Sustainable1

Quantifying the financial costs of climate change physical risks for companies

Authors:

Jennifer Laidlaw
Thought Leadership Senior Writer
S&P Global Sustainable1

Rick Lord
Head of Innovation Methodology
S&P Global Sustainable1

Kuntal Singh
ESG Innovation and Analytics Manager
S&P Global Sustainable1

Matthew MacFarland
Thought Leadership Editor
S&P Global Sustainable1

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Highlights

Companies already exposed to extreme weather events and the physical impacts of climate change will likely see increasingly significant financial costs over the coming decades.

Without adaptation measures, by the 2050s these costs will equal an average of 3.3% — and up to 28% — per annum of the value of real assets held by companies in the S&P Global 1200, according to the S&P Global Sustainable1 Physical Risk Exposure Scores and Financial Impact dataset.

These costs are annual and cumulative over time, representing a material financial risk for many companies, absent adaptation and resilience measures.

Different physical hazards are poised to create substantial financial costs in some sectors but not others. In the communications sector of the S&P Global 1200, most of the assets facing high financial impact are datacenters due to their sensitivity to extreme heat.

Extreme weather events have defined 2023, from Cyclone Freddy sweeping across several African countries, to wildfires in Canada that blanketed eastern North America in smoke, to extreme heat around the world that made July the hottest month on record by a wide margin.

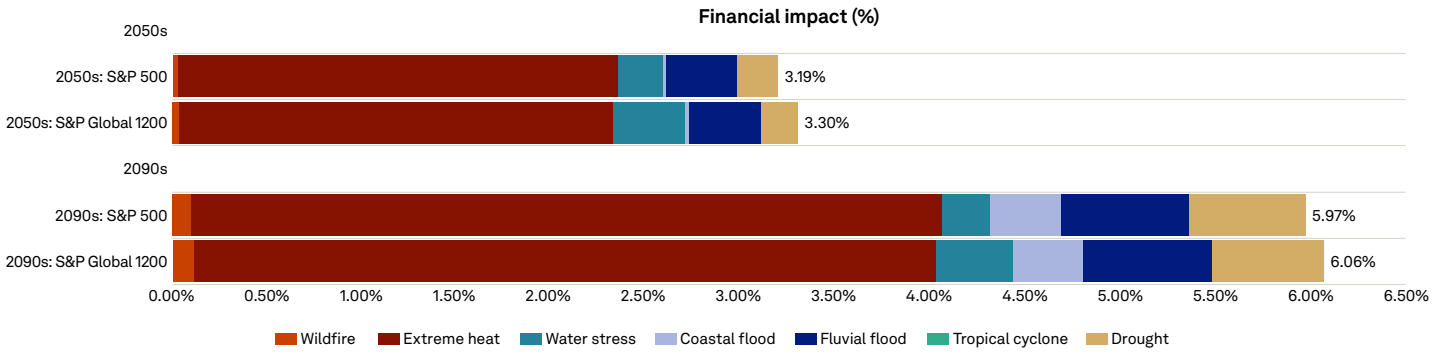
Scientists are increasingly making the connection between extreme weather events and climate change. As the damage from extreme weather events becomes more apparent, we seek in this research to measure the financial costs of climate hazards on corporate assets in different sectors and geographies.

Applying the S&P Global Sustainable1 Physical Risk Exposure Scores and Financial Impact dataset to companies in the S&P Global 1200, we find that by the 2050s the costs of the physical hazards of climate change will equal an average of 3.3% per annum — and up to 28% per annum — of the value of real assets held by companies in the index, absent adaptation. That average per-annum figure rises to 6.0% by the 2090s. These costs are annual and cumulative over time, representing a material financial risk for many companies.

The relative size of the financial impact in the 2050s and 2090s under this scenario is similar for the S&P 500.

Financial impact on major companies will nearly double from 2050s to 2090s

Weighted average financial impact on assets owned by constituents of the S&P 500 and S&P Global 1200 in the 2050s and 2090s



Data as of February 2023.

Financial impact is first calculated at the asset level and represents the sum of financial costs arising from exposure to climate hazards for an asset, expressed as a percentage of the typical replacement value for a given asset type. Financial impact at the company level is then calculated as the weighted average of the asset-level financial impact for all known assets owned by a company and its subsidiaries. Financial impact at the index level is calculated as the market capitalization-weighted average of financial impact of all companies in the index.

The climate change scenario used in this analysis, known as SSP3-7.0, is characterized by limited mitigation where total greenhouse gas emissions double by 2100 and global average temperatures rise by 2.8 degrees C to 4.6 degrees C by 2100.

Source: S&P Global Sustainable1.

The S&P Global Sustainable1 Physical Risk Exposure Scores and Financial Impact dataset defines for each company the financial impact due to changing hazard exposure, absent any adaptation and resilience measures. Financial impact at the company level reflects the weighted average financial impact for all assets linked to the company, weighted by the estimated value of the assets.

To assess the financial impact at the asset level, we use S&P Global Sustainable1 climate physical risk data, which assigns an exposure score for physical climate hazards to each of the more than 2 million corporate assets in the dataset. We assess seven physical climate hazards: extreme heat, water stress, coastal flood, fluvial flood, tropical cyclone, drought and wildfire. The hazard exposure score for an asset is combined with the asset type-specific sensitivity profile to quantify the future financial costs associated with each hazard. These costs can include a range of costs stemming from increased operational expenses to lost revenues due to business interruption through to physical damage and costs to repair assets. These costs are expressed as a percentage of the value of each asset type as an indicator of the financial impact at the asset level.

The assets considered are real assets or physical assets. The asset values are constant and indicate the relative value of different asset types, such as an office compared with an electric power plant. The costs associated with the hazards can, but do not always, reduce the value of a real asset.

These projections are based on the climate scenario known as SSP3-7.0, which is characterized by limited mitigation where total greenhouse gas emissions double by 2100 and global average temperatures rise by 2.8 degrees C to 4.6 degrees C by 2100. The S&P Global 1200 is an index that covers the largest companies across North America, Europe, Asia, Australia and Latin America, capturing approximately 70% of global market capitalization.

S&P Global Sustainable1 does not currently have complete data on all asset holdings of all companies in the S&P Global 1200, and these results could change as asset data coverage expands over time.

Some climate hazards will generate more significant financial costs for S&P Global 1200 assets than others, according to our data. Extreme heat is projected to generate the highest cost for companies in the 2050s, in part because nearly all assets will face at least some exposure to extreme heat, whereas exposure to other hazards is more variable. Water stress and fluvial flooding are the second- and third-most significant sources of financial impact for the S&P Global 1200. Water stress refers to the combination of reduced freshwater availability from sources such as rainfall and increased water demand from the general population, industrial use and agriculture.

For example, extreme heat could affect businesses across sectors through lower labor productivity: If it is too hot, employee health and safety and company operations can suffer. Energy grids can come under pressure as the general population cranks up air conditioning use. Transportation links can be damaged, leading to delays in supply chains.

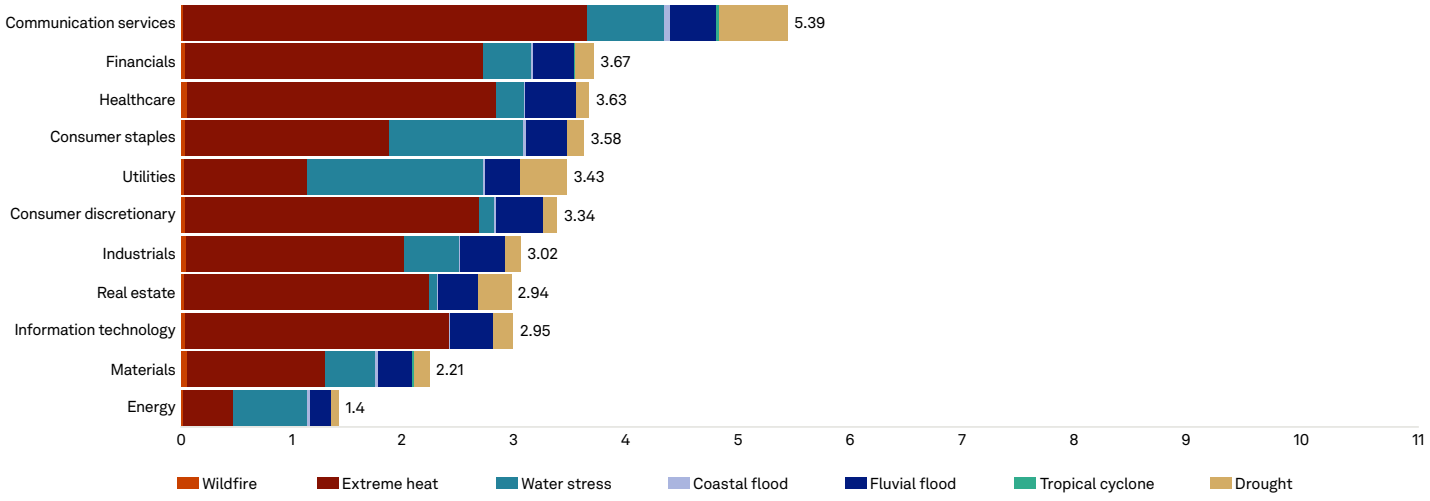
If we look further ahead to the 2090s, the financial impact of extreme heat intensifies, and hazards that are less severe in the 2050s become more significant without efforts to adapt.

How climate affects sectors differently

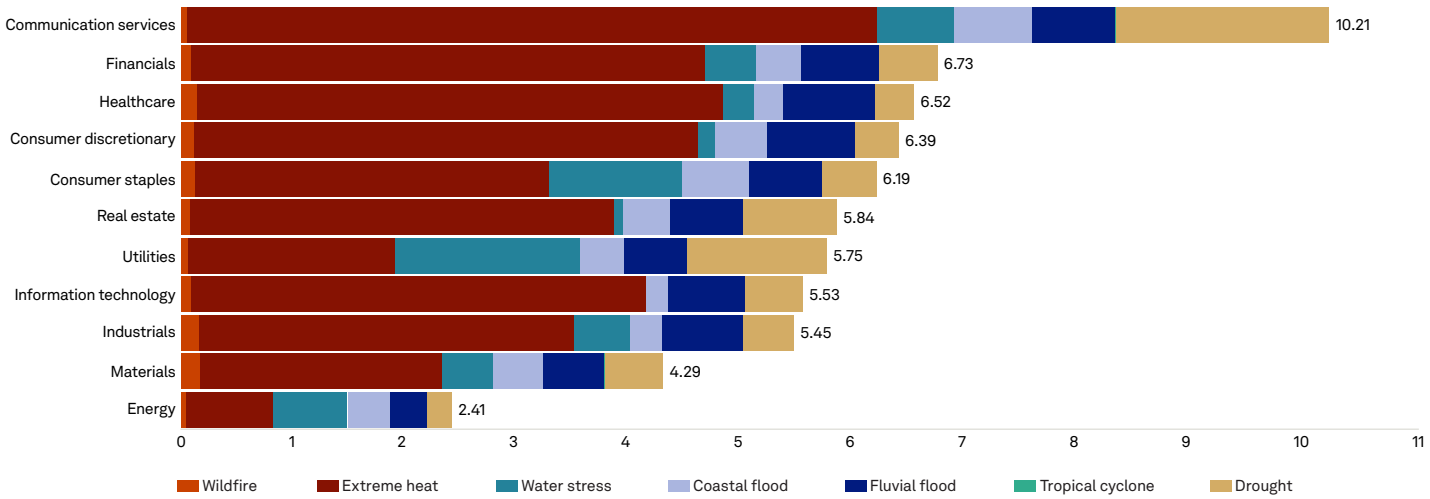
The potential financial impact of climate hazards could influence where a company decides to develop its operations or where investors put their money. A severe drought may decimate a vineyard while the productivity of a nearby office building might not be affected much at all. Such shifts, in turn, would change the risk profile of businesses and have a knock-on effect on banks, insurers and investors.

Some sectors face higher financial impact to their assets from climate hazards

2050s: Weighted average financial impact on assets owned by companies in the S&P Global 1200 by sector (%)



2090s: Weighted average financial impact on assets owned by companies in the S&P Global 1200 by sector (%)



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Source: S&P Global Sustainable1.

Our analysis shows that some sectors are more sensitive than others in terms of the potential financial impact of climate hazards. The location of an asset also influences how high the financial impact could be.

For example, the communication services sector in the S&P Global 1200 would face significant financial impact: 5.4% per annum of real asset values by the 2050s. This sector includes telecommunications firms, data providers and media companies. Extreme heat would generate the largest impact absent adaptation, followed by water stress, drought and fluvial flooding. In communication services, 97% of real assets with financial impact of 10% or more by the 2050s are datacenters, and datacenter assets have the highest average financial impact for this sector at 8.3%. Datacenters are sensitive to extreme temperatures and restricted access to water due to their dependency on heating, ventilating and air conditioning (HVAC) and cooling.

Extreme heat represents the largest share of financial impact for most sectors in the 2050s. While that holds true further out toward the 2090s, other hazards become much more significant. The financial impacts from coastal flooding and drought become more severe across many sectors.

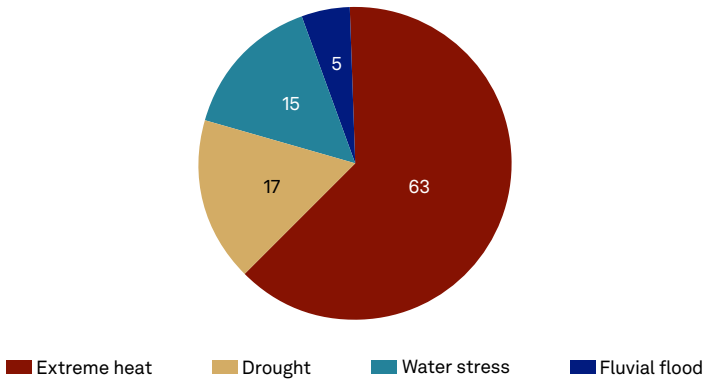
Datacenters

Zooming in on one type of corporate asset — datacenters — provides insight into how different climate hazards contribute to financial impact absent adaptation and resilience measures. Datacenters are also worth examining because they are fundamental infrastructure to the digital economy, and they are likely to become more important as technology evolves throughout the rest of the century.

The Physical Risk Exposure Scores and Financial Impact dataset covers more than 2,000 datacenters owned by S&P Global 1200 companies. These assets are particularly sensitive to extreme heat, which will have the highest financial impact by the 2050s, followed by drought and water stress.

Extreme heat, drought and water stress will cause the largest financial impacts to datacenters

Average share of financial impact by physical hazard on datacenters owned by S&P Global 1200 companies in the 2050s (%)



Data as of February 2023.

Not shown are tropical cyclone, wildfire and coastal flood, which each accounted for less than 1%.

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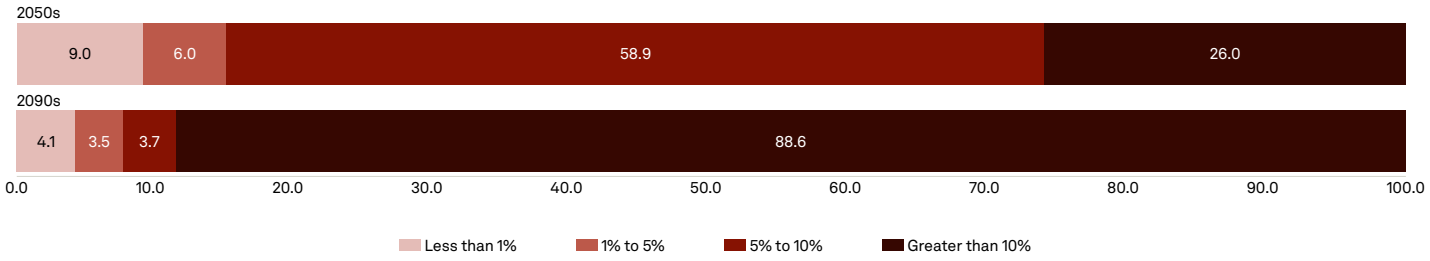
Source: S&P Global Sustainable1.

Extreme heat can lead to accelerated degradation of HVAC systems and thus increase capital expenditure. For example, take two hypothetical datacenters located on the same block in a city that is exposed to extreme heat. One of them is a small site operated by a local internet service provider while the other is a state-of-the-art facility operated by a multinational social network company. Periods of extreme heat would increase cooling costs and speed up the deterioration of HVAC systems for both datacenters. These costs can be expressed in relative terms for both assets (i.e., the percentage of typical asset value), but the absolute cost would be much higher for a state-of-the-art facility. The value of each facility is not known, which is why this analysis focuses on the relative impact.

While the absolute costs are likely to vary by location or the size of the asset, the vast majority of datacenters owned by S&P Global 1200 companies will face at least some financial impact by the 2050s. In that decade, about one-quarter of these datacenters could face financial impact equal to 10% or more of the asset's value. That share skyrockets to nearly 89% of datacenters by the 2090s.

Nearly all S&P Global 1200 datacenter assets face financial impact of 10% or more by the 2090s

Percentage of datacenter assets in the S&P Global 1200 facing financial impact from climate hazards in the 2050s and 2090s



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Source: S&P Global Sustainable1.

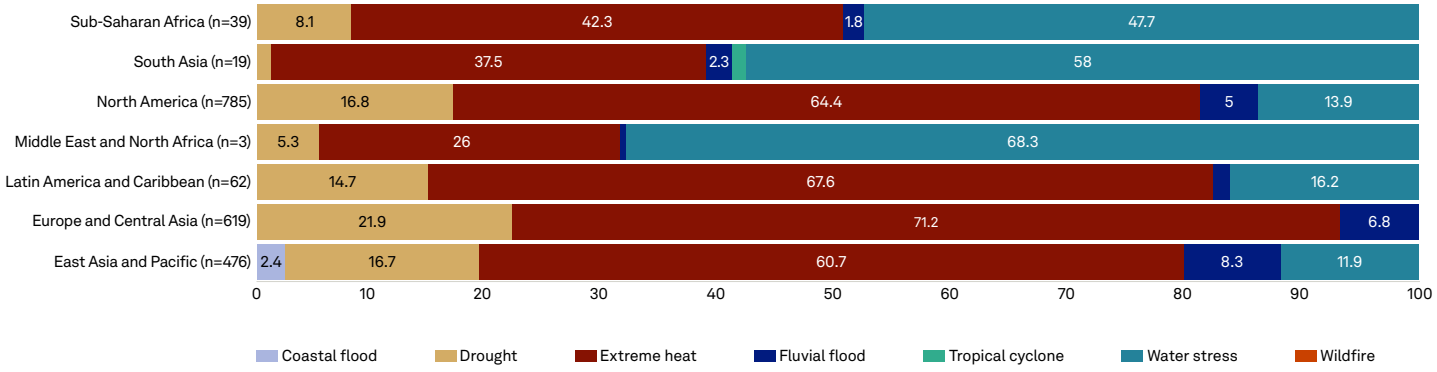
The regional differences of climate hazards

Location will also drive companies' exposure to physical risk hazards and what financial impact their assets may face. Extreme heat is the greatest source of financial impact for datacenters owned by S&P Global 1200 companies in Europe and Central Asia, North America, and Latin America and the Caribbean by the 2050s. However, in sub-Saharan Africa, South Asia, and the Middle East and North Africa, water stress will have the greatest financial impact.

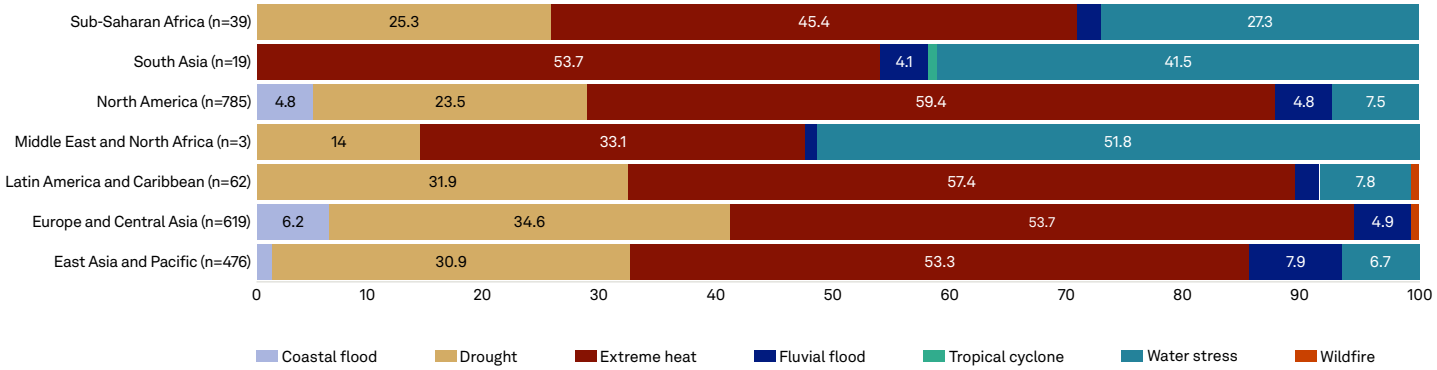
These two hazards can also reinforce one another, worsening the outcome in areas dealing with both. In sub-Saharan Africa, 80% of countries are likely to have more than 45 days of heat waves per year by 2050, compared with less than 15% currently, according to a report on potential economic losses from physical climate risks by S&P Global Ratings.

Financial impact on datacenters due to drought and coastal flooding will increase from the 2050s to the 2090s

2050s: Average share of financial impact by physical hazard for S&P Global 1200 datacenter assets by region (%)



2090s: Average share of financial impact by physical hazard for S&P Global 1200 datacenter assets by region (%)



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Source: S&P Global Sustainable1.

The slow pace of adaptation

A growing number of large corporates around the world have pledged to cut their greenhouse gas emissions as close to zero as possible and offset the remainder, usually by the distant deadline of 2050. But they remain the exception rather than the rule. Meanwhile, corporate action to adapt to the physical risks of climate change has been slow. An analysis of S&P Global ESG Raw Data, which is built on the S&P Global Corporate Sustainability Assessment, shows that just one in five companies across sectors has a plan to adapt to the physical impacts of climate change. Just over 46% of assessed companies globally conduct physical risk assessments, which could indicate how climate-related risks are embedded throughout a company. A certain amount of change is locked in due to the lag in the climate system owing to historic GHG emissions — many of the impacts of climate change will therefore materialize irrespective of the policy choices made today and absent adaptation.

In the run-up to COP28, there is urgent need for action on climate and the creation of solutions to address worsening physical risks. Adaptation and resilience will be key to preventing the worst damage from physical climate risks over the coming years. Understanding these hazards, weighing the severity of climate events in a geographical area, and then assessing the potential financial impact on assets could help companies make more effective decisions on adapting their operations to climate change.

Methodology of the Physical Risk Exposure Scores and Financial Impact dataset

Our data projects future financial costs of climate change on more than 20,000 companies and more than 2 million individual assets. The data includes the projected impacts of extreme heat, wildfire, water stress, drought, coastal flood, fluvial flood and tropical cyclone. The data is based on four climate scenarios, which consider future GHG emissions and to what extent governments have enacted policies to curb the effects of climate change. The dataset measures a physical asset's exposure to climate hazards through exposure scores. It also projects the future financial costs of evolving climate hazards and expresses these costs as a percentage of typical asset value to reflect the potential financial impact of those hazards absent adaptation and resilience measures. These costs can include a range of costs stemming from increased operational expenses, to lost revenues due to business interruption, through to physical damage and costs to repair assets.

Shared Socioeconomic Pathways Defined

The IPCC established the Shared Socioeconomic Pathways (SSPs) as a set of scenarios for projected greenhouse gas emissions and temperature changes. The SSPs incorporate broad changes in socioeconomic systems, including global population growth, economic growth, resource availability and technological developments:

- **SSP1-2.6** is a low-emissions scenario in which the world shifts gradually, but consistently, toward a more sustainable path. This SSP aligns with the Paris Agreement on climate change's target to limit the average increase in global temperature to well below 2 degrees Celsius by the end of the century. The global temperature is projected to increase by 1.7 degrees (a likely range of 1.3-2.2 degrees) by 2050 or by 1.8 degrees (1.3-2.4 degrees) by the end of the century
- **SSP2-4.5** is a moderate-emissions scenario, consistent with a future with relatively ambitious emissions reductions but where social, economic and technological trends do not deviate significantly from historical patterns. This scenario falls short of the Paris Agreement on climate change's aim of limiting the global temperature rise to well below 2 degrees, with a projected increase of 2.0 degrees (1.6-2.5 degrees) by 2050 or 2.7 degrees (2.1-3.5 degrees) by the end of the century

- **SSP3-7.0** is a moderate- to high-emissions scenario, in which countries increasingly focus on domestic or regional issues, with slower economic development and lower population growth. A low international priority for addressing environmental concerns leads to rapid environmental degradation in some regions. This SSP projects a global temperature increase of 2.1 degrees (1.7-2.6 degrees) by 2050 or 3.6 degrees (2.8-4.6 degrees) by the end of the century
- **SSP5-8.5** is a high-emissions scenario, in which the world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as a path to sustainable development. This SSP projects the global temperature increase at 2.4 degrees (1.9-3.0 degrees) by 2050 or 4.4 degrees (3.3-5.7 degrees) by the end of the century

Many companies do not disclose the value of their corporate assets. To help address such data gaps, S&P Global Sustainable1 has calculated typical asset replacement values for more than 250 unique asset types and ownership structures. These typical asset values can be used to produce a relative measure of financial impact — expressing the costs of climate physical hazard exposure as a percentage of the typical asset value and providing an indicator of the financial impact of those costs to an asset, or in aggregate for a company owning many assets.

The exposure scores and financial impact metrics are measured by looking at a specific hazard. For flooding, for example, we calculate the annual frequency of exceeding a historical 100-year flood level relative to a baseline period between 1950 and 1999 for four scenarios and all decades between the 2020s and 2090s. We then look at the business interruption, cleanup and repair and calculate the projected cost to an asset. The exposure scores demonstrate the presence of climate hazards at asset locations or in aggregate for a company, while the financial impact metrics quantify the financial costs of that exposure as a percentage of the future value of a specific asset type or group of assets, enabling users to focus on those hazards that will potentially have the greatest financial impact absent adaptation and resilience measures.

This research was prepared by and reflects the views of S&P Global Sustainable1, which is separate and independent from other businesses/divisions of S&P Global, including S&P Global Ratings.

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