STEELCASE INC.'S CLIMATE RISK SCENARIO ANALYSIS: UNDERSTANDING THE IMPACT OF CLIMATE CHANGE ON BUSINESS OPERATIONS

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Executive Summary

Introduction

Steelcase, Inc., a multinational leader in office furniture, is committed to leading the charge in its industry to set science-based targets that are in line with the Paris Climate Accords' 1.5ºC warming scenario. One part in achieving this goal is the inclusion of near- and long- term risks due to climate impacts in business planning. As such, the objectives of this Master's Project are to conduct a climate risk scenario analysis for Steelcase, Inc, which includes an analysis of North American supplier risk, a physical risk assessment of Steelcase Owned and Operated facilities, suppliers, and customers, and a transitional risk assessment of the Steelcase business and key materials related to manufacturing its products.

Importance of Scenario Analysis

For many industries and organizations, the impacts of climate change are likely to emerge over the medium to longer term. The uncertainty of climate change presents a challenge for them to fully understand and plan for the potential effects of climate change on their business, strategies, and financial performance. The Intergovernmental Panel on Climate Change's Sixth Assessment Report (Working Group II) stated that in North America, the inclusion of climate impact projections into the near- and long-term decision making will aid in reducing future risks (high confidence). There is no formal methodology of managing climate change risks. However, there are organizations that provide frameworks for companies to engage in climate risk scenarios, such as the Task Force for Climate Related Financial Disclosures (TCFD).

Research

The supplier risk analysis started with interviews of 5 suppliers across material supplied and company size. These interviews clarified how suppliers spoke about and understood climate risk, as well as planning for and measuring climate impacts. The results were then used to better inform the questions and format of the broader survey sent to all of Steelcase's North American suppliers. The responses to the survey indicated that some suppliers are planning for climate risk, although few are actively preparing adaptive or mitigative capacity measures. In concert with the ongoing supplier engagement, these concerns can be addressed.

The physical risk assessment was conducted using ArcGIS and data gathered from Steelcase to determine the regions in the United States where physical climate impacts would be greatest. Planning for future risk by implementing resiliency strategies for these hazards in the subsequent regions would reduce Steelcase's overall susceptibility to risk

The transitional risk assessment was performed using research on future scenarios that indicate possible pathways for the planet from a human-focused perspective. The use of industry reports was also included to analyze risks of key materials and future impacts on supply chains. For Steelcase, some ways to mitigate transitional risks include implementing circular economy practices, reducing reliance on international supply, and investing in technological development.

Primary Findings

This section was removed per non-disclosure agreement.

Primary Recommendations

These recommendations evaluate the potential effects of Steelcase's strategic plan. Further analysis should be conducted to find the financial impacts to Steelcase from the climate scenario analysis such as impacts on input costs, operating costs, and revenues. These recommendations might be used to make changes to Steelcase's business model, portfolio mix, and investments in capabilities and technologies. These recommendations attempt to identify applicable, realistic decisions to manage the identified risks.

Physical Risk

- A Climate Vulnerability Assessment (CVA) is advised to be conducted to fully understand the vulnerability of infrastructure to climate change at each location[1]
    - The CVA combines the hazards explored in this document with the planning and financing of adaptive measures for climate change
- Encourage suppliers to complete their own CVA and implement resiliency measures, particularly those in the identified at-risk regions.

Transition Risk

- SSP 1
    - Consumer sustainability requirements and high focus on green policy means a circular economy will be necessary
- SSP 3
    - Rough international trade and slow economic development make domestic supply chains key to continued success
- SSP 5

- Focus on high quality consumer goods that outpace competitors' innovations to maintain market share

Acknowledgements

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Disclaimer

Any opinions expressed in this report represent a consensus of the authors and do not represent the positions or policies of Steelcase or of the University of Michigan.

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Introduction

Climate Change Overview

Climate change is the "long-term change in the average weather patterns, which define Earth's local, regional and global climates".[2] Since early in the 20th century, changes in the Earth's climate have been primarily driven by human activities (95% certain), and has been linked to an increase in Earth's average surface temperature.[3] The term "climate change" is used to describe the subsequent effects of the global temperature rise.

The Intergovernmental Panel on Climate Change (IPCC) is an intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change. The IPCC is responsible for providing all governments at all levels with scientific information to aid in developing climate policies. The IPCC Fifth Assessment Report (AR5), published in 2014, contains the climate projection data utilized by global companies to report on their climate risks, including this report. To limit human and ecosystem damages, the 21st Conference of the Parties (COP21) in December 2015, 195 nations adopted the Paris Agreement, which pursues efforts to limit the temperature increase to 1.5°C above pre-industrial levels'. This mounting scientific evidence has laid clear groundwork for the urgency of companies to plan for the effects of climate change.

The IPCC Sixth Assessment Report (AR6), Working Group II contribution, was released on February 28th, 2022.[4] The AR6 released regional fact sheets on climate change impacts and risks. Specifically for North America, "Under current economic and consumption trends and paradigms, climate change impacts are projected to cause large market and non-market damages (high confidence)".[5] To reduce this risk, long-term mitigation plans are vital to stay below 1.5°C degree warming from pre-industrial levels'. The policies that are expected to be enacted to adhere to the Paris Agreement and will focus on "sustainable and resilient land use, consumption patterns, economic activities, and nature-based solutions with safeguards".[6]

The Use of Climate Scenario Analysis

For many industries and organizations, the impacts of climate change are likely to emerge over the medium to longer term. However, the magnitude, timing, and frequency of these impacts are not fully understood. This uncertainty presents challenges for many industries to fully understand and plan for the potential effects of climate change on their businesses, strategies, and financial performance. To effectively incorporate the potential effects in their strategy and risk management plans, industries need to consider how climate related risks evolve under different conditions. One way to do this is through a climate scenario analysis, which allows companies to explore a range of possible futures and assess how these forecasted impacts may affect their operations.[7] AR6 Working Group II stated that in North America, the inclusion of climate impact

projections into the near- and long-term decision making will aid in reducing future risks (high confidence).[8]

There is no formal methodology of managing climate change risks. However, there are organizations that provide frameworks for companies to engage in climate risk scenarios, such as the Task Force for Climate Related Financial Disclosures (TCFD). The TCFD framework is commonly used across U.S. industries when reporting their climate risks. The TCFD believes that a "scenario analysis is an important and useful tool for an organization to use, both for understanding strategic implications of climate-related risks and opportunities and for informing stakeholders".[9] TCFD puts climate risks into two categories: 1. transition risks (risks associated with the transition to a low carbon society) and 2. physical risks (the environmental impacts from climate change such as extreme weather events). The use of climate-related physical and transition risks will likely manifest themselves primarily and broadly in the form of constraints on GHG emissions, effects on energy production and usage, and effects on water availability, usage, and quality.

Potential Future Requirements for Climate Risk Reporting

The U.S. Securities and Exchange Commission (SEC) proposed a climate-related disclosure rule for public companies on March 21st 2022. If this rule is finalized, all public companies would need to report in 2024.

The finalized rule would require to report on:[10]

1. Climate-related risks and their actual or likely material impacts on the registrant's business, strategy, and outlook;
2. The registrant's governance and management of these risks;
3. The registrant's GHG emissions, starting first with Scope 1 and Scope 2 (direct emissions and indirect emissions from power purchase) and growing to include Scope 3 (indirect emissions from upstream and downstream entities in its value chain);
4. Audited climate-related financial risk metrics and related disclosures; and
5. Information regarding a registrant's climate-related targets, goals, and transition plan, if any

Data presented in this analysis aligns well with the requirements of the SEC proposed climate-related disclosure, specifically to "Climate-related risks and their actual and likely impact". The physical risk analysis in Section #2 will inform the *actual* impact, while the transition risk analysis in Section #3 will inform the *likely* impact (using several resources and assumptions to create a theoretical future based on warming degree mitigation and adaptation).

Project Overview

Steelcase Inc. has acquired the help of The University of Michigan to collaborate on risk and opportunities of climate change. Master students Grant Alpert, Michelle Black, and Katie Portz

were assigned Steelcase, an office furniture business founded in Grand Rapids, MI, to develop a series of company-specific climate scenario analyses.

Climate change effects have the potential to be particularly devastating to a large, interconnected company, as many supply chains are designed with efficiency rather than resiliency. When these types of firms experience severe and unpredictable events to their supply chain, the damages can be costly. As a result, this project seeks to address Steelcase's main challenge of assessing the impact of global climate change on Steelcase Corporation, their supply chain, and their clients. The Master's Team has been asked to prepare a series of Climate Risk Scenario Analyses (CRSA) that highlight potential transitional and physical risks in Steelcases operations and future financial situation. To ensure this analysis is in-depth and accurate, the CRSA will include scientific data, information from surveys and interviews, data on related markets, environmental regulations, and data from leading climate change institutions.

Prior to conducting the climate risk scenarios, an interview and survey was conducted. The interview and survey portion of the analysis will aid in understanding the current mitigations and adaptation capacities regarding climate change within Steelcase's supply chain in North America. The benefit of this analysis is to increase knowledge about the specificity of education in Steelcase's Supply Chain Engagement Seminar, with an aim to align current supply chain's climate change measures and expected impacts based on the transitional and physical scenario analysis.

An integrative review by Ghadge et al. highlights the importance of climate change impacts on supply chains.[11] There is not a "one model fits all" approach in analyzing climate change risks, but many commonalities. The following analysis by the University of Michigan's Master's Project Team included many approaches found in the article review, including:

- Qualitative and quantitative research conducted
    - Qualitative – Interviews and Surveys
    - Quantitative – Modeling RCP and SSP scenarios
- External and internal risks (hybrid approach)
    - Categorized into physical and transitional risks
- Climate change drivers (TCFD framework)
    - Market, Technology, Reputation, and Policy

Terminology

- **Carbon Disclosure Project (CDP)** - a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts.[12]

- **Task Force on Climate-Related Financial Disclosures (TCFD) -** created by the Financial Stability Board to improve and increase reporting of climate-related financial information.[13]
- **Climate Adaptation** - In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.[14]
- **Climate Mitigation** - A human intervention to reduce emissions or enhance the sinks of greenhouse gasses.[15]
- **Climate Risk** - The TCFD divided climate-related risks into two major categories: (1) risks related to the transition to a lower-carbon economy and (2) risks related to the physical impacts of climate change.[16]
- **Climate Risk Scenario Analyses (CRSA) -** scenarios allow an organization to explore and develop an understanding of how the physical and transition risks of climate change may impact its businesses, strategies, and financial performance over time.[17]
- **Physical Risk** - Physical risks resulting from climate change can be event driven (acute) or longer-term shifts (chronic) in climate patterns. Physical risks may have financial implications for organizations, such as direct damage to assets and indirect impacts from supply chain disruption.[18]
- **Transition(al) Risk** - Transitioning to a lower-carbon economy may entail extensive policy, legal, technology, and market changes to address mitigation and adaptation requirements related to climate change. Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organizations.[19]

SECTION 1: Interviews & Survey

Methodology

Qualitative and quantitative approaches were both utilized in the survey and interview development, data collection, and data analytics process. Five in-depth interviews with selected North American (NA) suppliers were conducted to provide information on the types of questions and vocabulary to use in a subsequent survey sent out to all NA suppliers. The processes involved in developing and facilitating the interviews and survey are detailed in the following sections.

Interviews

The interviews were conducted with five Steelcase suppliers with the purpose of gaining information on how generally NA suppliers measure, plan, and discuss climate change in their organization. These interviews were composed of open-ended questions to allow for broader discussions around the topics, which provided guidance on vocabulary and question structure in the survey. Suppliers were recommended by Steelcase's North America Procurement Director based on the supplier's working relationship with Steelcase and their varied material/process, company size, total annual sales, and location.

Careful consideration was given to wording of questions to ensure clarity and alignment with best industry practices. This resulted in the majority of the prompts being adapted from the Carbon Disclosure Project (CDP) and informed by the Task Force on Climate-related Financial Disclosures (TCFD), both of which are considered global standards in environmental and social reporting. The full list of interview questions and CDP & TCFD references are located in Appendix S1-IS1.

The interviewing process took place from May 2021 to July 2021 with the interviews lasting around 45 - 60 minutes virtually on Microsoft Teams. Questions were sent ahead of time by Steelcase to the company contact to allow for preparation and review.

At the end of the five interviews a qualitative analysis was conducted to pull out key findings that informed the creation of the larger NA supplier survey. Identifying characteristics of the individual respondents were omitted from interview documentation to provide anonymity.

Survey

After the conclusion of the interviews, the major takeaways were suppliers differed in:

1. Climate risk knowledge
2. Mitigation and adaptation efforts

The guiding question for the creation of our survey was:
"What current and future mitigation and adaptation efforts are being implemented in Steelcase's supply chain in North America regarding climate risks?"

The survey was developed in Qualtrics, through University of Michigan's licensing privileges. Questions included in the survey were based off of the five interviews with Steelcase NA suppliers. Questions were not required to be answered and consisted of "select the following" to allow for a quantitative analysis at the closing of the survey. The survey was sent via email**.**

The analysis includes summary statistics, regression models, and correlations matrices.

- Regression model's were considered statistically significant if the p-value was < 0.05
- Correlation Coefficient were considered "weak" if <0.50 and "moderate/strong" if >0.50

The survey was open from December 10, 2021 to January 1, 2022. The complete survey questions are listed in Appendix S1-IS2.

Results

Interview

Summary

The five company names were replaced with Firm A - Firm E for the analysis. All suppliers provided different materials/processes and ranged greatly their reported emissions and Steelcase's spend in FY 21.

Summary of 5 Suppliers (FY 21)	**Minimum**	**Maximum**
Steelcase Spend (USD)	*Removed per NDA*	*Removed per NDA*
Supplier Emissions (kgCO2e)	*Removed per NDA*	*Removed per NDA*

The major findings from the interviews are grouped below by 1. position, 2. responsibility for business risk, 3. risk documentation & certifications, 5. time horizons, 6. incentives, 7. transitional and physical risks, and 8. unique findings.

Findings:

This section was removed per non-disclosure agreement.

Survey

Demographics

The North American Supplier Climate Risk survey was built to analyze Steelcase's North American Supplier's mitigation and adaptation measures regarding climate risks. The survey was sent to a list including NA and EMEA. Their response rate is included in the table below:

Summary of Survey Respondents			
	Count of suppliers that were sent the survey	**Count of survey respondents**	**Response rate**
EMEA	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*
North America*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*
TOTAL	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*

* The analysis is that this report only uses North America responses.

Respondent Summary:

This section was removed per non-disclosure agreement.

Findings:

This section was removed per non-disclosure agreement.

Physical Climate Risk

Summary

To understand how Steelcase's supply chain is considering and planning for the physical risks of climate change, a portion of the survey was dedicated to ask specifically about these risks. Physical risks are the results of changing climate patterns, including acute events (drought, floods, extreme precipitation) and chronic events (increasing temperature, sea-level rise, and water scarcity. Considering recent scientific literature on climate projections, it is a high probability that extreme weather events will increase[20]. These increased risks have the potential to be particularly devastating to a large, interconnected company, as many supply chains are designed with efficiency rather than resiliency.

Findings:

This section was removed per non-disclosure agreement.

Transitional Climate Risk

Summary

To understand how Steelcase's supply chain is considering and planning for the transition risks of climate change, a portion of the survey was dedicated to ask specifically about these risks. Transition risks are the results of changes in society and they belong to four broad categories. Policy and legal risk is the risk that legal changes to adapt or mitigate climate change will affect a business. Technology risk relates to changing technology and the risk it poses to the function of the firms using that technology. Market risk and reputation risk are how customers changing perceptions and preferences can affect a business and its market reach. With a large, international company like Steelcase, any and all of these risks could drastically change the way the company and its supply chain operates.

Findings:

This section was removed per non-disclosure agreement.

Key Materials

The materials included in this analysis from the survey were determined by Steelcase's Key Materials, which are specified in Global Reporting Initiative (GRI) Index page 9.[21]

Findings:

This section was removed per non-disclosure agreement.

Findings

This section was removed per non-disclosure agreement.

Recommendations

Supply chains are highly complex systems with many factors influencing performance and adaptive capacity. To help suppliers navigate this rapidly changing environment, it is vital for Steelcase to be proactive in addressing where their supply chain is struggling in regards to climate change preparation, both in the short and long term. Based upon key findings from the survey and interviews, a summary of recommendations were developed to improve supply chain resiliency, increase supply chain engagement, and increase the quality of potential additional surveys. The following recommendations are to be utilized as an aid in proactive supply chain management, as it relates to climate change.

For Supply Chain Engagement

- Increasing education for Steelcase Suppliers on *how to* quantify physical risks. There is the IPCC Atlas which is composed of several global and local climate change scenarios for public use[22]
    - And the subsequent importance of using the physical risk data to create efficient adaptive capacity plans
- In the Supply Chain Seminars, include the TCFD Recommendations Report that defines and describes physical and transition risk[23]
- Inform suppliers that forecasted demand and supply can aid in the reporting of their climate-related transition market risk
- It is vital for Steelcase to have conversations with suppliers to understand the value in proactively planning for a carbon tax, since there is a potential for major changes to operations

For Future Survey Replication

- Questions involving vulnerability should use the IPCC report format below:
    - Virtually certain: 99–100% probability
    - Very likely: 90–100%
    - Likely: 66–100%
    - More likely than not: 50–100%
    - About as likely as not: 33–66%
    - Unlikely: 0–33%
    - Very unlikely: 0-10%
    - Exceptionally unlikely: 0–1%
- Questions involving "most often" or a time measure frequency should be quantified. For example, "which management structure deals with climate risk most often?" should be rephrased as, "which management structure deals with climate risk at least once a month?"
- Offer an incentive for full survey completion

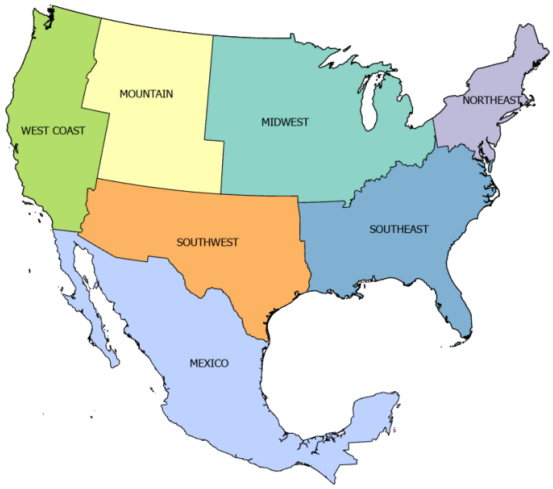
SECTION 2: Physical Risk

Methodology

Qualitative and quantitative methods were both utilized in the process of conducting physical climate risk scenarios (PCRS). This process initially focused on reviewing literature about physical climate risks as they relate to climate change, the anticipated impact of physical climate risks on business operations, and recommended structure for climate scenario analyses from the TCFD. This analysis was only conducted in the North American region.

After initial research was concluded, efforts were focused on relating the locations of Steelcase owned and operated facilities, customers, and suppliers to varying scenarios of physical climate risks. Locations of Steelcase owned and operated manufacturing facilities and customers were provided to the team directly by Steelcase. The locations of suppliers were collected through a survey sent out to North American Suppliers. Locations of all three categories were then geocoded from their respective Excel spreadsheets into ArcGIS, a software that can be used to handle and analyze geographic information by visualizing geographic data and statistics. Supplier and customer locations were aggregated to regions, since climate data occurs on a larger scale geographically. Refer to Figure S2-P1 below for a map of the regions:

Figure S2-P1: Region Boundaries for Analysis



To understand how these groups will be impacted by varying climate futures, this analysis utilized the RCP scenarios. RCPs represent a common set of emissions concentration levels and radiative forcing projections leading to a wide range of global warming temperatures. Figure S2-P2 outlines each RCP and its respective characteristics and emissions assumptions. These RCP models were overlaid on each location group and spatially joined via ArcGIS software. Climate models for each selected RCP and time frame were downloaded from publicly accessible data, provided through the EPA, NCDC, and the National Center for Atmospheric Research (NCAR).

Figure S2-P2: RCP Assumptions and Characteristics

RCP	Forcing	Emissions Assumption	Included in Scenarios?
2.6	2.6 W/m^2	Strongly Declining	Yes
4.5	4.5 W/m^2	Slowly Declining	No
6.0	6.0 W/m^2	Stabilizing	Yes
8.5	8.5 W/m^2	Increasing	Yes

For each variable included in the PCRS (RCP, time, and hazards), justification was provided to demonstrate its alignment with best industry practices, such as recommendations from the Task Force on Climate-related Financial Disclosures (TCFD). Furthemore, if Steelcase requested specific variables to be included in the PCRSA, then this was also incorporated.

Results on acute climate events were derived from synthesizing climate literature on the impact of climate change on extreme weather events and climate scenario results. Results on chronic climate events were solely derived from the spatial analysis. This data was aggregated by region to provide a more holistic view into the level of risk each region will have in regards to extreme weather.

The results show the forecasted physical climate risks for each region. Changes in temperature and precipitation are stated in Celsius degrees and inches respectively. Climate hazards were given a risk rating for each region. Risks are given on a 1 - 4 scale in relation to baseline events and solely given based on projected exposure to the event. Each acute hazard was rated based on the following criteria:

- Extreme heat risk: Took into account (1) temperature anomaly (2) general high concentration of pressure around the U.S.
- Flood risk : took into account (1) precipitation anomaly, (2) coastal flooding risk, (3) melting
- Storm risk: took into account (1) proximity to coast (2) historical presence of tornados (3) increase in precipitation (4) increase in temperature
- Winter weather risk: took into account (1) impact of jet stream course change on areas to be impacted

If an acute hazard was given an "N/A" risk rating or an asterisk by its score, this signifies that there was minimal information (or conflicting) about the effect of climate change on that particular hazard in that region. The scale is described as followed:

- 0 - Same or Less Frequency as Historic Trend (Slight risk)

- 1 - Slightly More Often Than Historic Trend (Low risk)
- 2 - Moderately More Often Than Historic Trend (Moderate risk)
- 3 - Highly More Often Than Historic Trend (High Risk)
- 4 - Severely More Often Than Historic Trend (Severe Risk)

Scores were then averaged for each region into a single score (0 - 4) that demonstrated its overall level of risk.

Explanation of Variable Selection:

Variable 1: Climate Hazards

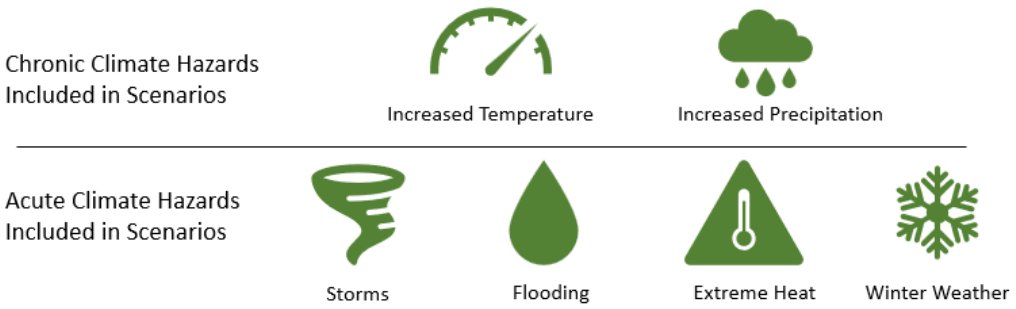
The *TCFD* recommends a diversity of climate hazards, both acute and chronic, be included.

- **Acute physical risks** define hazards such as an increase in severity or frequency of tornadoes, hurricanes, wildfires or floods. It is important for this study to note that the impact of climate change on acute climate hazards is complex and not completely understood by the scientific community. However, the best available information can give us a general idea of how climate change may affect extreme weather events.[24]The level of risk attributed to each acute climate hazard carries a degree of uncertainty that Steelcase should account for when reading recommendations.
- **Chronic physical risks** refer to longer-term, incremental changes in climate patterns, such as a deviation from the typical annual average rainfall or temperature[25].

Furthemore, the proposed Corporate Governance Improvement and Investor Protection Ac (H.R. 1187) bill provides guidelines for companies when considering which climate hazards to include, as well. These include increased average global temperatures and increased frequency of temperature extremes,increased severity and frequency of extreme weather events, increased flooding, sea level rise, ocean acidification, increased frequency of wildfires, decreased arability of farmland, and decreased availability of freshwater[26].

As a result, recommendations from the TCFD, the proposed bill, and Steelcase selected climate hazards were all taken into account when selecting the hazards included in our scenarios. The list is referenced in the Figure S2-P3 below. However, this is not an exhaustive or comprehensive list of all hazards that Steelcase could experience as a result of climate change.

Figure S2-P3: Climate Hazards Selection



Variable 2: Representative Concentration Pathways (RCPs)

The Task Force on Climate-related Financial Disclosures (TCFD), a leading framework to improve and increase reporting of climate-related financial information, recommends "companies identify and utilize a range of scenarios, including a 2°C scenario, that provide a reasonable diversity of potential future climate states"[27]. To ensure Steelcase PCRSA are aligned with TCFD recommendations of variable diversity and 2°C scenario , our team selected RCP 2.6, RCP 6.0 and RCP 8.5 to represent decreasing emissions, stabilizing emissions, and increasing emissions, respectively.

Variable 3: Time Frames

The TCFD recommends that firms utilize a combination of short to long term time frames. However, the TCFD does not define the actual length of short and long term time frames organizations should use. They encourage firms to decide how to "define their own time frames according to the life of their assets, the profile of the climate-related risks they face, and the sectors and geographies in which they operate".[28] However, HR 1187 states that frames to be considered, include 5, 10, and 20 year time frames. [29]

While there is a wide array climate data available, many datasets are incomplete or outdated. In the interest of utilizing the most comprehensive, complete, and updated data , the time frame of 2060 was used. Projected climate variability and changes discussed in our physical climate risk scenarios are in reference to a baseline of climate data collected at consistent locations, aggregated from 1986-2005.

Results

The following tables are the results of our physical risk assessment for each RCP scenario and the averages risk across each hazard for each region. An asterisk is used to symbolize that the average score includes an "N/A" rating.

Figure S2-P4: Chronic and Acute Hazard Results for RCP 2.6, 6.0, and 8.5

RCP 2.4 (Year 2060) - Climate Risk							
	Chronic		Acute				
Region	**Temp. Increase (°C)**	**Precip. Increase (mm)**	**Storm**	**Flooding**	**Extreme Heat**	**Winter Weather**	**Average (out of 4)**
Mexico	1.25	14.99	2	2	2	0	1.5
Midwest	1.25	24.89	2	2	2	1*	1.75
Mountain	1.25	24.89	2	2	2	0	1.5
Northeast	1.25	74.9	2	3	2	N/A	2.33
Southeast	1.25	74.9	3	3	2	1*	2.25
Southwest	1.25	24.89	3	3	2	1*	2.25
West Coast	1.25	14.99	3	3	2	0	2

RCP 6.0 (Year 2060) - Climate Risk							
	Chronic		Acute				
Region	**Temp. Increase (°C)**	**Precip. Increase (mm)**	**Storm**	**Flooding**	**Extreme Heat**	**Winter Weather**	**Average (out of 4)**
Mexico	1.5	24.89	3	2	3	0	2
Midwest	2.0	24.89	3	2	3	2*	2.5
Mountain	2.0	24.89	N/A	2	3	0	1.67
Northeast	1.83	100.08	3	4	3	N/A	3.33
Southeast	1.50	74.93	3	4	3	2*	3
Southwest	1.50	24.89	3	3	3	2*	2.75
West Coast	1.50	24.89	3	4	3	0	2.5

RCP 8.5 (Year 2060) - Climate Risk

	Chronic		Acute				
Region	**Temp. Increase (°C)**	**Precip. Increase (mm)**	**Storm**	**Flooding**	**Extreme Heat**	**Winter Weather**	**Average (out of 4)**
Mexico	2.25	39.88	4	3	4	0	2.75
Midwest	3.00	50.04	4	3	4	2*	3.25
Mountain	2.75	50.04	N/A	4	4	0	2.67
Northeast	2.67	108.46	4	4	4	N/A	4
Southeast	2.50	100.08	4	4	4	2*	3.50
Southwest	2.56	50.04	4	4	4	2*	3.50
West Coast	2.19	24.89	4	4	4	0	3.00

Figure S2-P5: Average Score for Each Acute Risk for Each Region

Averages for Each Risk per Region*				
	Acute			
Region	**Storm**	**Flooding**	**Extreme Heat**	**Winter Weather**
Mexico	3	2.33	3	0
Midwest	3	2.33	3	1.67*
Mountain	2	2.67	3	0
Northeast	3	3.67	3	0
Southeast	3.33	3.67	3	1.67*
Southwest	3.33	3.33	3	1.67*
West Coast	3.33	3.67	3	0

**A red highlighted cell signifies that this was one of the highest risk values for the region.*

Map of Each Group Analyzed

The three groups we sought to look at for our analysis were Steelcase owned and operated facilities, customers, and the supply chain. Below are maps of owned and operated facilities and supply chain. A map of customer locations can be found in Appendix S1-P1.

Figure S2-P6: Locations of Steelcase Owned and Operated Facilities by Region	*Figure S2-P7: Count of Suppliers from Survey in Each Region*
Removed per NDA	*Removed per NDA*

Findings

- The Northeast region generally had the highest precipitation anomalies under all RCP scenarios
- The Midwest, Southeast, Southwest and Northeast regions held the highest average risk for the four hazards we analyzed (Figure S1-P3)
- Midwest and Mountain regions had highest temperature anomalies in RCP 6.0 and 8.5
- The cost of energy usage is expected to increase under each scenario, with the highest expected cost to be under RCP 8.5
    - This is due to an increased number of extreme heat days leading to a greater energy demand to cool facilities
- Small shifts in average temperatures generally lead to large increases in the severity and frequency of extreme events[30]
- There is strong relationship between episodes of Arctic warming and severe winter weather events, which allows for frigid polar air to hit more southern and eastern[31]
- Academic efforts to model flooding under climate change are in their infancy and so are rarely used for commercial or regulatory applications[32]
- Increased storms and flooding may have an impact on damaging furniture and other office products causing an increase in demand for Steelcase products

Recommendations

Steelcase Owned and Operated Manufacturing Facilities, By Region

- A Climate Vulnerability Assessment (CVA) is advised to be conducted to fully understand the vulnerability of infrastructure to climate change at each location[33]
    - The CVA combines the hazards explored in this document with the planning and financing of adaptive measures for climate change

Steelcase Supply Chain, By Region

- Encouraging suppliers to complete the following:
    - Undertake green building retrofits or green roof design
    - Increase amount of green space to handle flooding from storms

    - Conduct risk assessments for extreme heat and storm risks through a Climate Vulnerability Assessment
    - Participate in developing infrastructure protection plans
    - Quantifying how physical risks will impact their financial performance
- Developing a procurement strategy that favors sustainable suppliers

Next Steps and Future Research

- More diversity of time frames should be utilized in subsequent physical scenario analysis
    - HR 1187 states that frames to be considered include 5, 10, and 20 year[34]
- More diversity in hazards should be utilized in subsequent physical scenario analysis
    - HR 1187 states that (in addition to the hazards examined in this report) sea level rise, ocean acidification, increased frequency of wildfires, decreased arability of farmland, and decreased availability of fresh water should also be considered[35]
- Implementing these risks into a strategic management plan and quantifying the financial impact of these physical risks on the income sheet, balance sheet, and cash flow statements are necessary next steps.[36]

Transitional Risk - Section 3

Methodology

Scenarios are a path that leads to a particular outcome and are utilized in many forms to inform strategy formation. Scenarios have been used to explore possible climate futures on different levels of climate changes. These scenarios are called Climate Change Scenarios. These scenarios use projections of what can happen and the pathways towards certain goals. These scenarios do not predict the future, but allow for the contrast of differ futures aiding in strategic decision making.

Socioeconomic development is a main driver of climate change, and thus climate change can have an impact back on social and economic activities. This relationship can be displayed in Figure S3-T1 below.

Figure S3-T1: Socioeconomic Climate Change Relationship Cycle[37]

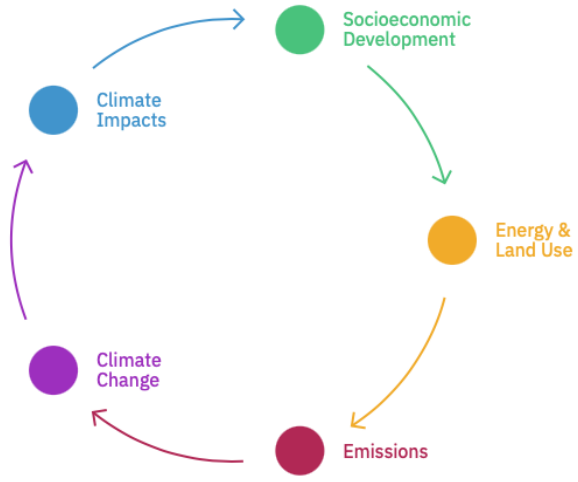
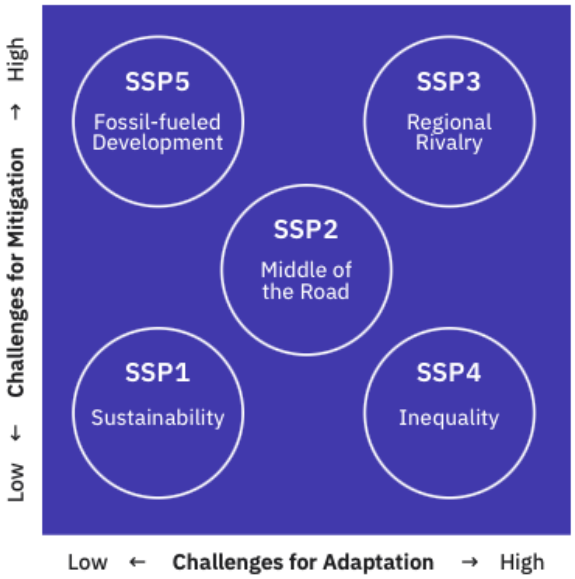
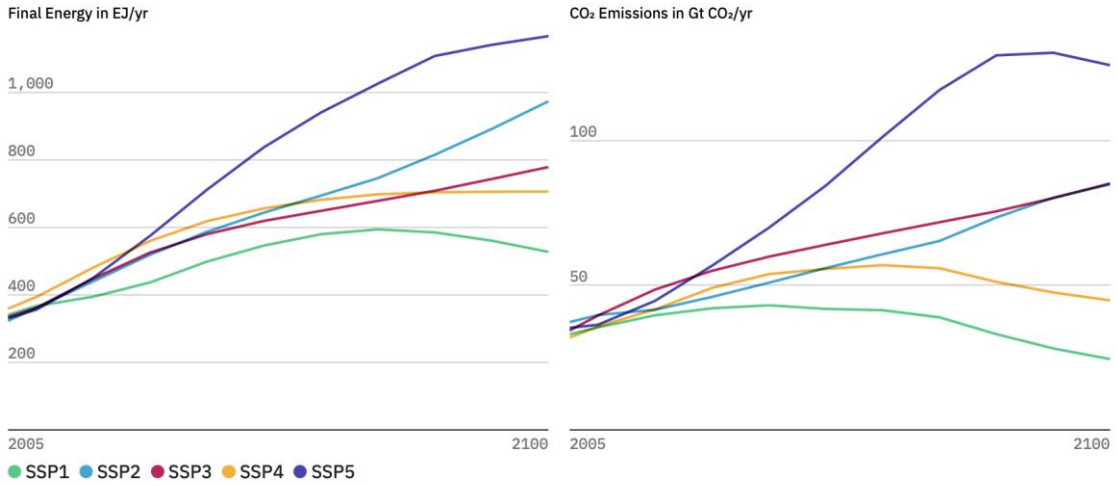


Figure S3-T2: Summary of Shared Socioeconomic Pathways Scenarios[38]



Shared Socio-Economic Pathways (SSPs) have been developed to include socioeconomic variables to explore possible climate change futures. The mitigation and adaptation levels vary across SSP scenarios (Figure S3-T2). Projections of the SSP final energy use and CO2 emissions from 2005-2100 are shown in Figure S3-T3.

Figure S3-T3: Emission & Energy Summary of Shared Socioeconomic Pathways Scenarios[39]



In CDP reporting today, companies primarily use Representative Concentration Pathways (RCPs) for their scenario analysis. It is important to note that RCPs do not include socioeconomic factors. More recently, companies, such as Target, are beginning to use SSP scenarios to use socioeconomic factors to inform their climate transition risk.[40]
For the transitional analysis in this report, three scenarios are analyzed: SSP1, SSP3, and SSP5.

- SSP1 (RCP1.9/2.5), **"Taking the Green Road"**
    - This future poses low challenges to mitigation and low challenges to adaptation
    - Global population peaks mid-century
    - Emphasis on human well-being
    - Environmentally friendly technologies and renewable energy
    - Strong and flexible institutions on global, regional, and national level
- SSP3 (RCP4.5), **"A Rocky Road"**
    - This future poses high challenges to mitigation and high challenges to adaptation
    - Population growth continues with high growth in developing countries
    - Emphasis on national issues due to regional conflicts and nationalism
    - Economical development is slow and fossil fuel dependent
    - Weak global institutions and little international trade
- SSP5 (RCP8.5), **"Taking the Highway"**
    - This future poses high challenges to mitigation and low challenges to adaptation
    - Global population peaks mid-century
    - Emphasis on economic growth and technological progress
    - Global adoption of resource and energy intensive lifestyles
    - Lack of environmental awareness

SSP scenario relationships with their corresponding RCP and degree warming are in Figure S3-T4 below.

Figure S3-T4: Shared Socioeconomic Pathways Scenarios & their Degree Warming[41]

Shared Socioeconomic Pathway	Representative Concentration Pathway	Mean Temperature for 2081–2100 **
SSP1	RCP1.9	1.4 ℃
SSP1	RCP 2.6	1.8 ℃
SSP2	RCP 4.5	2.7 ℃
SSP3	RCP 4.5	-
SSP3	RCP 7	3.6 ℃
SSP5	RCP 8.5	4.4 ℃

**AR6: (average increase relative to 1850–1900 ~ pre-industrial) [42]

SSP1 - "Taking the Green Road"

Central to SSP1 are the implementation of the UN's Sustainable Development Goals. Most modeling of SSP1 does not include strict greenhouse gas emission reduction, but rather increases in efficiency and technology that enable meeting climate targets. For example, increasing education reduces birth rate and population growth which inherently leads to lower emissions as technology improves.

The local, regional, and global policy emphasis is on first, consuming fewer products, and second, creating those products more sustainably. Consumption preferences, in general, lean towards purchasing less. One way this may be accomplished is through policy encouraging people to buy less. Education may also be a factor with people who are more educated reducing their consumption.

SSP3 - "A Rocky Road"

SSP 3 contains the most challenges on both the mitigation and adaptation front. Low trade dependency means that regions will reduce both imports and exports due to rivalry and high trade taxes. This will in turn make it more difficult for companies to obtain materials from international partners. Firms that can create supply chains that do not rely on much international trade will succeed in this environment. Additionally, the cost of national and international policy such as a carbon price or required decrease of consumption reflect the high challenges to corporations of mitigation. Some modeling reflects a high price of $1120/tCO2eq in 2100. Reducing carbon emissions prior to this steep tax will be beneficial, both from a mitigation and adaptation standpoint.. With higher mitigation challenges, technology develops slowly, so ideas

like closed loop recycling and advanced material recovery do not make as much of an impact as the world is slower to adopt some of these ideas.

Consumer consumption remains high, with most policies focusing on removing carbon emissions and adapting to climate change, rather than preventing it in the first place. This means that markets do not rely on reductions or removals, but consumption and production continue to advance with corporate innovation.

SSP5 - "Taking the Highway"

SSP 5 represents the high end of fossil fuel and energy use. Population growth stagnates, but increases in high income countries, with migration due to climate disasters requiring resettlement. GDP growth is high across the board, so consumers and businesses alike will look to continue purchasing goods.

Strong globalization means that trade is high, and access to raw materials remains easy. As energy demands continue to increase with GDP per capita, it may be difficult to access energy markets as readily as before, causing some strain on manufacturing. Additionally, with higher GDP, some populations may be less willing to perform manual labor, making technological development of automation necessary. Lastly, because there is limited climate policy incentivizing strong transition to renewable energy, it may be difficult to compete on cost with traditional fossil fuels. Low public interest also means sourcing renewables will be a challenge.

Results

Steelcase Business

The transitional risks vary due to different factors in each of the SSPs. However, the cumulative risk is generally equal, as seen below in Figure S3-T5. For a full analysis based on storyline inputs, the table can be found in Appendix S3-T1. A TCFD analysis of each scenario is below and grouped by TCFD's recommendation; market, policy, reputation, and technology.

Figure S3-T5: Summary of Steelcase Business Risks by SSP Scenario

	Market	Policy	Technology	Reputation	*Total*
SSP 1 "Taking the Green Road""	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*

SSP 3 **"A Rocky Road"**	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*
SSP 5 **"Taking the Highway"**	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*	*Removed per NDA*

Findings:

This section was removed per non-disclosure agreement.

Key Materials

This section of the scenario analysis will be focused on Steelcase's key materials in North America. Steelcase has determined their key materials in their Corporate Sustainability Report 2015, Global Reporting Initiative (GRI) Index.[43]
These key materials include:

- Aluminum, Fabric, Fiberglass*, Foam, Glass, Laminates, Paint, Plastic parts, Steel and steel parts, and Woodcore.

*Fiberglass was omitted from the analysis because there was no U.S. industry report relating to fiberglass in IBIS World.

A summary for each key material's industry in the United States including an industry summary, major players, key external drivers, key statistics, and industry structure are included in a separate report titled "Steelcase Key Materials: United States Industry Analysis Report". The report also outlines the four primary variables of transitional risk by TCFD; political, reputational, technological, and market risks. This report was informed by IBIS World, a database that is composed of Industry Market Research, Reports, and Statistics. Access to this database was through a license with the University of Michigan.

The analysis below was conducted by researching each key material's industry's, in the U.S., subsequent effects given the SSP variables. Each variable for the analysis was selected by the SSP's "story lines" and scenario inputs.[44] The variables analyzed include:

- Population
- Economic Growth per Capita
- Human Development
- Technological Process
- Fossil Fuel Resources
- Energy & Resource Intensity Lifestyle (ERIL)
- Global Cooperations
- Socioeconomic Challenges to Mitigation*

- Socio Economic Challenges to Adoption*

*These were not included in the analysis because they were either irrelevant to the key materials or relatively constant across each key material.

SSP1 “Taking the Green Road”, SSP3 “A Rocky Road”, and SSP5 “Taking the Highway” were analyzed. The corresponding changes to the variables for each SSP scenario can be found in Appendix S3-T2.

The analysis, by using IBIS World reports, attempts to quantitatively define the qualitative reports to provide Steelcase with relative levels of risk for each scenario, variable, and key material. The actual numbers used in the analysis are relative and to be used holistically in ranking and finding outliers.
Risks were identified by:

- 0 - no risk
- 1 - low risk
- 2 - medium risk
- 3 - high risk

These risks are for the overall defined U.S. industry.
A complete table of risk rankings can be found in Appendix S3-T3 and their subsequent explanation in Appendix S3-T4.

Summary

This section was removed per non-disclosure agreement.

Findings

Figure S3-T6: Summary of Key Material’s Industry Risks by SSP Scenario

Steelcase Key Materials (Manufacturing in the U.S.)	**SSP 1 “Taking the Green Road”**	**SSP 3 “A Rocky Road”**	**SSP 5 “Taking the Highway”**	*Total*
Aluminum	*Removed per NDA*			
Textile Mills				
Urethane Foam				
Glass Product				
Laminated Plastics				
Paint				
Plastic and Resin				

Iron & Steel	
Wood Paneling	
Total	

Figure S3-T7: Summary of Variable's Risks by SSP Scenarios

	SSP 1 "Taking the Green Road"	**SSP 3 "A Rocky Road"**	**SSP 5 "Taking the Highway"**	*Total*
Population	*Removed per NDA*			
Econ. Growth per Capita				
Human Devel.				
Tech Process				
Fossil Fuel Resources				
ERIL				
Global Cooperations				
Total				

Findings

Steelcase Business

- SSP1 greatest risk: lack of implementation of circular economy
- SSP3 greatest risk: disruptions in international trade will hamper supply chain stability
- SSP5 greatest risk: technological advancements will outpace Steelcase's capabilities

Key Materials

This section was removed per non-disclosure agreement.

Recommendations

Steelcase Business

- Consumer sustainability requirements and high focus on green policy means a circular economy will be necessary
- Rough international trade and slow economic development make domestic supply chains key to continued success

- Focus on high quality consumer goods that outpace competitors' innovations to maintain market share

Key Materials

This section was removed per non-disclosure agreement.

Appendix (S1)

Appendix S1-IS1

Interview Questions

This section was removed per non-disclosure agreement.

Appendix S2-IS2

North American Survey Questionnaire

This section was removed per non-disclosure agreement.

Appendix S1- IS3

Summary of interview responses for documented and verbally expressed goals and certifications around climate risk

This section was removed per non-disclosure agreement.

Appendix S1-IS4

Summary of interview responses for short-, medium-, and long-term time horizons for risk management.

This section was removed per non-disclosure agreement.

Appendix S1-IS5

Summary of interview responses for short-, medium-, and long-term time horizons for risk management.

This section was removed per non-disclosure agreement.

Appendix S1-IS6

Questions in NA Supplier Survey used to determine "knowledge" in Section 1 analysis

This section was removed per non-disclosure agreement.

Appendix S1-IS7

What Impacts a Company's Adaptation Measures

This section was removed per non-disclosure agreement.

Appendix S1-IS8

Use of Incentives vs. If a Firm is Measuring/Quantifying Physical Risks

This section was removed per non-disclosure agreement.

Appendix S1-IS9

Use of Incentives vs. Inclusion of Physical Climate Risks in Business Continuity Plan

This section was removed per non-disclosure agreement.

Appendix S1-P1

Supplier Response to Planning, Measuring, and Vulnerability to Physical Risks

This section was removed per non-disclosure agreement.

Appendix S1-T1

Vulnerability to Transitional Risk

This section was removed per non-disclosure agreement.

Appendix S1-T2

Planning for Carbon Tax

This section was removed per non-disclosure agreement.

Appendix S1-T3

Tracking for Energy, Carbon, Waste, & Water

This section was removed per non-disclosure agreement.

Appendix S1-T4

Goal/Planning for Energy, Carbon, Waste, & Water

This section was removed per non-disclosure agreement.

Appendix S1-T6

Tracking Energy, Water, Waste, Emissions by Material

This section was removed per non-disclosure agreement.

Appendix (S2)

Appendix S2-P1

Customer Locations Across North America

This section was removed per non-disclosure agreement.

Appendix (S3)

Appendix S3-T1

Complete Table of Steelcase Corporation Risk by SSP

This section was removed per non-disclosure agreement.

Appendix S3-T2

Summary of SSP and their subsequent variables

	SSP 1 *"Taking the Green Road"*	SSP 3 *"A Rocky Road"*	SSP 5 *"Taking the Highway"*
Socio-Economic Challenges to Mitigation	Low	High	High
Socio-Economic Challenges to Adoption	Low	High	Low
Population	Low	High	Low
Economic Growth per Capita	High	Low	High
Human Development	High	Low	High
Technological Process	High	Low	High
Fossil Fuel Resources	Low	-	High
Resource Intensity Lifestyle	Low	High	Very High
Energy and Food Demand	Low	Constrained & Regional	High
Global Corporations	High	Low	High

Appendix S3-T3

Complete Table of Key Material's Risk per SSP

This section was removed per non-disclosure agreement.

Appendix S3-T4

Explanation for Risk Levels from the Complete Table of Key Material's Risk per SSP

This section was removed per non-disclosure agreement.

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[2] https://climate.nasa.gov/resources/global-warming-vs-climate-change/

[3] https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

[4] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf

[5] https://www.ipcc.ch/report/ar6/wg2/about/factsheets/

[6] https://www.ipcc.ch/report/ar6/wg2/about/factsheets/

[7] https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf

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[10] https://www.natlawreview.com/article/sec-issues-long-awaited-proposed-rule-climate-disclosures

[11] "Managing climate change risks in global supply chains: a review and research agenda"#
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