Summary and Response to Peer Review

A draft of the *Methodology for the Quantification, Monitoring, Reporting, and Verification of Greenhouse Gas Emissions Reductions and Removals from Advanced Refrigeration Systems v3.0* was developed ACR for potential approval.

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 August 2, 2024 – September 1, 2024. The methodology was submitted for scientific peer-review September 9, 2024 – October 21, 2024. Comments and responses to scientific peer-review are documented here.

#	CITATION REFERENCE	REVIEWER COMMENT	AUTHOR RESPONSE	REVIEWER COMMENT (R2)
1	1, Methodology description, second paragraph (p 8)	More accurate to say: "Under the Kigali Amendment to the Montreal Protocol (UNEP, 2016), the phase down of HFC consumption is also underway, with developed countries reducing HFC consumption by 40% by 2024 and **most** developing countries leveling off consumption by 2024 and reducing consumption 10% by 2029." The word 'most' takes into account the group 2 countries,	Agreed and updated.	Closed.

		including India and much of the middle east, which freeze and phase down a bit later.		
2	2, Eligibility, section III, first paragraph. (p 12)	This paragraph says “Some of the SNAP-acceptable low-GWP refrigerants allowed for new and replacement advanced refrigeration systems that are increasingly being used are presented in Table 2.” Is the intention to allow other low-GWP refrigerants that EPA may subsequently add to the SNAP list? If so, please state this explicitly in the paragraph.	Yes, the intention is to allow other low-GWP refrigerants that U.S. EPA adds to the SNAP-acceptable list as long as they meet the Methodology definition. A clarification has been added to Section 2 Eligibility (see text immediately before Table 2).	Closed.
3	2, Eligibility, section III, first paragraph. (p 12)	Please explicitly define low-GWP refrigerant in the main body of the text prior to the Eligibility Criteria section, ideally up front at the very start. The term “low-GWP refrigerant” is referred to often, but isn’t explicitly defined in the text until page 15, except for an allusion to GWP<15 in footnote 2 on page 9. Low GWP is further defined in the definitions at the end of the document as both GWP<15 for new, additional and complete	The authors agree that defining “low-GWP refrigerant” (now replaced with the terms “ultra-low-GWP refrigerant” and “lower-GWP refrigerant”) early in the main body of the text is helpful. These new definitions have been added to Section 1 Methodology Description. Definitions for “ultra-low-GWP refrigerant” (GWP<15; for new, additional, and replacement systems) and “lower-GWP	Closed.

		replacement, then as GWP<1300 for retrofits. Consider a new definition of low-GWP for retrofits: as of September 2024, there are at least 3 retrofit options SNAP listed with GWP <650. Intriguingly, "low GWP" has traditionally been defined by regulators and advocates as less than or equal to 150, and **ultra**-low-GWP refrigerants have been defined as a 100-year GWP <10. Please consider using the term "ultra-low GWP refrigerant" throughout the text as GWP <15 is more consistent with the ultra-low GWP term. This distinction between low- and ultra-low matters: for instance, in Colorado, voluntary adoption of "ultra-low GWP" refrigerants defined as GWP <10 could earn more points toward meeting the state's new low carbon and energy building codes under development than "low-GWP refrigerants," defined as those with GWP <150. Additionally, some states and	refrigerant" (GWP<1300; for retrofit systems) have been added and replace "low-GWP refrigerant" throughout the Methodology. Regarding lower-GWP SNAP-acceptable refrigerants for retrofits, the authors only observe two options with a GWP<650 in the SNAP list: R-513A and R-450A. Both refrigerants are, per manufacturer specifications (see hyperlinks in the pervious sentence), designed as replacements for R-134a, which is used in small commercial refrigeration applications. Because the only retrofits eligible under the Methodology are to Large Commercial Refrigeration, restricting the GWP for retrofits to the lower threshold would likely eliminate the incentive provided by carbon credits for any Large Commercial Refrigeration retrofit projects. The GWP limit for retrofit projects has therefore been kept at <1,300. The requirement to use AR5 for ACR methodologies is found in the ACR Standard (see section 1.G Unit of	

		companies and even Federal agencies are aiming for further mandates requiring ultra-low GWP refrigerants with GWP <10. Finally, in the definition, please be sure to specify if you are using 100-year GWPs or 20-year GWPs, and which IPCC report methodology the GWP should be determined with (AR4 as commonly cited in regulations? Or the most recent GWP calculation version by IPCC, WMO? Or just the GWP listed by EPA SNAP?).	Measure): "GHG emission reductions and removals with a vintage year of 2021 or later shall use conversion calculations based on the 100-year Global Warming Potential factors listed in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), Working Group 1, Chapter 8, Table 8.7 for CH4 and N2O and Table 8.SM.16 for HFCs, PFCs, SF6, NF3, and all ODS." ARS 3.0 will only apply to newly listed projects, which must have a start date within the past 2 years, so possible vintage years will be 2022 and beyond.	
4	4.2.2.	The crediting period is too short to properly capture end-of-life for all but the shortest-lived equipment. This could pose a challenge in keeping consistent with your project boundary outlined in figure 1, which is supposed to include equipment disposal. Consider aligning expected equipment lifetimes with applicable crediting period(s).	Section 5.2 Annual Amortized Emissions Rate outlines how disposal emissions are amortized over the equipment lifetime (see especially the second half of paragraph 2). When the annual amortized emission rate is multiplied by the Crediting Period, all lifetime emissions, including disposal emissions, are reflected.	Thank you for the clarification. Closed.

5	Table 6	These rates seem reasonable. For added certainty, ACR may wish to consider comparing these emissions rate estimates with those listed in the California Refrigerant Avoided Cost Calculator, version 2022 or later.	The authors reviewed the refrigerant equipment lifetimes and emission leak rates for the sectors included in the California Public Utilities Commission's 2022 Refrigerant Avoided Cost Calculator (ACC). For large commercial refrigeration—both retail food and cold storage—the amortized annual emission rates calculated from the data in the Refrigerant ACC are 1% higher and 11% lower, respectively, than the rates calculated from U.S. EPA Inventory data for the Methodology. The Refrigerant ACC cold storage emission rate is likely different because it is not strictly commercial refrigeration. The emission rates calculated from Refrigerant ACC-listed data for refrigerated food processing and dispensing are 11% higher than those in the Methodology due to a longer assumed lifetime and higher end-of-life leak rate. See below on data sources to discuss potential differences in input data.	Thank you for the review. I believe your investigation shows similar (enough) leakage rates. I agree with your further clarification too adding a new annual amortized emission rate starting in 2026 for Large Commercial Refrigeration, consistent with new regulations. With these changes we can consider this closed.

			For the other categories, it is difficult to compare the Refrigerant ACC data with U.S. EPA data because the Refrigerant ACC does not categorize end uses the same way that U.S. EPA does: the Refrigerant ACC does not include a remote condensing units category, and the Refrigerant ACC lists stand-alone refrigeration units instead of stand-alone *commercial* refrigeration units. The 2022 ACC supporting materials document lists the California Air Resources Board (CARB) as the source for refrigerant leak data. It does not state where the equipment lifetime data comes from. Presumably, all CARB data would be reported for California equipment through the California Refrigerant Management Program (RMP), but the authors cannot find any relevant data publicly available on the RMP website. Regardless, the authors think it is more representative for the Methodology, which has applicability for the U.S. and	

			beyond, to include data from as wide a reporting area as possible, and with consistent end-use categorization. The U.S. EPA Inventory data used to calculate emission rates for the Methodology meets these requirements.	
6	Section 5.3, Baseline GWP, table 10	It seems to me that there needs to be a further baseline distinctions. Some retrofits/replacements will be required to meet the 150 limit come 2027, but only if MOST of the system is being replaced. Most existing equipment will still be allowed to continue using high-GWP refrigerant, even if significant "repairs" are made. These are precisely the systems ACR should want to incentivize to update, so they don't limp along leaking high-GWP refrigerant. (Rely on the full text of the final rule in the Federal Register, not just the EPA fact sheet, to determine what they rules do and do not apply to.) I urge ACR to look again carefully at the EPA final rules, and consider setting a higher baseline for	The authors strongly agree that retrofits should be included, and note that the peer review version of the Methodology explicitly includes retrofits under Section 2 Eligibility Conditions, project activity I.D. Further, it includes the U.S. EPA rule-specific requirements under the definition of "Retrofit or Retrofit project." Table 10 covers baseline GWPs for "New, Additional, and Replacement" systems only. It does not include retrofit systems. As noted in Section 5 Baseline Determination and Section 7.1 Parameters Monitored, baseline parameters (including quantity of refrigerant, emission rate, and GWP) for retrofit projects must use data on the system being retrofitted and	Thank you for the clarification. Closed.

		projects involving existing systems that are not required to abide by the 150/300 limits, such as systems that: • Are NOT Assembling a system for the first time from used or new components; • Are NOT Increasing the cooling capacity, in BTU per hour, of an existing system, and/ or; • Are NOT replacing 75% or more of evaporators (by number) and 100% of the compressor racks, condensers, and connected evaporator loads of an existing system. If a project meets those criteria, it is quite possible it isn't actually required to meet the 150/300 GWP limit, and therefore should perhaps qualify for a higher baseline when calculating GHG reductions.	the pre-retrofit refrigerant. There is no need for a baseline table for retrofits because it is clear in Section 5 and Section 7.1 that retrofits shall use information on the systems being replaced, not default baseline values.	
7	Section 5.3, Baseline GWP;	As the baseline section is currently written, it seems to me that this	Please see response to comment 6 (above).	Closed.

	see also section 7.1	methodology will (accidentally?) exclude retrofits that reduce retail food refrigeration GHG emissions come 2027, due to the lower assumed baseline(s) in table 10. Was that the intent to exclude retrofits going forward? Further down, in sections 7.1, ACR still states that "Project Proponents that retrofit an existing refrigeration system shall determine the GWP value based on the refrigerant historically used, sourced from regulatory compliance reporting and/or other verifiable operating documentation, and associated GWPs, sourced according to the *ACR Standard*." If that is still the case, it is important to add a qualifier to the baseline #s in table 10. Consider adding that qualifier, or establishing a separate baseline table for retrofits post-2026. Even with the new AIM act rules, retrofits are still defined and regulated differently than replacements / new equipment, and		

		will still present a large opportunity for GHG mitigation.		
8	6.1, Equation 1	See also comment 4. Consider aligning crediting period with equipment lifetime, especially for projects that begin in 2027 or beyond.	Please see response to comment 4.	Closed.