offers a better evaluation of gas collection efficiencies and methane oxidation processes.

## Data

This analysis incorporates data from the NIR<sup>52</sup> for waste input information. The NIR provides comprehensive data on methane emissions from landfills in the United States, as reported annually by the EPA to the UNFCCC since 1990. This extensive historical dataset allows for trend analysis and the assessment of emission reduction strategies over time. The NIR includes detailed waste input data, which is crucial for accurately estimating methane emissions based on the types and quantities of waste deposited in landfills. The EPA's standardized methodologies ensure that these estimates reflect actual measurements and consider factors such as waste composition, landfill management practices and climatic conditions. The NIR data supports compliance with international reporting requirements, informs policy and planning for reducing landfill methane emissions, and promotes transparency and accountability by providing public access to emission data. This data is essential for researchers, policymakers, and environmental planners in developing strategies to mitigate the environmental impacts of landfills.

## Scenario Parameters Used in This Estimate

We modeled the proposed gas collection and cover improvements outlined in the “key improvements” section. Table 1 outlines the key assumptions.

We assumed that at peak implementation of the proposed updates to regulation there would be a significant increase of gas recovery rates

across the board. Research has demonstrated that advancements in landfill gas collection systems significantly improve gas recovery rates. For instance, a study published by the American Institute of Physics<sup>53</sup> highlights effective landfill gas management strategies that optimize methane control and enhance gas recovery efficiency. Enhanced systems, such as more efficient gas collection wells, advanced flaring systems, and improved leachate management, have significantly reduced methane emissions and increased the volume of gas captured for energy production.

Themelis and Bourtsalas<sup>54</sup> reported that well-managed U.S. landfills can achieve methane capture efficiencies of approximately 85% with advanced gas collection and control systems.<sup>54</sup> Duan et al.<sup>55</sup> found that some landfills achieved recovery efficiencies close to 80%, with one landfill reaching 86%. Oonk demonstrated that improved gas collection technologies could achieve recovery rates up to 90% under optimal conditions.<sup>56</sup> Berger and Lehner<sup>57</sup> noted that optimizing gas treatment in older landfills could lead to recovery rates of up to 87%.

Further supporting these findings, the EPA and CARB have both reported that stringent regulations and the implementation of state-of-the-art gas collection systems can significantly increase methane capture efficiency, with some sites achieving rates above 85%.<sup>58,59</sup>

# Results

## Model Results of Updated Assumptions Baseline Shows Emissions From Landfills Higher Than Currently Reported Estimates

Proposed gas collection and cover improvements deliver large methane reductions under either EPA or Updated Assumptions Baselines.

The combination of gas collection and cover improvements delivers an estimated **56% reduction** in landfill methane emissions from 2025 until 2050 resulting in a reduction of **104 MMT methane** or **2,922 MMT CO<sub>2</sub>e** during this period, under the Updated Assumptions Baseline.

Under the Updated Assumptions Baseline, methane emissions are projected to be 63% higher than the EPA's baseline. However, when implementing gas collection and cover improvements, the reduction potential is also greater—64% compared to 42% under the EPA baseline. This highlights the increased impact of mitigation strategies under updated higher-emission projections.

The annual emissions decrease significantly when gas collection and cover improvements are implemented, with methane reductions reaching up to 2.7 MMT CH<sub>4</sub> and CO<sub>2</sub>e reductions of 75 MMT CO<sub>2</sub>e by 2060. The percentage reduction in CO<sub>2</sub>e emissions increases over time, from 10.7% in 2024 to 53.8% by 2060, showing a substantial mitigation impact from the proposed measures.

## Landfill Methane Emissions Reductions Modeled On Par With Oil and Gas Sector Proportion of Emissions Reductions

Thanks to the Biden-Harris Administration's demonstrated commitment to making methane reduction a cornerstone of its climate strategy, these reductions would build on the existing methane emissions mitigation success of the Administration's updated emissions regulations from the oil and gas sector. According to the finalized EPA rules announced in late 2023, the

**Figure 2: Annual Estimated CO<sub>2</sub>e Emissions Projections Comparing EPA to Updated Assumptions Baseline (2025-2050)**

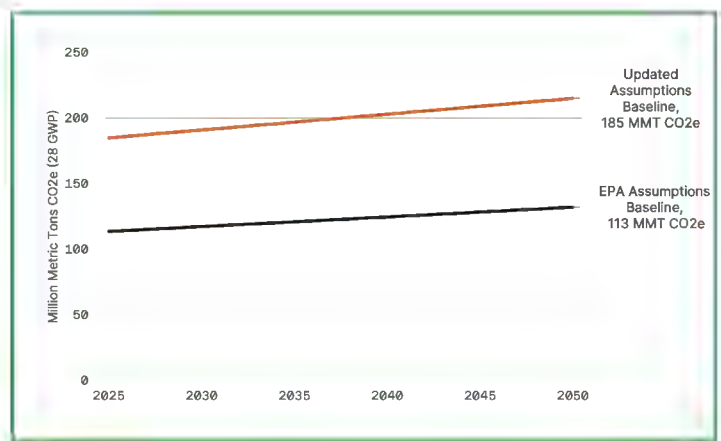
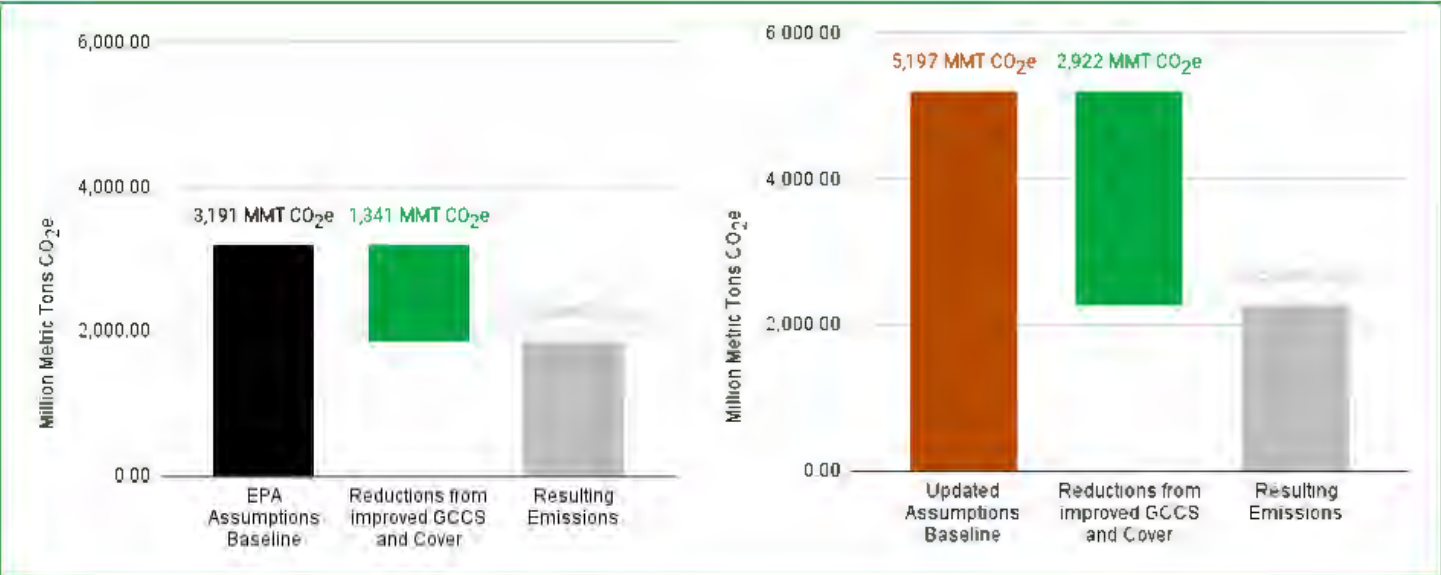


Figure 2 shows that by 2050, the Updated Assumptions Baseline projects CO<sub>2</sub>e emissions to be approximately 64% higher than the EPA Assumptions Baseline (185 MMT CO<sub>2</sub>e vs. 113 MMT CO<sub>2</sub>e). This significant difference underscores the potential underestimation of future emissions in the EPA's original baseline, suggesting that without enhanced mitigation strategies, actual emissions could be much higher than initially anticipated.

administration aims to reduce methane emissions from the oil and gas sector by 58 MMT between 2024 and 2038.<sup>60,61</sup> This new phase of regulations represents an additional 10-15% reduction, reinforcing the administration's commitment to cutting methane emissions from the oil and gas industry by a total of about 40-45%.<sup>62</sup> The impact of the improvements to the NSPS and EGs for MSW landfills outlined in this assessment, including the proposed gas collection and enhanced cover policies, are roughly equivalent to those of the oil and gas sector regulatory improvements, resulting in a reduction of 55% or 41 MMT of methane between 2025 and 2035.

Figure 3: Comparison of CO<sub>2</sub>e Reductions from Proposed Gas Collection and Cover Improvements, EPA Assumptions Baseline and Updated Assumptions Baseline



As Figure 3 demonstrates, there are still significant methane emissions reductions utilizing the EPA Assumptions Baseline. The cumulative impact of proposed improvements is substantial. Under the EPA Assumptions Baseline, these measures could reduce methane emissions by 47.9 MMT CH<sub>4</sub> (42%) and CO<sub>2</sub>e emissions by 1,341.20 MMT CO<sub>2</sub>e cumulatively from 2025 through 2050. However, the reductions are even more significant under Industrious Labs' Updated Assumptions Baseline, with potential decreases of 104 MMT CH<sub>4</sub> (56%) and 2,922 MMT CO<sub>2</sub>e cumulatively.

Table 2: Comparing EPA and Updated Assumptions Baselines Projected Cumulative Emissions Reductions between 2025 and 2050

| Source           | Cumulative Emissions 2025 Through 2050                        | MMT CH <sub>4</sub> | MMT CO <sub>2</sub> e* | %   |
|------------------|---------------------------------------------------------------|---------------------|------------------------|-----|
| EPA              | EPA Assumptions Baseline                                      | 114                 | 3,191                  |     |
|                  | Emissions with Proposed Gas Collection and Cover Improvements | 66                  | 1,850                  |     |
|                  | Overall Reduction                                             | 48                  | 1,341                  | 42% |
| Industrious Labs | Updated Assumptions Baseline                                  | 186                 | 5,197                  |     |
|                  | Emissions with Proposed Gas Collection and Cover Improvements | 81                  | 2,275                  |     |
|                  | Overall Reduction                                             | 104                 | 2,922                  | 56% |

Table 2 compares two scenarios for cumulative emissions reductions from 2025 to 2050.  
\*CO<sub>2</sub>e calculated at a 100 year Global Warming potential 28 GWP

**Table 3: Annual Emissions and Reduction Potential from Proposed Gas Collection and Cover Improvements—Updated Assumptions Baseline**

| Annual Emissions | Updated Assumptions Baseline |                        | Emission with Proposed Gas Collection and Cover Improvements |                        | Annual Avoided Emissions from Proposed Gas Collection and Cover Improvements from Updated Assumptions Baseline |                        |             |
|------------------|------------------------------|------------------------|--------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------|------------------------|-------------|
|                  | MMT CH <sub>4</sub>          | MMT CO <sub>2</sub> e* | MMT CH <sub>4</sub>                                          | MMT CO <sub>2</sub> e* | MMT CH <sub>4</sub>                                                                                            | MMT CO <sub>2</sub> e* | % Reduction |
| 2024             | 6.6                          | 183.6                  | 5.7                                                          | 159.9                  | 0.8                                                                                                            | 23.7                   | 12.9%       |
| 2030             | 6.8                          | 190.9                  | 4.3                                                          | 120.4                  | 2.5                                                                                                            | 70.4                   | 36.9%       |
| 2040             | 7.2                          | 202.9                  | 2.1                                                          | 58.5                   | 5.2                                                                                                            | 144.4                  | 71.1%       |
| 2050             | 7.7                          | 215.0                  | 2.2                                                          | 61.3                   | 5.5                                                                                                            | 153.7                  | 71.5%       |
| 2060             | 8.1                          | 227.0                  | 2.3                                                          | 64.7                   | 5.8                                                                                                            | 162.3                  | 71.5%       |

Table 3 provides, utilizing the updated assumptions baseline, annual emission estimates as well as modeled emissions avoided results for the proposed gas collection and cover improvements. The Updated Assumptions Baseline projects higher methane emissions across all years, with 2024 emissions at 6.6 MMT CH<sub>4</sub> (183.6 MMT CO<sub>2</sub>e) compared to 4.03 MMT CH<sub>4</sub> (112.8 MMT CO<sub>2</sub>e) under the EPA baseline. By 2060, emissions under the Updated Baseline reach 8.1 MMT CH<sub>4</sub> (227.0 MMT CO<sub>2</sub>e), significantly higher than the EPA's 4.98 MMT CH<sub>4</sub> (139.4 MMT CO<sub>2</sub>e). Proposed gas collection and cover improvements lead to substantial reductions in emissions. The reduction potential grows over time, with a 36.9% reduction in 2030 under the Updated Assumptions Baseline, increasing to 71.5% by 2050 and 2060. The avoided emissions in 2060 amount to 5.8 MMT CH<sub>4</sub> (162.3 MMT CO<sub>2</sub>e), emphasizing the effectiveness of these improvements, especially under higher emission scenarios.

\*CO<sub>2</sub>e calculated at a 100 year Global Warming potential 28 GWP

**Table 4: Annual Emissions and Reduction Potential from Proposed Gas Collection and Cover Improvements—EPA Assumptions Baseline**

| Annual Emissions | EPA Assumptions Baseline |                        | Emission with Proposed Gas Collection and Cover Improvements |                        | Annual Avoided Emissions from Proposed Gas Collection and Cover Improvements from EPA Assumptions Baseline |                        |             |
|------------------|--------------------------|------------------------|--------------------------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------------|------------------------|-------------|
|                  | MMT CH <sub>4</sub>      | MMT CO <sub>2</sub> e* | MMT CH <sub>4</sub>                                          | MMT CO <sub>2</sub> e* | MMT CH <sub>4</sub>                                                                                        | MMT CO <sub>2</sub> e* | % Reduction |
| 2024             | 4.0                      | 112.8                  | 3.6                                                          | 102                    | 0.4                                                                                                        | 12.0                   | 10.7%       |
| 2030             | 4.2                      | 117.2                  | 3.0                                                          | 85.1                   | 1.2                                                                                                        | 33.3                   | 28.4%       |
| 2040             | 4.5                      | 124.6                  | 2.1                                                          | 58.5                   | 2.4                                                                                                        | 65.8                   | 52.8%       |
| 2050             | 4.7                      | 132.0                  | 2.2                                                          | 61.3                   | 2.5                                                                                                        | 70.3                   | 53.3%       |
| 2060             | 5.0                      | 139.4                  | 2.3                                                          | 64.7                   | 2.7                                                                                                        | 75.0                   | 53.8%       |

Table 4 displays annual methane (CH<sub>4</sub>) emissions and CO<sub>2</sub>e for selected years from 2024 to 2060 under the EPA Assumptions Baseline as well as modeled emissions avoided results. The emissions decrease significantly when gas collection and cover improvements are implemented, with methane reductions reaching up to 2.68 MMT CH<sub>4</sub> and CO<sub>2</sub>e reductions of 75 MMT CO<sub>2</sub>e by 2060. The percentage reduction in CO<sub>2</sub>e emissions increases over time, from 10.7% in 2024 to 53.8% by 2060, showing a substantial mitigation impact from the proposed measures.

\*CO<sub>2</sub>e calculated at a 100 year Global Warming potential 28 GWP

# Organics Diversion

## Background

Organic waste, including food scraps, yard trimmings, and paper products, makes up a significant portion of landfill contents and is a primary source of methane emissions when decomposed anaerobically. Diverting these materials to alternative treatments such as composting and animal feed can drastically reduce new methane production in the long-term, and must be pursued alongside other reduction and control measures.

Studies have shown that reducing organic waste disposal in landfills has a vital role to play in preventing new methane generation. **The EPA highlights that diverting 75% of food waste to composting facilities or anaerobic digesters can reduce methane emissions by 80–90% over the waste's lifetime compared to landfilling.**<sup>63</sup> It is worthwhile to emphasize that burning waste via municipal incinerators should not be viewed as an acceptable alternative to landfilling, given their large polluting emissions and disproportionate impact on environmental justice communities.

The NSPS/EG federal regulations can play a role in encouraging organics diversion, by updating them to allow the use of organics diversion as an alternate compliance mechanism. The EPA would then establish rules for state, local, and tribal agencies to consider and approve landfill operator's plans to divert organic waste rather than landfilling it.

There are also a multitude of other relevant policy levers that would promote organics diversion. Released in 2024, the White House National Strategy to Reduce Food Loss and Waste and Recycle Organics, which focuses on preventing food waste and increasing recycling rates for organic materials, is a critically needed whole-of-government strategy to reduce organics landfilled or burned. This plan includes strategies such as food waste reduction, national consumer education campaigns and developing recycling infrastructure.<sup>64</sup>

The U.S. EPA is also advancing organics diversion through the Solid Waste Infrastructure for Recycling (SWIFR) grant program, funded by the Bipartisan Infrastructure Law, which allocates \$275 million over five years to enhance recycling infrastructure, including composting facilities and anaerobic digesters.<sup>65</sup> SWIFR grants have supported projects in jurisdictions across the country aimed at expanding food scrap collection and composting capabilities.<sup>66</sup>

Many state and local governments have taken action: Washington and California are the latest states to pass laws that institute organics diversion goals, food rescue and municipal-run organics recycling programs. **More than 20 states have enacted yard waste disposal bans.**<sup>67</sup> And states such as Maryland, Connecticut, Massachusetts, New York and Rhode Island have all adopted state organic waste bans for large commercial organic waste generators under certain circumstances.<sup>68</sup>

Several European countries have implemented regulations for organic waste diversion from landfills, achieving notable reductions in emissions.

- In Germany, a 2005 regulation banned the landfilling of biodegradable municipal waste, necessitating recycling and biogas production. This regulation has significantly reduced landfill methane emissions, contributing to a 42% reduction in waste emissions in the EU between 1995 and 2017.<sup>69,70</sup>
- Austria introduced a landfill ban on untreated municipal solid waste in 2004, ensuring that organic waste is composted or converted into biogas. This regulation has significantly decreased landfill methane emissions, aligning with the overall reduction in waste emissions observed in the EU.<sup>72</sup>
- In Belgium's Flemish Region, a 2000 regulation banned the landfilling of organic waste, emphasizing waste separation at the source and promoting composting. This policy has substantially reduced landfill methane emissions and improved composting rates.<sup>73</sup>

- Sweden, starting in 2005, banned the landfilling of combustible and organic waste, directing efforts towards recycling, composting, and energy recovery. This regulation has led to a notable reduction in landfill methane emissions and supports the overall decline in waste emissions within the EU.<sup>74</sup>

To achieve long-term reductions in methane emissions, it is essential to integrate organics diversion with improved waste-in-place methane mitigation regulations.

### Key Improvements

By integrating organic waste diversion with enhanced gas recovery and other methane control measures for waste-in-place, it is possible to achieve substantial, long-lasting reductions in landfill methane emissions, thereby contributing to climate change mitigation and the advancement of a more sustainable circular economy.

The policy levers for achieving substantial organics diversion are diverse. Within the context of the EPA NSPS/EG regulations, the EPA could allow the use of organics diversion as an alternate compliance mechanism, establishing parameters for state, local, and tribal agencies to consider and approve landfill operator plans to divert organic waste rather than landfilling it.

Considering the unknown of how many landfill operators would voluntarily choose this alternative compliance mechanism, unlike in the previous sections we are not attempting to model that explicit proposed change in the NSPS/EG regulations. Rather, we provide several scenarios where organics diversion is achieved, to demonstrate the overall efficacy of pursuing organics diversion policies and strategies alongside more effective methane controls at existing landfills.

### Methodology

Organics diversion was translated into the model as a reduced proportion of biodegradable waste. This includes all organic waste including food waste, yard waste, etc.<sup>75</sup> The proportion of organic waste diverted in 2022 per the NIR<sup>76</sup> was used as the baseline for diversion and this was increased at different rates depending on the scenario. Specific scaling is explained in more detail in the Appendix.

In this study, changes in the Degradable Organic Carbon (DOC) content of residual waste following organics diversion were not accounted for, based on several considerations. MSW comprises a variety of organic and inorganic components, and organics diversion typically involves not just the removal of food waste but also the intensified separate collection of other materials, such as paper, cardboard, and garden waste. Additionally, initiatives like deposit fees for bottles and cans, separate collection for packaging materials, and post-collection sorting further influence the composition of residual waste. Consequently, the overall biodegradable carbon content in the residual waste may not undergo significant changes. Although detailed documentation on this phenomenon is limited, particularly in Northwestern European countries with longstanding biodegradable waste landfill bans, industry observations and experiences suggest that the DOC content remains relatively stable. Furthermore, altering the DOC content for modeling purposes introduces complexity and potential controversy regarding the appropriate adjustments. Therefore, to avoid such complications, the DOC content was kept constant in this analysis. The methodology aligns with the broader approach of reducing landfill inputs by diverting MSW to other waste management processes, such as recycling and composting, as part of organics diversion strategies. Although adjusting the DOC content could be considered, it presents significant challenges due to the unpredictable nature of intensified collection and recycling schemes, making the current approach the simplest and most practical for modeling purposes.

Given the stronger alignment of the Updated Assumptions Baseline with independent satellite observations, we have chosen the Updated Assumptions Baseline as the foundation for all subsequent scenarios.

### Scenarios Modeled

The Proposed Gas Collection Improvements + Zero Organics by 2050 scenario represents a comprehensive approach to reducing methane emissions from landfills by combining GCCS policies with a complete halt to the landfilling of organic MSW by 2050. This scenario is designed to maximize the impact on methane emissions reductions through enforced regulations and significant changes in waste management practices.

When stacking more than two interventions in a scenario, it becomes challenging to discern the individual contributions of each intervention. Beyond two interventions, the specific impact of each measure becomes unclear, making it difficult to maintain the rigor needed for accurate analysis. For this reason, we focused on two key interventions: gas collection improvements and organics diversion. While methane oxidation or enhanced cover could add more benefits, limiting the scope to these two interventions ensures we can clearly differentiate their individual impacts. This approach provides a scientifically sound comparison, avoiding confusion around the contributions of each measure.

### Key Elements of Proposed Gas Collection Improvements + Zero Organics 2050 scenario

#### 1. Proposed Gas Collection Improvements:

As described earlier in this paper, improvements to gas collection systems are needed in the NSPS/EG regulations. To ensure efficient gas collection and control across all landfills, rigorous GCCS policies must be implemented, including the installation and expansion of systems within one year after waste placement to minimize methane emissions from new deposits. Horizontal gas collection systems should be incorporated in cells with larger footprints to avoid the inefficiencies associated with buried vertical systems. Additionally, integrating gas collection with leachate collection systems can enhance overall

performance. Regular monitoring and comparison of GCCS data with modeled gas generation are crucial, allowing for necessary updates to the design and improvements in the field.

#### 2. Zero Organics Landfilled by 2050:

Our goal is to illuminate the emissions potential of at-scale organics diversion, by modeling zero organic waste landfilled by 2050. To ensure that no organic municipal solid waste is landfilled from 2050 onwards, as Table 5 shows, a gradual increase in organics diversion capacity is necessary, with continuous growth to match rising waste generation. This approach will prevent new organic waste from contributing to landfill methane emissions, leading to significant reductions in overall methane emissions as the elimination of organic waste from landfills takes effect.



# Results of Organics Diversion Modeling

## Proposed Gas Collection Improvements + Zero Organics by 2050

As Table 6 shows, from 2025 to 2050, the implementation of enhanced gas collection is projected to achieve a substantial cumulative emissions reduction of 100 MMT of methane, representing a 54% decrease from the Updated Assumptions Baseline. This reduction equates to 2,801 MMT CO<sub>2</sub>e, calculated using a GWP of 28. As Table 7 shows, extending the timeline to 2099, the reduction becomes even more significant, with methane emissions reduced cumulatively by 485 MMT—a 79% reduction from the updated baseline. This translates to 13,567 MMT CO<sub>2</sub>e by 2099.

Proposed gas collection and 100% organics diversion by 2050 shows a progressive decrease in annual methane emissions, with notable impacts emerging after 2040 due to the combined effects of enhanced gas collection and control system (GCCS) policies as well as improved cover and the complete diversion of organic waste from landfills. Methane emissions continue to decline well into the future, as even the waste landfilled prior to the policy's implementation generates methane at increasingly reduced rates. The proposed methane reduction strategies offer substantial impact, with a projected reduction of 100 MMT of methane emissions by 2050 compared to the updated assumptions

**Table 5: Assumptions for Recovery Rate, Organics Diversion, and Methane Oxidation in Different Scenarios**

| Scenario Description                                             | Recovery Rate                        | Organics Diversion                    | Methane Oxidation Rate |
|------------------------------------------------------------------|--------------------------------------|---------------------------------------|------------------------|
| <b>Updated Assumptions Baseline</b>                              | 1% in 1986 increasing to 43% in 2021 | None                                  | 10%-20%                |
| <b>Proposed Gas Collection Improvements + Zero Organics 2050</b> | 43% increasing to 80% by 2040        | No landfilling of organic MSW by 2050 | 20%                    |

**Table 6: Comparing the EPA and Updated Assumptions Baseline's Cumulative Methane and CO<sub>2</sub>e Reductions Between 2025 and 2050**

| Source                  | Cumulative Emissions 2025 through 2050                                     | MMT CH <sub>4</sub> | MMT CO <sub>2</sub> e* | %          |
|-------------------------|----------------------------------------------------------------------------|---------------------|------------------------|------------|
| <b>EPA</b>              | EPA Assumptions Baseline                                                   | 114                 | 3,191                  |            |
|                         | Emissions with Zero Organics 2050 and Proposed Gas Collection Improvements | 82                  | 2,285                  |            |
|                         | Overall Reduction                                                          | <b>32</b>           | <b>907</b>             | <b>28%</b> |
| <b>Industrious Labs</b> | Updated Assumptions Baseline                                               | 186                 | 5,197                  |            |
|                         | Emissions with Zero Organics 2050 and Proposed Gas Collection Improvements | 86                  | 2,396                  |            |
|                         | Overall Reduction                                                          | <b>100</b>          | <b>2,801</b>           | <b>54%</b> |

\*CO<sub>2</sub>e calculated at a 100 year Global Warming potential 28 GWP

**Table 7: Emissions with Organics Diversion and Proposed Gas Collection Improvements (2025-2099)**

| Source                  | Cumulative Emissions 2025 through 2099                                     | MMT CH <sub>4</sub> | MMT CO <sub>2</sub> e* | %          |
|-------------------------|----------------------------------------------------------------------------|---------------------|------------------------|------------|
| <b>Industrious Labs</b> | Updated Assumptions Baseline                                               | 615                 | 17,209                 |            |
|                         | Emissions with Zero Organics 2050 and Proposed Gas Collection Improvements | 130                 | 3,642                  |            |
|                         | Overall Reduction                                                          | <b>485</b>          | <b>13,567</b>          | <b>79%</b> |

Table 7 presents the cumulative methane (CH<sub>4</sub>) and CO<sub>2</sub>e emissions reductions projected from 2025 to 2099 under Industrious Labs' Updated Assumptions Baseline. Without any intervention, the cumulative MSW landfill methane emissions are expected to reach 615 MMT CH<sub>4</sub> (or 17,209 MMT CO<sub>2</sub>e). However, with the implementation of organics diversion and proposed gas collection improvements, emissions could be significantly reduced to 130 MMT CH<sub>4</sub> (or 3,642 MMT CO<sub>2</sub>e). This represents a substantial overall reduction of 485 MMT CH<sub>4</sub> (or 79%).

\*CO<sub>2</sub>e calculated at a 100 year Global Warming potential 28 GWP

baseline. This leads to a corresponding reduction of 2,801 MMT CO<sub>2</sub>e, achieving a 54% overall decrease. Without organics diversion, emissions are still significantly reduced, from 186 MMT CH<sub>4</sub> and 5,197 MMT CO<sub>2</sub>e to 82 MMT CH<sub>4</sub> and 2,285 MMT CO<sub>2</sub>e by 2050. These figures highlight the critical role of improving gas collection in cutting methane emissions.

Figure 4 compares the cumulative CO<sub>2</sub>e emissions from 2025 to 2050 under the EPA Assumptions Baseline and the Updated Assumptions Baseline by Industrious Labs. The left side of the graph illustrates that under the EPA assumptions, cumulative emissions are projected to reach 3,191 MMT CO<sub>2</sub>e by 2050. Implementing organics diversion and improved gas collection could reduce this by 907 MMT CO<sub>2</sub>e, resulting in net emissions of 2,285 MMT CO<sub>2</sub>e.

On the right side of Figure 4, the Updated Assumptions Baseline projects much higher emissions, with cumulative emissions reaching 5,197 MMT CO<sub>2</sub>e by 2050. However, the same mitigation measures would lead to a larger reduction of 2,801 MMT CO<sub>2</sub>e, bringing the resulting emissions down to 2,396 MMT CO<sub>2</sub>e, similar as under the EPA baseline. This comparison highlights the much greater reduction potential

under the Updated Assumptions Baseline due to its higher initial emissions projections.

For the period from 2025 to 2050, the EPA Assumptions Baseline shows a 28% reduction in methane emissions (32 MMT CH<sub>4</sub>), while the Updated Assumptions Baseline shows a 56% reduction (100 MMT CH<sub>4</sub>). Under both baselines, the proposed mitigation strategies are effective in reducing emissions to similar levels in the long-term.

### Long Term Benefits

The Proposed Gas Collection Improvements + Zero Organics 2050 scenario highlights the importance of integrating stringent enforcement of gas recovery policies with comprehensive organics diversion strategies. This scenario demonstrates that while immediate impacts are driven by enhanced gas recovery, the long-term benefits are maximized through the complete diversion of organic waste, contributing significantly to climate change mitigation and improved waste management practices.

Table 7 shows that under the Updated Assumptions Baseline, the emissions reductions from 2025 to 2099 would lead to a significant cumulative decrease of 485 MMT CH<sub>4</sub>, or 13,567 MMT CO<sub>2</sub>e, representing a 79% reduction by 2099. This

**Figure 4: Cumulative Emissions Reductions from 2025-2050: EPA and the Updated Assumptions Baseline for Zero Organics 2050, Proposed Gas Collection Improvements Policies**



underscores the critical role of organics diversion in achieving sustained reductions in landfill methane emissions and highlights the extensive long-term environmental benefits of implementing such comprehensive waste management policies.

# Conclusions

The EPA has an opportunity to press the “emergency brake” on climate change by taking common sense steps to reduce methane emissions from landfills. By requiring landfill operators to start using available best practices and technologies, the EPA can make an immediate impact on climate-warming emissions, while delivering cleaner air and water for local communities. In the absence of federal action, the problem will only spread. The scenario modeling results emphasize the critical importance of implementing a combination of organics diversion, enhanced gas recovery systems, and optimized cover measures to effectively reduce methane emissions from landfills.

Our modeling shows that in the short-term, large methane emissions reductions will come from improvements to gas collection and cover, while organics diversion measures result in methane reductions in the long-run, as it takes time for these measures to have an impact.

## Proposed Gas Collection and Cover Improvements

Proposed gas collection and cover improvements achieve methane emissions reductions fast.

A combination of changes to gas collection and control systems and landfill cover practices will ensure a higher rate of gas collection across a higher number of regulated landfills. This is crucial as demonstrated in the Proposed Gas Collection and Cover Improvements Scenario, **a cumulative reduction of 104 MMT CH<sub>4</sub> (56%) by 2050** or 2,922 MMT CO<sub>2</sub>e.

## Integrated Policy Approach

Combining organics diversion with proposed gas collection improvements provides the most comprehensively effective methane reduction strategy. The Proposed Gas Collection Improvements + Zero Organics 2050 Scenario achieves the highest long term reductions with **a cumulative reduction of 100 MMT CH<sub>4</sub> (54%) or 2,801 MMT CO<sub>2</sub>e by 2050 and 485 MMT CH<sub>4</sub> (79%) or 13,567 MMT CO<sub>2</sub>e by 2099**. This integrated approach ensures substantial short-term and long-term benefits, making it a comprehensive strategy for methane reduction.



# Appendix

## Additional Scenarios

In analyzing landfill methane reduction, various scenarios were considered, each reflecting different mitigation strategies such as improvements in gas collection systems and organics diversion. The scenarios offered in the main report highlight the highest potential for emissions reductions, both with and without organics diversion. These scenarios highlight the critical impact of combining gas collection improvements with organics diversion to achieve significant methane reductions. The selected ones were prioritized for their clear potential to drive the largest CO<sub>2</sub>e reductions by mid-century, which is essential for meeting climate goals.

## Proposed Gas Collection Improvements

In this scenario, we assume a number of improvements to gas collection systems, including increased gas collection wells and earlier and extended gas collection periods. It is anticipated that by 2040, an overall average recovery efficiency of 80% will be achieved, the minimum value proposed for adoption in regulations by Scheutz and Kjeldsen (2019). Achieving this level requires more than just enforcing current policy, as unregulated landfills with no gas recovery will persist. Consequently, the gas recovery rate at regulated landfills must exceed 75% on average. Implementing stricter gas recovery regulations will be necessary, such as replacing the allowance to cease gas recovery after 15 years with a methane mass flow threshold value.

## Better Landfill Cover

This scenario proposes that the methane oxidation efficiency in landfill cover soil increases from 20% in 2021 to 35% in 2040. The current 20% efficiency is based on a mixture of landfill conditions as reported in the US-NIR. Achieving a 35% oxidation efficiency requires a suitable cover and methane flux rate of less than 10 grams per square meter per day. For a medium-sized landfill (150,000 metric tons of MSW per year) with an average height of 25 meters, it takes 80 years to reach this low flux

rate without active gas recovery. This scenario has limited impacts unless organics diversion is done in parallel with gas collection efforts.

## Research Based Metrics, 0% Oxidation

Microbial methane oxidation relies on sufficient gas-filled soil porosity to allow oxygen to diffuse into the soil. This slow process limits microbial methane oxidation to low flux rates. Additionally, the microbes need adequate moisture and moderate temperatures. In dry or cold climates, making microbial methane oxidation ineffective for large parts of the year. To illustrate the impact of the NIR's assumption of 20% methane oxidation, we designed scenario E with 0% methane oxidation. As expected, the scenario B line (with methane oxidation increasing from 10% in 1990 to 20% in 2010) is 20% below the scenario E line post-2010. Similarly, the scenario D line (further increasing from 20% in 2010 to 35% in 2040) is 35% below the scenario E line post-2040.

## Triple Diversion Scenario

The Triple Diversion Scenario suggests that the current rate of organics diversion triples by 2050. According to the most recent EPA NIR, an average of 331 MMT of MSW were generated annually between 2017 and 2021, with 65% (214 MMT) landfilled and 18% (60 MMT) either incinerated, composted, or anaerobically digested. The remaining 17% was likely recycled directly (e.g., paper, cardboard, glass, metal). Given the time required to plan, site, and realize waste management facilities, Triple Diversion Scenario assumes that increased organics diversion starts to take effect from 2030 onwards, with a linear increase in diversion capacity between 2030 and 2050. After 2050, the diversion capacity remains constant, leading to a growing amount of waste landfilled as waste generation continues to rise. The Triple Diversion line starts to deviate from the Direct Measurement Baseline from 2036, as waste landfilled before 2030 and between 2036 continues to generate methane. The impact of organics diversion on methane emissions is long-

term, becoming evident post-2070 as emissions rise again due to increased waste landfilled after 2050.

### **Zero Organics 2050**

Zero Organics 2050 envisions a more stringent organics reduction strategy, with gradual increases in organics diversion capacity to ensure no organic MSW is landfilled from 2050 onwards. This requires continued increases in diversion capacity to match growing waste generation. Consequently, this scenario's methane emissions decrease continuously until after 2099.

### **Zero Organics 2030**

To emphasize the delayed impact of organics diversion on observed methane emissions, we created the Zero Organics 2030 Scenario, which assumes no landfilling of degradable organic carbon from 2030 onwards. Though unrealistic, Zero Organics 2030 Scenario demonstrates that it only has lower methane emissions than the Proposed Gas Collection Improvements Scenario post-2050. Between 2024 and 2050, Zero Organics 2030 emits 36 MMT more methane than Proposed Gas Collection Improvements Scenario, highlighting that

organics diversion is not an alternative to enhanced gas recovery; both measures are essential for optimal landfill methane emission reduction. It is also important to note that even with this complete stop in organics landfilling the waste that was previously landfilled before 2030 continues to produce methane well into 2099.

### **Enforced Proposed Gas Collection Improvements & Triple Diversion**

To illustrate the impact of enforced gas recovery policies and organics diversion on landfill methane emission reduction, Proposed Gas Collection Improvements Scenario was combined with the Triple Diversion Scenario to create this scenario. From 2024 to 2040, this scenario follows the trajectory of the Proposed Gas Collection Improvements Scenario. Post-2040, this scenario gradually shows lower methane emissions than the Proposed Gas Collection Improvements Scenario. This demonstrates that while enhanced gas recovery has the most significant short-term impact, organics diversion contributes to a slower, long-term effect.

**Table 9: Scenario Assumptions**

| Scenario Description                                               | Gas Recovery Rate                                              | Organics Diversion                    | Methane Oxidation Rate        |
|--------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------|-------------------------------|
| <b>EPA Assumptions Baseline</b>                                    | 1% in 1986 increasing to 65% in 2021                           | None                                  | 10%-20%                       |
| <b>Updated Assumptions Baseline</b>                                | 1% in 1986 increasing to 43% in 2021                           | None                                  | 10%-20%                       |
| <b>Updated Assumptions Baseline, 0% Oxidation</b>                  | 1% in 1986 increasing to 43% in 2021                           | None                                  | 0%                            |
| <b>Proposed Gas Collection Improvements</b>                        | 1% in 1986 increasing to 43% in 2021 increasing to 80% in 2040 | None                                  | 20%                           |
| <b>Better Landfill Cover</b>                                       | 1% in 1986 increasing to 43% in 2021                           | None                                  | 20% increasing to 35% in 2040 |
| <b>Proposed Gas Collection Improvements</b>                        | 1% in 1986 increasing to 43% in 2021 increasing to 80% in 2040 | None                                  | 20%                           |
| <b>Triple Organics Diversion by 2050</b>                           | 43%                                                            | Triple 2023 diversions rate by 2050   | 20%                           |
| <b>Zero Organics 2050</b>                                          | 43%                                                            | No landfilling of organic MSW by 2050 | 20%                           |
| <b>Zero Organics 2030</b>                                          | 43%                                                            | No landfilling of any DOC by 2030     | 20%                           |
| <b>Proposed Gas Collection Improvements &amp; Triple Diversion</b> | 43% increasing to 80%                                          | Triple 2023 rate by 2050              | 20%                           |
| <b>Proposed Gas Collection Improvements &amp; Triple Diversion</b> | 43% increasing to 80%                                          | No landfilling of organic MSW by 2050 | 20%                           |

**Table 10: Scenarios' Cumulative Methane Emissions Reductions From Updated Assumptions Baseline**

| Cumulative Emissions                                    |                     | 2024-2050                      |           |                     | 2025-2099                      |           |
|---------------------------------------------------------|---------------------|--------------------------------|-----------|---------------------|--------------------------------|-----------|
| Scenario                                                | MMT CH <sub>4</sub> | MMT CH <sub>4</sub><br>Reduced | % Reduced | MMT CH <sub>4</sub> | MMT CH <sub>4</sub><br>Reduced | % Reduced |
| Updated Assumptions Baseline                            | 186                 |                                |           | 615                 |                                |           |
| Proposed Gas Collection Improvements                    | 93                  | 93                             | 50%       | 244                 | 371                            | 60%       |
| Enhanced Landfill Cover                                 | 159                 | 27                             | 14%       | 507                 | 107                            | 17%       |
| Proposed GCCS Policies & Enhanced Cover                 | 81                  | 104                            | 56%       | 204                 | 411                            | 67%       |
| Triple Organics Diversion by 2050                       | 176                 | 10                             | 5%        | 472                 | 143                            | 23%       |
| Zero Organics 2050                                      | 165                 | 20                             | 11%       | 292                 | 323                            | 53%       |
| Zero Organics 2030                                      | 128                 | 57                             | 31%       | 182                 | 432                            | 70%       |
| Proposed Gas Collection Improvements & Triple Diversion | 89                  | 96                             | 52%       | 193                 | 421                            | 69%       |
| Proposed Gas Collection Improvements & Triple Diversion | 86                  | 100                            | 54%       | 130                 | 485                            | 79%       |

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