

RESPONSE TO PEER REVIEW COMMENTS

March 2017

A methodology for *Emissions Reductions from Landfill Gas Destruction and Beneficial Use Projects* was developed by the American Carbon Registry (ACR), a nonprofit enterprise of Winrock International.

All new methodologies and methodology modifications, whether developed internally or brought to ACR by external parties, undergo a process of public consultation and scientific peer review prior to approval.

The methodology was posted for public comment from May 2, 2016 – June 3, 2016. Public comments and responses by the authors were finalized on July 12, 2016, and have been provided to peer reviewers. Reviewer comments and responses by the authors are given below.

This document is organized by sections of the methodology. The far left column of the table presented here contains the section number where the comment was made. Final document versions and versions as posted for public comment are also available on ACR’s website under Process Documentation.

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SECTION 1

SECTION 1		
Section	Comment Type	Comment / Response
General Comments	Initial Comment	<p>Summary of Comments I generally think the methodology is sound. I had three main issues to consider:</p> <ol style="list-style-type: none"> 1. The LFG combustion accounting for CO₂ and CH₄ - What is presented may be correct or at least consistent with other work, but it should be explained better. 2. CH₄ oxidation rate - 10% oxidation of CH₄ has been shown to be too low, and I would recommend adopting the US EPA cover and flux standards that vary from 0% to 35%. 3. GCCS operation and monitoring - I would consider adopting NSPS standards for GCCS operation and monitoring for candidate landfills.
	Author Response	<ol style="list-style-type: none"> 1. The equations have been revised for clarity and errors. 2. Please see the response to Comment #5. 3. Please see the response to Comment #3.
1.2	Initial Comment	<p>CAA and RCRA I don't believe CAA or RCRA is used in the methodology outside of Table 2</p>
	Author Response	<p>The following sentence has been amended in Section 3.2.1.1 to include references to both CAA and RCRA:</p>

SECTION 1		
Section	Comment Type	Comment / Response
		<i>To pass the regulatory surplus test, a project must not be mandated by existing laws, regulations, statutes, legal rulings, or any other regulatory frameworks that directly or indirectly affect the GHG emissions associated with a project such as the CAA or RCRA.</i>
1.4	Initial Comment	Project Commencement I would define project commissioning, so there is a definitive starting point for the start-up period. Commissioning could be the date that any gas is destroyed.
	Author Response	We have included a definition for Project Commencement in this section.
1.6	Initial Comment	RP Is there a specific reason for the long length of an allowable reporting period? I could see 2-3 years, but five seems long.
	Author Response	This is in agreement with Section 8c of the ACR Program Standard, which only requires verification once every 5 years, however project proponents can have shorter reporting periods if they desire.

SECTION 2

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Section	Comment Type	Comment / Response
2.1	Initial Comment	<p>GHG accounting of LFG combustion I am not sure I follow the GHG accounting with regards to landfill gas combustion. In the current proposed methodology, CO₂ is considered de minimus, but CH₄ is included. However, the CH₄ emitted from the control device should be a small non-combusted fraction of the CH₄ generated during waste decomposition, which is explicitly excluded. LFG combustion is not creating CH₄. However, LFG combustion is converting CH₄ to CO₂, which should be considered.</p> <p>There could be CH₄ emissions considered from LFG combustion, if you are comparing an energy project to a flare, since flares typically have higher destruction efficiencies. My thoughts on the system: The generated CO₂ and CH₄ in the landfill gas are not included. They enter the combustion device. Most of the CH₄ is converted to additional CO₂ and some CH₄ flows through without being destroyed. So the offset from the combustion device should be the CO₂e of the destroyed CH₄ minus the CO₂e of the generated CO₂, unless you are not considering any effects from biogenic CO₂. Some small mass of NMOCs will also be converted to CO₂, and those should be de minimus, but the CO₂ generated from the CH₄ combustion will be significant.</p>
	Author Response	<p>CH₄ not combusted is accounted for in the destruction efficiency in Eq. 4, which applies a 95% default (and conservative based on the default destruction efficiencies identified by the Bay Area Air Quality Management District derived from actual source testing) or</p>

SECTION 2		
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		allows project proponents to apply a site-specific destruction efficiency, of which both options account for uncombusted CH ₄ . Emissions from the conversion of CH ₄ to CO ₂ have been omitted due to its biogenic nature, since these are not included within the project boundaries.
2.1	Initial Comment	SSR2 Shouldn't SSR2 be included in the boundary? CH ₄ emissions from SSR2 are the main baseline emission source.
	Author Response	SSR2 should not be included within the project scenario because waste decomposition would occur in the absence of the project and therefore does not have to be accounted for. In other words, since emissions from waste decomposition would happen with or without the project, these emissions aren't included within the project boundary.
	Review Reply	Yes, waste decomposition would happen in the absence of the project, but that's the point, right? CH ₄ emissions from waste decomposition is the main emission source in the baseline (or the whole baseline). I went and checked both the CAR and CDM methodologies and they include CH ₄ from waste decomposition.
	Author Response	You are correct. Thank you for pointing out this error. Figure 1, the explanation and Table 3 have all been updated to reflect the correction.

SECTION 3

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Section	Comment Type	Comment / Response
3.2.1.1	Initial Comment	Regulatory test I'm unclear what the highlighted line means. Shouldn't the test just be for the destruction of methane?
	Author Response	The text here requires that there's also no regulation requiring the enhanced use of the gas, in addition to the destruction of it, meaning that any project activities meet the additionality requirements.

SECTION 4

SECTION 4		
Section	Comment Type	Comment / Response
4.1	Initial Comment	<p>Description used in Equation 1 and 2 I recommend changing the names of Equation 1 and 2. Equation 1 should be the Volume of CH₄ Combusted. Equation 2 should be the Net Mass of Destroyed CH₄.</p>
	Author Response	The name for each equation has been updated per the reviewer's suggestion.
4.1	Initial Comment	<p>Oxidation Factor A 10% oxidation factor has been commonly in LFG regulatory frameworks, but it has been shown to be too low in a number of studies. "Currently, the default value for the IPCC and the US EPA for landfill cover CH₄ oxidation is set at a relatively low value, between 0% and 10% of emitted CH₄ (IPCC, 2006; USEPA, 2004). This value was based on seasonal results for a New Hampshire landfill as determined by the studies of Czepiel et al. (1996a,b). Recently Chanton et al. (2009) reviewed the literature and compiled CH₄ oxidation results for 42 determinations of the fraction of CH₄ oxidized following and including Czepiel's landmark study and reported a mean value of 36 ± 6% for this parameter. Fifteen seasonal studies ranging from latitude 30 to 55N yielded a similar value of 35 ± 6%." (1) Chanton, J.; Abichou, T.; Langford, C.; Spokas, K.; Hater, G.; Goldsmith, D.; Barlaz, M. A. Observations on the Methane Oxidation Capacity of Landfill Soils. Waste Manag. 2011, 31 (5), 914–925. (2) Chanton, J. P.; Powelson, D. K.; Green, R. B. Methane oxidation in landfill cover soils, is a 10% default value reasonable? J. Environ. Qual. 2009, 38 (2), 654–663.</p>

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		Based on this and other work, the US EPA currently now recommends a varying oxidation fraction of 0 to 35% based on cover type and methane flux (Federal Register, V. 78, No. 230, p. 71971). I would consider adopting that standard.
	Author Response	The value of the oxidation factor in Equation 1 has been updated to reflect the updated science behind oxidation rates, which fluctuate based on landfill cover, depth and methane flux.
4.1	Initial Comment	<p>Equation 2</p> <p>I think there is an extra (at the beginning of the equation.</p> <p>Also, I cannot get this equation to match the results of other methane destruction Protocols. I was using the conversion factors of 0.0423 for the density of CH₄ and 0.000454 for tCH₄/lbCH₄. I guessed that the conversion factor noted (1/10⁶ - conversion to metric tons (mt/g) was to be used, but it's not clear. If needed, I would add to equation.</p> <p>For simplicity, you might just want to revise equation to CH₄ combusted * 0.0423 * 0.000454.</p>
	Author Response	<p>The opening parenthesis pertains to the closing parenthesis just after 95%.</p> <p>Equation 2 has also been revised to amend the typo of [1/106] to [1/10⁶].</p> <p>We ran 3 months of project data using the updated equations against the total reported using other comparable protocols. Results are consistent with comparable LFG offset protocols. Perhaps the difference is in the updated global warming potentials used in the ACR methodology (25) or you have multiplied by the erroneous clause (1/106) as well as (1/10⁶).</p>

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	Review Reply	I think it must have been the typo of 1/106. I now get similar results (small difference) for tons of CH ₄ destroyed. The CH ₄ combusted in table under equation 2 still says scfm.
	Author Response	Thanks for the catch - apparently when the revised table was copied it included the tracked changes. This section has been amended here as well.
4.1	Initial Comment	scfm For CH ₄ combusted and LFGcaptured I believe these should be scf and not scfm. Flow will be measured in scfm, but for calculations needs to be scf.
	Author Response	Both equations 1 and 2 have been revised per the reviewer's suggestion.
4.4	Initial Comment	GWP Would you consider linking the GWP to the EPA GWP so it updated as EPA updates?
	Author Response	Section 4.4 has been amended to reference the currently approved GWP per the ACR Standard, Section 1G, <i>Unit of Measure</i> , that dictates which version of the Assessment Report values to use for GWPs. Please see the revised section below.

SECTION 5

SECTION 5		
Section	Comment Type	Comment / Response
5	Initial Comment	<p>GCCS operation and monitoring I would consider a requirement that landfills that do not fall under NSPS should follow NSPS guidelines requirements for GCCS operation and monitoring (e.g., maintaining appropriate temperature and negative pressure at wells, startup, shutdown, and malfunction requirements, and surface monitoring requirements). (Federal Register / Vol. 81, No. 167). That will create a standard baseline for GCCS operation, and will help avoid providing offsets to poorly operated systems.</p>
	Author Response	<p>Since the NSPS requirements encompass much broader landfill operations (e.g. leachate recirculation), making a landfill that is not subject to regulation adhere to all aspects of the NSPS rules may provide an unnecessary obstacle to participate in a carbon credit program. ACR does agree that the requirements for monitoring startup, shutdown and malfunction should be monitored regardless and thus a monitoring requirement has been added to Section 5.2 in the form of a downtime log. In regards to the requirements pertaining to well monitoring, this is managed through the optimization of landfill gas sent to the destruction device and therefore ACR does not agree that an additional requirement to be in compliance with the NSPS is necessary.</p>
5.2.1	Initial Comment	<p>Clarification Control device? The destruction device?</p>
	Author Response	<p>Please see the revised text.</p>

SECTION 5		
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5.2.2	Initial Comment	Continuous CH4 Did you consider allowing handheld readings for landfills that don't have a continuous analyzer? I would guess that almost all LFG collection systems have continuous gas analyzers, but a few projects might not. Does EPA allow handheld readings for GHG mandatory reporting?
	Author Response	Best practice for methane content is using continuous readings, however a provision for emergency situations has been included. As such, Equation 1 has also been amended to include a weekly monitoring discount factor.
	Review Reply	I think allowing this flexibility for a short time period make sense. My only other comment is that I would increase from one month to 2 months. Having a continuous analyzer sent out, serviced and sent back within one month could be difficult depending on how quickly the manufacturer can service it.
	Author Response	We agree that a month might be too stringent giving the logistics of servicing the analyzer and have increased the grace period to 2 months per the reviewers suggestion.
5.2.3	Initial Comment	Field Checks The field checks must be 11 months apart, but also annually? Does that mean they only have one month to complete a "qualifying" check? that seems like a narrow window that could be missed if there are scheduling problems.
	Author Response	The sentence: <i>"Qualifying field checks must be separated by an elapsed time frame of a minimum of 11 months from the date of the preceding field check"</i> , has been moved as a footnote to that section and amended to read, <i>"Annual field checks must be separated by an elapsed time frame of a minimum of 11 months from the date of the preceding field check."</i>

SECTION 5		
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	Reviewer Reply	<p>Sorry, still a bit confused as to what would count as an annual field check. Does it just need to be within the next calendar year?</p> <p>For example - last field check was in April 2015, next field check in July 2016 - would this meet the requirement? If you interpreted "annually" as every 12 months then the July 2016 check would not meet the requirement. If that is not the intent, maybe add clarification as to what "annually" means. To my original concern and using the example above - I don't think you want a situation where your only option to meet the requirement is to have a field check conducted during a 1 month window in March/April 2016. That seems too restrictive to me.</p>
	Author Response	Please see the revised text.
5.2.3	Initial Comment	<p>Manufacture Calibration</p> <p>Please clarify - does this mean that a project would lose all reporting period credits if the equipment is not maintained per requirements or would the project just lose credits for the time period in violation (e.g. meter is 2 months overdue for calibration, so it loses those two months of credits).</p>
	Author Response	Please see the revised text at the end of this section for clarification.
5.2.4	Initial Comment	<p>Engine Operational Activity</p> <p>For simplicity, should all gas that flows to an engine or boiler be considered destroyed? You could consider adding similar language to the ARB LV protocol regarding the presence of a safety shut off valve.</p>
	Author Response	Please see the revised text at the end of the first paragraph in this section.

SECTION 6

SECTION 6		
Section	Comment Type	Comment / Response
6	Initial Comment	Typo “within in”
	Author Response	“In” has been removed. Thanks for the catch.
6	Initial Comment	Arid vs non arid Where does the 25 in. precipitation threshold come from?
	Author Response	The 25” precipitation threshold is derived from Section 2.4.4.1 (pg. 2.4-4) of the EPA’s Criteria for Municipal Solid Waste Landfills (https://www3.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf) as denoted in endnote iv here.
6	Initial Comment	Landfill location If a landfill is located near the arid/non-arid border or in a state where it's heavily mixed (eg Idaho), is there a way for them to determine what region their specific landfill lies in? The map might be difficult to read for sites located near a border. For example, eGrid has a database of zip codes and what subregion they are in.
	Author Response	Please see the revised text in the last sentence of the 5 th paragraph.
6	Initial Comment	Performance standard I think using a 15% penetration rate is a very reasonable threshold for the performance std.

SECTION 6		
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	Author Response	While ACR does not prescribe a percentage threshold for performance standards, we agree that in this context it is reasonable.

SECTION 7

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7	Initial Comment	EF updates Instead of updating the EFs periodically, you could just link to the latest EPA EFs, similar to linking to the latest eGRID values.
	Author Response	Non-electricity emission factors aren't updated nearly as frequently as eGRID data and as such, it is easier to provide emission factors for Scope 1 fossil fuel-based emissions within the methodology. ACR does however intend to update this appendix as emission factors are updated.