

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

VERSION 2.0

November 2017

# 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

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November 2017

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# ACKNOWLEDGEMENTS

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# ACRONYMS AND DEFINITIONS

If not explicitly defined here, the current definitions in the most recent version of the American Carbon Registry (ACR) Standard apply.

TERM	ACRONYM (if applicable)	DEFINITION
Baseline blowing agent	Baseline BA	The BA that is being transitioned to an Eligible BA through the Project Activity.
Blowing agent	BA	The material used to propel foam mixture for its required use. BAs can also be used as an insulating component of foam. BAs are the main component that make up the GHG emissions associated with foam manufacturing, use and EOL.
Blowing agent blends	BA blends	The use of two or more BAs in the baseline or project.
Blowing agent ratio	BA ratio	The quantity of the Eligible BA that is required to replace the Baseline BA to produce the same quality of foam including equivalent thermal performance. This ratio is applied to the quantity of Eligible BA that is used in the project to calculate the amount of Baseline BA that would have been used.
Carbon dioxide equivalent	CO <sub>2</sub> e	CO <sub>2</sub> e is a metric to compare other GHGs based on their GWP relative to CO <sub>2</sub> over the same timeframe. The IPCC publishes GWP values for converting all GHGs to a CO <sub>2</sub> e basis (see “Global Warming Potential”).
Carbon offset credits	Offsets	A carbon offset is a reduction in emissions of GHG made to compensate for or to offset an emission of GHG made elsewhere (one offset = 1 MT CO <sub>2</sub> e).

TERM	ACRONYM (if applicable)	DEFINITION
Default BA		For foam applications required to transition to a different BA as the result of a regulation, <i>the Default BA will be the BA that the project developer would have used instead of the Eligible BA. In these scenarios, the Default BA becomes the Baseline BA. See sections 4 and 5 for additional information regarding Default BA.</i>
Design specifications	Design specs	Documents such as spec sheets, formulation recipes, etc. showing the amount of BA required to produce the foam material for the project or job.
Eligible blowing agent	Eligible BA	<p>Foam BAs which are eligible to create carbon credits under this Methodology meet the following criteria:</p> <ul style="list-style-type: none"> <li>● Low-GWP (GWP less than 30)</li> <li>● Low-ODP (ODP less than .01)</li> <li>● Is not a hydrofluorocarbon</li> <li>● Is not a hydrocarbon</li> <li>● Is not prevented from use by any regulation</li> </ul>
Eligible foam application		Those applications within the foam manufacturing industry for which the demonstrable adoption rate of an Eligible BA is not considered common practice (Table 1).
End of life	EOL	The emissions associated with the decommissioning recovery and destruction of the foam. Does not include the emissions associated with manufacturing and use of the foam.
Foam manufacturing		The process of combining a BA with additional chemicals to produce foam. The process may be conducted to produce a product either in a manufacturing facility or at a construction location.

TERM	ACRONYM (if applicable)	DEFINITION
Foam use		After the foam is manufactured (e.g., blown with the BA) the material is then “used” (e.g. insulates a refrigerator, a building, etc.). The use of a foam can extend many years after manufacturing and this methodology captures the emissions associated with the use of the product for 10 years after manufacturing.
Formulators		Also known as "Systems Supply Houses". These entities provide the "A" side and the "B" side chemicals which are then blown at a manufacturing site to produce foam products or at a construction site for buildings.
Global warming potential	GWP	Global warming potential is a relative scale translating the global warming impact of any GHG into its CO <sub>2</sub> e over the same timeframe. This methodology references the 100-year GWPs in the IPCC Fourth Assessment Report (AR4) and, if unavailable, the GWPs from the IPCC Fifth Assessment Report (AR5). If neither are available, GWPs cited by the U.S. EPA SNAP Program shall be applied. GWPs found in this Methodology (Tables 3 and 10) shall be applied in the quantification of baseline and project emissions.
Hydrocarbon	HC	An organic compound containing only hydrogen and carbon atoms (e.g. pentane (C <sub>5</sub> H <sub>12</sub> ) and propane (C <sub>3</sub> H <sub>8</sub> )).
Hydrofluorocarbon	HFC	A gaseous compound that contains carbon, fluorine, and hydrogen. Most common HFCs used in foam blowing are <i>HFC-134a</i> , <i>HFC-152a</i> , <i>HFC-365mfc</i> , <i>HFC-245fa</i> and <i>HFC-227ea</i> .

TERM	ACRONYM (if applicable)	DEFINITION
Isocyanate	ISO or "A-side"	Isocyanate is the reactive chemical used in the manufacture of Polyurethane Foams.
Meter readings		The readings from meters used to record the quantity of BA and other materials used in the foam blowing process.
Polyol	"B-side"	Polyol is a blend of various chemicals and blowing agents to produce the foam structure and density.
Polyurethane foam	PUF	Foam created through the mix of polyurethane chemicals and a BA.
Production data		The records maintained (either from historical production data, MSDS sheets, industry standards, etc.) that accurately represent the foam production volume, the quantity of BA used, and any other relevant recordkeeping information for the baseline and project activity.
Project Activity		Transition to an Eligible BA in an Eligible Foam Application for foam manufacturing and use. See Applicability Conditions in Section 1.2.
Retail Food Refrigeration		<p>Stand Alone Equipment and Refrigerated Food Processing and Dispensing Equipment.</p> <p>Stand Alone Equipment (open or with doors) where all refrigeration components and integrated and, for the smallest types, the refrigeration circuit is entirely brazed or welded. These systems are fully charged with refrigerant at the factory and typically require only an electric supply</p> <p>Refrigerated Food Processing and Dispensing Equipment primarily process the product by</p>

TERM	ACRONYM (if applicable)	DEFINITION
		<p>combining ingredients, and mixing/ preparing the ingredients at the proper temperature. Other equipment in this category function mainly as holding tanks to deliver the product at the desired temperature or to deliver chilled ingredients for processing, mixing and preparation. These may use a refrigerant in a heat pump or utilize waste heat from the condenser unit located elsewhere. Equipment within this end-use category include but are not limited to those used to process/store: chilled and frozen beverages (carbonated and uncarbonated, alcoholic and nonalcoholic); frozen custards, gelato, ice cream Italian ice, sorbets and yogurts; milkshakes, smoothies, and whipped cream.</p>
Significant New Alternatives Policy	SNAP	<p>The U.S. Environmental Protection Agency's (EPA) SNAP program implements section 612 of the amended Clean Air Act of 1990, which requires EPA's continuous review of alternatives to find those that pose less overall risk to human health and the environment. Through these evaluations, SNAP generates lists of acceptable and unacceptable substitutes for each of the major industrial use sectors. The intended effect of the SNAP program is to promote a smooth transition to safer alternatives.</p> <p>Version 1.0 of this Methodology references the SNAP rule adopted in July 2015. [See 80 FR 42870 et seq (July 20, 2015)].</p>
Sources, sinks, and reservoirs	SSRs	<p>Sources: Any process that releases carbon into the atmosphere is known as a carbon source.</p> <p>Sinks: A natural or artificial reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period.</p>



TERM	ACRONYM (if applicable)	DEFINITION
		Reservoirs: A pool of carbon that has the potential to accumulate or lose carbon over time. Generally applicable in the land use sector (aboveground biomass, belowground biomass, litter, dead wood, soil organic carbon, and wood products).
Systems supply houses		See "Formulators".
Metric ton	MT	The metric unit of measurement for one carbon offset. 1 MT = 2,204.62 pounds or 1.10 US tons.
Transition dates		The dates under the EPA SNAP rule adopted in July 2015 and December 2016 that transition out previously allowed BAs (see Table 4) were invalidated by the U.S. Court of Appeals for the D.C. Circuit in August 2017.

# CONTENTS

<b>ACKNOWLEDGEMENTS</b>	<b>3</b>
<b>CONTENTS</b>	<b>10</b>
<b>1 BACKGROUND AND APPLICABILITY</b>	<b>13</b>
1.1 PURPOSE	13
1.2 APPLICABILITY CONDITIONS	13
1.3 SREPORTING PERIODS	15
1.4 CREDITING PERIODS	15
1.5 PERIODIC REVIEWS AND REVISIONS	15
<b>2 PROJECT BOUNDARIES</b>	<b>16</b>
<b>3 BASELINE DETERMINATION AND ADDITIONALITY</b>	<b>19</b>
3.1 BASELINE DETERMINATION	19
3.2 ADDITIONALITY ASSESSMENT	22
3.2.1 REGULATORY SURPLUS TEST	22
3.2.2 PRACTICE-BASED PERFORMANCE STANDARD	22
<b>4 QUANTIFICATION OF GHG EMISSION REDUCTIONS</b>	<b>23</b>
4.1 BASELINE EMISSIONS	24
4.1.1 BASELINE EMISSIONS ASSOCIATED WITH THE FOAM MANUFACTURING AND FIRST YEAR OF FOAM USE	24
4.1.2 BASELINE EMISSIONS ASSOCIATED WITH THE REMAINING YEARS OF FOAM USE	24
4.1.3 CALCULATING BASELINE BA BLENDS	25
4.2 PROJECT EMISSIONS	26
4.2.1 PROJECT EMISSIONS ASSOCIATED WITH THE FOAM MANUFACTURING AND FIRST YEAR OF FOAM USE	26
4.2.2 PROJECT EMISSIONS ASSOCIATED WITH THE REMAINING YEARS OF FOAM USE	26
4.2.3 CALCULATING PROJECT BA BLENDS	26
4.3 LEAKAGE	27
4.3.1 MARKET-SHIFTING LEAKAGE EMISSIONS	27
4.3.2 ACTIVITY-SHIFTING LEAKAGE EMISSIONS	27

4.4 EMISSION REDUCTIONS .....	28
<b>5 MONITORING AND DATA COLLECTION .....</b>	<b>30</b>
5.1 DESCRIPTION OF THE MONITORING PLAN .....	30
5.2 DATA COLLECTION AND PARAMETERS TO BE MONITORED .....	31
5.2.1 PARAMETERS MONITORED .....	33
<b>APPENDIX A: DEVELOPMENT OF PERFORMANCE STANDARD .....</b>	<b>35</b>
<b>APPENDIX B: ELIGIBLE BA GWP .....</b>	<b>39</b>
<b>APPENDIX C: REFERENCES AND OTHER INFORMATION .....</b>	<b>40</b>

## FIGURES

Figure 1: Illustration of the Project Boundary.....	16
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## TABLES

Table 1: Eligible Foam Applications .....	14
Table 2: List of Identified SSRs .....	17
Table 3: GWP of Common Baseline BAs .....	19
Table 4: EPA SNAP Rule Change of Status as of July 2015 .....	20
Table 5: Emission Factors for HFC-134a and HFC-152a .....	23
Table 6: Emission Factors for HFC-245fa and HFC-365mfc.....	24
Table 7: Eligible Foam Applications .....	35
Table 8 Market Penetration Rate of Eligible BAs.....	37
Table 9: Market Penetration Rate including HC BAs .....	38
Table 10: GWPs for selected Eligible BAs.....	39

## EQUATIONS

Equation 1.....	25
Equation 2.....	26
Equation 3.....	27
Equation 4.....	28
Equation 5.....	29

# 1 BACKGROUND AND APPLICABILITY

## 1.1 PURPOSE

Certain industries use blowing agents (BAs) in the production of foam. These BAs contain chemicals that contribute to global warming by releasing greenhouse gases (GHGs) during manufacture, use, and end-of-life (EOL). Over the years, industry has begun a transition away from BAs that have high global warming potential (GWP) and high ozone depleting potential (ODP) toward BAs with lower GWP and low or zero ODP. However, certain foam applications have low market adoption rates for low GWP BA and that is generally a result of technical and financial barriers limiting use of low GWP options in these applications. This Methodology is meant to stimulate innovation and accelerate a transition to low GWP BAs in certain foam applications more rapidly than would otherwise occur. The Methodology is based on a robust data set from the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM) methodology AMS-III.N (Avoidance of HFC Emissions in Rigid Polyurethane Foam Manufacturing).

## 1.2 APPLICABILITY CONDITIONS

A transition to the use of an Eligible BA for the production of foam is considered a “Project Activity” under this Methodology.

In addition to satisfying the latest ACR program eligibility requirements as found in the ACR Standard, projects must satisfy the following conditions:

- The project is located in North America.
- The project is within an Eligible Foam Application (See Table 1).
- Other than for projects which use a Default BA, records of the Baseline BA used in the project must show a minimum of 2 years of usage of a BA with a GWP >30 prior to the Project Activity.

**Table 1: Eligible Foam Applications<sup>1</sup>**

FOAM APPLICATION	DESCRIPTION
<b>XPS boardstock</b>	XPS boardstock, block, and billet that is used for insulation in the following applications: roofing, walls, flooring, and pipes. Does not include XPS sheet foam applications.
<b>Two-component rigid PU spray foam</b>	Spray foam is a two-part polyurethane application that when combined forms a solid foam insulation; involves a gun, nozzle or straw and forms foam as the ingredient chemicals are blended together.
<b>Rigid PU injected foam</b>	<p>A manufacturing process for producing component parts by injecting two or more liquid streams into a mold or part. Materials are fed into a mix-head, mixed, and forced into the mold cavity where they react, foam, cool and harden to the configuration of the cavity. Only Rigid PU injected foam used in the following sub-applications are eligible:</p> <ul style="list-style-type: none"> <li>• Marine flotation or buoyancy</li> <li>• Heating, Ventilation, Air Conditioning and Air Handling Systems</li> <li>• Refrigerated Transport – Foam used in refrigerated logistics services such as refrigerated cargo boxes and coolers</li> <li>• Industrial Refrigeration Systems – Large, “engineered” systems used in supermarkets, industrial process refrigeration, cold storage, and walk-in freezers applications that employ cold storage panel insulation.</li> <li>• Retail Food Refrigeration other than Industrial Refrigeration Systems</li> <li>• Garage and entry doors</li> </ul>
<b>Rigid PUF residential refrigerators and freezers</b>	Appliances used to preserve food and beverages in residential applications.

<sup>1</sup> See Appendix A and Tables 8 and 9 for market penetration analysis for Eligible Foam Applications.

## 1.3 REPORTING PERIODS

Projects shall have one reporting period which must not exceed 12 months in length. Baseline and project emissions shall be quantified (per Section 4) using the total volume of BA that would have been used in the absence of the Project Activity over a maximum of 12 months (baseline emissions) and the total volume of Eligible BA that was used during the project (project emissions) over the same corresponding time period.

## 1.4 CREDITING PERIODS

The crediting period shall be ten years. The Methodology's quantification approach is based upon the UNFCCC small system method which includes the manufacturing and use of the foam product. The Methodology excludes any calculation of EOL emissions. EOL emissions may be considered in future versions of this Methodology.

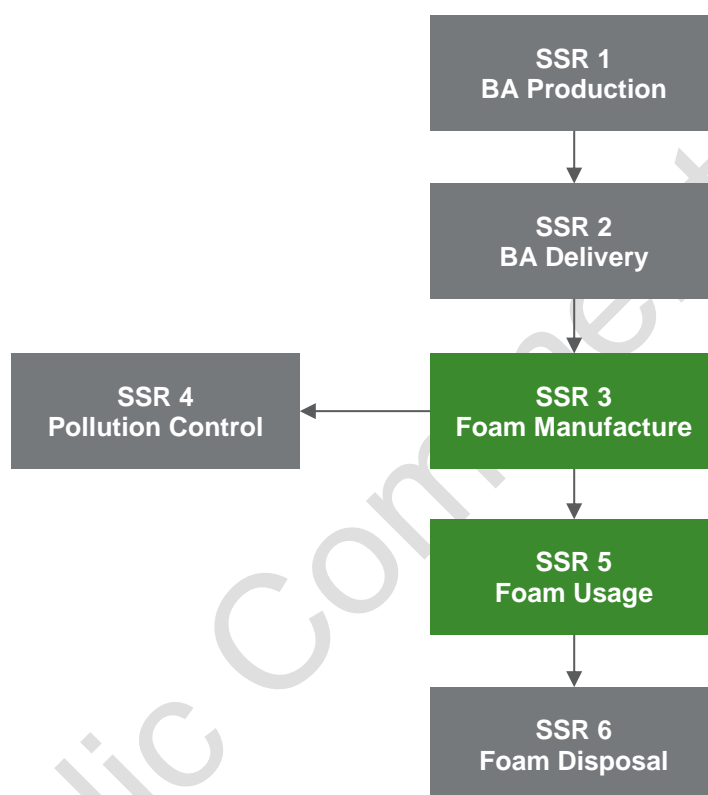
## 1.5 PERIODIC REVIEWS AND REVISIONS

ACR may require revisions to this Methodology to ensure that monitoring, reporting, and verification systems adequately reflect changes to project activities. This Methodology may also be periodically updated to reflect regulatory changes, emission factor revisions, or expanded applicability criteria. Before beginning a project, the project proponent should ensure that they are using the latest version of the Methodology.

## 2 PROJECT BOUNDARIES

The project boundary delineates the sources, sinks, and reservoirs (SSRs) that must be included or excluded when quantifying the net changes in emissions associated with the transition to an Eligible BA. Figure 1 illustrates the GHG assessment boundary for a project.

**Figure 1: Illustration of the Project Boundary**



All SSRs in green are included and must be accounted for under this Methodology. SSRs in gray are not included under this Methodology.



**Table 2: List of Identified SSRs**

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EX-CLUDED (E)	QUANTIFI-CATION METHOD
1. BA Production	Fossil fuel emissions from the production of the BA.	CO <sub>2</sub>	E	N/A
		CH <sub>4</sub>	E	N/A
		N <sub>2</sub> O	E	N/A
	Emissions from the production of the BA.	HFC or Low GWP BA	E	N/A
2. BA Delivery	Emissions from the delivery of the BA to the project site.	HFC or Low GWP BA	E	N/A
		CO <sub>2</sub>	E	N/A
	Fossil fuel emissions from the delivery of the BA to the project site.	CH <sub>4</sub>	E	N/A
		N <sub>2</sub> O	E	N/A
3. Foam Manufacture	Emissions from the manufacture of the foam using a BA in the baseline and project.	HFC or Low GWP BA	I	Equations 1, 2 & 3
4. Pollution Control	Fossil fuel emissions from air pollution control equipment used in the baseline and project.	CO <sub>2</sub>	E	N/A
		CH <sub>4</sub>	E	N/A
		N <sub>2</sub> O	E	N/A
5. Foam Usage	Emissions from the use of the foam in the baseline and project.	HFC or Low GWP BA	I	Equations 1, 2 & 3

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)	QUANTIFICATION METHOD
6. Foam Disposal	Fossil fuel emissions from the transport of the foam to EOL.	CO <sub>2</sub>	E	N/A
		CH <sub>4</sub>	E	N/A
		N <sub>2</sub> O	E	N/A
	Emissions from the equipment used to destroy the foam at EOL	CO <sub>2</sub>	E	N/A
		CH <sub>4</sub>	E	N/A
		N <sub>2</sub> O	E	N/A
	Emissions from the foam at EOL (e.g. landfill, shredding, incineration, etc.)	HFC or Low GWP BA	E	N/A

## 3 BASELINE DETERMINATION AND ADDITIONALITY

### 3.1 BASELINE DETERMINATION

The baseline for a project is calculated using: (1) the GWP of the Baseline BA, (2) data associated with the quantity of Eligible BA used in the project<sup>2</sup>, and (3) the emission factor associated with the Eligible Foam Application.

As a reference, Table 3 lists some of the most common BAs currently used in North America.

**Table 3: GWP of Common Baseline BAs<sup>3</sup>**

BA	GWP <sup>4</sup>
HFC-152a	125
HFC-365mfc	794
HFC-245fa	1030
HFC-134a	1430

<sup>2</sup> This data is used to calculate the amount of Baseline BA that would have been used to produce a foam of equivalent thermal performance that is produced with the Eligible BA.

<sup>3</sup> This is not an exhaustive list but rather a guidance table for project proponents.

<sup>4</sup> IPCC, Fourth Assessment Report (100- year GWP time horizon).

In August 2017 the U.S. Court of Appeals for the D.C. Circuit ruled to invalidate the July 2015 SNAP rule change [80 Federal Register at 42923, 40 CFR 82, Subpart G, Appendix U] which placed regulatory transition dates on the use of HFCs in foam manufacturing and use. As a result, the transition dates in Table 4 from version 1.0 of this methodology have been removed and there is no longer a regulatory requirement to transition from the use of HFCs in foam manufacturing and use.

Even though the Appeals Court ruling did not specifically address the December 2016 SNAP transition dates, the ruling addressed the EPA's inability to regulate HFCs and specifically to require companies to transition away. Thus, it is likely that the December 2016 SNAP transition dates will also no longer be valid.

**Table 4: EPA SNAP Rule Change of Status as of August 2017**

FOAM APPLICATION	BAS BEING TRANSITIONED OUT OF SNAP PROGRAM	SNAP TRANSITION DATE
Rigid PUF residential refrigerators and freezers and Rigid PUF injected foam (all eligible sub-applications) as specified in SNAP Table 6, [80 Fed Reg at 42923] 40 CFR 82, Subpart G, Appendix U	HFC-134a HFC-245fa HFC-365mfc (and blends, where applicable) Formacel TI Formacel Z-6	July 2015 SNAP transition dates no longer valid.
XPS boardstock	HFC-134a HFC-245fa HFC-365mfc (and blends, where applicable) Formacel TI Formacel B Formacel Z-6	July 2015 SNAP transition dates no longer valid.
Two-component rigid PU Spray foam	Certain blends of HFC-365mfc, HFC-245fa, & HFC-227 (see regulation for details) Formacel T1 HFC-134a HFC-245fa	December 2016 SNAP transition dates: <b>High-pressure two-component spray foam:</b> Unacceptable for all uses as of January 1, 2020 and January 1, 2025 for military or

FOAM APPLICATION	BAS BEING TRANSITIONED OUT OF SNAP PROGRAM	SNAP TRANSITION DATE
		<p>space- and aeronautics-related applications.</p> <p><b>Low-pressure two component spray foam:</b> Unacceptable for all uses as of January 1, 2021 and January 1, 2025 for military or space- and aeronautics-related applications.</p>

## 3.2 ADDITIONALITY ASSESSMENT

Emission reductions from the project must be additional, or deemed not to occur in the “business-as-usual” scenario. Assessment of the additionality of a project will be made based on passing the two tests cited below. These two tests require the project proponent to demonstrate that the project is surplus to regulations and reduces emissions below the level established in the Methodology.

- Regulatory Surplus Test, and
- Practice-Based Performance Standard

### 3.2.1 Regulatory Surplus Test

In order to pass the regulatory surplus test a project must not be mandated by existing laws, regulations, statutes, legal rulings, or other regulatory frameworks in effect as of the start date that directly or indirectly affect the credited offsets. The project proponent must demonstrate that there is no existing regulation that mandates the project or effectively requires the GHG emission reductions associated with the transition to an Eligible BA.

### 3.2.2 Practice-Based Performance Standard

For a project to qualify for offsets under this Methodology it must also be demonstrated that the Eligible Foam Application has a low market adoption rate for Eligible BAs. This Methodology has already completed a market adoption analysis, and hence an additionality demonstration for the foam applications stated in Table 1. Project proponents must only show that their project falls into one of the Eligible Foam Applications found in Table 1.

Market research showing these applications to have low market adoption rates included, but was not limited, to the following: 1) review of the EPA SNAP rule, 2) various CARB and industry research reports, 3) a market characterization study commissioned for the Methodology, and 4) conversations with various regulatory bodies and industry experts. Additional applications may be added through revisions to this Methodology. A discussion of the development of the performance standard is found in Appendix A.

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS

Quantification of emission reductions requires the calculation of baseline emissions and project emissions using production data, the GWPs of the Baseline and Eligible BA, and the emission factor associated with the Eligible Foam Application.

The GHG emissions from the BA used in foam production occurs at three phases of the product lifecycle, (i.e. manufacturing, use, and EOL). Only manufacturing and foam use for the first 10 years are considered in this Methodology<sup>5</sup>.

**Table 5: Emission Factors for HFC-134a and HFC-152a<sup>6</sup>**

FOAM APPLICATION	PRODUCT LIFE IN YEARS	FIRST YEAR LOSS (%) <sup>7</sup>	ANNUAL LOSS (%)
XPS – HFC 134a	50	25	0.75
XPS – HFC 152a	50	50	25
Rigid PUF residential refrigerators and freezers	15	7	0.5
Rigid PUF injected foam (all eligible sub-applications)	15	12.5	0.5

<sup>5</sup> All offsets for a project's manufacturing and use over the 10-year crediting period will be issued following verification. For example, an XPS foam production line using 100% HFC-134a (Baseline BA) with a GWP of 1430 converts to 100% of an Eligible BA with a GWP of 1 on January 1, 2017. The reporting period is January 1, 2017 through December 31, 2017. All foam produced on the foam line within that timeframe has the potential to create offsets under this Methodology, provided the required monitoring and recordkeeping is maintained. Assuming the quantity of Eligible BA used during that timeframe was 250,000 pounds and the BA ratio is 2, the emission reductions associated with the manufacturing and 10-year use of foam produced during the reporting period would be 102,935 MT CO<sub>2</sub>e or 102,935 offsets issued, following verification.

<sup>6</sup> Source: Table 7.6 and Table 7.7, Page 7.37, Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

<sup>7</sup> Includes emissions associated with the foam manufacturing.

**Table 6: Emission Factors for HFC-245fa and HFC-365mfc<sup>8</sup>**

FOAM APPLICATION	PRODUCT LIFE IN YEARS	FIRST YEAR LOSS (%) <sup>9</sup>	ANNUAL LOSS (%)
Rigid PUF injected foam (all eligible sub-applications)	15	10	0.5
Two-component rigid PU Spray foam	50	15	1.5
Rigid PUF residential refrigerators and freezers	15	4	0.25

## 4.1 BASELINE EMISSIONS

### 4.1.1 Baseline emissions associated with the foam manufacturing and first year of foam use

These emissions are calculated as the total quantity of Baseline BA that would have been used for the foam manufacturing in absence of the Project Activity, multiplied by the first-year loss emission factor associated with the foam application (Tables 5 and 6), multiplied by the GWP of the Baseline BA. For foam applications required to transition to a different BA as the result of a regulation, the GWP of a Default BA may be used if it can be demonstrated that the Default BA is the alternative most likely to be used upon transition. Project proponents shall provide documentation, which shall include financial, market and/or technical analyses, to justify the use of the Default BA. This documentation shall be subject to review by the ACR and assessment by the chosen verification body.

### 4.1.2 Baseline emissions associated with the remaining years of foam use

These emissions are calculated as the total quantity of Baseline BA that would have been used in the foam manufacturing in the absence of the Project Activity, multiplied by the annual loss

<sup>8</sup> Source: Table 7.6 and Table 7.7, Page 7.37, Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

<sup>9</sup> Includes emissions associated with the foam manufacturing.



emission factor associated with the foam application (Tables 5 and 6) multiplied by the number of years remaining in the project<sup>10</sup>, multiplied by the GWP of the Baseline BA.

### 4.1.3 Calculating Baseline BA Blends

When the BA is a blend, baseline emissions are only calculated for the constituent BA that is being transitioned to the Eligible BA. In the event that each constituent of the Baseline BA is transitioned, each constituent of the Baseline BA is calculated separately.

#### Equation 1

$$BE_{BBA} = \{[(Q_{BBA} \times FYL_{BBA}) + (Q_{BBA} \times AL_{BBA} \times YR)] \div 2204.62\} \times GWP_{BBA}$$

#### WHERE

$BE_{BBA}$	Baseline emissions (MT CO <sub>2</sub> e)
$Q_{BBA}$	The quantity of Baseline BA (in pounds) which would have been used to manufacture the foam in the absence of the project activity, using Equation 2
$FYL_{BBA}$	The first-year loss emission factor associated with the foam application (See Tables 5 and 6)
$AL_{BBA}$	The annual loss emission factor associated with the foam application (See Tables 5 and 6)
$YR$	The number of years remaining in the project (equal to 9 years)
$GWP_{BBA}$	The GWP of the Baseline BA <sup>11</sup>

To calculate the quantity of Baseline BA that would have been used in the absence of the project activity, Equation 2 is applied.

<sup>10</sup> Emission reductions are quantified over 10 years. The first-year emissions are accounted for in the first year loss emission factor, therefore, a maximum of 9 years remain to be calculated for usage emissions.

<sup>11</sup> For projects required to transition as a result of a regulation, the GWP of the Default BA will be used.

## Equation 2

$$Q_{BBA} = Q_{EBA} \times BAR$$

### WHERE

$Q_{BBA}$	The quantity of Baseline BA (in pounds) which would have been used to manufacture the foam in the absence of the project activity
$Q_{EBA}$	The quantity of Eligible BA (in pounds) which is used to manufacture the foam for the project
BAR	Blowing Agent Ratio - The quantity of Eligible BA, as compared to the Baseline BA, that is required to replace the Baseline BA to produce a foam with equivalent thermal performance (%)

## 4.2 PROJECT EMISSIONS

### 4.2.1 Project emissions associated with the foam manufacturing and first year of foam use

These emissions are calculated as the total quantity of Eligible BA that is used in the project, multiplied by the first-year loss emission factor associated with the foam application (same as the emission factor used in Equation 1), multiplied by the GWP of the Eligible BA.

### 4.2.2 Project emissions associated with the remaining years of foam use

These emissions are calculated using the total quantity of Eligible BA used in the project, multiplied by the annual loss emission factor associated with the foam application (same as the emission factor used in Equation 1), multiplied by the number of years remaining in the project, multiplied by the GWP of the Eligible BA.

### 4.2.3 Calculating Project BA Blends

When the BA is a blend, project emissions are only calculated for the Eligible BA portion of the blend.

### Equation 3

$$PE_{EBA} = \{[(Q_{EBA} \times FYL_{EBA}) + (Q_{EBA} \times AL_{EBA} \times YR)] \div 2204.62\} \times GWP_{EBA}$$

#### WHERE

$PE_{EBA}$	Project emissions (MT CO <sub>2</sub> e)
$Q_{EBA}$	The quantity of Eligible BA (in pounds), which is used to manufacture the foam for the project
$FYL_{EBA}$	The first-year loss rate emission factor of the foam application (set equal to emission factor used in Equation 1)
$AL_{EBA}$	The annual loss rate emission factor of the foam application (set equal to emission factor used in Equation 1)
$YR$	The number of years remaining in the Project Activity (9 years)
$GWP_{EBA}$	The GWP of the Eligible BA

## 4.3 LEAKAGE

### 4.3.1 Market-shifting leakage emissions

Transition to an Eligible BA does not cause the displaced BA to be used elsewhere. There is no market-shifting leakage and hence is to be disregarded.

### 4.3.2 Activity-shifting leakage emissions

If the Project Activity results in the equipment used in the baseline being transferred to another location or activity in which a BA with a GWP greater than 30 is used, leakage effects are to be considered. If the baseline equipment is also used in the project or is decommissioned, then leakage is to be disregarded.

- **Activity shifting leakage emissions associated with the foam manufacturing and first year of foam use:** These emissions are calculated as the total quantity of BA with a GWP greater than 30 that is being used at the new location with the baseline equipment, multiplied by the first year loss emission factor associated with the foam application (Tables 5 and 6), multiplied by the GWP of the BA.

- **Activity shifting leakage emissions associated with the remaining years of foam use:** These emissions are calculated as the total quantity of BA with a GWP greater than 30 that is being used at the new location with the baseline equipment, multiplied by the annual loss emission factor associated with the foam application (Tables 5 and 6), multiplied by the number of years remaining in the project, multiplied by the GWP of the BA.

#### Equation 4

$$LE_{LBA} = \{[(Q_{LBA} \times FYL_{LBA}) + (Q_{LBA} \times AL_{LBA} \times YR)] \div 2204.62\} \times GWP_{LBA}$$

#### WHERE

$LE_{LBA}$	Activity shifting leakage emissions (MT CO <sub>2</sub> e)
$Q_{LBA}$	The quantity of BA (in pounds) that is used at the new location
$FYL_{LBA}$	The first-year loss emission factor associated with the foam application of the BA used at the new location (See Tables 5 and 6)
$AL_{LBA}$	The annual loss emission factor associated with the foam application of the BA used at the new location (See Tables 5 and 6)
YR	The number of remaining years in the project (9 years)
$GWP_{LBA}$	The GWP of the BA used at the new location

## 4.4 EMISSION REDUCTIONS

The emission reductions achieved as a result of the transition to an Eligible BA are calculated as the baseline emissions minus the leakage emissions (if applicable) minus the project emissions. Annual losses beyond year ten and EOL emissions shall not be calculated.

## Equation 5<sup>12</sup>

$$ER = ((BE_{BBA} - LE_{LBA}) - PE_{EBA}) * (1 - DF)$$

### WHERE

ER	Emission reductions (MT CO <sub>2</sub> e)
BE <sub>BBA</sub>	Equation 1 - Baseline emissions (MT CO <sub>2</sub> e)
PE <sub>EBA</sub>	Equation 3 - Project emissions (MT CO <sub>2</sub> e)
LE <sub>LBA</sub>	Equation 4 - Leakage emissions (MT CO <sub>2</sub> e)
DF	0.1 – Discount Factor (if applicable) <sup>13</sup>

<sup>12</sup> As stated in Sections 4.1 and 4.2, where a BA blend is used, emissions are to be quantified separately for each constituent BA. As a result, a summation of baseline, project, and leakage emissions for the project shall occur to accurately quantify total emission reductions associated with a project.

<sup>13</sup> See Footnote 14 for applicability

## 5 MONITORING AND DATA COLLECTION

Each project shall include a monitoring, reporting and verification plan sufficient to meet the requirements of the ACR Standard. The plan shall describe the collection of all data to be monitored and in a manner which meets the requirements for accuracy and precision of this Methodology.

This Methodology is based on determining the amount of BA that was or would have been used prior to project implementation and the amount of an Eligible BA used during the project. Project proponents are expected to provide data based on production quantity inputs to the manufacturing process (as shown in Figure 1). The Monitoring Plan shall provide inputs for all applicable equations used in this Methodology.

The project proponent is responsible for the collection and maintenance of all required data and monitoring parameters.

Individual manufacturing facilities or construction sites may be aggregated into a single project provided each of the facilities/sites meet the Applicability Conditions (1.2) and the project proponent provides the monitoring and recordkeeping as required by this Methodology.

### 5.1 DESCRIPTION OF THE MONITORING PLAN

The project proponent must prepare a monitoring plan describing the following:

- The location and recordkeeping/retention for all stored data.
- The methods used to generate data.
- Transfer points and methods of non-automated transfer of data.
- If applicable, describe any calibration procedures and the frequency with which calibration and other maintenance requirements are performed.
- Describe the internal audit and other quality assurance/quality control procedures.
- Sampling methods utilized and performed during the reporting period, if applicable.

The rationale for monitoring project implementation is to document all project activities implemented by the project proponent.

## 5.2 DATA COLLECTION AND PARAMETERS TO BE MONITORED

### 5.2.1 Monitoring requirements for all project types

For all projects, the process for monitoring the project's emission reduction parameters includes:

- Records documenting the foam application used in the baseline and project.
- For all foam applications, other than projects which will use the Default BA, records documenting the Baseline BA used in the project showing a minimum of 2 years of usage prior to the Project Activity.
- Records documenting the amount of the Eligible BA consumed in the Project Activity. Acceptable documentation may include any of the following, but are not limited to:
  - ◆ Weight records (in pounds) of Eligible BA material used<sup>14</sup>;
  - ◆ Flow meter records of Eligible BA material used;
  - ◆ Number of products produced using the Eligible BA and the quantity (in pounds) of material in each unit manufactured;
- Records documenting the calibration of any weigh scales, flow meters, or similar measurement devices used to document the amount of Eligible BA consumed in the Project Activity.
- Records used in support of the BA ratio for the project including all calculations to derive the BA ratio.
- Equipment log for all equipment used in the project.
- Identification and log of any equipment modified, replaced, or decommissioned as a result of the Project Activity and any equipment moved for use outside of the project boundaries (leakage).
- For project proponents applying a Default BA: financial, market and/or technical analyses to justify the use of the Default BA.

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<sup>14</sup> For projects supplying pre-shipment weight information for the Eligible BA via tanks, drums, totes, or containers that are sent to a manufacturing facility or construction site (for instance, in spray foam applications), the return weight of the tanks, drums, totes, or containers shall also be provided to ensure that any "heel" remaining has been accurately deducted. Alternatively, a project supplying pre-shipment weight information may also validate this information by providing additional evidence to the verifier to corroborate the pre-shipment weight. If the return weight is not provided and no corroborating evidence is provided to document the weight of Eligible BA consumed in the project activity, the project must apply the discount factor found in Equation 5.

## 5.2.2 Additional monitoring requirements for Formulators and/or Systems Supply Houses<sup>15</sup>

For projects where a Formulator or a Systems Supply House is the Project Proponent (e.g. provides the A side and B side materials as a foam system in tanks, totes, drums or other containers) the following requirements must also be met in addition to those requirements in Section 5.2.1:

- Records documenting that the foam system supplied to the foam manufacturer by the Formulator/Systems Supply House was shipped to and received by the foam manufacturer. Acceptable documentation may include, but are not limited to:
  - ◆ Bills of lading or other business records provided by the transport company as receipt of shipped material.
- Records documenting that the foam system supplied to the foam manufacturer by the Formulator/Systems Supply House was used in the application identified by the Project. Acceptable documentation may include any of the following:
  - ◆ Documentation from the Formulator/Systems Supply House;
  - ◆ Documentation from the foam manufacturer;
  - ◆ Signed attestation from the foam manufacturer.

## 5.2.3 Additional monitoring requirements for spray foam projects

For projects where a Formulator/Systems Supply House that is supplying spray foam is the Project Proponent (e.g. the A-side and B-side materials are supplied in tanks, totes, drums or other containers for use in Spray Foam applications) the following requirements must also be met in addition to those requirements in Section 5.2.1:

- Attestations must be obtained from distributors and contractors representing a minimum of 10 percent of the volume of Eligible BA included in the Project Activity<sup>16</sup>.
  - ◆ Attestations must document the following:
    - ◆ Approximate date(s) of foam production;
    - ◆ Confirmation that all A side and B side materials sent to the construction site were consumed on the date(s) specified.

<sup>15</sup> For all applications except spray foam.

<sup>16</sup> Attestations must be collected from a minimum of one distributor and two foam insulation contractors, per project.



- ◆ For consecutive annual or sub-annual projects, attestations may only be provided from the same distributors and contractors once every third project validation/verification.

## 5.2.4 Parameters Monitored

PARAMETER	BAR
Units	%
Description	(BA ratio) The quantity of Eligible BA, as compared to the Baseline BA, that is required to replace the Baseline BA to produce a foam with equivalent thermal performance
Relevant Section	4.1
Relevant Equation(s)	2
Source of Data	MSDS sheets, foam production records, meter readings, product or design specifications, engineering calculations
Measurement Frequency	Once, at the beginning of each project

PARAMETER	Q <sub>EBA</sub>
Units	Pounds
Description	Quantity of Eligible BA used in project
Relevant Section	4.1 and 4.2
Relevant Equation(s)	2 and 3
Source of Data	Operating records, purchase records, usage records, meter readings
Measurement Frequency	Throughout the project

PARAMETER	$Q_{LBA}$
Units	Pounds
Description	Quantity of BA that is shifted to the new location that results in activity shifting leakage
Relevant Section	4.3
Relevant Equation(s)	4
Source of Data	Records associated with moving the equipment to a new location, operating records, purchase records, meter readings, attestations
Measurement Frequency	Throughout the project

# APPENDIX A: DEVELOPMENT OF PERFORMANCE STANDARD

In developing the Methodology, information about BA use in the foam industry was gathered and reviewed. This included several studies, reports, and conversations with industry experts, regulatory personnel, and foam manufacturers. Additionally, a market research report was commissioned on the “Global Foam Blowing Agents Market Size, Share, Development, Growth, and Demand Forecast”. The ACR peer review process was also relied upon to identify the market penetration of all BAs and then to identify the Eligible Foam Applications, which are shown in Methodology Table 1 and repeated below.

**Table 7: Eligible Foam Applications**

FOAM APPLICATION	DESCRIPTION
XPS boardstock	Boardstock, block, and billet that is used for insulation in the following applications: roofing, walls, flooring, and pipes. Does not include XPS sheet foam applications.
Two-component rigid PU spray foam	Spray foam is a two-part polyurethane application that when combined forms a solid foam insulation; involves a gun, nozzle or straw and forms foam as the ingredient chemicals are blended together.
Rigid PU injected foam	<p>A manufacturing process for producing component parts by injecting two or more liquid streams into a mold or part. Materials for the component are fed into a mix-head, mixed, and forced into the mold cavity, where they react, foam, cool and harden to the configuration of the cavity. Only Rigid PU injected foam used in the following sub-applications are eligible:</p> <ul style="list-style-type: none"> <li>● Marine flotation or buoyancy</li> <li>● Heating, Ventilation, Air Conditioning and Air Handling Systems</li> <li>● Refrigerated Transport – Foam used in refrigerated logistics services such as refrigerated cargo boxes and coolers</li> <li>● Industrial Refrigeration Systems – Large, “engineered” systems used in supermarkets, industrial process</li> </ul>

FOAM APPLICATION	DESCRIPTION
	refrigeration, cold storage, and walk-in freezers applications that employ cold storage panel insulation. <ul style="list-style-type: none"> <li>● Retail Food Refrigeration, other than Industrial Refrigeration Systems</li> <li>● Garage and entry doors</li> </ul>
<b>Rigid PUF residential refrigerators and freezers</b>	Appliances used to preserve food and beverages in residential applications.

To construct the performance standard, it was important to determine which sectors had high penetration rates for low GWP BA. Based on market research, it was determined that the following sectors already had high penetration rates for certain low GWP BA (primarily HC BA which are commonly considered to be lower GWP BA):

- PU Spray, other than two-component PU Spray
- Rigid PUF discontinuous panel
- Rigid PUF continuous laminate/boardstock
- Rigid PUF block for pipe sections
- Rigid PUF discontinuous block for panels
- Rigid PUF pipe-in-pipe
- Rigid PUF discontinuous block for pipe sections
- Rigid PUF continuous block
- XPS sheet

The primary outcome that the Methodology is meant to incentivize (reduced GHG emissions from foam BA consumption) is already being achieved in the above applications at rates that are higher than acceptable for crediting under this Methodology. Further, it was also clear that the use of HC BA should be considered business as usual for foam production. There are many additional concerns with HC BA such as high flammability risks, cost associated with flame proofing and safety measures, status as volatile organic compounds, and the generally lower thermal efficiency of foams produced by HC BA as compared to many alternatives. For these reasons, the Methodology credits only advanced formulation BAs and HC are ineligible for crediting.

Table 8 shows the market penetration rates of Eligible BAs. Table 9 shows the market penetration rates of Eligible BAs with the addition of the percentage of HC BAs consumed in these applications. As is shown, the eligible foam applications have extremely low adoption rates for Eligible BA and are also not achieving high rates of low GWP BA adoption, in general.

**Table 8 Market Penetration Rate of Eligible BAs<sup>17</sup>**

APPLICATION	2013	2014	2015	2016	2017
Rigid PUF injected foam – Marine flotation and buoyancy	1.29%	1.61%	2.04%	2.51%	2.89%
Rigid PUF injected foam – Heating, Ventilation, Air Conditioning and Air Handling Systems	2.06%	2.52%	3.21%	3.84%	4.41%
Rigid PUF injected foam – Refrigerated Transport	1.46%	1.80%	2.30%	2.77%	3.21%
Rigid PUF injected foam – Industrial Refrigeration Systems	1-2%	1-2%	1-2%	1-2%	1-2%
Rigid PUF injected foam – Retail Food Refrigeration	1.56%	1.91%	2.45%	2.88%	3.32%
Rigid PUF injected foam – Garage and Entry Doors	1.61%	2.14%	3.03%	3.88%	4.65%
Rigid PUF residential refrigerators and freezers	1.18%	1.48%	1.92%	2.34%	2.75%
XPS (Board, Billet, and Block only)	7-8%	7-8%	7-8%	7-8%	7-8%
Two-component Rigid PU Spray Foam	5%	5%	5%	5%	5%

<sup>17</sup> Eligible BAs assessed in the market analysis included all known HFOs, Methyl Formate, and inert gases.

**Table 9: Market Penetration Rate including HC BAs**

APPLICATION	2013	2014	2015	2016	2017
Rigid PUF injected foam – Marine flotation and buoyancy	8.21%	8.89%	9.69%	10.68%	11.89%
Rigid PUF injected foam – Heating, Ventilation, Air Conditioning and Air Handling Systems	10.54%	11.36%	12.41%	13.50%	14.84%
Rigid PUF injected foam – Refrigerated Transport	6.86%	7.41%	8.12%	8.86%	9.76%
Rigid PUF injected foam – Industrial Refrigeration Systems	7-8%	6-7%	7-8%	7-8%	7-8%
Rigid PUF injected foam – Retail Food Refrigeration	7.12%	7.72%	8.53%	9.25%	10.11%
Rigid PUF injected foam – Garage and Entry Doors	5.45%	6.90%	8.61%	10.41%	12.43%
Rigid PUF residential refrigerators and freezers	9.26%	9.63%	10.00%	10.73%	12.00%
XPS (Board, Billet, and Block only)	8-9%	8-9%	8-9%	8-9%	8-9%
Two-component Rigid PU Spray Foam	5%	5%	5%	5%	5%

## APPENDIX B: ELIGIBLE BA GWP

The following is a table of Eligible BAs that are listed as acceptable substitutes under the SNAP program. This list is not exhaustive, it is only the list of substitutes under SNAP that are applicable to this Methodology.

**Table 10: GWPs for selected Eligible BAs**

ELIGIBLE BA	GWP
Methyl formate	1 <sup>18,19</sup>
HFO-1336	2 <sup>20</sup>
trans-1-chloro-3,3,3, -trifluoroprop-1-ene (HCFO-1233zd(E))	7 <sup>21,22</sup>
CO <sub>2</sub>	1 <sup>23</sup>
Methylal	3 <sup>16,24</sup>
HFO-1234ze	1 <sup>15,25</sup>

<sup>18</sup> Federal Register, Volume 65, Number 243. Monday, December 18, 2000

<sup>19</sup> Per the Federal Register, the GWP is stated as “very low or zero” in all Federal Register listings (for Methyl Formate and Ecomate). For purposes of this Methodology, the GWP shall be set equal to 1 in Project emission reduction calculations.

<sup>20</sup> AR5

<sup>21</sup> Federal Register, Volume 79, Number 203. Tuesday, October 21, 2014.

<sup>22</sup> Per the Federal Register, the GWP has been reported as 1 to 7 in various publications. For purposes of this Methodology, the GWP shall be set equal to 7 in Project emission reduction calculations.

<sup>23</sup> AR4

<sup>24</sup> Per the Federal Register, the GWP is reported as less than 3. For purposes of this Methodology, the GWP shall be set equal to 3 in Project emission reduction calculations.

<sup>25</sup> Per AR5, the GWP is less than 1. For purposes of this Methodology, the GWP shall be set equal to 1 in Project emission reduction calculations.

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