Primer for Cascade Climate's Claims and Accounting workshop:

Balancing short-lived and long-lived climate pollutants within net-zero frameworks

New York Climate Week - September 2025

Cascade Climate

This primer was intended to provide participants background context for a Claims and Accounting workshop at New York Climate Week in September 2025. This content has not been modified or updated from the original document beyond removing workshop logistical information.

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Who is Cascade Climate?

Cascade Climate is a philanthropic-backed nonprofit helping mobilize a comprehensive response to the climate crisis by **accelerating high-potential solutions that remain on the margins of mainstream climate action.** We do this by leading ambitious initiatives spanning markets, policy and science to overcome the biggest bottlenecks to progress.

Our initial efforts have largely focused on enhanced rock weathering—a durable carbon removal approach with the potential for agricultural co-benefits, such as pH control, improved nutrient availability, and crop yield improvements—and we have expanded our work into the world of super pollutant mitigation to address the urgent risks associated with near-term warming.

Recent writings on our approach to super pollutant mitigation:

- Super Pollutant Mitigation Needs a Bigger Push—And We're Joining the Effort - July 2025
- Crossing the Bridge: How Voluntary Climate Finance Can Accelerate Sustained Policy and Industry Adoption - September 2025

The urgency of super pollutant mitigation

Mitigation of super pollutants is both urgent and underfunded.

To avert the accelerating risks of near-term warming and potential tipping points, today's climate actions must go beyond CO_2 mitigation and prioritize activities that can meaningfully contribute to reducing near-term warming on rapid timescales. The mitigation of super pollutants—climate-warming agents that are far more powerful at warming the climate than carbon dioxide per ton—represents our best tool to meaningfully reduce radiative forcing on short timescales.

Climate Super Pollutants
Warming agents far more potent than carbon dioxide per ton

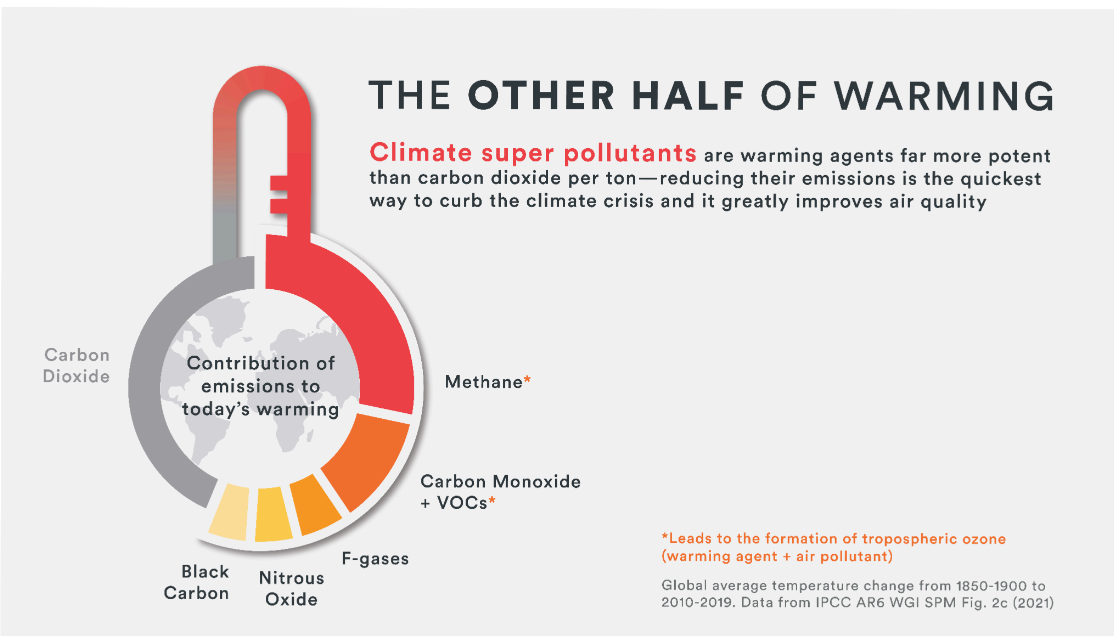
WARMING AGENTS	MAJOR HUMAN SOURCES	ATMOSPHERIC LIFETIME	WARMING POTENCY GWP20	WARMING POTENCY GWP100
Carbon Dioxide (CO_2)		Centuries	1	1
Methane (CH_4)		Decades	~80	~30
Tropospheric Ozone (O_3)*	CH_4, CO, VOCs	Weeks to months	n/a	n/a
Carbon Monoxide (CO)*		Weeks to months	~6	~2
Volatile Organic Compounds (VOCs)*		Minutes to years	~2	~0.4
Fluorinated-gases (F-gases; e.g. hydrofluorocarbons (HFCs))		Years to decades	~4100	~1500
Nitrous Oxide (N_2O)**		Centuries	~270	~270
Black Carbon (BC)*		Days	~2400	~660

*Air pollutant
**Depletes the ozone layer

Sources of Global Warming Potentials (GWP): CO2, CH4, VOCs (as ethane), HFCs (as HFC-134a), N2O from IPCC AR6 WGI 2021; CO, BC from IPCC AR5 WGI 2013. GWPs are for emitted compounds; tropospheric ozone is not emitted but formed in the atmosphere. GWP20/100 refers to the warming impact of a pulse of emissions over a 20/100-year time horizon, relative to that from CO2.

Courtesy of Climate and Clean Air Coalition (CCAC).

Super pollutants have much shorter residence times in the atmosphere than CO_2, but a much higher warming impact. Collectively, these compounds account for [35% or more] of global warming to date, with some estimates [as high as roughly half]. [Studies] [suggest] that full-scale efforts to slash super pollutant emissions could avoid more than 0.5°C of warming by 2050 and more than 1.5°C by 2100.



Courtesy of Climate and Clean Air Coalition (CCAC).

Reductions and removals on the path to net zero

CO_2 emissions reductions, super pollutant mitigation, and GHG removal all play distinct roles on the path to net zero.

Different tools are needed to address near-term warming compared to long-term warming—the former being the progression in global temperatures over the next several decades, and the latter being the temperature trajectory over the coming century and beyond.

GHG emissions must be cut across economic and land-use sectors to restore global temperatures to pre-industrial levels. However, not all GHGs are created equal; the most abundant long-lived climate pollutant, CO_2, has lower radiative forcing impacts but stays in the atmosphere for centuries. Precisely because of CO_2's long residence time, mitigating a tonne of CO_2 today does little to slow the rate of near-term warming.

Carbon dioxide removal (CDR) will be necessary to compensate for residual emissions and to drive towards net-negative CO_2 over the long term. Investment in CDR today is critical to both protect and enhance our natural carbon sinks through temporary nature-based removals, and to support the rapid learning and scale up of high-durability removals towards future gigaton capacity. However, the climate benefit of carbon removal accrues slowly—while these investments are essential for long-term climate stability, CDR will not meaningfully contribute to mitigating warming in the next several decades. There also remains ongoing debate within the carbon removal community on the role that more temporary natural climate solutions should play on the path to net zero.

Because of their high radiative forcing impact but shorter atmospheric lifetimes, super pollutant reductions provide the potential to meaningfully lower near-term warming and reduce the risk of crossing climatic tipping points, with benefits felt in years-to-decades. Because their climate impact is frontloaded, super pollutant reductions are a crucial complement to CO_2 reductions and removals—"buying time" for deep CO_2 cuts and removals scale-up. While super pollutant reductions provide critical near-term risk reduction, they are not a substitute for the durable removals needed to achieve and sustain net-zero long-term.

Super pollutant mitigation provides a high-impact, near-term complement to CO_2 reductions and removals, providing the potential to meaningfully reduce radiative forcing on short timescales, which would lower peak warming and reduce the risk of crossing climatic tipping points.

The equivalency of CO_2 and non-CO_2 gases

Key question: *Can super pollutants and CO_2 be considered fungible with each other via equivalency metrics?*

Context:

Historically, most climate mitigation policies have considered the impact of GHGs by determining the global warming equivalency between different pollutants as compared to CO_2, and measuring reductions in terms of CO_2 equivalence—or "CO_2e." The CO_2e unit allows different GHGs to be treated as "fungible" in carbon accounting.

Fungibility is at the core of how we value CO_2 and non-CO_2 gases today, and fungibility using equivalency with a 100-year global warming potential (GWP100) is the de facto standard for international reporting and most national inventories and NDCs. UNFCCC guidance directs Parties to use 100-year GWP values from IPCC assessments.

Fungibility comes with several distinct benefits:

- **Simpler reporting:** A single CO_2-equivalent number makes inventories, targets, and climate goals easier to produce and understand at both corporate and national levels. A single metric also makes cross-sector policies much more straightforward—for example, combining heavy industry and agricultural emissions under a domestic compliance system.
- **Enables comparison across projects in a market context:** Treating emissions as fungible allows for the use of more standard financial instruments (CO_2-equivalent carbon credits, asset-backed securitization, blended finance) across CO_2 and non-CO_2 gases with "carbon" as an investable asset class. This can reduce transaction costs and increase participation from institutional financiers and large corporate actors.
- **Cost-effective abatement:** Theoretically, the use of a single metric enables policymakers to compare different mitigation options on the same scale and choose to prioritize the most cost effective mitigation approaches.

However, some researchers and jurisdictions are exploring alternatives to an equivalency framework. There is a growing body of research that suggests that treating all GHGs as fungible via CO_2e can undervalue the temperature effects of short-lived pollutants, leads to worse climate outcomes, and can create perverse incentives (e.g., using temporary methane cuts to offset long-lived CO_2 emissions). Equivalency approaches embed subjective design choices (e.g., time horizon) that reflect value judgements (e.g., near-term vs. long-term climate priorities), and without transparency, they can be gamed to present those choices as objective fact. As such, many experts caution against treating CO_2 and non-CO_2 gases gases as fully interchangeable, especially in policy targets.

Equivalency approaches and metrics

GWP Metrics

What is GWP?
Via the GHG Management Institute, Global Warming Potentials (GWPs) measure the globally averaged relative radiative forcing of a greenhouse gas compared to CO_2, defined as the cumulative direct and indirect forcing from a unit mass of gas integrated over time. GWPs allow comparison of emissions or removals across gases, and apply to units of mass (e.g., kilograms, metric tons), not volume. Despite their widespread usage and importance in climate decision making, common GWP metrics like GWP100 were not intended to be used as definitive metrics; they were proposed in the IPCC's First Assessment Report in 1990 as "simple" and "preliminary" metrics where the time horizons used had no particular scientific importance.

GWP100: The de-facto standard metric that compares the climate impact of greenhouse gases by measuring the amount of heat a specific mass of the gas absorbs over 100 years relative to the same mass of CO_2.

- *Primary criticisms: De-emphasises short-lived pollutants relative to their near-term temperature effect; the 100-year horizon is arbitrary and can hide near-term warming risks.*

GWP20: Takes the same approach as GWP20, but looks at radiative forcing over a 20 year timeframe rather than a 100 year timeframe, giving much higher CO_2e multipliers for short-lived but potent gases.

- *Primary criticisms: The choice of 20 years rather than 100 is equally subjective; it would serve to shift incentives towards shorter lived gases, but faces the same underlying equivalency challenges. Would require a material shift away from the 100 year timeframe, the implications of which are not yet fully understood.*

GWP*: Newer metric based on changes in emission rates relative to a historical baseline, designed to better reflect temperature outcomes rather than integrated radiative forcing. In practice, this use of historical baseline emissions means that non-increasing but constant levels of super pollutant emissions would show little or no additional warming when using GWP*.

- *Primary criticisms: Concerns that GWP* can be misinterpreted or misused to understate responsibility for sustained emissions; internalizes and discounts continued high levels of anthropogenic emissions; difficult to calculate and confusing to explain.*

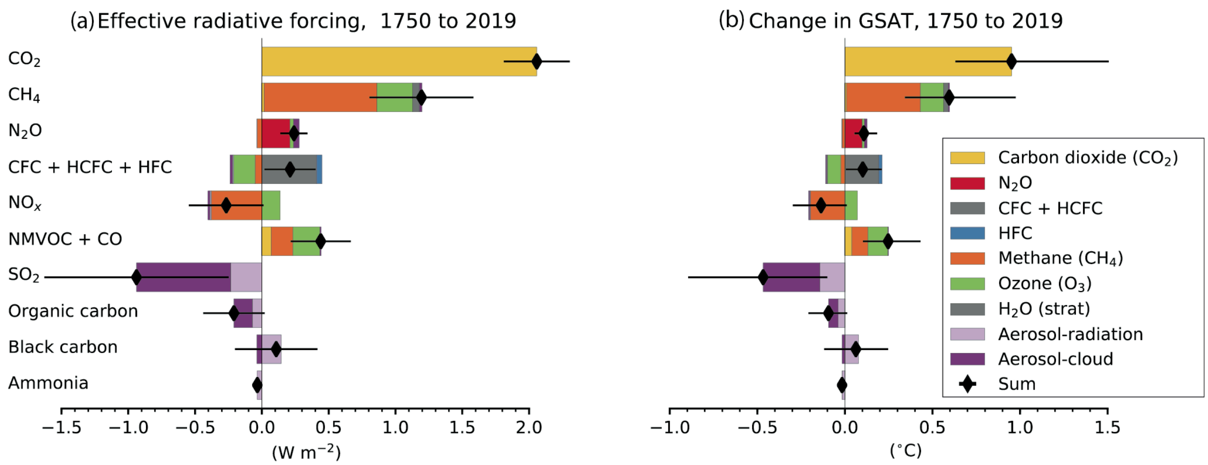
Summary of Emission Metrics

Metric	Definition	Pros	Cons
GWP-20	The amount of energy one ton of a gas absorbs in the atmosphere relative to carbon dioxide over a specific time period.	• Emphasizes the effect of short-lived gases • Less uncertainty than temperature metrics and GWP-100	• Less policy relevance than metrics that measure temperature • Does not estimate any effects after 20 years
GWP-100		• Accounts for long-term effects • Less uncertainty than temperature metrics	• Less policy relevance than metrics that measure temperature • Deemphasizes the effect of short-lived gases
GTP-100	The surface temperature change from one ton of a gas relative to carbon dioxide at the end of a specific time period.	• Greater policy relevance than measures of radiative forcing	• Only measures temperature change at one moment in time so can miss temperature peaks • More uncertainty than radiative forcing metrics
GWP*	The amount of energy a step-change emission of a gas absorbs in the atmosphere relative to a pulse emission of carbon dioxide over a specific time period.	• A more accurate representation of the environment because it compares a pulse of CO_2 to a step change of a short-lived gas • Designed to be easily implementable into current policy	• Relies on GWP values to calculate the effect of step emissions, making the metric less accurate than CGTP • Applicable only for short-lived gases - other metrics are needed for long-lived gases.
CGTP	The surface temperature change from a step-change emission of one gas relative to a pulse emission carbon dioxide at the end of a specific time period.	• A more accurate representation of the environment because it compares a pulse of CO_2 to a step change of a short-lived gas • Uses a formal definition to quantify the effect of a step change emission, improving on GWP* approximations • Compares temperature effects, making it useful for many climate goals	• Applicable only for short-lived gases - other metrics are needed for long-lived gases. • Only measures temperature change at one moment in time so can miss temperature peaks

Summary of emissions metrics, via the Carbon Containment Lab. GTP (Global Temperature change Potential) and CGTP (Combined Global Temperature Change Potential) are not discussed in this briefing, but are described in detail in the link above.

Radiative Forcing (RF) Metrics
Radiative Forcing is the metric used to measure the Earth's energy balance — the difference between the amount of incoming shortwave radiation from the sun and outgoing thermal radiation from the Earth that goes back into space. It is the unit by which scientists measure the Earth's excess trapped heat, measured in watts per square meter, or W/m^2.

GWP is a radiative forcing-based metric, but **GWP and RF are not interchangeable;** RF provides a snapshot of Earth's energy imbalance for a given GHG at a given point in time, while GWP is a relative, time-integrated metric that sums the cumulative radiative forcing of a GHG over a given time horizon (e.g., 100 years) against a reference gas (e.g., CO_2). You can find a short briefing note on Radiative Forcing-based accounting **here**.



Via IPCC AR6 WGI Chapter 6 2021. Panel (a) represents radiative forcing and Panel (b) represents the change in global surface temperature (GSAT).

Several organizations have put forward approaches that utilize RF as a complement to traditional GWP-based accounting approaches to better consider short-lived climate impacts:

- In a policy context, the Institute for Governance and Sustainable Development (IGSD) has worked with the state of Punjab in India to develop a government-led Action Plan to deal with emissions of non-CO_2 GHGs. The Action Plan sets out a dual approach pairing long-term CO_2 reductions with fast, near-term cuts in short-lived non-CO_2 greenhouse gas emissions, based on the radiative forcing approach. More on the strategy behind this approach and its potential effect on India's obligations under the EU's Carbon Border Adjustment Mechanism (CBAM) is here.
- In a market context, the Global Heat Reduction Initiative has brought a Radiative Forcing Protocol to market issue "Heat Reduction Credits". These credits are issued in tonnes of CO_2e units and include heat reduction data from super pollutants over any timeframe (GWP10, 20, 100) - complementing GWP metrics, rather than replacing them.

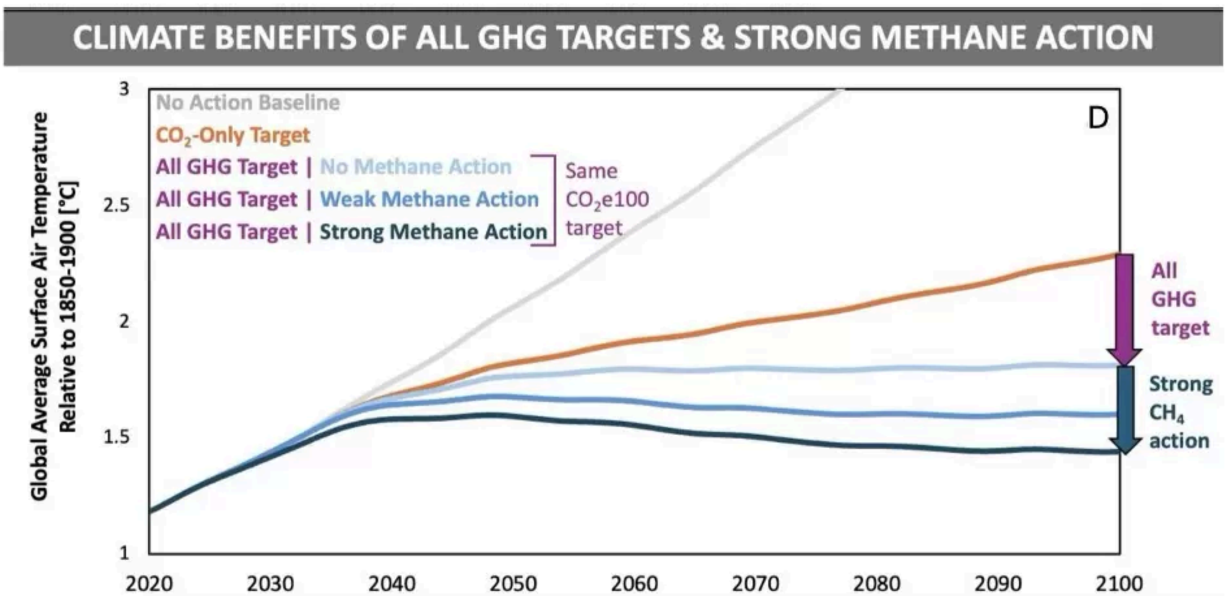
Non-equivalency-based approaches

"Multi-bucket" approaches

Established methods of combining gases into CO_2-equivalents using GWPs lead to ambiguity because they obscure the distinct warming impacts of different GHGs. The "two-bucket" or "multi-bucket" framework separates out accounting and goal-setting for short-lived and long-lived pollutants.

Ideally, a multi-bucket framework would lead to better estimations of the likelihood for emission pathways to meet a near-term warming goal. Because each "bucket" differs by atmospheric lifetime and radiative forcing dynamics, the approach is also more representative of the underlying science and physical differences between gases than using conversions to a single CO_2e-based metric and goalset.

A shift toward this approach is likely to encounter near-term implementation challenges around more complex reporting, comparability problems against single-basket systems and goals, and subjective metric choices in both the private and public sector. As an example, this approach would require corporations to maintain dual ledgers for different gases in the private sector, and significant international coordination so national inventories and corporate reports remain comparable in the public sector.



Illustrative scenario of methane mitigation impacts of warming under the same CO_2e target - via [Climate & Clean Air Coalition](#).

Hybrid approaches

Horizontal stacking: “Horizontal stacking” is a market-based accounting approach for climate projects with benefits on different timescales. The approach “stacks” the climate impact of projects to ensure that their cumulative radiative forcing remains constant over time—e.g., that the warming impact of an emission is cancelled out by net cooling impact of the interventions being supported in a given year. In practice, this means GHG credit buyers would match super-pollutant credits against shorter-lived emissions in their footprint, or replace them with longer-lived carbon removal credits as their atmospheric impact expires.

In theory, the benefit of this is two-fold: it allows private sector action on near-term warming via support for super pollutant mitigation projects immediately, while also providing the long-term demand necessary to begin to scale carbon removal over the coming decades. This would ensure that radiative forcing impacts are maintained over that transition towards durable CDR.

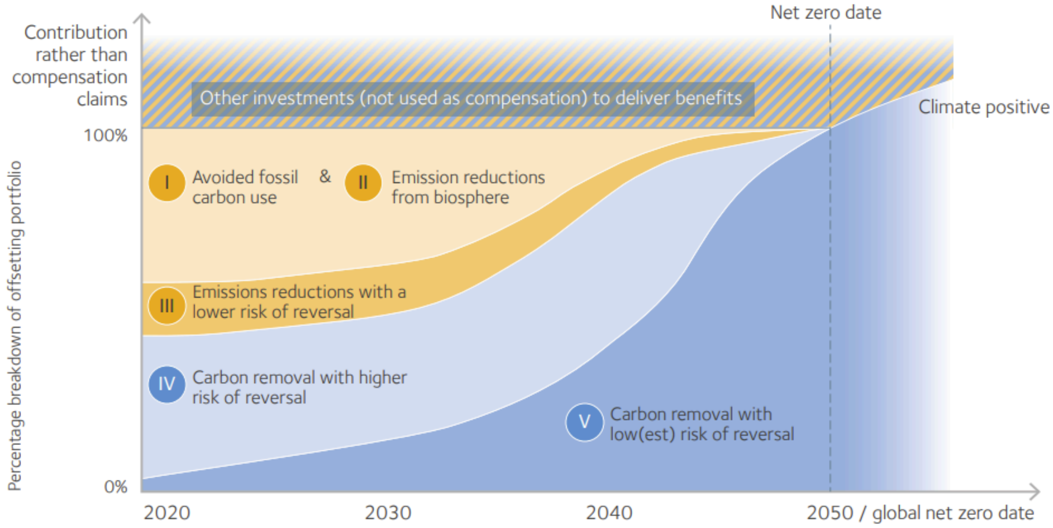
This approach may also come with implementation challenges, including complexity for market adoption among general market audiences and the need for buyers to "carry" emissions liabilities until short-term credits are replaced.

Additional relevant frameworks and initiatives

"Contributional allocation" approach: Market-based approach where companies choose to prioritize climate investments in areas they deem to have the greatest impact, rather than for the purpose of "compensating" (e.g., offsetting) specific climate damages. This approach provides more flexibility to companies who want to tell an impact-based story, but could inhibit companies from making credible net zero claims. This approach is particularly utilized for supporting early-stage, innovative climate projects that might not be "market ready" to make claims against, but require catalytic capital to move up the maturity curve towards scale.

"Like-for-like" accounting: The "like-for-like" approach—typically discussed in the CDR context—asserts that fossil carbon emissions originating from long-term geological stores should only be counterbalanced by removals with guaranteed storage durations (e.g., greater than 1,000 years). Guidance that follows the "like-for-like" principle therefore emphasizes redistributing excess atmospheric CO_2 from fossil emissions back to historical geological pools, and discounts the value of more temporary nature-based removals. This approach is currently being considered within SBTi's Corporate Net Zero revision process, and is the basis of the Oxford Principles approach to net-zero-aligned offsetting.

Many proponents of like-for-like accounting suggest that this transition to high-durability CDR needs to happen over time, given the early nature of these approaches today. In certain cases, like-for-like accounting may also be used to refer to matching specific gases to specific emissions profiles for the purposes of offsetting (e.g., using a methane abatement ton to compensate for a company's methane emission), as is the case with "horizontal stacking" described above.



Via Oxford Principles.

Relevant initiatives and resources (non-comprehensive)

- In the leadup to Climate Week, Absolute Climate and Carbon180 have released a piece on "Principles for Responsible Use of Short-Lived Climate Pollutant (SLCP) Mitigation for CO_2 Compensation", which explores how short-lived climate pollutants like methane should be accounted for when used to offset long-lived greenhouse gas emissions like CO_2. Co-authors Peter Minor (Absolute Climate) and Noah McQueen (Carbon180) spoke about these principles at the workshop.
- In the leadup to Climate Week, Calyx Global and the Carbon Containment Lab have collaborated on a piece around the current state of super pollutant crediting in the voluntary carbon market. Donna Lee, one of the co-authors, shared more on this data and the market context at the workshop.
- The e-Ledgers Institute is a non-profit organization focused on rigorous emissions accounting practices based on the principles of financial accounting. Under their approach—which is currently being piloted by a number Fortune 500 companies—emissions and removals are separated into "E-liabilities" and "E-assets", where "E-liabilities" represent units of GHG emissions that can be attributed to a given entity or product, and "E-assets" represent units of GHG removals that can be attributed to a given entity or product. Their E-Asset framework establishes the conditions under which an act of removing GHG from the atmosphere can be recognized as a tradeable asset on an E-ledger, and when such an asset can be used to "net" against E-liabilities (to help establish an entity or product's claim to be "net zero"). More information on the E-Ledgers carbon accounting approach can be found here.