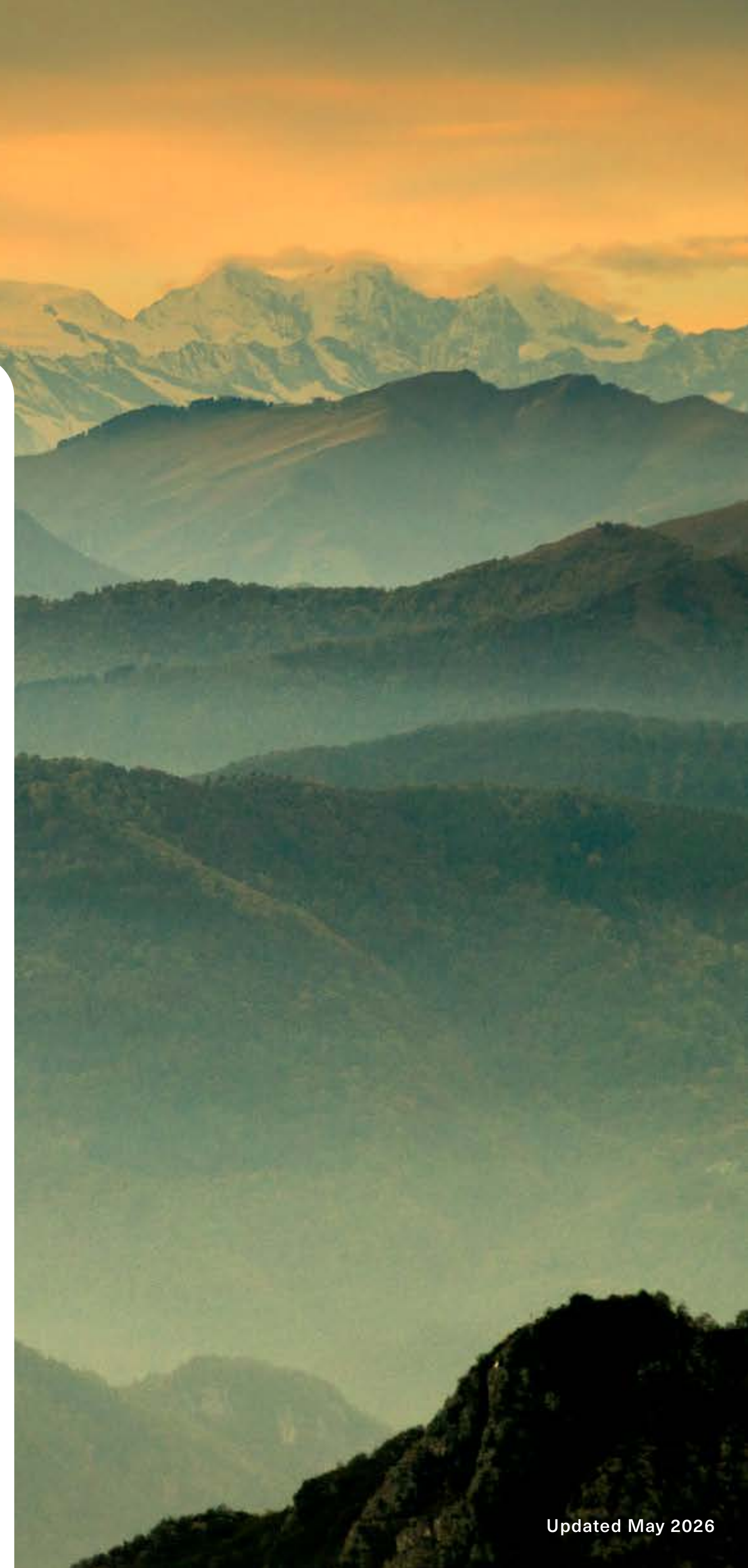
The missing link in effective climate action

The roadmap for reducing global heat starts with measuring what matters

GLOBAL HEAT REDUCTION™

CLIMATE DECISION INTELLIGENCE



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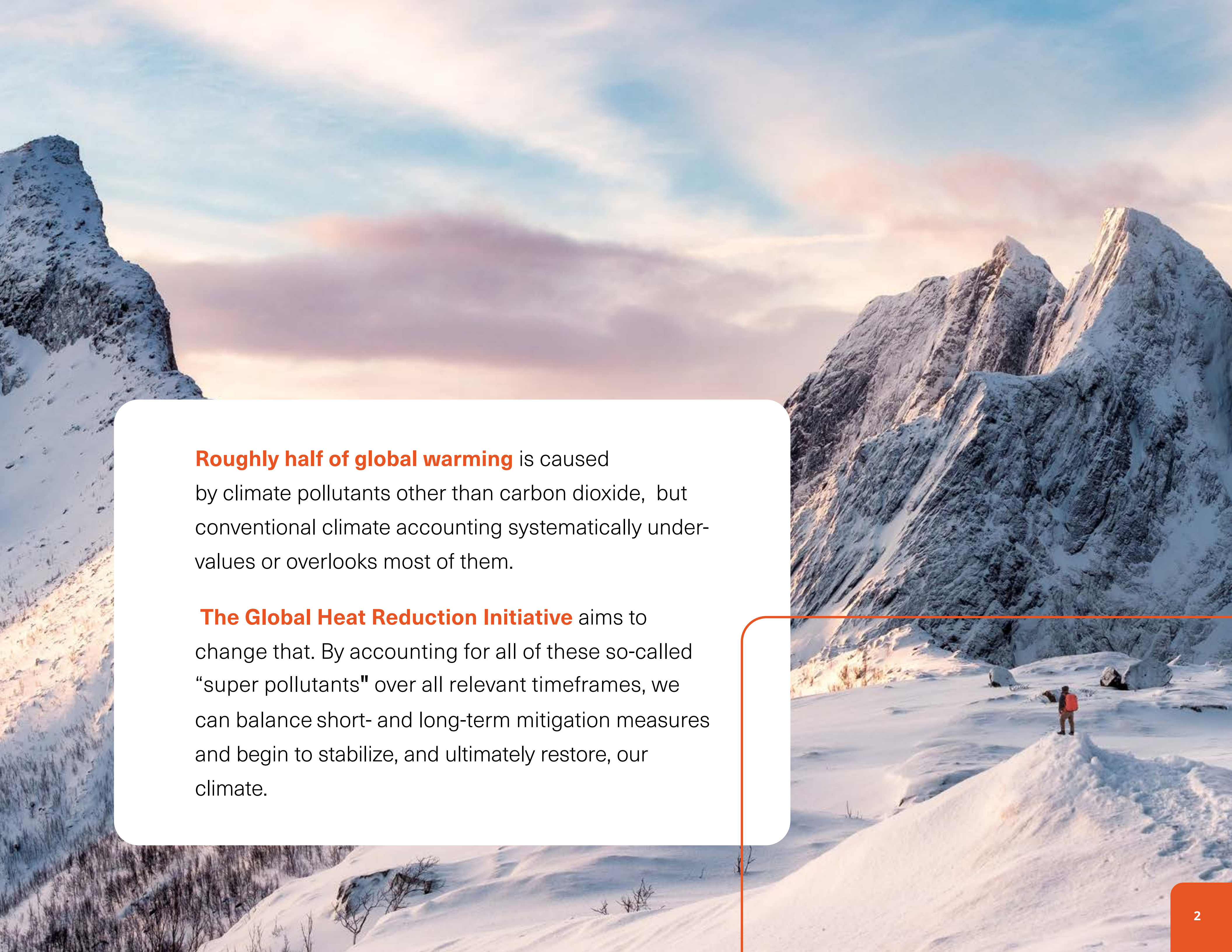


Roughly half of global warming is caused by climate pollutants other than carbon dioxide, but conventional climate accounting systematically under-values or overlooks most of them.

The Global Heat Reduction Initiative aims to change that. By accounting for all of these so-called “super pollutants" over all relevant timeframes, we can balance short- and long-term mitigation measures and begin to stabilize, and ultimately restore, our climate.

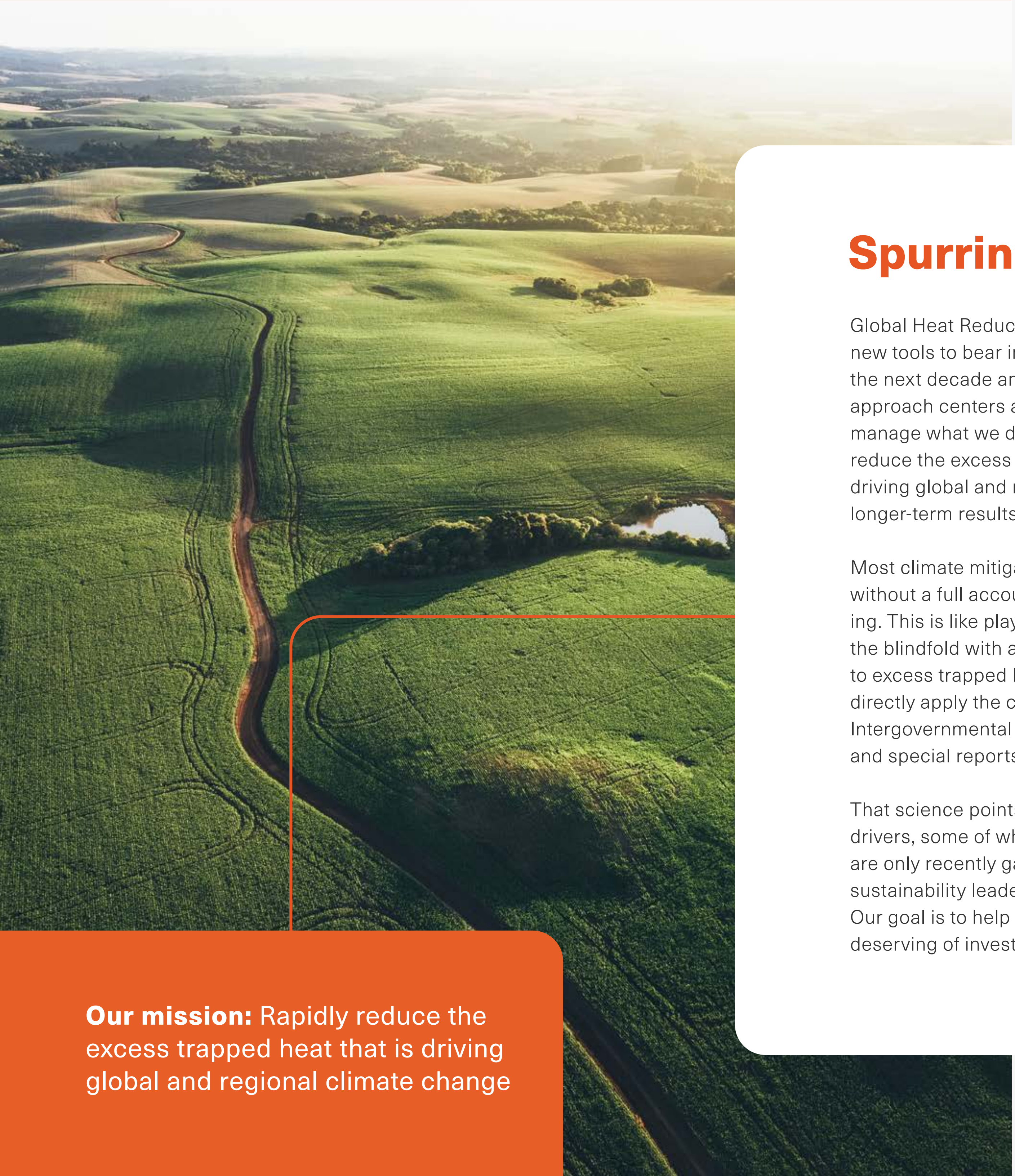
The climate crisis heats up

The 2020s have shaped up to be a crucial period in how we experience the climate crisis and understand our options for mitigating it. **Extreme heatwaves** are scorching traditionally hot and temperate regions alike. **Hotter oceans** are driving larger, more frequent and ferocious hurricanes. Around the world, heat-driven **freak floods** wash away unsuspecting communities within hours. As **massive wildfires** and the accompanying air pollution blanket vast swaths of land from North America to Australia, Arctic sea ice is beginning to retreat even in the winter months.

We can measurably lower global temperatures and make significant progress in this decade, but it will require a new approach.

The Paris Agreement's temperature threshold of 1.5° - 2°C Celsius above pre-industrial levels, once seen as decades away, is now perilously close. **2024 was the hottest year on record** – at 1.55°C above pre-industrial levels –and the last ten years through 2025 were the ten hottest years, according to the World Meteorological Organization.

More and more, it is becoming clear that this is what we have been warned about – a climate crisis that is quickly swelling beyond our control. "Humanity has opened the gates to hell," said U.N. Secretary General Antonio Gutteres, as he opened his organization's 2023 General Assembly. But through it all there is not only hope, but also an opportunity for fundamental near-term progress on arresting climate change. **Despite everything, humanity can still measurably lower global temperatures, including making significant progress in this decade.** But doing so will require a new approach.



Our mission: Rapidly reduce the excess trapped heat that is driving global and regional climate change

Spurring targeted action

Global Heat Reduction (GHR) was launched to bring critical new tools to bear in the battle to slow global warming within the next decade and beyond. Our Total Climate Accounting™ approach centers around the time-tested idea that we can't manage what we don't measure. Our mission is to rapidly reduce the excess trapped heat in the atmosphere that is driving global and regional climate change, for near-term and longer-term results.

Most climate mitigation activities today are undertaken without a full accounting of the core drivers of global warming. This is like playing darts while blindfolded. GHR removes the blindfold with an approach that reveals all contributors to excess trapped heat in the atmosphere. In doing so, we directly apply the consensus science summarized in the Intergovernmental Panel on Climate Change (IPCC) synthesis and special reports of the past decade.

That science points to a wide range of climate change drivers, some of which are widely recognized, while others are only recently gaining serious attention among corporate sustainability leaders, policymakers, and climate financiers. Our goal is to help prioritize mitigation activities that are most deserving of investment in the immediate term.

Not all greenhouse gases are equal

The most widely recognized climate change driver is carbon dioxide (CO_2). Today, 40 billion tons of CO_2 are released annually by human activities. Because it takes centuries for CO_2 to dissipate, more than one trillion metric tons have accumulated in the atmosphere since the Industrial Revolution.

While CO_2 is the most ubiquitous of all greenhouse gases (GHGs) on a ton-for-ton basis, it has the weakest global warming effect among them. Based on these properties, CO_2 has traditionally served as the base reference against which we measure the potency of other GHGs, expressed as their carbon dioxide equivalency, or CO_2e.

Why timeframe of analysis is important

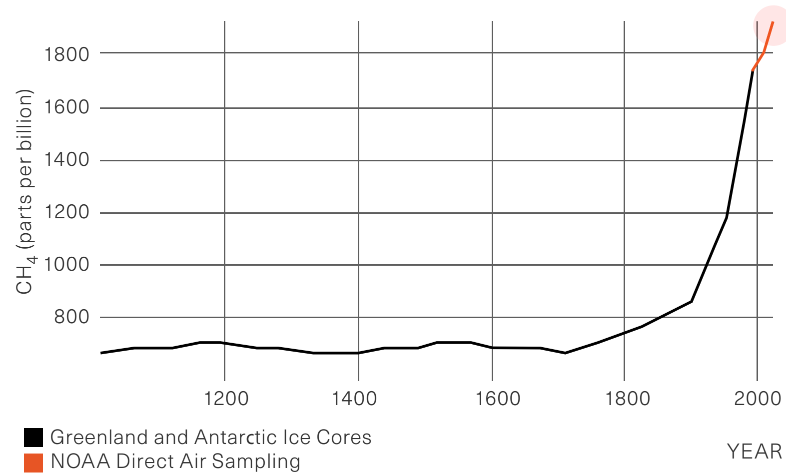
Because every GHG degrades at a different rate in the atmosphere, this relative potency, or "global warming potential" (GWP), must be calculated over a specific timeframe. Since most GHGs last for a century or longer in the atmosphere, the convention has been to default to a 100-year period when calculating the GWP ("GWP-100").

This convention is far less applicable, however, when considering shorter-lived gases like methane. Methane has an average atmospheric lifetime of about 10-12 years, before breaking down into CO_2 and water. Compared over 100 years, a ton of methane is considered about 27-30 times more potent than a ton of CO_2. But its GWP over 20 years is 84-87 times more than CO_2. And if you consider that same ton of methane during its initial year of emission, it is up to 150 times more potent. Therefore, when the warming effect of a ton of methane is compared to that of a ton of carbon dioxide over 100 years, the resulting equivalency significantly understates the actual potency of methane over its atmospheric lifetime. This illustrates why the GWP-100 approach is inadequate to drive the near-term actions required to keep temperatures from crossing critical thresholds.

During its first year of emission, a ton of methane is up to 150 times more potent than a ton of CO_2.

Atmospheric Methane Concentrations Since the Year 1010

Data sources: Etheridge et al., 1998 and NOAA Global Monitoring Laboratory

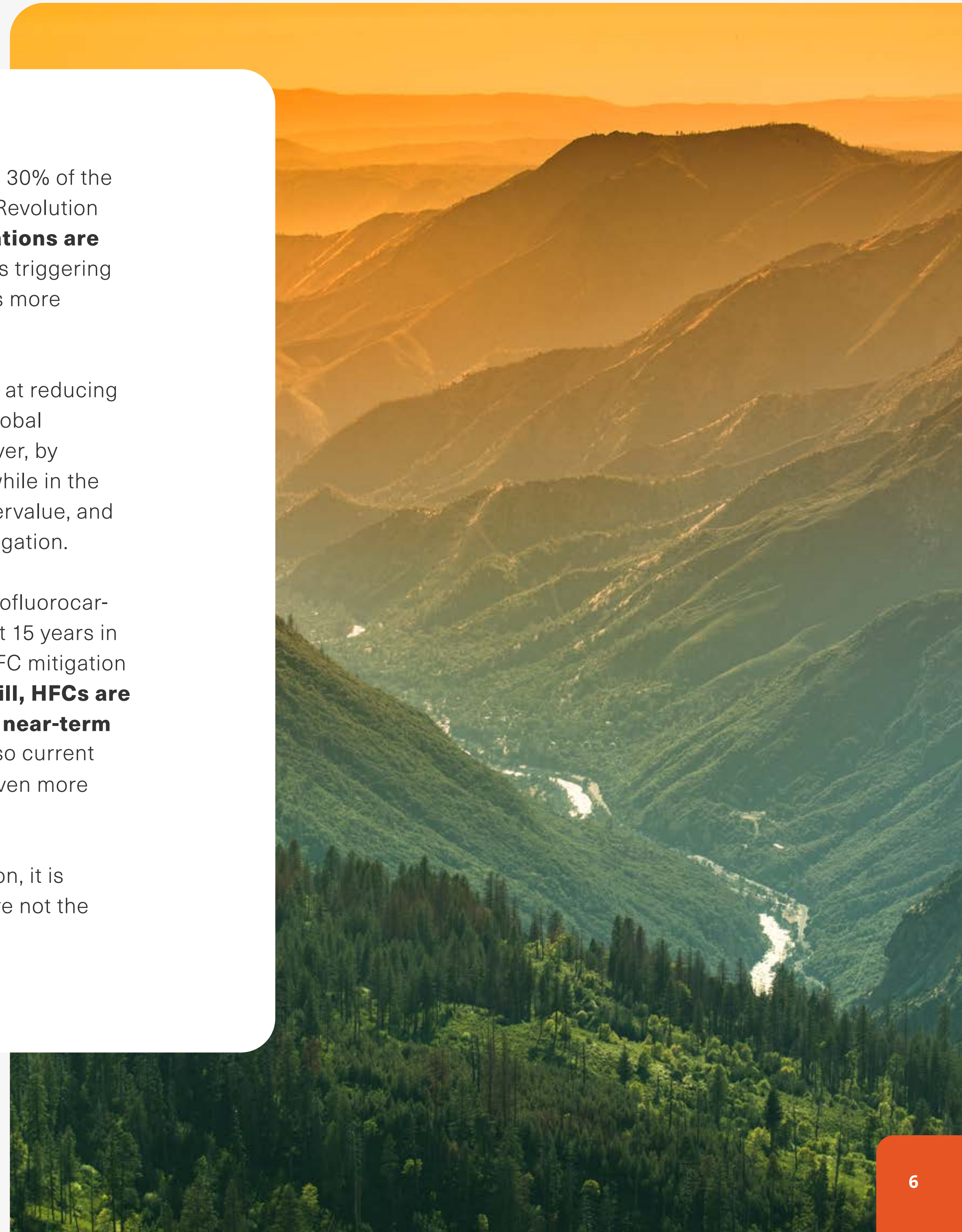


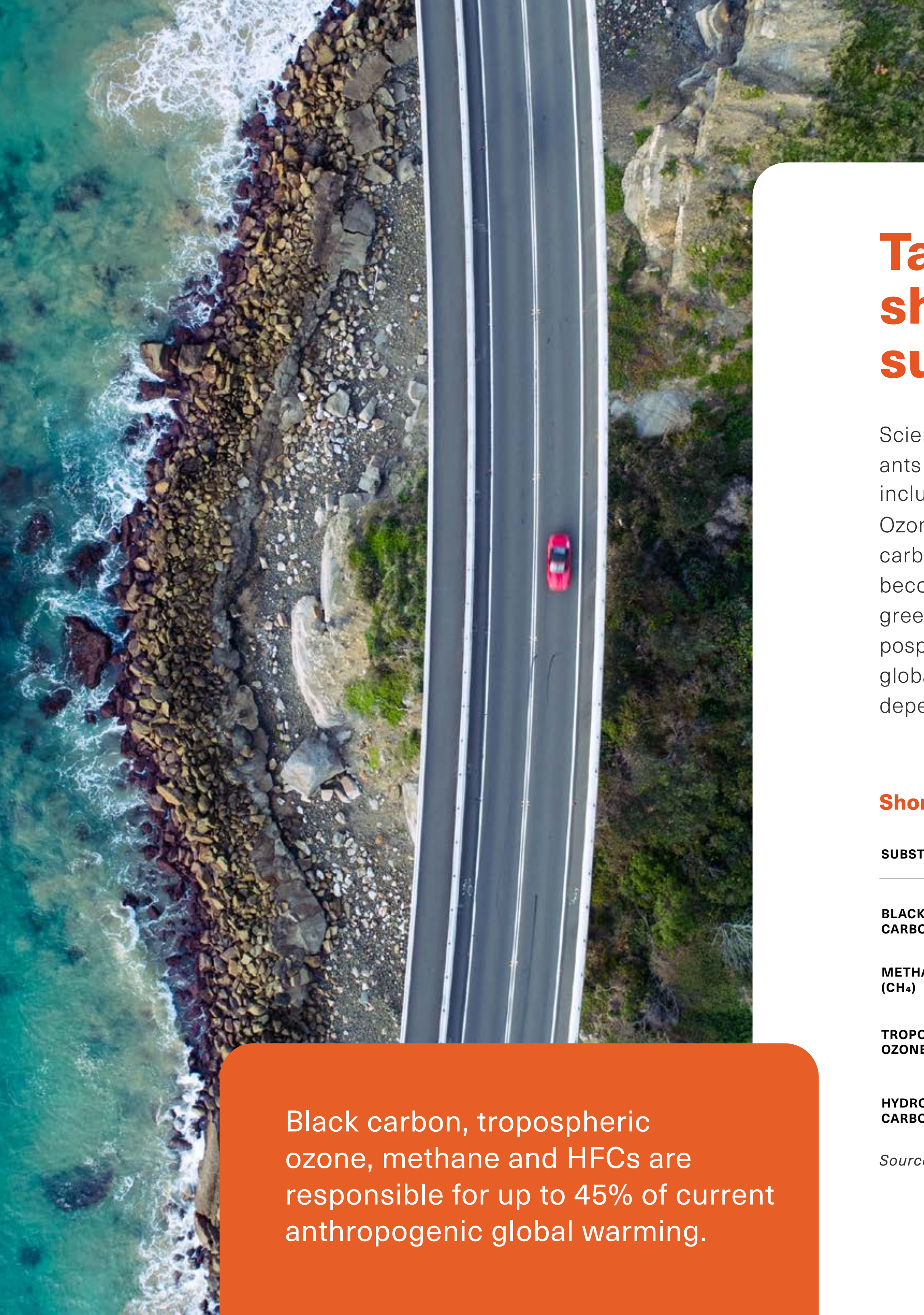
This is crucially important. NASA attributes up to 30% of the global warming since the onset of the Industrial Revolution to methane. **Atmospheric methane concentrations are rising every year**. Meanwhile, global warming is triggering the thawing of permafrost, which in turn releases more biogenic methane – a dangerous feedback loop.

It is not surprising that regulatory regimes aimed at reducing methane emissions and initiatives such as the Global Methane Pledge have gained momentum. However, by failing to account for methane's actual impacts while in the atmosphere, carbon markets systematically undervalue, and therefore undermine, investment in methane mitigation.

The same is true for another class of GHGs, hydrofluorocarbons (HFCs), which in many cases last only about 15 years in the atmosphere. Like methane, the benefits of HFC mitigation are felt most acutely during that time window. **Still, HFCs are up to 14,800-times more powerful in driving near-term atmospheric heat than CO_2 over 100 years**, so current climate accounting practices undervalue them even more than methane.

In addition to addressing this accounting limitation, it is important to recognize that greenhouse gases are not the only drivers of global warming.





Tackling additional short-lived climate super pollutants

Scientists have identified other anthropogenic climate pollutants with even shorter atmospheric lifetimes than methane, including tropospheric ozone (O_3) and black carbon (BC). Ozone lasts in the lower atmosphere for just a few weeks. Black carbon stays aloft only for days. Neither of these pollutants becomes well-mixed in the atmosphere the way long-lived greenhouse gases do, but they can pack a powerful punch. Tropospheric ozone can be up to 1,200-times more potent as a global warming agent than CO_2, and BC up to 52,000-times, depending on regional factors.

Black carbon, tropospheric ozone, methane and HFCs are responsible for up to 45% of current anthropogenic global warming.

Short-Lived Climate Pollutants

SUBSTANCE	ANTHROPOGENIC SOURCES	LIFETIME IN ATMOSPHERE	LOCAL	REGIONAL	GLOBAL
			IMPACTS/MITIGATION		
BLACK CARBON (BC)		DAYS	●	○	⊕
METHANE (CH_4)		12 YEARS	●	○	⊕
TROPOSPHERIC OZONE (O_3)		WEEKS	●	○	⊕
HYDROFLUOROCARBONS (HFCs)		15 YEARS (WEIGHTED BY USAGE)			⊕

Source: Climate and Clean Air Coalition

According to the Climate and Clean Air Coalition (CCAC), a voluntary partnership of over 160 governments, intergovernmental organizations, and NGOs convened by the United Nations Environment Program (UNEP), tropospheric ozone and black carbon, together with methane and HFCs, are responsible for up to 45% of current anthropogenic global warming.

Even though they only briefly remain in the atmosphere, these “short-lived climate pollutants” (SLCPs) and their precursor pollutants are emitted daily and increasingly. This contributes to the steadily thickening, heat-trapping blanket around the planet. SLCPs, sometimes called “super pollutants,” act as supercharged heat-trapping accelerants.

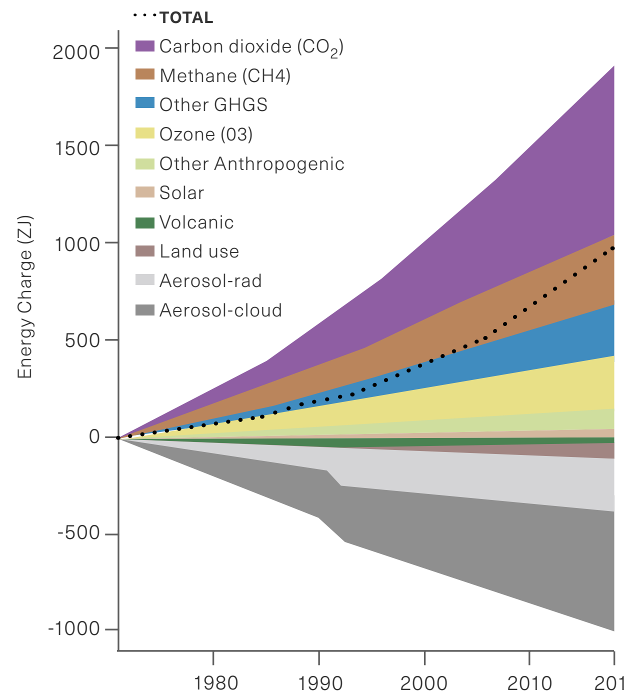
A major opportunity to slow down global warming in this decade is to precipitously cut emissions of methane and other climate super pollutants. The required technologies are widely available today, often for pennies on the dollar compared to CO_2 mitigation. Additionally, eliminating these pollutants would generate enormous co-benefits. Both ozone and black carbon are byproducts of fossil fuel use, burning organic matter, agriculture, and industrial processes. Both are associated with a host of health problems, from lung and heart diseases to cancer and millions of annual premature deaths worldwide.

According to the CCAC, we can avoid 0.6°C of global warming by 2050 just by reducing emissions of methane, black carbon and HFCs. In that same timeframe, CO_2 reductions, which make their biggest impact in the long-term, yield 0.1°C in avoided warming. Thus, reducing SCLPs is a crucial bridge strategy.

Finally, it is important to keep in mind that some emissions, rather than warming the planet, actually cool it down. In particular, sulfate and nitrate aerosols, which scatter and reflect solar radiation, have masked the effects of CO_2 , effectively slowing the rate of global warming, even while posing serious hazards to people and the environment. As countries work to reduce harmful air pollutants, it is essential to take stock of the additional warming associated with these reductions to properly balance the climate equation.

Components of Radiative Forcing

Estimated net cumulative energy change for the period 1971–2018. The dotted line represents the central estimate.



Source: Sixth Assessment Report (AR6), Working Group 1, 2021: Technical Summary. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Reduce, Reflect, and Restore

Without full situational awareness, it is difficult to identify the most effective actions needed to mitigate global warming.

In addition to reducing pollutants, two other climate mitigation strategies missing from current climate accounting must be included over time: increasing the Earth's reflectivity and restoring habitats. Together, these approaches represent the three "Rs" of climate mitigation.

Climate scientists regularly point out the major role played by albedo, the Earth's overall reflectivity. Clouds and surfaces covered in snow, ice and white sand have a high albedo, meaning they reflect more of the sun's heat back into space than dark surfaces and help cool the planet. Dark surfaces like asphalt, soil, or ocean water absorb heat. Melting ice and snow in polar regions and mountain ranges expose darker rock and soil, effectively lowering the Earth's albedo and driving temperatures higher.

Likewise, ecosystems serve as part of the Earth's natural climate defense system. Displacing desert ecosystems in favor of agriculture, mining, and urban environments, for instance, usually lowers the Earth's albedo. A similar phenomenon occurs when phytoplankton is lost due to warming oceans. Phytoplankton metabolism releases gases that lead to cloud formation. Less phytoplankton means fewer clouds. Fewer clouds means less heat reflected into space, even warmer oceans, and greater loss of phytoplankton.

Efforts to **safely** reflect more of the sun's heat into space and restore climate-positive ecosystems are underway or being contemplated. Cities are experimenting with **more reflective roofs, surfaces, and streets** to reduce the urban heat island effect. Black carbon mitigation can reduce deposition of dark particles onto ice and snow and slow the rate of melting. Rerouting of shipping and reduced use of ice breakers in the Arctic can also help lower impacts on sea ice.

Despite their importance, the effects of short-lived climate pollutants, albedo changes and ecosystem alterations cannot be accounted for using GWP-100-based methods. Again, conventional climate accounting does not give us the full picture. And without full situational awareness, it is difficult to identify the most effective actions needed to mitigate global warming, especially in the critical near-term before longer-term decarbonization strategies can take hold.

To change this, we must move toward a more comprehensive climate accounting mechanism based on the common denominator by which all climate drivers can be measured – the relative degree to which they heat or cool the atmosphere. Global Heat Reduction aims to do just that.

The Underlying Common Denominator: Radiative Forcing

Scientists evaluate all climate drivers, whether natural or human-caused, by their relative ability to heat or cool the planet. This is their "radiative forcing" impact.

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. As such, radiative forcing (measured in watts per square meter, or W/m^2) is the underlying common thread that ties together all climate accounting. This fundamental fact is embedded in all IPCC reports.

Carbon dioxide equivalencies (CO_2e) are derivative of the basic differences in radiative forcing between each GHG and CO_2. To incorporate the full spectrum of climate drivers, it is likewise possible to determine the radiative forcing equivalency between CO_2 and any climate pollutant, albedo change, or other non-emissions factor.

GHR's approach to climate change mitigation is based on this science. To start gaining ground in the fight against climate change, we must complement GWP-100 with an accounting method that works for all drivers.

The tool that allows us to do this exists today – the Radiative Forcing Protocol, built on the sound foundation of IPCC-vetted climate science. The Protocol was published after more than a decade of work, spearheaded by SCS Global Services and its visionary founder and CEO, atmospheric chemist Stanley P. Rhodes, Ph.D (1942-2023). It was independently reviewed by several members of the UNEP's Climate and Clean Air Coalition (CCAC) Scientific Advisory Panel.

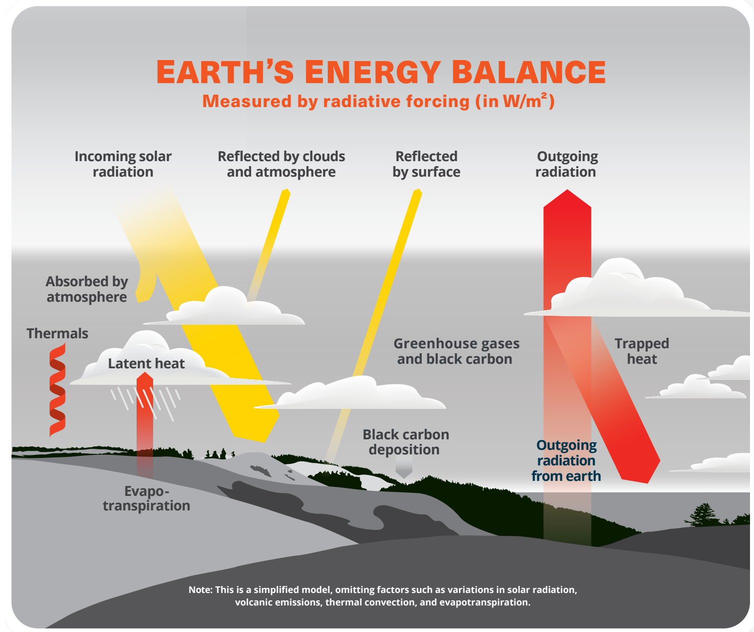
The Radiative Forcing Protocol reports relative radiative forcing values in watts per square meter (W/m^2), and also introduced a method to convert values for any climate change driver in relation to CO_2 into an equivalency unit called carbon dioxide forcing equivalency (CO_2fe).

GHR's method enables companies, investors, and governments to meet their net zero goals while prioritizing the mitigation activities most likely to reduce global warming in the near term.

From Protocol to Actionable Decision Tool: Total Climate Accounting™

GHR's Total Climate Accounting framework transforms the Radiative Forcing Protocol into a practical tool for market adoption and decision-making.

To make results more understandable and accessible, the framework is a **CO_2e-PLUS approach**. It retains all the information required to calculate conventional CO2e values and support routine reporting requirements (i.e., the Footprint), while simultaneously providing a whole new level of information encapsulated in what we call the **Heatprint**™.



Whereas the footprint summarizes "outputs" (the total GHG emissions in CO2e based on GWP100), the Heatprint summarizes "outcomes" – i.e., the actual heating or cooling impact on the climate. Moreover, these outcomes are calculated over any timeframe of interest (e.g., 2030, 2040, 2050), not just 100 years, to shine a light on the impact over crucial near-term and longer-term planning horizons.

Heatprint values are converted from W/m^2 and reported in the more commonly understood heat unit, Terajoules. Heatprints can be calculated for an organization, facility, project baseline, product, or service. This Heatprint then serves as the benchmark against which improvements can be measured.

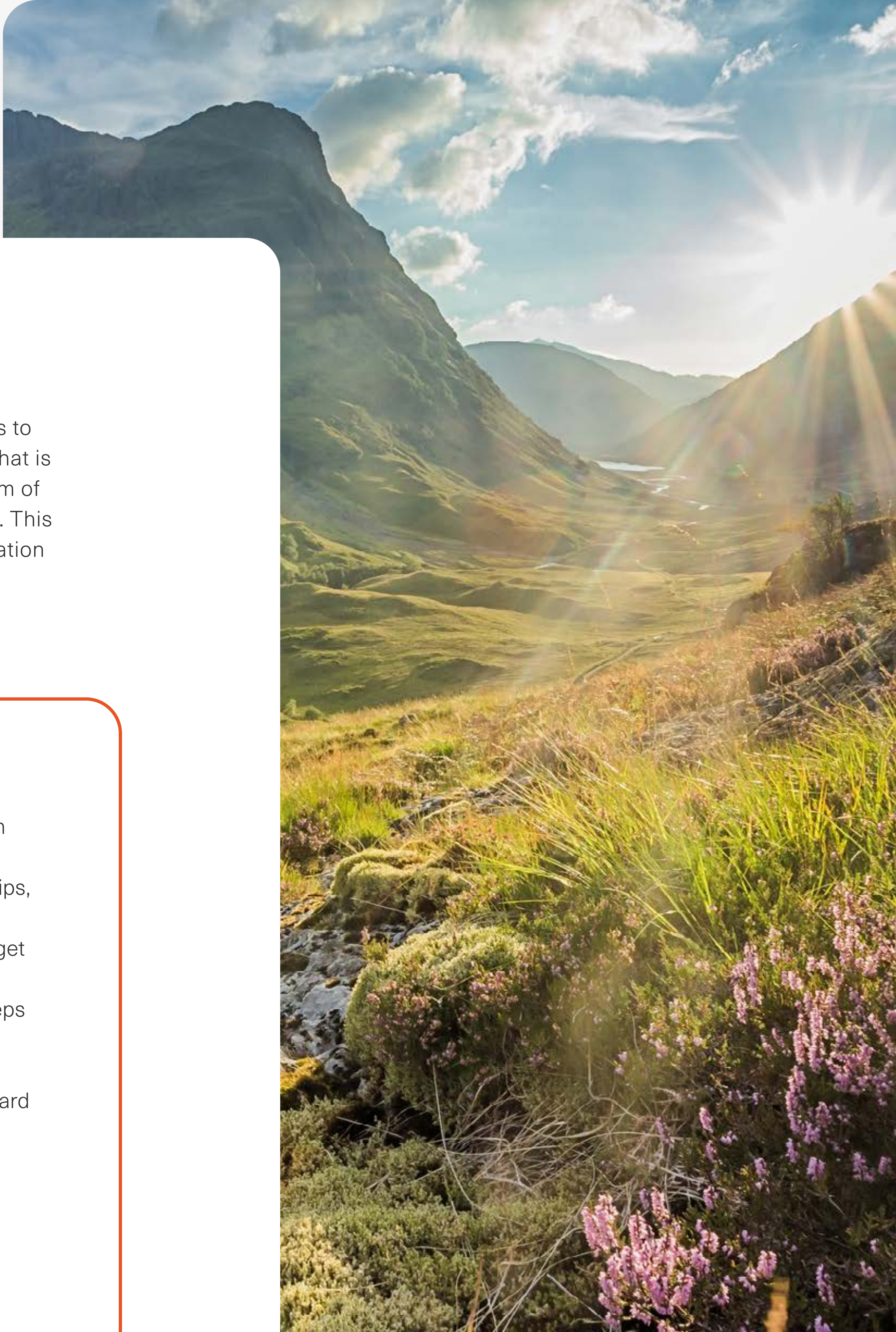
This approach enables companies, investors, and governments to meet their net zero goals, reduce risk, prioritize those mitigation activities most likely to reduce global warming in the near-term, and attain the greatest climate return-on-investment (ROI) per dollar spent.

Our Goal

Global Heat Reduction is committed to catalyzing efforts to drive down the excess heat trapped in the atmosphere that is fueling temperature rise and climate change, with the aim of ultimately bringing the Earth's climate back into balance. This is a big goal that no single company, country, or organization can achieve by itself.

We believe it is possible to accelerate global action by generating understanding of, and incorporating, the full breadth of climate drivers and their impacts over both the near- and long-terms. With more complete information at their fingertips, companies, governments, project developers and registry operators, philanthropies, and others organizations can target the most impactful climate mitigation investments, reduce risks related to global warming, and earn recognition for steps they are already taking but which haven't been measured.

By building partnerships across the economy, we look forward to inspiring the next chapter in effective climate action.



Conclusion: Climate success is a choice

We have the necessary tools and technologies at our disposal today. It's up to us to use them.

The climate crisis is accelerating, but this is no time to despair. With a fuller understanding of the science and better ways to apply it, we can make a tangible difference in the next decade. We have the necessary tools and technologies at our disposal today. It's up to us to use them.

By doubling down on the reduction and removal of climate super pollutants, along with steps to preserve and even increase the planet's albedo through smart choices about the built environment and vital ecosystems, we can measurably reduce excess atmospheric heat within the next decades.

Short-term and long-term measures are two sides of the same coin. Getting to net zero CO_2, and beyond, remains vitally important. We must remain committed to stepping up our efforts to slash CO_2 and other GHG emissions.

Complementing existing decarbonization efforts with actions aimed at direct, near-term heat reduction is the key to blunting the sharpest edges of the climate crisis and buying ourselves time to let CO_2 cuts reach their full effect over decades. This is how we can build a bridge to net zero by 2050, stabilize our climate, and, in the longer term, begin to restore it to its pre-industrial equilibrium.

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