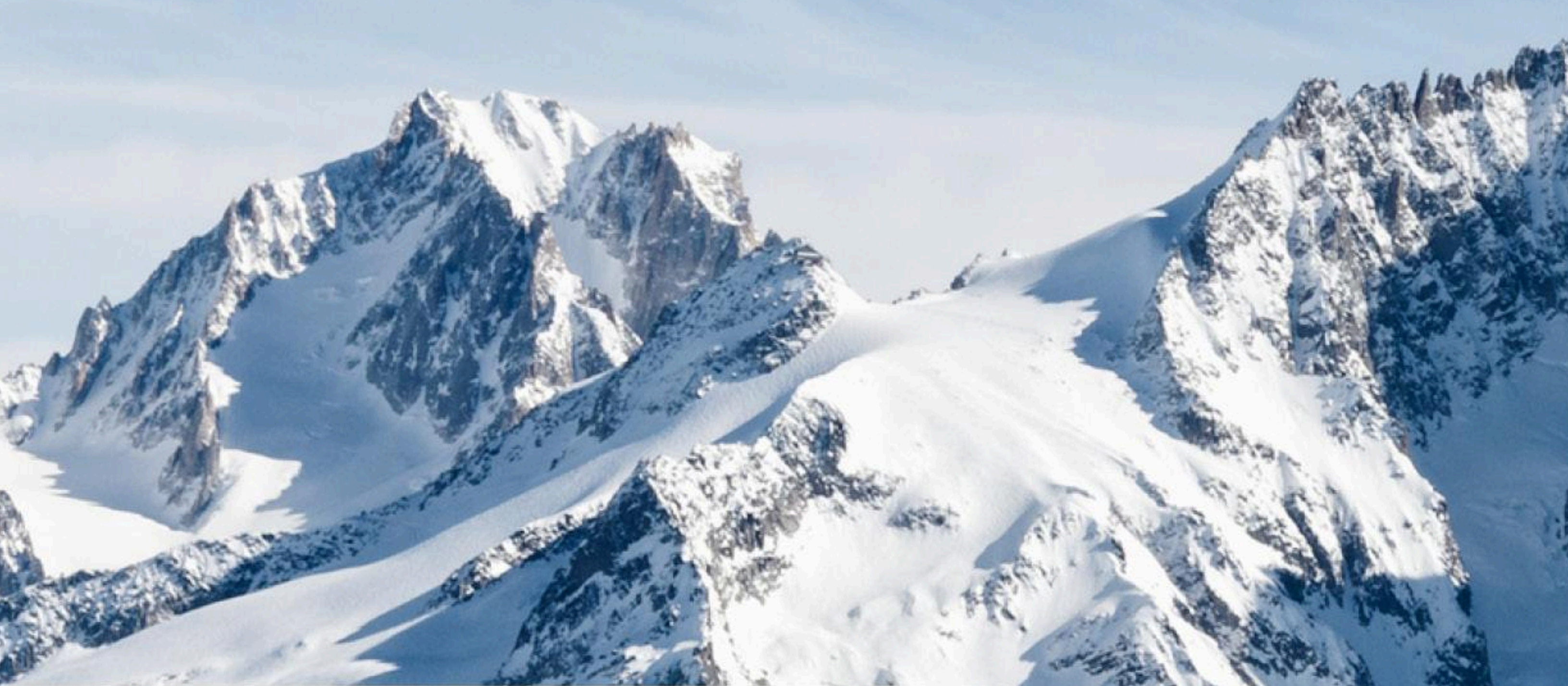

The Heatprint™: A Crucial New Decision Tool for Effective Climate Action

Enabling capital allocators, business leaders, and policymakers to better manage risk, cost and climate outcomes across near- and long-term timeframes.

GLOBAL HEAT REDUCTION™

CLIMATE DECISION INTELLIGENCE

Executive Summary

Organizations today have no shortage of greenhouse gas emissions data. Carbon accounting, CO_2e reporting, and long-term net-zero planning are now standard parts of climate strategy. But decision-makers increasingly face a different challenge: understanding how to interpret these emissions data in terms of actual impact, and identifying which actions reduce climate risk fastest, especially over crucial near-term timeframes.

Climate related physical and financial risks are no longer theoretical or distant. Heat, wildfire, flooding, insurance pressure, supply-chain disruption, and infrastructure stress are already affecting operational and financial decisions. As a result, organizations need climate information that supports both long-term decarbonization and near-term risk reduction.

Total Climate Accounting™ is Global Heat Reduction's framework for translating internationally-vetted radiative forcing science into practical decision intelligence.[1] Total Climate Accounting adds a time-resolved heat lens called a Heatprint™ which helps organizations evaluate how different emissions sources and mitigation actions influence atmospheric heat over time. The Heatprint complements conventional GHG inventories and CO_2e reporting by connecting emissions data to timing, climate impact, and capital allocation decisions.

The need is simple. A tonne is not a tonne in terms of climate impact. The same 1,000 t CO_2e reduction, calculated using the 100-year global warming potential (GWP100), can produce very different heat outcomes depending on:

- whether the intervention addresses CO_2, methane, HFCs, black carbon, or another climate driver;
- whether the pollutant is long-lived or short-lived;
- where and when the emissions occur; and
- whether the goal is to reduce risk by 2030, 2040, 2050, or over a longer planning horizon.

For investors and asset managers, corporate CFOs and sustainability teams, public agencies, data service providers and carbon-credit buyers, that distinction matters. A portfolio optimized only for t CO_2e may not be optimized for heat reduction, near-term risk reduction, or climate return per dollar spent (i.e., climate ROI).

The Heatprint analysis fills this important gap, providing the additional information required to compare climate mitigation options, sequence investments for maximum impact, and communicate investment's climate impact in terms that are closer to the physical outcome experienced in the atmosphere, by our organizations, and in our lives.

This paper explains the decision problem that the Heatprint addresses, the science behind Total Climate Accounting, the structure of the framework, and use cases where the approach is most immediately relevant: enterprise climate strategy, investment and portfolio valuation (including emissions reduction projects and credits), data platform integration, and public-sector climate planning. This paper also clarifies that the Heatprint is an adjunct to, rather than a substitute for, GHG inventories and CO_2e accounting. By adding the impact-lens to emissions-output reporting, climate finance will more naturally flow to those solutions most likely to slow the rate of warming over the critical next two decades.

Key takeaway

The Heatprint, based on Total Climate Accounting, adds a key decision layer to climate accounting by covering a broader range of climate drivers that shows which actions reduce atmospheric heat fastest, and over what timeframe.

1. The Problem: CO_2e is Necessary, But Insufficient

Carbon dioxide equivalence, calculated as t CO_2e using GWP100, was designed to support comparable emissions inventories. It is useful, widely adopted, and required for regulatory and voluntary reporting. But when the

[1] Radiative forcing is the underlying metric used to describe the heating or cooling effect of different emissions on the climate.

question shifts from “What did we emit?” to “Which action reduces climate risk fastest?,” a single 100-year emissions-equivalent number can obscure decision-critical information.

GWP100 spreads the radiative effect of different gases across a fixed 100-year horizon. That convention creates a common reporting unit, but it also makes very different climate drivers look more interchangeable than they are. Methane, many HFCs, black carbon, and other short-lived climate pollutants exert the bulk of their climate effect within days, months, or a few years , whereas CO_2 persists and accumulates over centuries. Both categories matter, but they matter differently over time.

That difference becomes especially important between now and 2050, the net zero target. Organizations are increasingly making capital decisions related to near-term physical risk, insurance exposure, public-sector heat concerns, supply-chain vulnerability, and pressure to demonstrate measurable progress this decade. A long-term CO_2e metric alone cannot answer which interventions reduce heat fastest in the years when risk is compounding. This is why near-term super-pollutant mitigation and long-term CO_2 reduction should be treated as complementary strategies. CO_2 reduction determines the long-term pathway; reductions in methane, HFCs, black carbon, and other short-lived climate pollutants can reduce heat faster in the years when physical risk is accelerating.

How this affects capital allocation

A company may have several climate projects under consideration or already being implemented, such as methane abatement, fleet electrification, tree-planting initiatives, refrigeration management, procurement changes, or process-efficiency improvements. Under a conventional carbon footprint viewpoint, those projects may appear comparable if the reported t CO_2e are comparable. Through the Heatprint lens, the company can see how each projects’ near-term and long-term physical impacts can differ substantially. The Heatprint is not the sole decision tool for the organization, but rather, augments other decision factors with a vital reality check on efficacy. It gives the organization a more complete decision framework: heat avoided, timing of impact, pollutant mix, cost, uncertainty, and alignment with both near-term and long-term objectives.

2. Total Climate Accounting: A CO_2e-PLUS Framework for Calculating a Heatprint

Total Climate Accounting is GHR's commercial framework for translating radiative forcing science, as described in the Intergovernmental Panel on Climate Change (IPCC) consensus reports, into decision intelligence. It is best understood as a CO_2e-PLUS approach: the conventional GHG inventory and resultant CO_2e-based carbon footprints remain in place, while the Heatprint adds an essential complementary lens, reporting the atmospheric heat impact associated with an organization, project, or portfolio over time. It can be expressed in physical energy terms such as terajoules (TJ), in W/m^2 for technical audiences, and in accessible equivalencies for stakeholder communication.

Because the Heatprint is time-resolved, it can show annual and cumulative heat impact across any time horizon – for example 1, 5, 10, 25, and 100 years – rather than presenting only a single 100-, or even 20-, year equivalence. This allows organizations to see both the immediate value of short-lived climate pollutant reductions and the durable importance of these reductions over time, along with the importance of reducing CO_2 and other long-lived GHGs.

What’s included:

- Long-lived, well-mixed greenhouse gases, including CO_2, nitrous oxide, SF_6, some HFCs, PFCs, and other gases commonly tracked in GHG inventories.
- Short-lived, well-mixed greenhouse gases, including methane and some HFCs.
- Additional short-lived climate pollutants that can materially affect near-term heat, black carbon, organic carbon, precursor gases to the formation of ozone (NOx, VOCs), and sulfate and nitrate aerosols where data

quality is sufficient.

- Time-resolved heat impact across multiple horizons, so the same analysis can support near-term risk decisions and long-term decarbonization strategy.
- Legacy effects of greenhouse gases where past emissions remain relevant to present-day forcing and cumulative heat impact.
- Surface reflectivity effects ("albedo") where they are methodologically supported today, especially black carbon deposition on snow and ice. Broader non-emission albedo applications may become part of the framework as data and methods mature.

CO_2e (GWP100) compared to Heatprint

Dimension	CO_2e (GWP100)	Heatprint
Primary function	Comparable GHG emissions inventory and reporting.	Decision support built on top of the inventory.
Timeframe	Usually a single time horizon (100-year).	Multiple time horizons, enabling immediate, near-term and long-term comparison.
Pollutant insight	Aggregates GHGs into a common tonne metric.	Disaggregates climate drivers and shows their heat trajectory over time, including drivers omitted from conventional accounting, and provides aggregated total heat impact.
Pricing and prioritization	Useful for compliance and tonne-based tracking.	Provides the information needed to determine Climate ROI – heat avoided per dollar spent – and incentivizes additional mitigation measures frequently overlooked or undervalued.
Relationship to standards	Core basis for current regulatory and voluntary reporting.	Complementary layer intended to supplement existing accounting.
Public assertions	Basis for voluntary reporting	Provides decision-useful information to share with internal and external stakeholders, including climate drivers omitted from conventional reporting.

Two levels of assessment:

1) A **Level 1 Assessment** is based on an existing GHG emissions inventory where results are disaggregated by pollutant.

2) A **Level 2 Assessment** goes deeper, tapping the same data that organizations or project developers collect for their inventory or carbon footprint. For organizations, this includes activity data such as fuel use, electricity use, material flows, refrigerant information, waste-management data, and other Scope 1, 2, and 3 inputs. For project developers, this is the data used to generate the project and baseline values. In some cases, additional data may be required where material short-lived climate pollutants, regional effects, or project-specific assumptions are central to the assessment results.

3. The IPCC-aligned Science Behind the Heatprint

Radiative forcing (RF) measures whether human activity is adding to or reducing the excess heat trapped in the Earth system. (Technically, RF is the net change in downward minus upward radiative flux at the top of the atmosphere, expressed in watts per square meter (W/m^2)). Positive forcing adds heat, while negative forcing reduces it. RF is the core underlying metric used to understand how all climate drivers alter the Earth's energy balance. CO_2e metrics are based on RF – GWP values exist because RF can be estimated for different gases over time.

Total Climate Accounting is based on RF, which is applicable to all climate forcers (not just gases). This common feature lends itself to aggregation across different timeframes, with legacy impacts of climate pollutants integrated over each year of the analysis. That makes it suitable for decisions where timing matters.

The Radiative Forcing Protocol v2.1 is the methodological backbone for the Total Climate Accounting framework. It is derived from information provided in the IPCC AR5 and AR6 reports, and was independently reviewed by selected members of the Climate and Clean Air Coalition Scientific Advisory Panel. Total Climate Accounting turns the Protocol into decision-useful guidance for organizations, whether they are assessing their current operations, or deciding where to allocate capital.

4. Use Cases

Use Case 1 - Enterprise Climate Strategy and Capital Allocation

For CFOs, sustainability officers, investment portfolio managers, public-sector leaders, infrastructure managers, and operating teams responsible for climate strategy, capital planning, and stakeholder reporting.

Goal

Apply Heatprint lens to existing data to identify the most cost-effective and impactful climate options to achieve stated goals.

Decision Insight Sought

The organization has a net zero roadmap which identifies which projects reduce the most tonnes of CO_2e (GWP100), e.g., by 2050. But it does not identify which projects reduce the most atmospheric heat by 2050 or which mitigation dollars produce the greatest near-term risk reduction. The Heatprint provides answers for these additional questions, and can help organizations quantify and communicate the true climate value derived from actions already underway or to which they are already committed — such as methane reduction, refrigerant management, black carbon reduction — that may be undervalued or invisible in a conventional CO_2e-only view.

Data and Deliverables

An organization begins with its existing GHG inventory and relevant activity data, then has GHR extend the analysis to produce a Heatprint. The Heatprint helps the team identify major hotspots, compare actions, and sequence capital investments. Potential deliverables include annual and cumulative heat-reduction trajectories and targets, comparative project ranking by climate impact, and heat avoided per dollar invested (climate ROI).

Pilot Studies

In an apparel sector application, the heat reduction result was translated into a stakeholder-friendly equivalency: eliminating the annual energy demand of 377 average U.S. homes. This type of translation helps sustainability teams communicate tangible outcomes rather than abstract outputs.

In another case, a municipal solid waste company applied the Heatprint lens to its composting operations across 2030, 2040, and 2050 horizons to secure greater municipal investment. Additionally, the company used the framework to quantify the near-term climate benefits of installing an anaerobic digester to generate renewable natural gas for its truck fleet. Finally, it compared expanding composting operations against fleet electrification over identical near-term timeframes.

While both projects delivered a t CO_2e reduction, revealing the stark difference in their near-term heat reduction altered the company's investment priorities. As the client lead noted, "the analysis made me realize that it may be better to tackle those methane emissions before undertaking some other projects." This highlights the core commercial value: clear visibility into which interventions maximize heat reduction over an organization's specific decision horizons.

A third pilot enabled an agricultural company to compare its Scope 3 footprint against competitors reliant on crop residue burning. The resulting black carbon emissions — typically omitted from standard carbon footprints — were accounted for under the Total Climate Accounting framework, revealing hidden differences in real-world heat impact.

Use Case 2 - Carbon Credits, Emissions Reduction Projects, and Investment Portfolio Valuation

For carbon credit buyers, super pollutant project developers, marketplaces, exchanges, registries, standards bodies, funds, and corporate climate teams with internal abatement programs or insetting strategies seeking to distinguish projects by actual climate impact rather than t CO_2e GWP100 alone.

Goal

Apply Heatprint lens to provide an enhanced market valuation basis for projects based on their near-term heat reduction potential and relevance to buyer, registry, and investor goals.

Decision Insight Sought

Under conventional carbon accounting, 1,000 t CO_2e from a methane-eliminating or HFC-eliminating project may appear equivalent to 1,000 t CO_2e from a CO_2-only project. The heat outcomes can differ materially, particularly over a 10-25 year horizon. The same is true at the investment level: two portfolios with identical CO_2e totals can cause drastically different near-term warming, depending on which gases their holdings emit.

Data and Deliverables

Total Climate Accounting evaluates a project-level GHG inventory by climate driver, baseline scenario, project scenario, and timeframe. The Heatprint shows atmospheric heat emitted or avoided per project, per credit class, or per standardized unit of claimed CO_2e reduction. Buyers receive an additional basis for comparing credit types; developers receive a defensible way to explain differentiated near-term climate value.

Pilot Study

In this study, a well-capping, methane-focused project was compared to a CO_2-emissions reduction project with the same t CO_2e (GWP100) claim. The well-capping project reduced 3.7-x more heat in the first ten years than the CO_2-only project. That difference is the basis for value-based pricing: not every tonne has the same atmospheric value over the timeframe a buyer cares about.

Use Case 3 - Public-Sector Climate Planning

For public agencies, districts, committees, and boards responsible for climate action plans, infrastructure investment, and constituent-facing climate risk reduction.

Goal

Apply Heatprint lens to incorporate all climate drivers into data collection and analysis, so that public-sector action plans prioritize the most cost-efficient heat and climate mitigation outcomes for taxpayers.

Decision Insight Sought

Public agencies often plan against long-term CO_2e-based targets, but face near-term, constituent-facing pressures, extreme heat, wildfire, flooding, and infrastructure stress, that a 100-year metric does not help sequence. The Heatprint, based on Total Climate Accounting, shows which publicly funded interventions, such as fleet electrification, waste and wastewater management, or building retrofits, reduce the most near-term heat per dollar of public spending, helping agencies defend budget requests and demonstrate measurable progress within a single budget or political cycle.

Data and Deliverables

A public agency begins with its existing emissions inventory or climate action plan, and GHR extends the analysis to identify key hotspots across departments or programs, along with the projects delivering the most heat avoided per public dollar spent. Deliverables can include comparative program ranking, near-term heat reduction trajectories aligned to budget and political cycles, and stakeholder-ready reporting for boards, committees, and constituents.

Pilot Study

A county-level project is currently underway. Results will be reported in Q1 2027.

Use Case 4 - Data Services and Platforms

For SaaS platforms, carbon registries, ESG data providers, and climate analytics services seeking to add time-resolved heat impact metrics to their existing datasets.

Goal

Integrate Heatprint data within an existing data platform, enhancing the value of the platform's existing carbon accounting, ESG and/or risk analytics datasets for its own clients.

Decision Insight Sought

Data platforms currently offer clients CO_2e-based footprints, inventories, carbon credit portfolios, and more, without a means of showing which drivers or interventions matter most within a decision-relevant timeframe. Adding the Heatprint gives a platform's clients the same near-term, time-resolved view already available to GHR's direct enterprise, government, and investor clients.

Data and Deliverables

GHR connects its Heatprint computational engine to a platform via API, using the platform's existing disaggregated emissions or reductions data (organizational footprints, mitigation investment options, offsets and insets, Scope 1, 2, and 3 data, etc.) as inputs. Results are calculated automatically and reported side-by-side with CO_2e, across near- and long-term timeframes, with accessible heat equivalencies for the platform's end users. GHR also trains the platform's team on the underlying time-resolved data and works with the platform to display near-term heat and pollutant reductions.

Pilot Study

A Heatprint data-layer integration with a carbon credit registry is currently underway. Results will be reported in Q1 2027.

5. Climate ROI: From Output to Outcome

Climate ROI measures impact per dollar spent, expressed as atmospheric heat avoided (e.g., terajoules) over a specific timeframe. Connecting heat reduction to avoided physical risks, insurance exposure, and economic damages bridges climate science and financial decision-making.

This shifts the prioritization conversation. While a budget allocated solely by standard carbon metrics (GWP100) produces one sequencing of projects, allocating by heat avoided per dollar maximizes near-term cooling. Adding the Heatprint as an outcome variable allows capital to be deployed more strategically.

Because decision-makers have varying horizons, the Heatprint allows each to customize their analysis:

- Cities can focus on immediate local extreme heat and net-zero targets.
- Corporations can protect long-lived assets across 2030 and 2050 horizons.

- Asset Managers can optimize portfolio balance, near-term cooling, and permanence.
- Data Platforms can surface time-resolved insights on where emission cuts land fastest.

Why This Matters for Markets

Voluntary carbon markets and climate portfolios face escalating pressure to prove credible impact. Buyers, boards, and regulators now require granular insights into timing, durability, and physical outcomes that traditional CO_2e metrics obscure.

Integrating Heatprint data transforms two critical areas:

- **Carbon Markets:** It differentiates projects that look identical in CO_2e terms but deliver vastly different near-term cooling impacts.
- **Enterprise Portfolios:** It supplements traditional GHG inventories to show how a company actively reduces atmospheric heat and strategically balances immediate risks with long-term decarbonization.

6. Strategic Implications

Total Climate Accounting reframes climate management by shifting the focus from volume outputs to atmospheric outcomes. This evolution enables robust project valuation, portfolio assessment, and outcome-based reporting against near-term milestones while simultaneously driving toward Paris 2050 targets. Crucially, it translates complex radiative forcing science into a practical, usable investment tool.

Capital markets, insurance, policy, and science are collectively demanding more granular, decision-ready climate data. While specific regulatory requirements will evolve, the trajectory is clear: institutions must understand the timing, physical risks, pollutant-specific impacts, and climate value of their interventions. Total Climate Accounting and Heatprint operationalize this need, allowing leaders to manage near-term heat reduction and long-term decarbonization under a single, unified framework to slow global warming, faster.

Appendix: Key Terms

Total Climate Accounting™: A practical CO_2e-PLUS application of radiative forcing science that augments conventional CO_2e accounting with a time-resolved heat lens, the Heatprint.

Heatprint™: The annual and cumulative heat impact of an organization, project, or portfolio, calculated across decision-relevant timeframes and expressed in physical heat metrics such as terajoules or W/m^2, with accessible equivalencies where useful.

Climate ROI: Heat avoided per dollar spent over a decision-relevant timeframe.

Radiative Forcing (RF): The net change in downward minus upward radiative flux at the top of the atmosphere, expressed in W/m^2. RF is the physical basis from which CO_2e metrics are derived.

Short-lived climate pollutants: Climate forcers with relatively short atmospheric lifetimes, including methane, black carbon, tropospheric ozone, and HFCs. Reducing sources of these emissions is especially important for near-term heat reduction.

Legacy effects: The residual atmospheric burden of past long-lived greenhouse gas emissions that continues to contribute to present-day forcing.

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