PEER REVIEW COMMENTS AND RESPONSES

An *Emission Reduction Measurement and Monitoring Methodology for Destruction of Ozone Depleting Substances and High-GWP Foam* was prepared by EOS Climate and ACR. The methodology was posted for public comment from May 2 – June 3, 2016.

1. General Comments

1st Peer Review	Author Response	2nd Peer Review	Author Response
Consistent capitalizations are required for “table” and “equation” throughout the document.	Changes have been made.		
Better terminology than “found” can be used.	Terminology changed to, for instance, “included”, “provided”, etc.		
“Mass” and “weight” were used interchangeably. This should be avoided, especially when SI units are used. Also, mass can be determined using density and volume. Unit weight needs to be known to calculate weight. The document mainly contains SI units and use of mass throughout is recommended.	“Weight” changed to “mass” as recommended.		
Including a list of tables and a list of figures after the table of contents is recommended.	List of tables and ToC added.	The list of tables end with Table A4. The tables A5, D1, D2, D3, etc. are not included in the List of Tables. The Tables DX need to be checked for table number. Currently, the tables go from Table D2 to Table D4 and there is another jump from D6 to D12 and then back to D7, etc. Please check all table numbers.	All table numbers have been corrected.
It would be good to define all acronyms even if some may be rather obvious.	We have added additional acronyms to the acronym table.		
Multiple methods (ASTM, Scheutz, AHRI, etc) are included in the methodology to identify the type/composition of ODS/high GWP	This is beyond scope of the methodology. Flexibility is given to the project proponent to determine the appropriate analytical method		

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BAs and determine the amount and concentration of the BAs. A table would be very helpful to provide a summary of the applicability of the specific methods for specific BA types, applications, shape/size/form of foam, etc. Currently, it is not straightforward to discern what methods to use for which cases.	and it is up to the project proponent to provide the rationale for the chosen method.		
There are various instances of references to documents, reports, models, etc. by EPA, CARB, CAR, etc. The appropriate references should be provided for all these cases. For example, USEPA (2009), CAR (2010), etc. with the full reference provided at a reference list at the end of the document.	References have been corrected and a reference list added.	-Please check all references in the references list for inclusion of dates, inclusion of all author names, and use of a consistent style (e.g., APA, MLA, Chicago, etc.). - Please use alphabetical order in the references list. If the order follows the order of appearance in the text, the references should have a designated number.	All references have been placed in alphabetical order and use the APA format.
Please be consistent in referencing EPA: USEPA, EPA, or U.S. EPA.	Changed reference to EPA.		
When references are included in the text, the author name(s) should always be followed with the year of the publication. Including only author name(s) is not sufficient. This applies to agencies such as EPA, CAR, etc. as well.	References have been corrected and a reference list added.		
A list of references should be included at the end of the document. Full references were provided in footnotes in some cases, however, this practice is	References have been corrected and a reference list added.		

1st Peer Review	Author Response	2nd Peer Review	Author Response
not consistent throughout the document. Also, the style of the citations should be consistent (APA, MLA, Chicago, etc.).			

2. Introduction

1st Peer Review	Author Response	2nd Peer Review	Author Response
Please add "CEMS" to acronym list	CEMS added to acronym list		
Please add "HBR" to acronym list	HBR added to acronym list		
"TEAP" not seen in acronym list – please add	TEAP added to acronym list		
Page 3, Definition (4) "Destruction": Recommend revising "so that the destructed ODS" to "so that the destroyed ODS"	Definition revised.	Agree with the revised definition.	
Page 4, Definition (8) "Emission Rate": Recommend revising "lost to the atmosphere" to "released to the atmosphere" Furthermore, the definition only mentions leaks from operation and servicing. However, refrigerant emissions occur during equipment manufacture, installation, operation, maintenance, and at end-of-life. Foam is not serviced and blowing agent emissions occur at manufacture and during the lifetime of the building or equipment. There can also be	Definition changed from: "Emission rate" means the rate at which refrigerant or foam blowing agent is lost to the atmosphere, including emissions from leaks during operation and servicing events." To: "Emission rate" means the rate at which refrigerant, fire suppresants, medical aerosols or foam blowing agent is released to the atmosphere."	This change was not fully implemented. Definition still says: "Emission rate" means the rate at which refrigerant, fire suppressant, or foam blowing agent is *lost to the atmosphere*. "Lost" was not changed to "released" and "medical aerosols" were not incorporated.	Now definition 10 - Wording changed to "released" and medical aerosols incorporated

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emissions during installation and at end-of-life/deconstruction/demolition.			
Page 4, Definition (12) "High-GWP Foam Blowing Agent": Recommend revising last sentence to "When reclaimed, ODS or HFC blowing agents have identical chemical properties as ODS or HFC refrigerants and may be sold and used as refrigerants. Unless they are reclaimed to virgin specifications, they cannot be sold on the market."	Definition changed, per recommendation.	Agree with the revised definition.	
		Suggest adding definitions for "enclosed equipment de-manufacturing systems" and "non-enclosed equipment de-manufacturing systems." The definitions should address the extent to which emissions can escape from foam removal projects and get released to the atmosphere. For example, would a warehouse be categorized as an "enclosed system" or would an "enclosed system" require capture of all fugitive BA released into workplace air during decommissioning through some engineering control process (e.g., thermal oxidation unit, or condensing apparatus)?	Definitions for enclosed and non-enclosed systems added

2. Eligible Activities – Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response
Unclear as to why solvents are not included in the destruction protocol – is it because the main ODS solvent that is also high-GWP, CFC-113 is already included as a refrigerant?	The original ODS destruction protocol excluded solvents because under RCRA, used fluorochemical solvents are required to be destroyed. Our understanding is there are no meaningful quantities of virgin (never used) CFC or HCFC-based solvents.		
Is foam blowing agent HFC-365mfc not included because of extremely low usage in North America?	That is correct. Based on our understanding, there is no meaningful production of foam using HFC-365mfc in the U.S.		
Perhaps not quite pertinent to this specific protocol, but wouldn't it be better to distribute functional medical aerosol inhalers to developing nations rather than destroy them?	At the 38th Meeting of the Open-Ended Working Group of the Parties to the Montreal Protocol in Vienna in July 2016, there were no nominations for CFC essential uses for 2016. The last CFC essential use exemption was authorized for 2015. While parties could require essential use exemptions for CFCs in future years, the parties state that "it may be concluded that the phaseout of the use of new CFCs has been completed". As such, this methodology no longer includes		
Is HCFC-123 not included in the fire suppressant sources because of its relatively low GWP? Or is it because it is still allowed in new centrifugal chillers until 2020?	HCFC-123 production is still permitted and therefore is not allowable for destruction.		

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Page 8, 2.2(l): Recommend updating to reflect EPA's proposed amendment to the section 608 rule, which proposes to extend, as appropriate, the requirements to non-ozone-depleting, substitute refrigerants, such as HFCs. EPA published the proposed rule on November 9, 2015, and it is expected to be finalized this year. *In addition, recommend considering the following information from EPA's Section 608 regulations on safe disposal:* Individuals removing refrigerant from small appliances, MVACs, and MVAC-like air conditioners, when preparing them for disposal, are not required to be certified technicians. However, the equipment used to recover refrigerant from appliances prior to their final disposal must meet the same performance standards as refrigerant recovery equipment used for servicing. Persons involved in the final disposal of appliances must certify to their EPA Regional Office that they have obtained and are properly using EPA-certified refrigerant recovery equipment. Note that EPA has recently proposed to remove this certification requirement. This information is available online at: https://www.epa.gov/section608/stationary-refrigeration-safe-disposal-requirements.	Thank you. Updates, per the comment, were made to section 2.2(l).	Language seems fine since protocol only applies to ODS refrigerants.	
Pages 8-9, 2.2.1(b): Agree with the list of eligible ODS refrigerants. Please note that	OK.		

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CFC-11 is likely only used in a small number of equipment, primarily chillers.			
Page 9, 2.2.2(b): Agree with the list of eligible high-GWP insulation foam blowing agents.	OK.		
Page 10, 2.2.2(c)(3): Recommend specifying how the foam must be separated from the application. For example, to what degree must the foam remain intact? Saw and scrape/filet methods can yield a wide range of particle sizes, and particle size impacts the amount of BA released in the process of separating the foam from the application. Therefore, reviewer suggests specifying a minimum volume or particle size to define the completeness level of "intact." Although the majority of foam is shredded into particle sizes ranging from 16-32 mm in the baseline scenario (Scheutz et al. 2012), some recyclers have the capability to adjust the output particle size. Thus, further clarification on the term "intact" is needed. To be considered eligible for improvements over the baseline, reviewer would recommend a threshold of on the order of 1 ft^3 for recovered foam pieces. In addition, reviewer suggests elaborating on how the foam must be stored and transported (e.g., sealed plastic drums, impermeable plastic bags, hermetically sealed containers). If the intact foam is compressed, compacted, stressed, or	It is in the best interest of a project proponent to maximize the degree to which the foam remains intact as, per the procedures in Appendix B, sampling is required to determine the composition and mass ratio of the BA present in the foam. In practice, it is not possible to verify particle size as all verification activities occur after removal and destruction have occurred. Therefore, no adjustments have been made to the eligibility provisions for intact foams. However, a section on best practice could be added if the reviewer believes this would be beneficial in conveying the suggested information. Lastly, significant benefits, over baseline, are achieved due to the avoidance of fugitive release from shredding and landfill. Section 2.2.2 requires storage and transport via sealed containers.	While we recognize it is in the best interest of a project proponent to maximize the amount of BA recovered from the foam, the sampling methodology required to determine the composition and mass ratio of the BA present in the foam (Appendix B) may not appropriately reflect actual real-world practices and not sufficiently account for BA losses during the removal of appliance foam. We agree that the specified sample size (8 in^3) is reasonable to determine the amount of BA present in the intact foam and ultimately destroyed, however, this assumption may not appropriately reflect the remaining size distribution of pieces of foam after separation from the appliance or other product. This assumption could allow an overestimation of BA destroyed for less efficient foam removal processes (e.g., manual scraping or fileting that would stress and/or break foam cells, releasing BA). We recommend	The sampling procedures in Appendix B related to the particle size cutoff are limited to ascertaining the type of blowing agent(s) and the mass ratio of blowing agent(s), not the quantity of blowing agent(s). The mass of foam is determined through weigh scales at the destruction facility per Appendix B (a)(1). The size of the average foam piece sent for destruction is not necessary as mass is already determined through procedures in Appendix B. Regarding Section 2.2.2, this section lays out basic eligibility requirements. The suggested sections for reference are inappropriate for this section as they are relevant to monitoring and quantification requirements stated elsewhere.

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otherwise compromised during transport due to improper storage, BA could be released to the atmosphere.		requiring documentation to prove that the 8-in^3 sample is indeed a worst-case representation of the size distribution of foam pieces. Can it be shown that average pieces are not smaller than this size, and/or that removed foam has not been compacted or otherwise compromised? We also recommend adding a section on best practices to convey proper procedures during removal of foam to minimize fugitive BA releases as a result of stressing or breaking foam cells containing BA. In Section 2.2.2, we recommend referencing additional information in Section 6.6(a) (pg. 44): "When transporting intact high-GWP insulation foam, all recovered foam pieces must be placed in air-tight and water-tight storage until arrival at the destruction facility." Suggest also referencing Section 4 on page 68 in Appendix D. Suggest also requiring that foam material should not be compacted during transport, which can result in fugitive BA releases.	Compaction losses will be reflected in reduced credit generation. Project proponents will have an incentive to minimize blowing agent losses and thereby institute these types of best management practices.

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Page 11, 2.2.4(b): Halon 1301 should not be eligible in the methodology because it should not be destroyed. It is critical to maintain and add to halon 1301 stockpiles. An analysis conducted by this peer reviewer in November 2015 estimated the availability of halon 1301 resources needed to service the existing aviation fleet, account for aviation growth through 2050, and service existing non-aviation applications. The most conservative scenario estimated that available halon 1301 reserves are projected to run out by 2041. Therefore, any material that is recovered from systems should be reclaimed and sold for reuse.	We disagree that Halon 1301 should not be allowed for destruction for the following reasons: 1) This methodology is not a regulation. The decision to destroy halon, if eligible under this methodology, would be voluntary. As has been the case for CFC refrigerants, any destruction of halons recovered from systems, rather than selling the halons for re-use, would be entirely driven by market dynamics. While it is possible that prices for used and reclaimed/recylced halons would increase, it is also highly likely that there would be an increase in any needed certifications/standards and market penetration for halon alternatives across multiple applications. 2) Under the methodology, destruction of any stockpiled halon would not be eligible. Only destruction of halon recovered from systems would be eligible for crediting. 3) We have not seen the projections referred to and would be interested in seeing the modeling assumptions. If these	In the November 2015 analysis, the total amount of halon 1301 assumed to be available to meet demands would come from the remaining bank of halon 1301 in commercial aviation stockpiles (1%), computer facilities (91%), and maritime uses (8%). The model does not assume a continuing need for halons in new, non-aviation applications as there are viable halon alternatives currently available for these applications. However, the model projects that halon 1301 will be required for maintenance of older, currently installed, non-aviation systems (i.e., North Slope, military, and nuclear facilities). The military stockpiles and installed base, the installed base for the North Slope, and the installed base for nuclear facilities are assumed not to be available to meet aviation needs. Furthermore, the amount of halon currently installed in aviation applications is accounted for in the worldwide supply, but is also assumed not to be available for future aviation needs. The analysis assumes that there continues to be a need for halon	Halon 1301 stockpiles are not eligible for destruction credits under the Methodology. Any destruction of halon 1301 from decommissioned systems would be a voluntary action. The experience related to destruction of CFC refrigerants over the past 7 years since the original ODS destruction protocols were approved indicates that market dynamics ensure that demand for servicing older systems will be met, while allowing motivated parties to offset part of the costs of new systems with "carbon revenue". We expect the same dynamics to apply to halon 1301 – any potential revenue from carbon credits will not override demand either in the near term, or over the next 4 decades if demand persists as assumed in the cited analysis.

1st Peer Review	Author Response	2nd Peer Review	Author Response
	analyses are similar to those used in the HTOC assessments to forecast continuing needs in the aviation sector, we would expect that , halons that are in use in all non-aviation commercial systems (e.g., data centers, archives) have not been part of the modeling and therefore would not impact the forecast. Further, if the model is assuming that there will continuing need for halons in non-aviation applications as indicated by the commenter, this would likely over-estimate projected needs into the future as there are viable halon alternatives today. 4) Per the 2014 Assessment Report of the UNEP Montreal Protocol Halons Technical Options Committee (HTOC): a. Halons are still required in the maintenance of many older installations designed for halons, i.e., retrofits with halon alternatives are not possible. b. For nearly all new applications, halon alternatives are available. The primary exception is	1301 for various critical fire suppression uses, specifically in civil aviation. In order to estimate the current and projected civil aviation fleet worldwide, including mainline aircraft, regional aircraft, business jets, and turboprops, fleet estimates from Airbus, Boeing, Bombardier, and Flight International market reports were used. The number of installed halon modules per aircraft and sequentially the installed base of halon across the entire commercial aviation fleet was estimated using activity data and manufacturer feedback for engine nacelles, cargo compartments, APUs, and lavex systems. The installed base of halon was projected out to 2050. Quantities of halons (i.e., 1301 and 1211) recovered from non-aviation systems at end-of-life were accounted for in the analysis and they are assumed to contribute entirely to the necessary supply scenarios for civil aviation. Therefore, any incentives to destroy these quantities could reduce the amount of halon necessary for meeting civil aviation demand. However, we agree that	

1st Peer Review	Author Response	2nd Peer Review	Author Response
	engine fire protection in civil aviation. c. Halon alternatives have been successfully used in all new military applications developed since the early 1990s, including engine fire protection. d. HFC-125 is a viable alternative that the commercial aviation industry has chosen not to pursue; in 2012, the industry formed a consortium to create a strategy to develop halon alternatives. e. The EU has established cut-off dates for critical halon uses in new equipment/facility design, including new commercial aviation. As of 2010 - 2011, halons systems were no longer permitted in most applications. For new aircraft (including commercial planes), halon systems were prohibited for engine and auxiliary power units as of 2014, and will be	the selling of halons recovered from currently installed systems for re-use or destruction would be driven by market dynamics. It is also the case however, that incentives to destroy halon 1301 may compromise having the appropriate amount of materials available for reclaim and reuse. It would be a perverse outcome, if new production of halon 1301 would be required under a critical use exemption if viable materials had been previously destroyed. Halon 1211 should be eligible for the protocol, but halon 1301 stocks should only be eligible if they cannot be properly reclaimed to purity standards for resale (i.e., ASTM D5632 Standard Specification for Halon 1301, or ISO 7201 specifications).	

1st Peer Review	Author Response	2nd Peer Review	Author Response
	prohibited for protection of cargo compartments beginning in 2018. For existing, "legacy" systems, the EU regs allow continued use of halons, with end-dates ranging from 2016-2020 (e.g., existing halon-based portable extinguishers and fixed systems on commercial cargo ships) to 2035 to 2040 (e.g., for existing halon-based systems on serveral aircraft and military applications. All of the above indicates that 1) current estimates of the quantities of halon stockpiles that will be needed to maintain existing systems are likely to be upper bound estimates that assume business as usual and do not account for transitions that will be occurring across the industry; and 2) that any discreet quantities of halons that may be recovered from specific systems at end-of-life and subsequently destroyed have likely not been accounted for in the forecasts mentioned above and		

1st Peer Review	Author Response	2nd Peer Review	Author Response
	therefore would likely not alter a reliable supply scenario for civil aviation . The use of a carbon market incentive may, however, help to promote an increase in the pace of innovation where it has been lagging.		

3. Eligibility

1st Peer Review	Author Response	2nd Peer Review	Author Response

4. Offset Project Boundary - Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response
Table 4.1, extra CO_2 row duplicated at bottom of page 16	The referenced line for CO2 is necessary as it is relevant to fossil fuel emissions (beginning further on in the column).		
Table 4.2, extra CO_2 row duplicated at bottom of page 18	Same issue as above.		
Page 17, 4(d): This section is missing the relevance of the unshaded boxes in Figure 4.2: "SSRs in unshaded boxes are relevant only to baseline emissions."	Figure 4.2 corrected.	Missing "to" in sentence: SSRs in unshaded boxes are relevant only to baseline emissions.	Comment addressed.
Page 19, Table 4.2: SSR8 should read "High-GWP Insulation Foam Recovery and Collection"	Table 4.2 corrected.	No additional comments.	

1st Peer Review	Author Response	2nd Peer Review	Author Response
Page 19, Table 4.2: Footnote for SSR9 is not clear. The wording is misleading and can be interpreted in several ways. The implication for project boundary is not defined, nor is the emission level for the baseline compared to either recovery scenario.	This was meant to refer to quantification of project emissions for projects involving intact foam. Shredding emissions are not quantified, therefore are not included, in the quantification of project emissions for intact foam projects. The footnote is revised as follows: *SSR9 is only relevant to projects that extract high-GWP blowing agent. For projects that destroy high-GWP blowing agent from intact foam, quantification of project emissions from shredding is not required.*	This footnote is still not clear. Is the footnote meant to distinguish between projects where foam is removed manually (where fugitive emissions occur) versus using fully automated closed loop technology (where fugitive emissions are captured)? If so, we recommend revising the language in the footnote for clarity and to use similar terminology to differentiate between the foam removal processes (i.e., automatic that removes intact foam in an *enclosed* system versus manual that removes foam in a *non-enclosed* system). Suggested revision: SSR 9 is only relevant to projects that manually remove foam in a non-enclosed equipment de-manufacturing system for extraction of high-GWP blowing agent. For projects that destroy high-GWP blowing agent from intact foam in an enclosed equipment de-manufacturing system, quantification of project emissions from foam removal is not required. Regarding the sentence, "For projects that destroy high-GWP blowing agent from intact foam, quantification of	We have revised the footnote as suggested. This was meant to convey that only projects that remove foam in an enclosed equipment de-manufacturing system do not have to account for removal emissions. The revised footnote provides this clarity. Projects that destroy high-GWP blowing agent from intact foam do indeed require quantification of project emissions. Intact foam definition added.

1st Peer Review	Author Response	2nd Peer Review	Author Response
		project emissions from foam removal is not required," emissions can still occur from foam removal in this scenario (unless the removal is conducted in a closed loop system with emissions capture). Why are quantification of emissions in this scenario not required? Further, we suggest including a definition in the protocol for projects involving "intact foam" to specify what is meant by intact. The level of intactness could be subject to various interpretations.	

5. Quantifying GHG Emission Reductions - Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response
Equation numbers are out of order after 5.8. Need to go back to following the order. Check the references to these equation numbers in the ensuing sections.	Equation numbers have been fixed along with references to equation numbers.		

6. Monitoring

1st Peer Review	Author Response	2nd Peer Review	Author Response
Page 30, sentence (g)(7), I think you meant "AHRI-*certified*" lab, not just "AHRI lab".	Thank you. Edit made.		
In Table 6.1, verify/check the equation numbers against the corrected equation numbers in Section 5.	Table 6.1 corrected.		

7. Verification Requirements

1st Peer Review	Author Response	2nd Peer Review	Author Response

Appendix A: Emission Factor Tables - Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response

Appendix B: High-GWP Mass and Composition from Intact High-GWP Foam Projects – Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response
(b)(4)(C) Are the results from the ASTM and Scheutz method comparable? Is it possible to direct users to one of the methods based on some criteria?	The methods cited in this section come from the CARB 2014 ODS Destruction Protocol and we have remained consistent with the CARB approach. More analysis would be needed to understand whether one		

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	approach would be more appropriate based on certain characteristics. To date, there have been no foam destruction projects conducted and there is no empirical evidence available upon which to base a recommendation or requirement. This would be a good addition moving forward as more experience is hopefully gained with foam destruction projects.		

Appendix C: Mass and Composition from Refrigerant, Medical Aerosol, Fire Suppressant and Extracted High-GWP Blowing Agent Projects – Quantification Methodology

1st Peer Review	Author Response	2nd Peer Review	Author Response
Verify/check the equation numbers against the corrected equation numbers in Section 5.	Equation numbers have been corrected.		

Appendix D: Discussion and Rationale for Updates to CARB ODS Protocol

1st Peer Review	Author Response	2nd Peer Review	Author Response
Good use of newer data to update foam GHG emissions assumptions by using the RUK Ingenieugruppe study. Have the authors had a chance to review ARB research project 11-308	Yes, we are familiar with the study and have reviewed it. While CFC-11 emissions are lower than CH_4, we do not agree that CFC-11 emissions should be interpreted as "not	The revisions to the foam emissions methodology are well-explained and reasonable, based on an excellent analysis of available data and assumptions concerning CFC-11	

1st Peer Review	Author Response	2nd Peer Review	Author Response
"Emissions of potent greenhouse gases from appliance and building waste in landfills" (May 31, 2016), by Dr. Nazli Yesiller and Dr. James L Hanson of the Global Waste Research Institute of the California Polytechnic State University at San Luis Obispo? Although not entirely conclusive, the study indicates that CFC-11 emissions from waste foam in landfills is not significant. Link to study at: http://www.arb.ca.gov/research/research.htm (search for contract "11-308" or keyword "landfill").	significant". Additionally, if analyzing based solely on CFC-11 emissions, prior to conversion to CO_2 equivalent emissions, total emissions appear relatively small but on a CO_2 equivalent basis, CFC-11 emissions are significant.	emissions from insulating foam sources. Good additions to the eligible high-GWP foam sources, I concur with all the sectors added. Excellent work, no further comments.	
In Table E-6, I am unclear on the assumptions or data used to indicate the column titled "Sub Used to Replace One lb R-22 (lbs)". I am not clear what this number represents – perhaps an example calculation could be included?	This refers to the substitute refrigerant volume (the substitute based on the refrigerant in the 2nd column of the table) that generate the aggregate emissions from the replacement of 1 pound of HCFC-22. Similar to CFC refrigerants and the other eligible ODS in this methodology, HCFC-22 substitutes also have global warming potentials which must be taken into consideration as a project emission source.		
Pages 60-63: Suggest either using "CFC-11" instead of "R-11" for consistency to the rest of the methodology or define the use of the refrigerant (R) designation.	Revised reference to R-11 on cited pages.		

1st Peer Review	Author Response	2nd Peer Review	Author Response
Page 62, Table E.2: The approach of using the mid-point of the range of degradation rates from various climate zones (66%) as the estimate for the average U.S. landfill is not recommended. Peer reviewer suggests either using a study that is more regionally focused for the United States or aligning each region/climate zone with those in the United States. For example, the dry temperate climate zone is similar to the desert climate of the Southwest United States and wet temperate climate of Europe is similar to the Mid-Atlantic United States. Peer reviewer also suggests conducting a sensitivity analysis on how these chosen degradation rate values will effect calculated emission reductions because of the large potential range.	We believe that the information presented in the table is fairly representative of the range of climates in the U.S. and we are not aware of any study that is more regionally focused for the U.S. It is not possible to align regionally as the implication would be that it would be necessary to track each foam source in a project to determine where it would have been disposed. This is not possible in practice.	We still think it is possible to align CFC-11 landfill degradation rates for each region/climate zone presented in Table D.2 with those in the United States. To ensure this alignment can be done properly, the project boundaries should be defined and that can be determined based on the point of origin for the foam, which would already be documented per Chapter 6. A refrigerator, for example, would typically be landfilled in the same region/climate zone from which it originated.	The methodology has been revised to include a different approach to determine emission rates. A recent study for CARB is now utilized to provide baseline blowing agent emission rates. Please see Appendix D section I for revised discussion.
Page 64: Change "Goodwin et al." to "Godwin et al."	Revision made.		
Page 68, Table E.5: Peer reviewer can provide a more detailed review of the data presented in this table upon request.			
Page 73: EPA's SNAP program has not proposed to phase out the use of HFC fire suppressants. The current proposed rulemaking proposes to list *perfluorocarbons (PFCs)* as unacceptable for use in total flooding applications, not HFCs. Please see the	The last sentence of section III.E. has been modified to : Market share of PFC-based fire suppressants are adjusted downward to account for proposed restrictions under the U.S. EPA SNAP program. It	In April 2016, EPA proposed and requested comments on listing certain PFCs as unacceptable in fire suppression total flooding uses. However, EPA did not finalize that change in the final rulemaking published in December 2016. Suggest	The discussion in Appendix D.IV.E does note that the SNAP action to de-list PFC fire suppressants is a proposal. Whether the SNAP action becomes final, we expect that the industry has already migrated out of PFC agents given

1st Peer Review	Author Response	2nd Peer Review	Author Response
proposed rule for more information: https://www.epa.gov/snap/snap-regulations#pane-21.	is possible that the SNAP program will also restrict the use of high-GWP HFC fire suppressants, similar to actions taken in other sectors. This Methodology will be revised to conform to future SNAP regulations that are relevant to the quantification of substitute emissions. Similarly, market share of HCFC-based fire suppressants will be adjusted to account for the ongoing HCFC phaseout in the United States.	readjusting PFC market share and revising entire italicized text shown in the Author Response column to: *This Methodology will be revised to conform to future SNAP regulations that are relevant to the quantification of substitute emissions. Similarly, market share of HCFC-based fire suppressants will be adjusted to account for the ongoing HCFC phaseout in the United States.*	the regulatory direction. Also, suggested wording re SNAP adjustments is already in the document (Appendix D.IV.E).
Pages 74-77: Text in Tables E.9, E.10, and E.12 is overlapping and difficult to read. Table E.11 is missing.	Tables have been revised and renumbered. Table E.11 was a typo.		
		Pg. 68, Section 4: This Methodology applies a default value of 10% for Equation 5.9 (page 27) from reference ICF (2011) to calculate Rem_f, i.e., the total GHG emissions from removal of high GWP foam from appliances in a non-enclosed equipment de-manufacturing system. ICF (2011) states, "It is assumed that approximately 15% of the blowing agent remaining at time of disposal is emitted during manual foam recovery. This assumption is based on	JACO is out of business. The company replacing JACO in the US market is using enclosed advanced appliance recycling systems which will mitigate foam removal emissions. The Yesiller et al. (2016) literature review derived a BA emission rate from foam removal of approx. 4%. The revised document reflects this more current information and retains a conservative 10% default value as both new systems and the extensive

1st Peer Review	Author Response	2nd Peer Review	Author Response
		conversations held with the Appliance Recycling Centers of America, Inc. (ARCA) and JACO Environmental, Inc. (JACO), whose estimates ranged from 5-25%, as well as UNEP (2005), which reports that emissions from manual foam removal can range from 10-15% but could be lower if best practices are used. For automated foam recovery, blowing agent losses are estimated at only 5% (UNEP 2005)." Please provide a rationale for choosing the less conservative 10% value from UNEP (2005) rather than 15% from ICF (2011). Is there a mechanism in the methodology to apply a lower Rem_f value if best practices are used?	literature review from Yesiller et al provide significantly lower rates than 15%. 10% is conservative based on the most recent data available.
		Page 74: Table numbers are out of order in Appendix D. Sentence says "*Table E.12* provides the calculations of emissions of the CFC substitutes associated with destruction of CFC medical aerosols." Shown as *Table D.12* in the actual table. Should actually be *Table D.7.*	Comment addressed.
		Pg. 74, Table D.12: Remove/fix reference to R-22.	Comment addressed.
Foam Baseline Emission Rates: The revision made by moving away from	-1) The emission rates presented in Table E.3 have been quantified in the	Please refer to the RUK study in Table D2. This will make the level of	This section of the methodology has been completely revised to

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the Scheutz study is an improvement in the methodology in the correct direction. The comments that I have are grouped under three categories. 1) The emission rates provided in Table E.3 are very precise for how little data these values are based on as well as the fact that the data used were obtained entirely outside of the U.S. Emission rates ending in "5" and "0" should be considered. I am not sure if the reliability of data in Table E.3 is even +/- 10%. 2) The data in Table E.2 (the numbers in this table also are very precise for the analysis that they are based on) is a better approach than what is provided in Scheutz for landfill decomposition rates. However, the only relevant data is what is provided in the first data row (Europe: Central, without biological pre-treatment). I agree with the text that the climatic zones are reasonably applicable for the U.S. However, none of the other categories indicate "without biological treatment". This is somewhat surprising since the only place that uses biological (and mechanical) treatment is Northern Europe. Also, the waste composition in Asia and Africa are expected to be highly different than Europe and	same manner as the emission rates in the current CARB ODS Destruction Protocol but are now based on the corrected formula presented in the methodology using the new data presented in the methodology. For purposes of consistency with the previous versions of the methodology, the precise emission rates are preferable. 2) The data point for Central Europe from the RUK (2012) paper was highlighted as "without biological treatment" to distinguish other locations in Central Europe that do have biological treatment. As the commenter notes, biological treatment is common throughout Northern Europe. A footnote was added to table D.2 to clarify that all of the locations other than Northern Europe are without biological treatment. -On the second point, in the context of carbon offset quantification it would not be conservative to use a higher value than the midpoint of the range presented in the table. Using	precision more acceptable in Table D2. For data in Table D2, please note that the waste composition used in Europe is the only waste composition that applies to the U.S. The data in the RUK report for the other locations include significantly different waste compositions than the typical waste composition applicable to the U.S. Another note for the RUK data is that the values provided in Table D2 are based on modeling in which the analysis assumed that there was no gas collection at the disposal facilities. This assumption does not apply to the U.S., where modern landfills are required to have gas collection and removal systems. It would be good to include these issues as perhaps footnotes to the table. I understand that due to the lack of data related to fate of BAs in landfills, the limited (and not entirely applicable to the U.S.) data needs to be used in the methodology. I think it would be good to include these limitations for informational purposes in the document.	incorporate emission rates derived from: Yesiller, N., Hanson, J.L., Bogner, J.E. (2016) *Emissions of Potent Greenhouse Gases from Appliance and Building Waste in Landfills*, Draft Final Report, for the California Air Resources Board and the California Environmental Protection Agency, January 9, 2016. As such, the quantification utilized previously and based in part on the analysis found in the RUK study is now no longer incorporated into the quantified foam baseline emission rates. A brief discussion of the RUK study is still included in Appendix D for informational purposes only.

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Northern America. In summary, I think using a higher value than the mid-point of the range in Table E.2 should be considered. This would provide a conservative estimate. 3) To further support use of a higher emission rate than the 66%, peer reviewer conducted an extensive field landfill emissions study at a California landfill. Peer reviewer obtained measurable emissions of CFC-11, HCFC-141b, HFC-134a and HFC-245fa, with rather high values in some cases. These gases are considered trace components and we were expecting very low or below detection limit measurements, which typically were not the case. There is not sufficient amount of information regarding the fate of the F-gases in a landfill environment, in particular for the U.S., at this time.	the midpoint of the range will result in a reduced emission rate which leads to fewer carbon offset credits which is a more conservative assumption in this context. 3) New data will be reviewed and incorporated as appropriate when it becomes available. At this time, it appears that the information from the California study supports the current emission rate estimates in the methodology.		

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Using data for California, peer reviewer conducted an extensive materials flow analysis for the 4 gases listed above (CFC-11, HCFC-141b, HFC-134a and HFC-245fa) in a research investigation. The MFA included the pathways starting at the time of discard of the foam through disposal at a landfill. Reviewer determined that: 1) For C&D applications: 92-94% of the BA in the discarded foam was disposed at the landfill. 2) For domestic appliance applications: 31-34% of the BA in the discarded foam	Thank you for the additional data. It would be very helpful to understand whether the reviewer also has obtained estimates on the percentage of blowing agent released from the landfilled foams that were analyzed. This information could be useful in updating Table E.1 in the future.	The information from the MFA would be useful in assigning relative weight to the release pathways (shredding, compaction, and landfilling/landfill emissions) of BAs from the different applications. Currently, there is 24% assigned to shredding (on/off depending on appliance/building foam) and 19% assigned to compaction. These values could be refined for the five different applications.	Data from the MFA discussed in the below study are now incorporated into the methodology to determine foam baseline emission rates: Yesiller, N., Hanson, J.L., Bogner, J.E. (2016) *Emissions of Potent Greenhouse Gases from Appliance and Building Waste in Landfills*, Draft Final Report, for the California Air Resources Board and the California

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was disposed at the landfill, with 0% CFC-11 for a 1995-2050 scenario. 3) For commercial appliance applications: 70-72% of the BA in the discarded foam was disposed at the landfill, with 0% CFC-11 for a 1995-2050 scenario and 0% HFC-134a for both 1960-2010 and 1995-2050 scenarios. 4) For TRU applications: 54-64% of the BA in the discarded foam was disposed at the landfill, with 0% HFC-134a for both 1960-2010 and 1995-2050 scenarios. 5) For marine and other applications: 85-86% of the BA in the discarded foam was disposed at the landfill, with 0% HFC-134a for both 1960-2010 and 1995-2050 scenarios. These values together with relative percentages of the BA types in the different applications may be used in calculation of emission rates. This is something that may be considered in updating the ACR methodology.			Environmental Protection Agency, January 9, 2016. The MFA has been utilized to determine baseline emission rates for all eligible foam sources.
		Table D1: Correct "HHCFC-22" Check all instances of the revised "HCFC-22" for similar issues.	Comment addressed.
		- Please refer to the tables in the text prior to the location that the table appears. This does not apply to the tables in Appendix A. Without specific mention in the text, it is at times	All tables are now referred to in the text prior to the table. Additionally, source information is provided for the information presented in all tables.

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		difficult to discern the relevant table(s). - Please indicate the original source in the tables if data are obtained from previously published papers, reports, etc.	