

ACS Module: Voluntary Human Respiratory Carbon Retention (VHRCR)

Module Version: 1.0

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Applicable Standard: Absolute Carbon Standard v2.1

Module Type: Capture and Storage

Certificate Type: Negative-Emissions Certificate (NEC)

1. Technical and Scientific Background

1.1 Overview of the Respiratory Carbon Cycle

Human respiration is a continuous metabolic process in which atmospheric oxygen (O₂) is inhaled and carbon dioxide (CO₂) is exhaled as a byproduct of cellular respiration. The average adult exhales approximately 200 mL of CO₂ per minute at rest, equating to roughly 0.36 grams of CO₂ per exhaled breath (assuming a tidal volume of ~500 mL, of which ~4% is CO₂ by volume). Over the course of a day, a single human exhales approximately 0.9 kg of CO₂.

1.2 The Breath-Holding Intervention

Voluntary Human Respiratory Carbon Retention (VHRCR) is the deliberate, temporary cessation of exhalation by a human participant. During a breath-hold event, CO₂ that would otherwise be released into the Polluting Pool is retained within the participant's bloodstream and pulmonary system — collectively treated as the Use Pool under the Anthropogenic Emissions Model (AEM). This retention constitutes a measurable delay in the transfer of carbon from the Use Pool to the Polluting Pool.

The average untrained adult can hold their breath for approximately 30–90 seconds. Trained participants ("Certified Breath Retention Operators," or CBROs) may sustain holds of 2–5 minutes. The current world record for static apnea exceeds 24 minutes, representing the theoretical upper bound of individual retention capacity per event.

1.3 Vertical Stacking and Aggregation

Given that a single breath-hold event retains on the order of 6–18 mg of CO₂ (based on the exhalation rate of ~6 mg CO₂/second multiplied by a hold duration of 1–3 seconds for minimal-effort micro-holds, or up to ~2.16 g for a 6-minute elite hold), achieving the equivalent of 1 metric ton of CO₂ requires massive horizontal scaling across participants and/or temporal aggregation across repeated events.

To reach 1 tonne of CO₂-equivalent retention:

- At an average retention of ~12 mg per 2-second micro-hold: approximately **83.3 million breath-hold events** are required.
- Alternatively, approximately **1,157 trained participants** performing continuous 60-second holds, 8 hours per day, for 365 days could theoretically aggregate to 1 tonne of delayed CO₂ flux per year.

The Module introduces the concept of "**Vertical Stacking**" — the simultaneous coordination of multiple participants performing synchronized breath-holds in the same physical column of atmosphere. While this has no additional physical effect on carbon retention beyond horizontal aggregation, the visual and organizational distinctiveness of vertical stacking (e.g., participants on different floors of a building, on scaffolding, or in ascending hot air balloons) serves as a monitoring convenience and a compelling demonstration of collective climate action.

1.4 Limitations and Scientific Candor

It must be acknowledged with full transparency that VHRCR does not store carbon in any durable sense. The retained CO₂ is released upon the participant's next exhalation — typically within seconds to minutes. The carbon never enters the Stored Pool as defined by ACS. The "storage duration" is approximately 10⁻⁴ to 10⁻² of a single day, which is approximately 10⁻⁹ of the 1,000-year Storage Durability Threshold.

This Module proceeds on the basis that the sheer enthusiasm and collective coordination of participants may, in some yet-to-be-demonstrated manner, compensate for the negligible physical climate benefit.

2. Applicability Requirements

2.1 Eligible Projects

This Module is applicable to projects that meet all of the following criteria:

1. The project involves the organized, voluntary retention of exhaled CO₂ by living human participants through deliberate breath-holding.
2. The Project Developer is an incorporated entity (not an individual holding their breath alone in a room, regardless of their determination).
3. All participants are consenting adults (18+) who have received medical clearance for voluntary apnea activities.
4. The project does not involve any form of involuntary breath retention, including but not limited to: underwater submersion without consent, competitive choking, altitude

deprivation, or any activity that could reasonably be described as "not breathing against one's will."

5. The project has access to timing equipment capable of measuring breath-hold durations to a resolution of at least ± 0.5 seconds.
6. The project can demonstrate the enrollment of a minimum of **10,000 active participants** ("Breath Retention Operators") to achieve a creditable volume of retained CO₂.

2.2 Excluded Activities

The following activities are not eligible under this Module:

- Breath-holding performed by non-human animals, regardless of lung capacity (e.g., whales, dolphins, competitive goldfish).
- Simulated breath-holding using mechanical ventilator interruptions.
- "Passive" breath retention occurring during sleep apnea, as this is neither voluntary nor additional.
- CO₂ retention achieved by simply breathing less frequently without a defined hold event ("casual shallow breathing" is not a creditable activity).
- Any activity in which the participant is deceased, as exhalation has permanently ceased and the associated carbon is managed under entirely different biogeochemical pathways.

2.3 Regulatory Additionality

Given that no known jurisdiction on Earth currently requires its citizens to hold their breath for climate purposes, all VHR CR projects are deemed regulatorily additional by default.

2.4 Financial Additionality

Project Developers shall demonstrate that participants would not have held their breath in the organized, monitored, and aggregated manner described by this Module in the absence of carbon finance. Recreational breath-holding (e.g., swimming, hiding from siblings) is considered non-additional and shall be excluded from creditable activities. Revenue from Certificate sales must be shown to be a necessary incentive for the coordination infrastructure, participant recruitment, and monitoring systems.

3. Assessment Scope and Boundary

3.1 System Boundary

The system boundary for VHR CR projects encompasses the following Use Pool activities and associated emissions fluxes:

Included within the system boundary:

- The metabolic generation of CO₂ by the participant during the breath-hold event (ongoing, involuntary, occurs regardless).
- The temporary retention of CO₂ within the participant's respiratory and circulatory systems during a defined hold event.
- The subsequent exhalation of retained CO₂ upon conclusion of the hold event (classified as a ReRelease flux).
- Process Emissions associated with project coordination, including energy consumed by timing devices, digital platforms for participant registration, data servers, travel by Project Developers to breath-holding sites, and the manufacturing of any branded "I Held My Breath for the Climate" merchandise.
- Emissions from participant transportation to organized breath-holding events (if events are conducted at specific physical locations).

Excluded from the system boundary (per Section 3.1.1 materiality thresholds):

- The participant's baseline metabolic CO₂ production, which would occur regardless of the project (this is non-additional respiratory activity).
- Emissions associated with the participant's meals before and after the event, although the Module acknowledges that a carbohydrate-heavy pre-event meal may marginally increase CO₂ production rates.
- Emissions from involuntary gasps, sighs, or exclamations of frustration during the monitoring process.

3.2 Temporal Scope

Each creditable breath-hold event ("Retention Instance") is assessed from the moment of final inhalation to the moment of first exhalation. The Monitoring Period follows the default ACS period of one year. Vintages shall correspond to the calendar year in which the breath was held.

3.3 Spatial Scope

VHRCR projects may operate in any geography where voluntary breath-holding is legal (presumed to be all jurisdictions, pending further legal research). For Vertically Stacked events, the spatial scope extends from the lowest participant's altitude to the highest participant's altitude, measured in meters above sea level.

3.4 Capture Flux Classification

Under AEM, the VHRCR Capture flux is defined as the CO₂ that is metabolically produced and

would have been exhaled into the Polluting Pool but is instead temporarily retained in the Use Pool. It is critical to note that this CO₂ was already in the Polluting Pool prior to the participant's most recent inhalation — the participant captured it, briefly detained it, and then returned it. The net Capture over the full inhalation-hold-exhalation cycle is, regrettably, zero.

The Module addresses this inconvenience in Section 6.

4. Reported Values

4.1 Required Data Points

The following data shall be collected and reported for each Monitoring Period:

ID	Name	Symbol	Units	Description
V1	Total Participants	N _p	count	Total number of active Breath Retention Operators
V2	Total Retention Events	N _e	count	Total number of creditable breath-hold events
V3	Mean Hold Duration	\bar{t}_{hold}	seconds	Arithmetic mean of all hold durations
V4	Median Hold Duration	\tilde{t}_{hold}	seconds	Median hold duration (to assess skewness from elite holders)
V5	Total Aggregate Hold Time	T _{agg}	seconds	Sum of all individual hold durations
V6	Estimated CO ₂ Retained	m _{CO₂}	grams	Total mass of CO ₂ temporarily retained
V7	Process Emissions	PE	t CO ₂ -eq	Emissions from project coordination and logistics
V8	Vertical Stack Height	h _{stack}	meters	Maximum vertical separation in stacked events (if applicable)
V9	Participant Satisfaction Score	PSS	1-10 scale	Average self-reported satisfaction (not used in calculations, but important for morale)

4.2 Calculated Quantities

ID	Name	Symbol	Units	Description
C1	Gross Temporary Retention	GTR	t CO ₂	Total CO ₂ temporarily withheld from the Polluting Pool
C2	Net Climate Benefit	NCB	t CO ₂ -eq	GTR minus Process Emissions and ReRelease (see Section 6)
C3	Retention Intensity	RI	mg CO ₂ /s/person	Per-participant retention rate
C4	Vertical Stacking Multiplier	VSM	dimensionless	An enthusiasm coefficient applied to stacked events (see Section 6)

5. Monitoring

5.1 Participant Registration

All Breath Retention Operators shall be registered in a centralized digital platform maintained by the Project Developer. Registration shall include a unique participant ID, date of birth, medical clearance documentation, and a signed acknowledgment that the participant understands the climate benefit of their individual contribution is, statistically, indistinguishable from zero.

5.2 Event Monitoring

Each Retention Instance shall be monitored using one of the following Tier approaches:

Tier 1 — Self-Reported Timing (Lowest Confidence):

Participants use personal stopwatch devices and self-report hold durations via a mobile application. An uncertainty margin of $\pm 50\%$ shall be applied to all Tier 1 data to account for optimistic self-reporting, accidental early starts, and the well-documented human tendency to round breath-hold times upward.

Tier 2 — Supervised Group Events:

Participants perform breath-holds in the presence of a certified observer ("Apnea Verification Officer") who independently records start and stop times. An uncertainty margin of $\pm 15\%$ shall be applied.

Tier 3 — Instrumented Monitoring (Highest Confidence):

Participants wear nasal airflow sensors or capnography devices that directly measure the

cessation and resumption of CO₂ exhalation. Data is transmitted in real time to a write-only database. An uncertainty margin of ±5% shall be applied.

Projects seeking Absolute Class designation shall use Tier 2 or Tier 3 monitoring for at least 80% of creditable events. Projects relying primarily on Tier 1 monitoring shall be designated Catalytic Class.

5.3 Vertical Stacking Verification

For events claiming Vertical Stacking, GPS-enabled altitude data or building floor verification shall be collected for each participant to confirm that participants are, in fact, at different elevations. Participants standing next to each other on flat ground do not constitute a vertical stack, regardless of height differences among individuals.

5.4 Data Quality and Fraud Prevention

The following safeguards shall be implemented:

- Random audit breath-holds: at least 5% of reported events per Monitoring Period shall be independently verified through unannounced in-person or video observation.
- Anomaly detection: any participant reporting more than 200 breath-hold events per day, or hold durations exceeding 15 minutes, shall be flagged for review.
- Biometric cross-referencing: participants shall not register multiple accounts. One person holding their breath counts once per hold, regardless of how many devices they are carrying.

5.5 Reversal Reporting

Given that 100% of retained CO₂ is re-released upon exhalation (constituting a complete and immediate reversal), reversal reporting under this Module is simplified: every Retention Instance is simultaneously a Capture event and a full reversal. Reversals shall be reported in aggregate at the conclusion of each Monitoring Period. The 10-calendar-day reporting window for reversals is acknowledged but deemed impractical given that reversals occur approximately every 30–300 seconds.

6. Calculations and Models

6.1 Gross Temporary Retention

The Gross Temporary Retention (GTR) for a Monitoring Period shall be calculated as:

$$\text{GTR} = \Sigma (t_{\text{hold}_i} \times R_{\text{CO}_2_i}) \text{ for all events } i = 1 \text{ to } N_e$$

Where:

- t_{hold_i} = duration of the i-th breath-hold event (seconds)
- $R_{\text{CO}_2_i}$ = the participant's estimated CO₂ production rate during the hold (g CO₂/s), default value 0.006 g/s for adults at rest, adjustable based on participant body mass and activity level per Module-approved lookup tables

6.2 ReRelease Quantification

Per AEM definitions, all temporarily retained CO₂ is classified as a ReRelease flux upon exhalation:

$$\text{ReRelease} = \text{GTR}$$

This is the central thermodynamic and philosophical challenge of the Module. The retained carbon is released in its entirety, resulting in:

$$\text{Net Atmospheric Capture} = \text{Capture} - \text{ReRelease} = 0$$

6.3 The Temporal Displacement Benefit (TDB)

To address the inconvenient mathematical reality identified in Section 6.2, this Module introduces the concept of the **Temporal Displacement Benefit (TDB)**. The TDB assigns a fractional climate value to the temporary delay of CO₂ entry into the Polluting Pool, on the theoretical basis that any moment during which CO₂ is not in the atmosphere is a moment during which it is not contributing to radiative forcing.

$$\text{TDB} = \text{GTR} \times (t_{\text{hold}} / T_{\text{reference}})$$

Where:

- $T_{\text{reference}}$ = the ACS Storage Durability Threshold expressed in seconds = 1,000 years × 365.25 days × 86,400 s/day = **3.156 × 10¹⁰ seconds**

For a project with a mean hold time of 60 seconds:

$$\text{TDB} = \text{GTR} \times (60 / 3.156 \times 10^{10}) = \text{GTR} \times 1.9 \times 10^{-9}$$

This means that for every tonne of CO₂ temporarily retained, the project may claim approximately **0.0000000019 tonnes** (1.9 nanograms) of CO₂-equivalent climate benefit, before Process Emissions deductions.

6.4 Vertical Stacking Multiplier (VSM)

The Vertical Stacking Multiplier is an enthusiasm and visibility coefficient applied to synchronized, vertically distributed breath-hold events. It is defined as:

$$\text{VSM} = 1 + \ln(h_{\text{stack}} / h_{\text{ref}})$$

Where:

- **h_stack** = the vertical separation between the lowest and highest participants (meters)
- **h_ref** = reference height of 2 meters (approximate height of a single standing human)

For a 10-story building ($h_{\text{stack}} \approx 30$ m):

$$\text{VSM} = 1 + \ln(30/2) = 1 + 2.71 = 3.71$$

The VSM is applied as a multiplier to the TDB. The scientific basis for this multiplier is, candidly, nonexistent, but it rewards logistical ambition.

6.5 NEC Issuance Formula

Adapting ACS Formula (7) for VHRCR projects:

$$\text{NEC_VHRCR} = (\text{TDB} \times \text{VSM}) - \text{ProcessEmissions} - \text{UnobservRev} - \text{NonAdditional}$$

Where:

- **UnobservRev** = 0 (all reversals are fully observable and occur immediately)
- **NonAdditional** = estimated recreational breath-holding that would have occurred in the absence of the project, calculated as 0.1% of GTR by default (accounting for swimming, underwater exploration, and hiding from responsibilities)

6.6 Practical Issuance Example

Scenario: A project with 100,000 participants, each performing 10 supervised 60-second holds per day for 365 days, with a 30-meter vertical stacking event once per month.

- $N_e = 100,000 \times 10 \times 365 = 365,000,000$ events
- $\text{GTR} = 365,000,000 \times 60 \text{ s} \times 0.006 \text{ g/s} = 131,400,000 \text{ g} = \mathbf{131.4 \text{ tonnes CO}_2}$
- $\text{TDB} = 131.4 \times (60 / 3.156 \times 10^{10}) = \mathbf{2.50 \times 10^{-7} \text{ tonnes CO}_2\text{-eq}}$
- VSM (for monthly stacked events) = 3.71 (applied to stacked event subset only; blended $\text{VSM} \approx 1.02$ across all events)
- $\text{TDB} \times \text{VSM} \approx \mathbf{2.55 \times 10^{-7} \text{ tonnes CO}_2\text{-eq}}$
- **ProcessEmissions** (estimated): servers, app hosting, observer travel, merchandise = **~85 tonnes CO₂-eq**

$$\text{NEC_VHRCR} = 2.55 \times 10^{-7} - 85 = \text{approximately } \mathbf{-85 \text{ tonnes CO}_2\text{-eq}}$$

The project is therefore a net emitter of approximately 85 tonnes of CO₂-equivalent per year. No NECs shall be issued. The project shall accumulate an emissions debt per Section 1.13.1 of ACS.

6.7 Path to Viability

To achieve positive NEC issuance, a VHRCR project would need to either:

1. **Reduce Process Emissions to below 2.55×10^{-7} tonnes CO₂-eq per year** — effectively requiring the entire project to be run by a single volunteer using a sundial as a timer and communicating results via carrier pigeon (itself an additional emissions source).
2. **Scale participation to approximately 3.3×10^{13} simultaneous participants** — roughly 4,000 times the current global population — holding their breath in perfect synchrony while generating zero coordination emissions.
3. **Extend hold durations to approximately 950 years per hold** — at which point the participant's survival becomes the more pressing scientific question.

The Module acknowledges that none of these paths are currently feasible.

Appendix A: Compatibility Notes with ACS v2.1

This Module has been developed in alignment with Section 1.9 of ACS v2.1. The following ACS requirements are addressed:

ACS Requirement	Module Treatment
Zero baseline (Section 2.2)	Applied. No counterfactual avoided emissions claimed.
Storage Durability Threshold (Section 5.1)	Not met. Storage duration is 10^{-9} of threshold. TDB approach used as workaround.
ACS Consensus Criteria (Section 4.1)	Underlying respiratory physiology is well-established in peer-reviewed literature. The climate benefit of holding one's breath is not.
Buffer Pool (Section 5.6)	Not applicable. No durable storage occurs.
Additionality (Section 1.11)	Financial and regulatory additionality are readily demonstrated, as no rational economic actor or government would pursue this activity without extraordinary incentive.
Environmental and Social Safeguards (Section 1.12.2)	Participant safety is paramount. Medical clearance is required. Competitive breath-holding that induces hypoxic blackout is prohibited.

Appendix B: Frequently Asked Questions

Q: Does this Module actually work?

A: In the strictest physical sense, no. The net carbon benefit of temporary breath-holding is zero before accounting for process emissions and deeply negative after.

Q: Then why does this Module exist?

A: To demonstrate the importance of durable carbon storage in carbon crediting frameworks and to illustrate why the ACS Storage Durability Threshold exists.

Q: Can I earn carbon credits by holding my breath?

A: You are welcome to try. Based on the calculations in Section 6.6, you would need to hold your breath for approximately 950 years to generate a single NEC, assuming zero process emissions.

Q: What about Vertical Stacking?

A: Vertical Stacking is primarily an aesthetic and motivational feature. It multiplies a number that is effectively zero by a number that is slightly larger than one, yielding a number that is still effectively zero.

Q: Is this Module compatible with ACS?

A: Structurally, yes. Substantively, it would not survive the Minimum Quality and Relevance Criteria review described in Section 1.6 of ACS, as the project's case for creating a climate benefit is, to use a technical term, nonexistent.