Yale Carbon Containment Lab

Primer on Carbon Credits from Fluorocarbon Emissions Reductions (last revised 5/15/2023)

Reducing fluorocarbon emissions from cooling systems and foam applications is one of fastest and most cost-effective ways available today to slow global warming. Many such emissions reduction activities can generate revenue through the carbon markets. Under existing methodologies, the following activities may be eligible:

- Commercial refrigeration system retrofits and installations
- Leak detection and reduction in commercial refrigeration systems
- Low Global Warming Potential (GWP) blowing agent usage in foam manufacturing
- Recovery and reclamation of used refrigerants
- Recovery and disposal of refrigerants from stockpiles or equipment
- Recovery and disposal of foam blowing agents from appliances or buildings

See Table 1 for registry and eligibility information, and Table 2 for a full comparison of each methodology.

Table 1: Carbon Credit Methodologies for Fluorocarbon Emissions Reductions

Registry	Methodology Name	Approved Countries/Regions	Eligible Activities
ACR	Advanced Refrigeration Systems v2.1 (link)	U.S., Canada, or Mexico	Deployment of advanced refrigeration systems in select commercial applications. Both retrofits and new installations may be eligible.
ACR	Certified Reclaimed HFC Refrigerants, Propellants, and Fire Suppressants v2.0 (link)	U.S., Canada, or Mexico	Use of certified reclaimed HFCs to charge existing or newly manufactured refrigeration, air conditioning, aerosol, or fire suppression equipment.
ACR	Destruction of Ozone Depleting Substances and High-GWP Foam v2.0 (link)	For sourcing material: U.S. or Canada For destruction: anywhere	Destruction of ODS refrigerants from equipment or stockpiles, or destruction of foam blowing agents from appliances or buildings.
ACR	Destruction of Ozone Depleting Substances from International Sources v1.0 (link)	For sourcing material: outside the U.S. For destruction: anywhere	Destruction of select ODS refrigerants from equipment or stockpiles.
ACR	Transition to Advanced Formulation Blowing Agents in Foam Manufacturing and Use v3.0 (link)	U.S., Canada, or Mexico	Replacement of high-GWP blowing agents in foam manufacturing with low-GWP alternatives. Blowing agents eligible for replacement vary by species, region, and foam end-use category.
CARB	Destruction of U.S. Ozone Depleting Substances Banks (link)	U.S.	Destruction of ODS refrigerants from equipment or stockpiles, or destruction of foam blowing agents from appliances or buildings.
CAR	U.S. Ozone Depleting Substances Project Protocol (link)	U.S.	Destruction of ODS refrigerants from equipment or stockpiles, or destruction of foam blowing agents from appliances or buildings.
CAR	Article 5 Ozone Depleting Substances (link)	For sourcing material: Article 5 countries For destruction: U.S.	Destruction of select ODS refrigerants, either recovered from equipment or acquired from stockpiles that cannot legally be resold (or can be legally resold but are held by an Article 5 government).
CAR	Mexico Halocarbon Protocol (link)	Mexico	Destruction of select halocarbon refrigerants from stockpiles, equipment, or used servicing cylinders. Eligibility varies by species.
Verra	Infrared Automatic Refrigerant Leak Detection Efficiency v1.1 (link)	Anywhere	Installation of infrared automatic leak detection systems in commercial refrigeration systems using HFCs.
Verra	Recovery and Destruction of Ozone Depleting Substances v1.1 (link)	Parties to the Montreal Protocol	Destruction of ODS refrigerants and blowing agents (both CFCs and HCFCs). Refrigerants may be recovered or stockpiled gas. Blowing agents must be recovered from end-of-life appliances.

Table 2: Carbon Credit Methodologies for Fluorocarbon Emissions Reductions – Full Comparison

Registry	Methodology Name	Approved Countries/ Regions	Eligible Activities	Baseline Assumptions	Notable Features
American Carbon Registry	Advanced Refrigeration Systems v2.1, last revised 2021 (link)	U.S., Canada, or Mexico	Deployment of advanced refrigeration systems in select Large Commercial Refrigeration, Remote Condensing, or Standalone Commercial Refrigeration systems. Both retrofits and new installations may be eligible.	Projects replacing Large Commercial Refrigeration systems must use empirical system-specific data to estimate baseline emissions or use a conservative default rate. Baseline charge sizes range by equipment type. Baseline GWPs range by equipment type and region.	• New refrigeration systems must be approved by the U.S. EPA Significant New Alternatives Policy (SNAP) program to qualify. • All ODSs from decommissioned equipment must be recovered and destroyed in accordance with either the ACR or CARB ODS Destruction Methodology. All HFCs from decommissioned equipment must be managed in accordance with EPA regulations. • Project must occur within one year. • Project is credited for ten years of avoided emissions. • Project emissions include future leakage of replacement refrigerants. • Default baseline annual leak rates are assumed to be 25.67% for Large Commercial Refrigeration, 12.62% for Remote Condensing Units, and 7.20% for Standalone Commercial Refrigeration.
American Carbon Registry	Certified Reclaimed HFC Refrigerants, Propellants, and Fire Suppressants v2.0, last revised 2022 (link)	U.S., Canada, or Mexico	Use of certified reclaimed HFCs to charge existing or newly manufactured refrigeration, air conditioning, aerosol, or fire suppression equipment.	98% baseline emission rate for all recovered and reclaimed HFCs (i.e. 2% baseline recovery and reclamation rate assumed).	• Excludes CFCs and HCFCs. • Project activities include reclamation of material and subsequent sale to a distributor, wholesaler, or end-user. • Project must occur within one year, beginning on the date that reclaimed HFCs are first sold. • Reclamation must be carried out to AHRI 700 Standards. • Point of origin, documentation, and chain of custody required for each specific quantity of HFCs recovered (documentation requirements vary depending on the size of recovery containers). • All project emissions are assumed to be negligible.
American Carbon Registry	Destruction of Ozone Depleting Substances and High-GWP Foam v2.0, last revised 2023 (link)	For sourcing material: U.S. or Canada For destruction: anywhere	Destruction of select ODS refrigerants, high-GWP foam blowing agents, and high-GWP insulation foam. Refrigerants may be recovered from equipment or acquired from government stockpiles.	100% baseline emission rate for all eligible sources.	• Point of origin and chain of custody required for all eligible sources. • Project must occur within one year. • Destruction facility may be RCRA-approved or meet TEAP screening criteria. Destruction facility must also have all local, state, or federal permits required to destroy ODS. • Project emissions do not include replacement gases for destroyed refrigerants. • Eligible refrigerants: CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, CFC-115, HCFC-22, HCFC-123. See Methodology Sections 2.2.2-2.2.5 for eligible blowing agents and foam.

American Carbon Registry	Destruction of Ozone Depleting Substances from International Sources v1.0, last revised 2021 (link)	For sourcing material: outside the U.S. For destruction: anywhere	Destruction of select ODS refrigerants from equipment or stockpiles.	Ten-year baseline emission rates for gas range from 61% to 95%, depending on species.	• Destruction facility may be RCRA-approved or meet TEAP screening criteria. Destruction facility must also have all local, state, or federal permits required to destroy ODS. • Project must occur within one year. • Credits for ten years of avoided emissions. • Project emissions include future leakage of gases replacing destroyed refrigerants. • Point of origin and chain of custody required for all eligible sources. • Eligible refrigerants: CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, CFC-115.
American Carbon Registry	Transition to Advanced Formulation Blowing Agents in Foam Manufacturing and Use v3.0, last revised 2022 (link)	U.S., Canada, or Mexico	Replacement of high-GWP blowing agents in foam manufacturing with low-GWP, low-ODP alternatives. Blowing agents eligible for replacement vary by species, region, and foam end-use category.	100% baseline emission rate for all eligible sources. Projects must have two years of baseline blowing agent usage data or use a default baseline blowing agent subject to review by ACR.	• Project must occur within one year. • Length of project crediting period varies based on the specific foam end-use category (ranging 2 to 50 years). • End use of foam must be one of the four following applications: XPS boardstock, two-component rigid PU spray foam, rigid PU injected foam, rigid PUF residential refrigerators and freezers. • Replacement blowing agents must have a GWP less than 30 and an ODP less than 0.01, must not be a hydrocarbon or saturated hydrofluorocarbon, and must meet all applicable regulations.
California Air Resources Board	Destruction of U.S. Ozone Depleting Substances Banks, last revised 2014 (link)	U.S.	Destruction of ODS refrigerants from equipment or stockpiles, or destruction of foam blowing agents from appliances or buildings.	Ten-year baseline emission rates for gas range from 61% to 95%, depending on species.	• Destruction facility may be RCRA-approved or meet TEAP screening criteria. Destruction facility must also have all local, state, or federal permits required to destroy ODS. • Point of origin and chain of custody required for all eligible sources. • Project emissions include future leakage of gases replacing destroyed refrigerants. • Projects can sell credits into the California Compliance Offsets Program. • Eligible refrigerants: CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, or CFC-115. • Eligible blowing agents: CFC-11, CFC-12, HCFC-22, HCFC-141b.
Climate Action Reserve	U.S. Ozone Depleting Substances Project Protocol, last revised 2012 (link)	U.S.	Destruction of select ODS refrigerants and foam blowing agents. Refrigerants may be recovered or stockpiled gas. Foam may be recovered from appliances or building panels.	100% baseline reclamation rate for refrigerant recovered from equipment. Ten-year baseline emission rates for stockpiled gas range from 61% to 95%, depending on species.	• Project must occur within one year. • Project is credited for ten years of avoided emissions. • Destruction facility may be RCRA-approved or meet TEAP screening criteria. Destruction facility must also have a Title V air permit, and all other local, state, or federal permits required to destroy ODS. • Point of origin and chain of custody required for all eligible sources. • Project emissions include future leakage of gases replacing destroyed refrigerants. • Eligible refrigerants: CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, or CFC-115. • Eligible blowing agents: CFC-11, CFC-12, HCFC-22, or HCFC-141b.

Climate Action Reserve	Article 5 Ozone Depleting Substances, last revised 2012 (link)	For sourcing material: Article 5 countries For destruction: U.S.	Destruction of select ODS refrigerants, either recovered from equipment or acquired from stockpiles that cannot legally be resold (or can be legally resold but are held by an Article 5 government). Eligible refrigerants must be phased out in their country of origin.	Ten-year baseline emission rate for stockpiled gas that can be legally resold is 94%. Ten-year baseline emission rate for stockpiled gas that cannot be legally resold must be calculated based on leaked quantity between seizure and destruction.	• Project must occur within one year. • Project is credited for ten years of avoided emissions. • Destruction facility may be RCRA-approved or meet TEAP screening criteria. Destruction facility must also have a Title V air permit, and all other local, state, or federal permits required to destroy ODS. • 100% baseline emission rate for refrigerant recovered from equipment. • Point of origin and chain of custody required for all eligible sources. • Project emissions include future leakage of gases replacing destroyed refrigerants. • Eligible refrigerants: CFC-11, CFC-12, CFC-113, CFC-114, CFC-115.
Climate Action Reserve	Mexico Halocarbon Protocol, last revised 2021 (link)	Mexico	Destruction of select halocarbon refrigerants. CFC refrigerants from stockpiles or equipment are eligible. HCFC and HFC refrigerants recovered from equipment end-of-life or during equipment retrofitting are eligible, as well as remnants of virgin HCFC-22 or HFC from servicing cylinders.	Baseline emission rate for refrigerant recovered from equipment at end-of-life or from servicing cylinders is 100%. Ten-year baseline emissions rates for gas recovered during equipment retrofitting range from 22% to 83%, depending on species and unit type. Ten-year baseline emissions rate for stockpiles is 65% if the stockpile can be resold (otherwise, it must be calculated based on leakage between seizure and destruction).	• Project must occur within one year. • Project is credited for ten years of avoided emissions. • HCFC and HFC stockpiles were eligible up until 2022. • Point of origin and chain of custody required for all halocarbon sources. • Project emissions include future leakage of gases replacing destroyed refrigerants. Destruction facility must be permitted under Mexico's General Law for the Prevention and Management of Wastes and meet all TEAP screening criteria (in addition to acquiring all required local, state, and federal air or water permits). • Eligible refrigerants: CFC-11, CFC-12, CFC-113, CFC-114, HCFC-22, HFC-32, HFC-125, HFC-134a, HFC-143a.
Verra	Infrared Automatic Refrigerant Leak Detection Efficiency (VM0001) v1.1, last revised 2017 (link)	Anywhere	Installation of infrared automatic leak detection systems in commercial refrigeration systems using HFCs.	Measured annual leak rate from HFC and HCFC equipment to be retrofitted (averaged over three consecutive years). The baseline cannot exceed the latest EPA Green Chill program leak rates.	• Only reductions in HFCs are eligible to be credited. • Leak management data should be drawn from equipment owner's compliance records for ODS refrigerants. • Historical and current year leak rates can be calculated using charge sizes and refrigerant refill purchases for each piece of equipment. • Revisions to expand eligible leak detection technologies are ongoing.
Verra	Recovery and Destruction of Ozone Depleting Substances (VM0016) v1.1, last revised 2017 (link)	Parties to the Montreal Protocol	Destruction of ODS refrigerants and blowing agents (both CFCs and HCFCs). Refrigerants may be recovered or stockpiled gas. Blowing agents must be recovered from end-of-life appliances.	In Article 5 countries, 100% baseline emission rate at equipment end-of-life. Otherwise, uses Climate Action Reserve Protocol's default rates (see above). Ten-year baseline emission rate for stockpiled gas is 65%.	• Project is credited for ten years of avoided emissions. • In Article 5 countries, assumes 100% venting rates at equipment end-of-life in the absence of regulatory prohibition. • Point of origin required for all ODS sources. • Destruction facility must have host country permit for ODS destruction and meet TEAP screening criteria. • Project emissions include future leakage of gases replacing destroyed refrigerants.

Carbon Credit Methodologies for Fluorocarbon Emissions Reductions

(last revised 5/15/2023)

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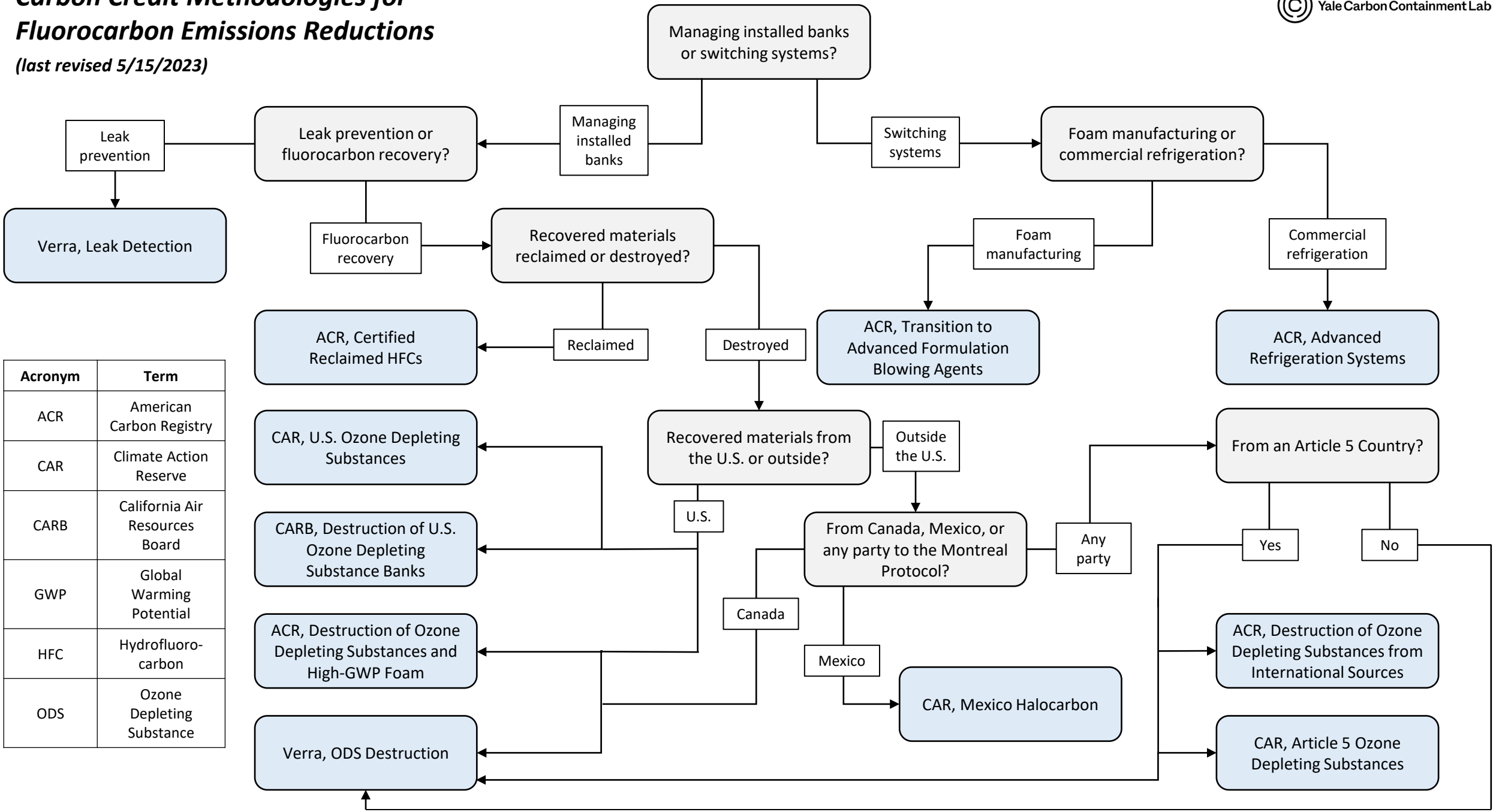

Acronym	Term
ACR	American Carbon Registry
CAR	Climate Action Reserve
CARB	California Air Resources Board
GWP	Global Warming Potential
HFC	Hydrofluoro-carbon
ODS	Ozone Depleting Substance