

SUMMARY AND RESPONSE TO PEER REVIEW COMMENTS

A draft of version 3.0 of the *Methodology for the Quantification, Monitoring, Reporting, and Verification of Greenhouse Gas Emissions Reductions from the Transition to Advanced Formulation Blowing Agents in Foam Manufacturing and Use* was developed by ACR. Version 3.0 updates previous versions that were developed in partnership with Dentons U.S., LLP, Foam Supplies, Inc., Global Chemical Consultants, and Susan Wood Consulting. True Manufacturing, Inc. cooperated with version 2.0 of this methodology.

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 updated methodology was posted for public comment from November 17, 2021 - December 17, 2021. The updated methodology was reviewed by an independent panel of experts beginning in January 2022. Comments and responses are documented here.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
1	1	1.4	Consider revising the last sentence in the first paragraph of section 1.4. It is confusing. Does it make more sense to separate the text after the last comma as a new sentence?	Noted and sentence separated	Resolved.
2	1	1.4	Is it possible that a project might include different foam end-uses with different leakage lifetimes in the same project and thus the crediting periods for each end-use would be different? If so, how would the crediting period be defined? If this scenario is possible, consider including details in the methodology on how to define the project crediting period.	Most projects don't include multiple foam end-uses	Resolved.
3	1	1.6 #1	Consider referencing updated "GHG Project Plan" instead of GHG Plan for consistency with program language.	Noted and changed	Resolved.
4	1	1.6 #2	Consider rephrasing to require an addendum to the original validation and verification report that shows the new "calculated baseline emissions, project emissions, and ERTs" (rather than <i>calculations</i> , since the VV report never shows actual calculations).	Noted and changed	Resolved.
5	1	5.2.3	The list at the end of the section appears to include incorrect numbers (4-6).	Noted and corrected	Resolved.
6	2	Definitions	Blowing agent definition would be better with 'expand' rather than 'propel'	Noted and changed.	Acknowledged

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
7	2	Definitions	Should Eligible BA include reference to <i>'is not an HCFC'</i> ?	By default, the parameters, < 30 GWP and low ODP already exclude HCFCs	<p>HCFC-123 has an ODP of 0.012 which is close to your lower threshold. We would not want to encourage its use inadvertently because it is toxic.</p> <p>ACR: HCFC-123 has GWP of 79 which is above 30 and hence is ineligible. Agreed that use of toxic material should be discouraged.</p> <p>ISSUE CLOSED.</p>
8	2	Definitions	Should Eligible BA refer to 'saturated' HFCs or HCFCs only to allow for use of HFOs and/or HCFOs?	<p>By default, the parameters < 30 GWP and low ODP already exclude HFCs and HCFCs</p> <p>Per this definition, eligible BA also includes natural BA like CO₂, and non HFO/HCFO BA like Methyl Formate, Methylal as well as HFOs and HCFOs (see Table 10)</p>	<p>I think the point is being missed here. The term hydrofluorocarbon includes both saturated and unsaturated HFCs and an example of an unsaturated HFC is HFO-1234ze(E). The terms HFO and HCFO have no meaning in chemistry. They are simply marketing</p>

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
					<p>terms to avoid reference to HFC and HCFC, even when unsaturated. Therefore, the current wording rules out HCFOs and HFOs.</p> <p>ACR: Accepted and changed language to exclude only “saturated HFCs”. See Definitions page 5.</p> <p>ISSUE CLOSED.</p>
9	2	Definitions	On what basis are hydrocarbons excluded as Eligible BAs?	Hydrocarbons are excluded based on their already higher market penetration rate. According to P&S Market Research data, in 2017, around 2,200 MT of HCs were used to manufacture Rigid PUF compared to 270 MT of HFOs.	Noted and accepted.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				See Table 9 that shows market penetration with HC included.	
10	2	Definitions	Would 'End-of-Life' include emissions from the waste stream after de-commission (e.g. from landfill)?	Yes. EOL and post-disposal	<p>Would a reference to 'post-disposal' be useful in the definition to make its inclusion explicit?</p> <p>ACR: Definition of "post-disposal" added. See Definitions, page 5.</p> <p>ISSUE CLOSED.</p>
11	2	Definitions	'Leakage' is an unusual word to use in the foam context to reflect emissions. 'Loss(es)' is a more typical term.	Agreed. This term "Leakage" is used by the EPA for the purposes of estimating GHG emissions at the national level and used here for consistency	Noted and accepted.
12	2	Definitions	"A" side and "B" side terminology only relates to PU/PIR technology while the standard includes other types of foam to which the terms do not relate.	A and B side terminology only applies to spray foams in this methodology	A Systems Supply House could deal with more than just PU/PIR formulations, so the definition of "Formulators" should say something like <i>'These entities typically provide</i>

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
					<p><i>the "A" side and the "B" side chemicals for PU spray foams among others, which are then blown at.....'</i></p> <p>ACR: Accepted and suggested change made in the definition. See Definitions, page 6.</p> <p>ISSUE CLOSED.</p>
13	2	Definitions	Why does the 'Leakage Lifetime' only refer to the useful lifetime and not the whole lifecycle?	See Definitions section. Changed from "useful lifetime" to "lifetime of the product, including disposal and post-disposal"	Acknowledged
14	2	Definitions	'Polyol' should actually be referred to as 'pre-blended polyol' when defined as written here.	Noted and updated.	Acknowledged
15	2	1.1	Would reverse the order of reference to high GWP and high ODP, since measures on ozone came first.	Noted and updated.	Acknowledged
16	2	1.1	How are 'low market adoption rates' defined?	See Appendix A; Market penetration rates of all eligible BA are equal or below 5% except for XPS which in 7-8%.	Noted

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				See below #14	
17	2	1.2 (Table 1)	Why is phenolic foam not included in this table or, at least, in Appendix A?	Phenolic foam is not included in Table 1.2, Eligible Foam Applications, because it is typically used in a variety of rigid PUF applications that were found to already have higher market penetrations for low GWP BA. See page 36 of the methodology.	Noted and accepted.
18	2	1.2 (Table 1)	Is the content of this Table dynamic? If not, why not?	See below # 19	Noted (but see below).
19	2	1.2 (Table 1)	If the Table is dynamic at what Market Penetration levels would an Application be removed from the list?	Performance standards, including those based on current levels of adoption or market penetration rates for a technology or practice, for all ACR methodologies are reviewed and updated at least every 5 years. This ensures that additionality and baseline assessments are based on the most current data available. Each sector is different in terms of the drivers of adoption.	OK - so the 5 yearly review is seen as sufficient to keep up-to-date. If that is accepted practice, I am OK with that. I think you are also saying that there is no fixed threshold for market penetration even when reviewed. That seems to me to lack transparency, but maybe I am missing something.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				<p>These may include but are not limited to: availability, trade negotiations, regulation, upfront cost for transitioning, cost or benefits of competing technology, fixed term rebates or incentives, presence of an extraordinary event to speed adoption, fixed term, long term sustainability of the transition, etc. ACR reviews all of these and their interactions unique for each methodology on a regular basis to determine an appropriate threshold for performance when used as a basis for additionality.</p>	<p>ACR: Performance standards for ACR methodologies are updated <u>at minimum</u> every five years, per the ACR Standard (governs ACR Program and establishes standard practice for the ACR program as a whole. This process includes a review of all of the types of information you cite and can depend on numerous factors in each sector. The process includes a public consultation and peer review whereupon the performance standard, its basis and its reasonableness for the sector is reviewed in a public forum. This ensures transparency before any update to a performance standard is finalized.</p> <p>ISSUE CLOSED.</p>

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
20	2	1.4	Typo in this section: Line 5 – ‘leakge’ should read ‘leakage’	Noted and corrected	Acknowledged
21	2	1.4	Since ‘Leakage Lifetime’ is a defined term, I think it should be capitalized when referred to in the text.	Noted and updated	Acknowledged
22	2	1.4	In this text, there is confusion between ‘rates’ & ‘amounts’. A rate would be a percentage loss. As the amount of remaining BA decreases the actual annual amount lost would decrease.	The term “annual leakage rate” is used consistent with EPA’s use of the term in the National GHG Inventory. The EPA uses this term to mean a constant annual leakage rate in reference to the initial BA content (at manufacturing) in the foam product.	OK. This is probably a discussion to be had with EPA, but I can see that you need to remain consistent with their practices. ACR: Agreed. ISSUE CLOSED.
23	2	1.4	The text make reference to losses ‘post-disposal’ but the final sentence of the first paragraph speaks of ‘manufacturing to disposal’ implying that post-disposal is not included. Clarity needed.	Noted and changed.	Acknowledged
24	2	1.4	The decision to base the methodology on UNFCCC ‘small system method’ means that much of the potential emission saving is ignored and project impacts under-estimated. This method should be referenced in Appendix C but doesn’t appear to be so.	The second paragraph in section 1.4 is removed because the methodology now includes EOL and post-disposal.	Acknowledged. I think this is the right action.
25	2	1.4	How is remaining BA valued at de-commissioning? It should be explained here.	Methodology allows 100% emission rate based on BA	The inclusion of the reference to ‘post-disposal

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				content at manufacturing. This is consistent with assumptions made in the EPA National GHG Inventory.	addresses this point, so I am now fine with it.
26	2	1.6	There seems to be a conflict between 1.4 and 1.6 with 1.6 including 'disposal' but 1.4 excluding EoL, so there is a definitional issue which is particularly confusing.	The second paragraph in section 1.4 is removed.	Acknowledged
27	2	1.6	What is meant by 'post disposal' for 'some BAs'?	According to EPA's National GHG Inventory, two BA end-use categories "Rigid PU: Domestic Refrigerator and Freezer" and "PU and PIR Rigid: Boardstock" continue to emit after disposal e.g., when they're sitting in a landfill or wherever they end up after disposal.	So it should say 'some applications' not 'some BAs'. ACR: Agreed and changed to "some BA end-use categories". See section 1.6, page 16. ISSUE CLOSED.
28	2	1.6	If I understand the approach outlined here correctly it is assuming 100% emission even though some or much of that may take place post-disposal. Is that correct and, if so, would that not potentially over-estimate emissions and credits bearing in mind that emissions from landfills can potentially take several decades?	Yes, some of the emissions would occur after disposal for the above two categories. This is consistent with assumptions made by the EPA in the National GHG Inventory and the associated supporting research.	I agree that it is not an over-estimate in quantity, it is simply an acceleration of the credit ahead of the time at which the climate benefit will materialize against the baseline. So, it is an overestimate at a given point in time even

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				<p>According to EPA’s GHG Inventory, it takes around 25 additional years post disposal for 100% of the BA in the foam to be emitted. This does not represent an overestimate as all of these emissions will definitely occur eventually and the action to avoid them occurs at time of manufacture of the foam.</p>	<p>though things will balance out in the end. (see General comment at #41)</p> <p>ACR: Agreed that it is an overestimate at a given point in time (particularly in the initial years). However, as explained before, issuance of offset credits (in general, not only for this project type) is based on GWP100 values that correspond to 100 years’ worth of warming and hence does not apply to a particular point in time but to the entire 100-year time horizon. Thus, the standard accounting framework in the carbon markets always rewards at the time of action- not over the time period of the warming itself. This disconnect between the physical warming and the</p>

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
					<p>market mechanism that rewards the actions that avoid warming has always been present in the carbon market and is an acknowledged construct of the market. Carbon offset credits using GWP100 are issued for the reporting period during which the activity to avoid emissions occurs. ACR acknowledges this point but is unable to change this construct market-wide.</p> <p>ISSUE CLOSED.</p>
29	2	1.6	The acronym ERT should be defined at first use, not within the subsequent bullets.	Noted and defined	Acknowledged
30	2	1.6	Although the acronym 'VV' is relatively easy to deduce from the context, it is not explicitly defined and arguably should be.	Noted and defined	Acknowledged
31	2	3.1	There is considerable reference in this section to End Use Categories (EUCs) mentioned in EPA SNAP Rules 20 and 21. For example Table 4 mentions EUCs A, B, C, D & E taken from SNAP rules 20 and 21. However, the Fact Sheets on	Table formatted to fit the key in the same page	Acknowledged. It looks much better.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
			both of those rules do not use these letters to differentiate EUCs as far as I can see. The key to the letters spills over to page 22 but should be on the same page as Table 4 for ease of reference.		
32	2		Equally, the link between the EUCs used by SNAP and the Eligible Foam Applications in Table 1 should be made clearer, since Table 4 is not an exhaustive list of SNAP EUCs	Noted. Footnote 7 added to explain this.	Acknowledged
33	2	3.1	In Table 4 shouldn't the column header be '2021 onwards' or 'from 2021'? Otherwise, it looks as though only two years are covered by the Methodology.	This Table is updated annually based on updates to Federal and State level regulations. A new column for 2022 will be added to Table 4 this year, likely in Q3 or Q4.	Noted and accepted. Obviously, this doesn't wait for the 5-year review
34	2	3.2	The use of the word 'surplus' is unusual in this context when the title of the Section refers to Additionality.	"Regulatory surplus" is a term used in ACR's definition of Additionality (See ACR Standard) and consistently used throughout all ACR standards and methodologies. https://americancarbonregistry.org/carbon-accounting/standards-	OK.... I have learned something here. Thanks for the explanation.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				methodologies/american-carbon-registry-standard/acr-standard-v7-0_final_dec2020.pdf	
35	2	3.2.1	In Footnote 8, there is a typo on 'Manufacturing'	Noted and corrected.	Acknowledged
36	2	3.2.2	Consistent with comments 13 & 14 of this Review, there should not just be reference to the addition of applications but also to their removal, if this is to be practiced.	Please refer to response #19	Noted, but also see my comment to #19 on transparency of process. ACR: SEE follow up response in # 19. ISSUE CLOSED
37	2	4	While Footnotes 10 & 11 are cited as the source of the Leakage Lifetime in years and the Leakage Lifetime Emission Rate data shown in Tables 5 & 6, I have checked the US Greenhouse Gas Emissions & Sinks document and cannot find those page numbers or any reference to Leakage Lifetime (see attached).	These are included in Annex 3- Part A of the US GHG Emissions and Sinks: 1990-2019 report. https://www.epa.gov/system/files/documents/2022-02/us-ghg-inventory-2022-annexes.pdf	Using the link you have provided here, the relevant equations seem to be from pages A-250 to A-252 of Annex 3 and the relevant Table seems to be A-128 rather than A-136 given in footnotes 10 & 11. Please check again. ACR: Sorry, mistakenly the link provided was for draft US GHG Inventory 1990-2020. Here is the link to

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
					<p>the 1990-2019 report that was used to update this methodology Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019 – Annexes (epa.gov)</p> <p>ACR has confirmed that information provided in footnotes 11 and 12 (formerly 10 and 11) are correct.</p> <p>ISSUE CLOSED.</p>
38	2	4	Using the equation on Page 24, I cannot see any scenario which would give an LLER of less than 100%. Is there one?	Version 3.0 of this methodology allows 100% emission rate for all BA end-uses.	Noted and accepted.
39	2	5.2.1	Is there a reason why a minimum of 2 years of data is required? Does this have to be continuous (daily) use or could it be occasional use?	This is to ensure that the high-GWP BA (claimed as baseline BA) was used for a considerable amount of time before switching to low-GWP BA. Two years ensures that high-GWP BA was not used temporarily. It has to a	Noted and accepted. I assume that continuous means 'every time blowing agent is used' rather than 'daily'.

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				continuous use over the 2-year period.	
40	2	5.2.2 & 5.2.3	I don't see anywhere the requirement to disclose the formulation of the B-side to relate the blowing agent quantity to the overall B-side quantity. Have I missed that?	This is disclosed at verification in the calculation spreadsheets submitted by the project proponent to the verifier and viewed during the site visit in production records.	<p>Noted and accepted, but wouldn't some reference to that point in the methodology itself be helpful?</p> <p>ACR: Section 5.2.4 includes Blowing Agent Ratio (BAR) as a monitored parameter. Calculation of BAR requires disclosure of quantities of A- and B- side chemicals used for both baseline and project blowing agents to complete these calculations.</p> <p>ISSUE CLOSED.</p>
41	2	General	Overall, I feel that the adoption of the LLER% accounts for the total CO ₂ -eq saving across the lifecycle in the first year and, as such, over-estimates the savings in temporal terms. This can be substantial when some product types	You are correct that the atmospheric warming and emissions of BA will occur over some time period, but ERTs are awarded	I am happy to acknowledge that you are acting in line with wider practice on ERTs and realize that you must do

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
			<p>have significant residual blowing agent in them even in the post-disposal phase of the lifecycle. All of the accuracy pursued through a detailed project methodology is therefore seemingly squandered by a gross inaccuracy in the assessment of climate benefit in real time. Is there an explanation that justifies this approach? I don't see it addressed in the methodology itself.</p>	<p>immediately. There is no uncertainty in the fact that the emissions of high GWP BA will occur (they all eventually leak) and there is no uncertainty about the amount of warming that will occur and over which timeframe (determined by the chemical structure). There is never temporal equivalency of ERTs awarded and atmospheric warming with carbon offsets from any project type. The issuance of ERTs is always tied to the time when the action was taken and/or the avoidance of emissions actually happened if the magnitude of avoidance is in question or the likelihood of the action occurring is in question (not the case for avoided BA emissions). For example, carbon dioxide has a lifetime of approximately 100 years and thus the</p>	<p>that for consistency. However, I still believe that these projects create a temporal distortion by crediting up-front despite their ultimate certainty.</p> <p>I also detect that there may be a little confusion in this explanation between the assessed time horizon and the actual atmospheric lifetime of the gases involved (the highlighted text). For example, the atmospheric lifetime of carbon dioxide is 300-1,000 years (NASA). It is the assessed time horizon that is 100 years. It's an important distinction.</p> <p>ACR: Agreed that assessed time horizon is 100 years based on which the GWP100 values are determined while the</p>

#	Reviewer #	Document Section	Round 1 Reviewer Comment	Round 1 Author Response	Round 2 Reviewer Comment
				<p>atmospheric warming occurs over that time. However, when the combustion of oil is replaced with solar energy the avoided CO2 emissions are achieved at the moment the power is delivered, not over the known lifetime of atmospheric heating. The amount of heating that will occur is known from the emission. Therefore, credits are awarded at the time that the action to avoid emission is taken.</p>	<p>actual atmospheric lifetimes for most climate pollutants can be much longer. Please see comment #28 for response regarding temporal distortion and common accounting practice in carbon markets.</p> <p>ISSUE CLOSED.</p>