MARKETING COMMUNICATION

WELLS FARGO Asset Management

INVESTMENT PERSPECTIVES

Risks of a changing climate: Exploring the investment implications

Climate change is occurring now amid expectation its severity will increase over time. This will likely have material investment repercussions.

While many implications are negative, opportunities exist for the prepared. Understanding climate change's financial implications is key.

Wells Fargo Asset Management (WFAM) is embedding climate analysis into its investment process across asset classes and sectors.

Climate change effects are not hypothetical. They are not an abstract notion to consider in the future. They are happening now and affecting the markets in which we invest.

WFAM is taking action to address climate-related risks throughout its investment process—at the security and portfolio level—with an eye toward providing our clients with solutions that reflect the realities of a changing world. In this piece, we will:

- Illustrate the urgency of climate change and its wide-ranging financial effects
- Explain why climate change is a key variable in investment decision-making and demonstrate how investors can identify material climate-related risks and opportunities
- Describe what WFAM is doing about it, including the efforts of our Climate Change Working Group

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From "what if" to "how severe"

The question of climate change is evolving from *"what if"* to *"how severe."* This shift raises vital questions over the costs that society will bear, with events like these reflecting the new normal:

Record-breaking heat waves and high temperatures previously unseen in recorded history occurring worldwide

Consecutive years of record economic losses from extreme weather events such as wildfires, massive flooding, and intense droughts

Sea ice and glaciers melting at rates surpassing even the most pessimistic climate models

November 2019

We believe investors simply cannot afford to ignore a topic with such substantial ramifications, financial and otherwise. And we're not alone. Awareness and a sense of urgency are on the rise. A growing chorus of stakeholders—from regulatory bodies to the average consumer—are demanding more effective and expedited actions to mitigate and prevent worst-case climate scenarios. The power of their combined voice is resulting in new regulations and norms, as well as changing patterns of market demand.

For example, when consumers change purchasing decisions based on climate factors, a company might implement new tactics to engage them. Alternatively, entire industries may employ new strategies when regulators implement new standards. Regardless of the motive, a company embarking on such changes can face costly growing pains, from major capital expenditure to firm-wide operational transformation. To gain an accurate understanding of investment implications, we need to carefully analyze how climate-driven physical, policy, and technology risks change firms' competitive environment and their individual competitive positions.

Understanding climate-related risks in a changing world

Climate change can have a material impact on investment strategies through different types of risk, including:

1. **Physical risk:** Direct or indirect risks arising from a changing climate—for example, exposure through owned assets or supply chains to risks such as sea level rise or extreme weather events
2. **Transition risk:** Risks emerging from changing regulations, the cost of carbon, consumer preferences, and supply constraints, as the world moves to a low-carbon economy in an effort to mitigate climate change's worst long-term physical risks
3. **Liability risk:** Risks organizations face from being sued for damages over their role in climate change—to date, more than 1,200 climate change cases have been filed in more than 30 jurisdictions

On the following page, you'll see examples of companies that are responding to these influences. As the pace of change accelerates, these cases help illustrate the opportunities found within the aforementioned risks.

In May 2019, the National Oceanic and Atmospheric Administration (NOAA) reported Earth's atmosphere contained its highest concentration of carbon in human existence, a new record of 415 parts per million (ppm). This marks the seventh consecutive year of a steep increase, as carbon emissions continue rising.

Why is this significant? If the current trends continue and the business-as-usual approach is mostly unchanged, the potential for catastrophic outcomes will increase significantly.

Climate change is here:
Effects on business strategy

- Vehicle electrification: Volkswagen committed $91 billion in research and development.
- Rise of renewable energy: General Electric's power unit revenues fell 33% (of which 5% was organic) in Q2 2019. However, GE's renewable revenue rose 33%. Renewables provided two-thirds of global capacity additions in 2018.[1]
- Updated risk models underpinning property insurance: Actuaries rank climate change as a top risk for 2019, according to the Casualty Actuarial Society, Canadian Institute of Actuaries, and Society of Actuaries 12th Annual Survey of Emerging Risks.

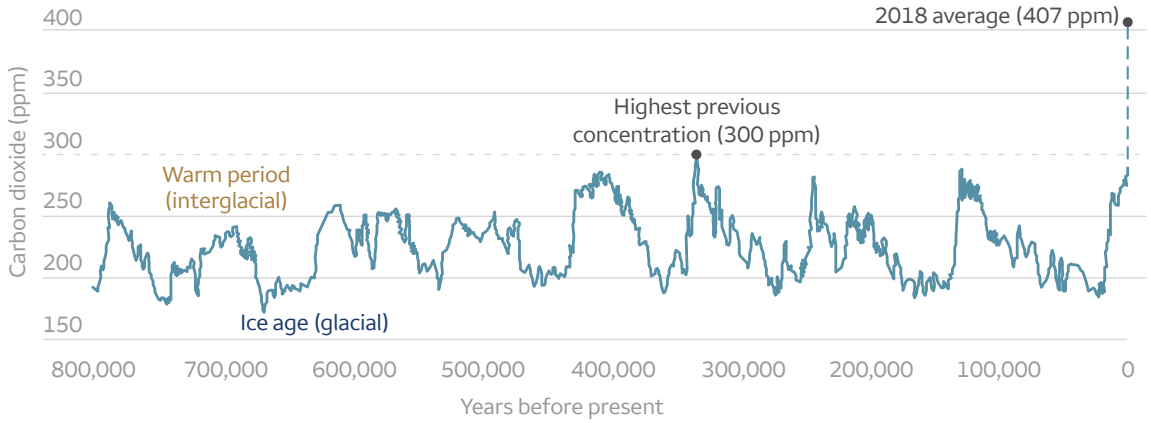
1. International Renewable Energy Agency

- Carbon emissions: European power utility firms will reduce carbon emissions by 2030, according to Bloomberg research. The firms will focus capital expenditure on renewables and networks as they retire coal plants.
  - Relatedly: 20 banks have announced an end to financing new coal plant projects.

Climate change is influencing business and resulting in financial implications across sectors. Look out for WFAM's new climate-focused sector report series, in which we explore underlying trends and potential effects in-depth.

Carbon emissions have been markedly rising since industrialization. Through the greenhouse effect, the amount of carbon in our atmosphere directly influences global temperature levels. Rising temperatures, in turn, prompt a host of secondary effects across complex systems, including the natural disasters highlighted on page 1. Furthermore, these effects are depleting and degrading many aspects of the global ecological system in which our economies depend.

CO_2 during ice ages and warm periods for the past 800,000 years



Atmospheric CO_2 concentrations in ppm for the past 800,000 years, based on European Project for Ice Coring in Antarctica (EPICA) data. The peaks and valleys in carbon dioxide levels track the coming and going of ice ages (low CO_2) and warmer interglacials (higher levels). Throughout these cycles, atmospheric CO_2 was never higher than 300 ppm. In 2018, it reached 407.4 ppm (black dot). Source: NOAA Climate.gov, based on EPICA Dome C data (Lüthi, D., et al., 2008) provided by NOAA NCEI Paleoclimatology Program

Identifying climate-related impacts across asset classes and sectors

So, how does all of this relate to portfolios? The following table outlines the range of systems affected by climate change—and how the changes are contributing to financial risks across asset classes.

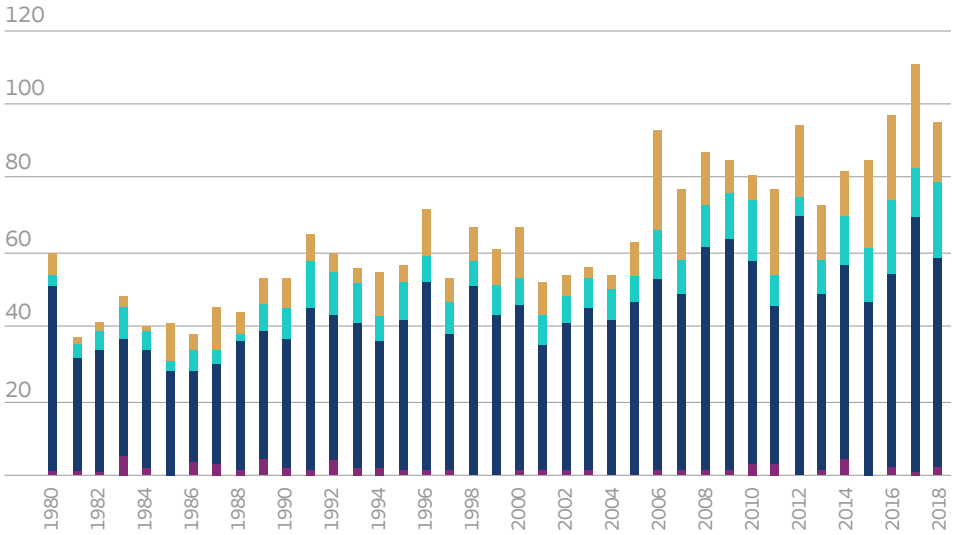
System affected	Evidence of natural impact	Example of financial risk by asset class
Climatological	Extreme temperatures, droughts, wildfires	Investment-grade fixed income: Pacific Gas and Electric Company was a strong investment-grade utility through mid-2017. The company defaulted in January 2019 due to losses stemming from wildfires linked to persistent drought and higher temperatures.
Hydrological	Changing rainfall patterns, increased rainfall intensity leading to flooding	Equities: Extreme weather and flooding has cost global crop trader and processor Archer Daniels Midland (ADM) $125 million in the first half of 2019. ADM's financial results for merchandising and handling and transportation fell year over year due to "continued high water conditions in U.S. rivers." These effects contributed to a 63% fall in adjusted operating profit in ADM's origination division.
Meteorological	Number and intensity of extreme events such as hurricanes	Cross-asset class: Climate change has been affecting the frequency and intensity of Atlantic hurricanes, resulting in substantial financial implications. For example, in 2018, Hurricane Florence resulted in nearly $25 billion in damages, with impacts to sectors as varied as insurance, retail, agriculture, transportation, and industrials.
Various	Sea level rise/flooding, carbon sink capacity, temperature, acidification	Municipal fixed income: Miami Beach has large capital expenditure costs due to seawater inundation and the need to construct pumps and dikes. This directly affects the city's future financial profile and potential valuation of its bonds.

Climate change is also altering the way investors evaluate specific industries. Consider the stark implications for insurance and reinsurance companies. In 2017, natural disasters caused overall economic losses of $340 billion, with insurers paying record claims of nearly $140 billion.[2] This is an extension of a trend: Over the past three decades, extreme weather events have more than tripled, with inflation-adjusted insured losses rising fivefold. Meanwhile, claim and reserve uncertainty have increased.

What's more, we must remember that insurance is just a means for risk to be priced and passed on to the insured: people, companies, and governments. Ultimately, these insured parties will bear the associated costs. Climate change will therefore challenge insurers to select, price, and reserve risks with greater foresight. And this will challenge insurance buyers to take higher premiums into account.

2. Munich Re: A Stormy Year

Loss events in the U.S., 1980–2018 (number of relevant events by peril)



Geophysical events
(earthquakes, tsunamis, volcanic activity)

Hydrological events
(floods, mass movement)

Meteorological events
(tropical storms, extratropical storms, convective storms, local storms)

Climatological events
(extreme temperatures, droughts, forest fires)

Accounted events have caused at least one fatality and/or produced normalized losses ≥ U.S. $100K, $300K, $1M, or $3M (depending on the assigned World Bank income group of the affected country).

Source: Munich Re (Münchener Rückversicherungs-Gesellschaft) NatCatSERVICE, 2019

Taking action as a consensus forms

It's telling that Earth's current geological age is labeled Anthropocene,[3] recognizing that this is an era in which human activity and its effects surpass all other variables that could influence our world. Human activities are contributing to atmospheric carbon concentrations to a degree that far exceeds Earth's history of cyclical variations. This is driven by global population growth, rising demand for fossil fuel-derived energy, and other human-caused activities such as deforestation.

Fortunately, a consensus is emerging and stakeholders are beginning to take action. The focus: There is an urgent need to broaden and accelerate the restructuring of our global economic systems toward a low-carbon economy that can mitigate climate change.

What's driving this consensus? A growing appreciation for the catastrophic outcomes we'll face in worst-case climate scenarios, as well as the resulting financial implications.

The focus:
There is an urgent need to broaden and accelerate the restructuring of our global economic systems toward a low-carbon economy that can mitigate climate change.

3. Anthropocene (adjective): relating to or denoting the current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment (Oxford University Press, 2019)

The severity of risks depends on how long the economic transition is delayed. If society and commerce move swiftly and aggressively, it's possible we can prevent the worst-case scenarios of physical risks that would occur in a world of unmitigated climate change. However, the path to ***preventing*** that world entails its own set of risks and opportunities. Those working to facilitate the low-carbon transition understand this dynamic.

- Multilateral commitments made in the Paris Agreement, signed in 2016, mark the most obvious global initiative to drive the shift to a low-carbon economy.
- More recent developments, such as the U.K.'s and France's commitment to achieve net-zero carbon emissions by 2050, have immense transition risk-related implications across industries for investors.
- While the U.S. pulled out of the Paris Agreement, states that represent a substantial proportion of the country's economic output continue to demonstrate their commitment to decarbonize.
- California committed to generating all of its electricity needs through renewable sources by 2045. New York committed to carbon-free electricity by 2040 and a net-zero carbon economy by 2050.

Certain industries will feel the effects of the transition to a low-carbon economy more than others will. Consider the energy sector's exposure to the transition risk known as stranded assets. However, no industry will remain completely unaffected.

Central banks worldwide are also grasping the systemic financial effects of climate change, to the point where they're explicitly acknowledging the importance of accounting for climate risks in their macroeconomic scenarios. As of November 2019, 46 central banks have committed to mobilizing mainstream finance to support the transition to a low-carbon and sustainable economy—as part of the Network for Greening the Financial System (NGFS). New York's financial services regulator—which oversees insurance and banking firms with trillions of dollars in assets—has also joined the NGFS.

The global financial sector is not ignoring these signals. To mitigate the potential impact of transition risk, collaborative investor initiatives such as Climate Action 100+ have launched with an aim to engage the largest carbon emitters and encourage proactive action on climate change. Far from a niche effort, Climate Action 100+ represents more than 370 institutional investors with more than $35 trillion in assets under management.

What are stranded assets?

Assets that experience unexpected devaluations can be considered as stranded, through three perspectives:

1. Regulatory (change in policy or regulation)
2. Economic (change in relative costs/prices)
3. Physical (assets exposed to sea level rise, flooding, or drought)

For example, coal mines and coal-powered generation plants are exposed to stranding in a shift to a low-carbon economy. The reason: Underlying assets originally considered in coal valuation models are no longer able to earn economic return. Real assets can also be stranded. A multiyear climate study to understand the vulnerability of Amtrak's Northeast Corridor[4] shows how sea level increases can negatively affect major transportation lines.

4. Amtrak NEC Climate Change Vulnerability Assessment

Another example of transition risk is occurring in the insurance/reinsurance industry. Today, some of the largest global insurers (including Munich Re; Swiss Re; Zurich; Axa; Allianz; and, most recently, Chubb) have stopped insuring coal issuers. This is an early indicator of stranded assets' potential impact. Taken together, these developments are a signal from the market about the importance of urgent action—and the potential for even greater near-term impact.

What we're doing about it

WFAM created the Climate Change Working Group, which researches and integrates climate risk analysis into various facets of its investment process in a structured way. This cross-functional group leads top-down, system-level risk analysis and works directly with sector analysts to identify bottom-up, issuer-level implications. The initiative helps us assess and understand the emerging risks and opportunities that climate change presents. Our working group keeps abreast of the latest climate risk developments and takes the following actions:

- Conducts independent research
- Builds analytical frameworks
- Develops processes to consider climate scenarios and stress tests accompanied by traditional financial analysis

We assess physical, transition, and liability risks at the issuer, industry, and portfolio levels. Our differentiated approach allows us to:

1. **Holistically evaluate climate risks across global markets in a singular process** with top-down and bottom-up research across asset classes—an important consideration as responses to climate risks can diverge for many asset managers from a credit-versus-equity perspective.
2. **Integrate findings into investment decisions** through a unified model that includes senior leaders from our investment and ESG teams who sit side by side with our portfolio managers and sector analysts, working together to optimize risk decisions.
3. **Evaluate negative and positive impacts** with an understanding that, while climate change's worst effects may be significantly negative, a broad range of companies stand to benefit as society mobilizes to contain climate risks.

The Task Force on Climate-Related Financial Disclosures recommendations:

The Financial Stability Board (FSB) established the Task Force on Climate-Related Financial Disclosures (TCFD) to:

- Better understand the financial effects on companies and the global financial system
- Help companies disclose decision-useful information to facilitate a better understanding of climate-related risks and opportunities for financial markets

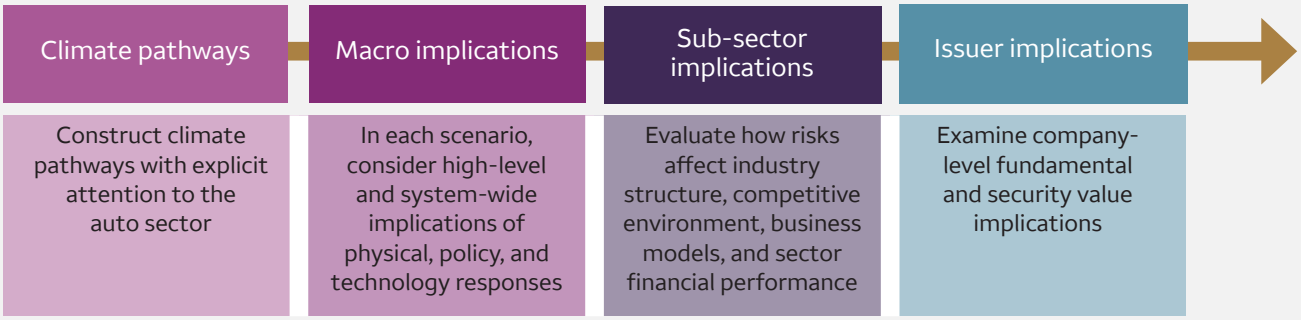
The final recommendations, released in June 2017, can be broken into four dimensions of disclosure:

1. **Governance:** How climate change is handled by governing bodies (a company's board and management)
2. **Strategy**: What is the organizational strategy concerning climate change and the transition to a low-carbon economy
3. **Risk management:** How climate change risks are identified, assessed, and managed
4. **Metrics and targets:** Which metrics and targets are used to assess and manage climate change

Support for the TCFD continues to grow, with nearly 800 organizations supporting TCFD, including global financial firms responsible for assets in excess of $118 trillion.[5]

5. TCFD 2019 Status Report

Sector example process: Evaluating the impact of climate risk on automotive sector issuers



We are launching a new commentary series to illustrate how WFAM's thinking around climate change influences our investment approach from a practical perspective. The series—based on our investment teams' internal work—will focus on the sector implications of climate change. It's designed to demonstrate:

- How climate change can influence decision-making
- Our strong foundation in understanding the investment implications of a changing world

You can learn more about this example in our new series' first edition focusing on the automotive sector.

Climate change scenarios

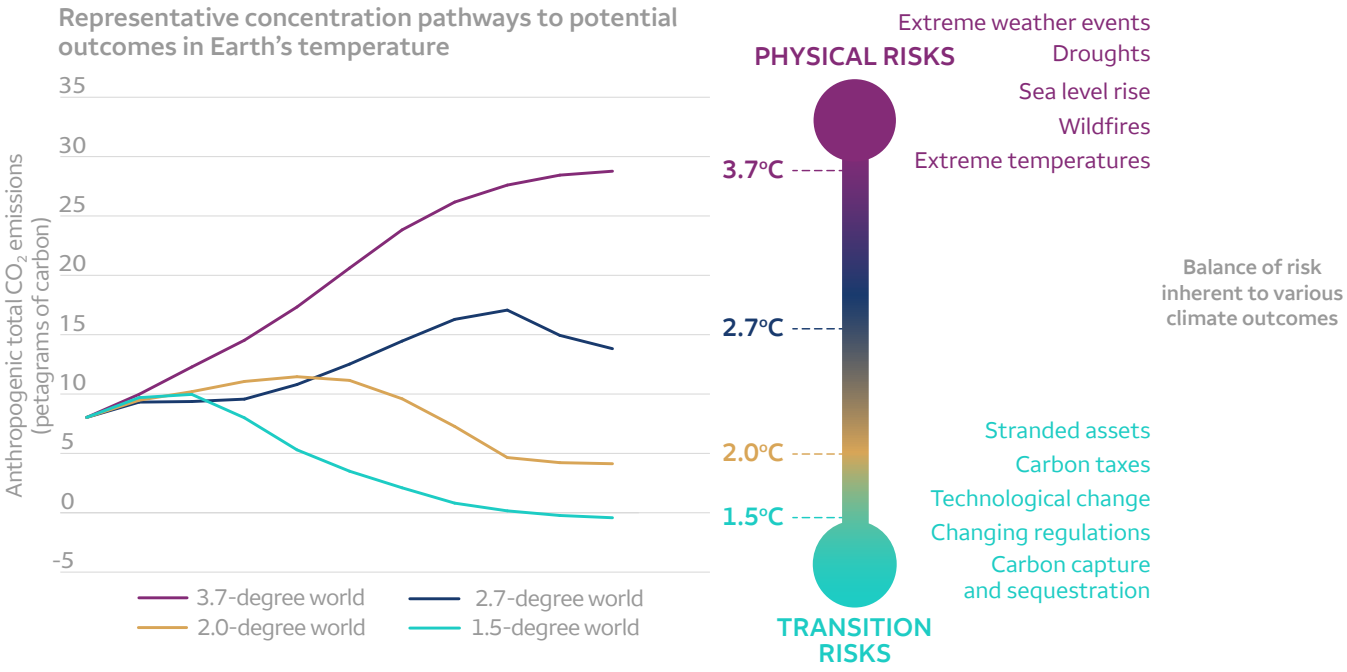
Climate change scenarios can help us frame a range of outcomes and potential financial implications. However, they are not unassailable. Asset managers must make a number of assumptions, and the complex systems affected by climate change are notoriously difficult to accurately model. So the likelihood of ending up exactly along the path of any particular climate scenario is slim.

With that in mind, we believe climate scenarios' utility is more about helping investors understand the range of financial outcomes and potential disruptions associated with each scenario—not as an absolute quantification of risks to input directly into investment models. We can better recognize climate implications from the perspectives of security selection, sector impacts, and asset allocation. This helps us be generally correct instead of precisely wrong.

The risks resulting from climate change are evident today. Regardless of how stakeholders choose to address the issue—and irrespective of their success—the dimensions of physical and transition risk are now a permanent feature of our world.

If the global community works toward a net-zero carbon economy (aiming for a 1.5 C world), physical risks would certainly continue—but not at the catastrophic level a 3.7 C world would present. Instead, as illustrated on page 9, the risk balance would tilt toward transitional risks due to the fast and aggressive efforts needed to mitigate atmospheric carbon levels in pursuit of a 1.5 C world. The sooner and more thoughtfully society transitions, the less disruptive and costly physical events will be over time.

How Earth's potential climate outcomes can affect the balance of climate risk



Source for line chart: Intergovernmental Panel on Climate Change; source for graphics regarding potential Earth climate outcomes and climate risks: WFAM, for illustrative purposes only

As investors, we must understand how climate change-related risks and opportunities can affect our strategies across different asset classes and time frames. This is imperative regardless of the final number reflecting the degree change in Earth's temperature, the path that gets us there, and the changing world we live in.

Final takeaways

We understand there are a number of unknowns regarding how climate change will affect the global economy—in the context of both near- and long-term outcomes. This is especially true considering the complexity of the issue and the number of interconnected variables that will influence the eventual results. Nonetheless, it's clear that the wide-ranging impacts of climate change have serious investment implications. Investors must pay close attention to climate impacts—from physical changes to the transition to a low-carbon economy—to understand emerging material risks and where future opportunities lie.

Our approach to incorporating climate risk into our investment process is informed by research from multiple perspectives. We understand that climate change is a dynamic issue whose changing nature requires us to update our views to consider the latest information and most likely scenarios. This includes:

- Climate-related trends that underlie new regulations
- Extreme weather events' impact on supply chain resiliency
- Potential financial risks involved in issues such as stranded assets
- How industries are proactively changing their business models

Climate change may be a complex and dynamic topic. However, we are committed to using our fundamental research capabilities to identify and understand the trends that materially affect investment risks and opportunities.

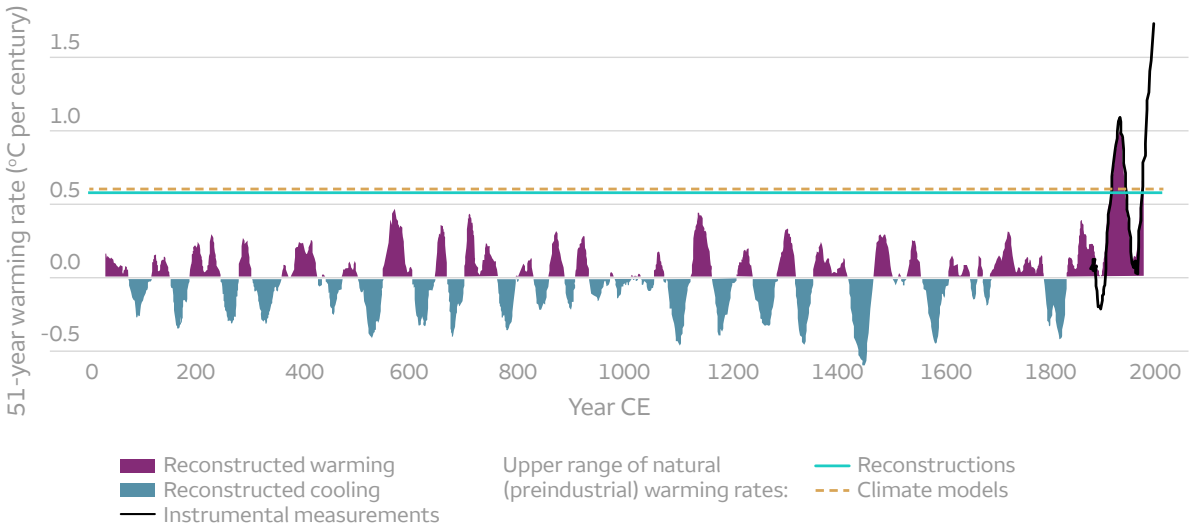
At WFAM, we strongly believe that while climate change is unavoidable, being unprepared is not.

Appendix

A history of global climate change

To further convey the gravity of Earth's changing climate and its effects (as discussed on page 2), following is a chart that shows the global mean warming and cooling rates over the past 2,000 years.

Global warming/cooling rates over the past 2,000 years



Source: University of BERN. In red are the periods (each across 51 years) in which the reconstructed temperatures increased. Global temperatures decreased in the periods in blue. The green line shows that the maximum expected warming rate without anthropogenic influence is just under 0.6 degrees per century. Climate models (dashed orange line) are able to simulate this natural upper limit very well. At more than 1.7 degrees per century, the current rate of warming is significantly higher than the expected natural rate of warming and higher than values for every previous century. Instrumental measurements since 1850 (in black) confirm these figures.

We want to help clients build for successful outcomes, defend portfolios against uncertainty and create long-term financial well-being.

- To learn more, contact us at WFAMInstitutionalClientRelationsInternational@wellsfargo.com.

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