MIT Sloan 2026 Finance Lab
MSCI Inc.

Building Corporate Adaptation and Resilience Frameworks: Sector-Specific Engagement Tools for Asset Owners

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Cambridge, MA
Jan 26th, 2026

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AGENDA

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Background and Motivation

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From Physical Risk to Financial Impact

Hazard – a physical climate stressor (flood, wildfire, storm etc.)

Exposure – How much of the company's assets or revenues are subject to hazards

Vulnerability – How severe the damage would be in the hazard occurs

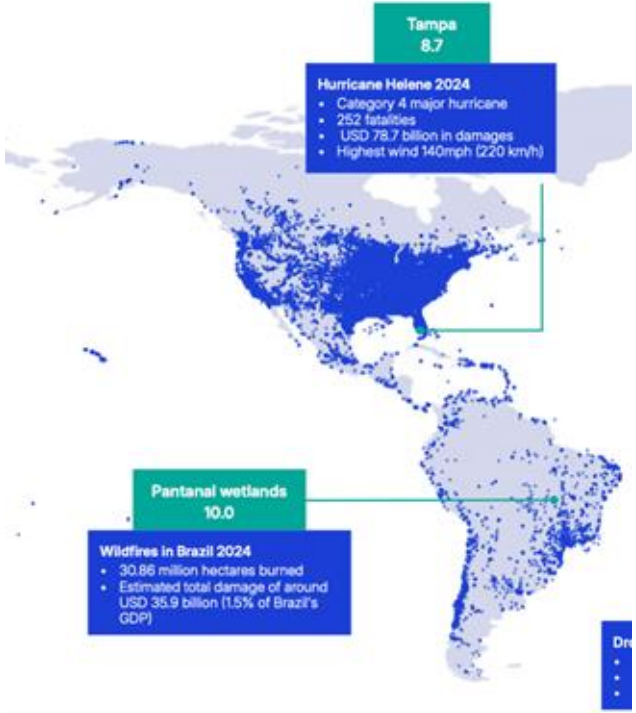
Adaptation – Investments and operational measures that reduce expected loss

Resilience – The ability to absorb disruption and recover quickly

Exposure creates potential loss
Vulnerability amplifies it.
Adaptation and **resilience** determine the realized financial impact.
Financial Impact transmits through: Asset impairment, revenue disruption, cost increase, insurance and financing conditions.

Physical Climate Risk Is Financially Material

- The location of companies' assets affects returns and volatility. (MSCI, Hidden in Plain Sight)
- 55% of firms in listed-equity portfolios face severe hazards.
- Up to 61% of portfolio value exposed.
- Storm-exposed firms tend to underperform.



Source: MSCI (2025), Hidden in Plain Sight: Physical Risk in Asset Owners' Portfolios

Rising Awareness, Lagging Action

Evidence	Implications
• **Only 16% of highly exposed firms** integrate physical risk into ERM.	• **Exposure is underestimated**
• **89% of assets analyzed** face multiple hazards.	• **Risks are mispriced**
• **USD 181B uninsured losses in 2024.**	• **Adaptation gaps persist**

High Exposure → Low Integration → Residual Loss → Investor Risk

Source: MSCI (2025), Hidden in Plain Sight: Physical Risk in Asset Owners' Portfolios

What the Literature Tells us - and What It Does not

Established findings

1. Physical risk affects **returns & volatility**
2. Impacts differ **by sector & hazard type**
3. **Transmission** occurs via assets, revenues, and costs
4. Exposure influences **cost of capital & financing**

Structural Gaps

1. No **standardized sector-level** hazard mapping
2. No explicit **financial channel weighting** logic
3. Adaptation evaluated qualitatively, not **systematically scored**
4. Limited **investor-usable benchmarking** tools

Our Contribution

1. **Sector-specific hazard materiality** mapping
2. Financial channel **transmission weighting** methodology
3. Quantitative **adaptation & resilience scoring** model
4. **Investor-ready benchmarking** outputs for engagement

We operationalize academic evidence into a financially grounded, sector-specific, investor-usable climate adaptation framework.

Sources: Hong et al. (2012); Battiston et al. (2017); Addoum et al. (2020); Pankratz (2021); MSCI (2025).

Research Question & Project Outline

Research Question:
How can asset owners systematically assess, benchmark, and engage corporate issuers on climate adaptation and resilience in a sector-specific, financially material, and investor-usable way?

1. Which natural hazards are most relevant to each sector, and how exposed and vulnerable are firms across operations and value chains?
2. Through which financial channels do climate hazards affect firms, and how large are the resulting losses across sectors?
3. How can this project enhance investor engagement and support more consistent, risk-informed investment decisions?

Climate Financial Materiality Framework

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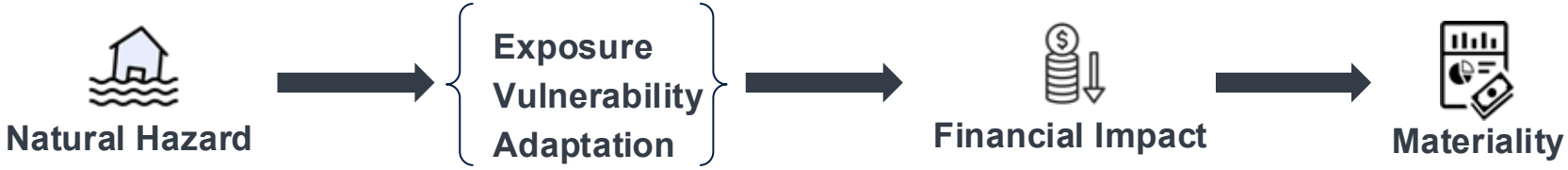
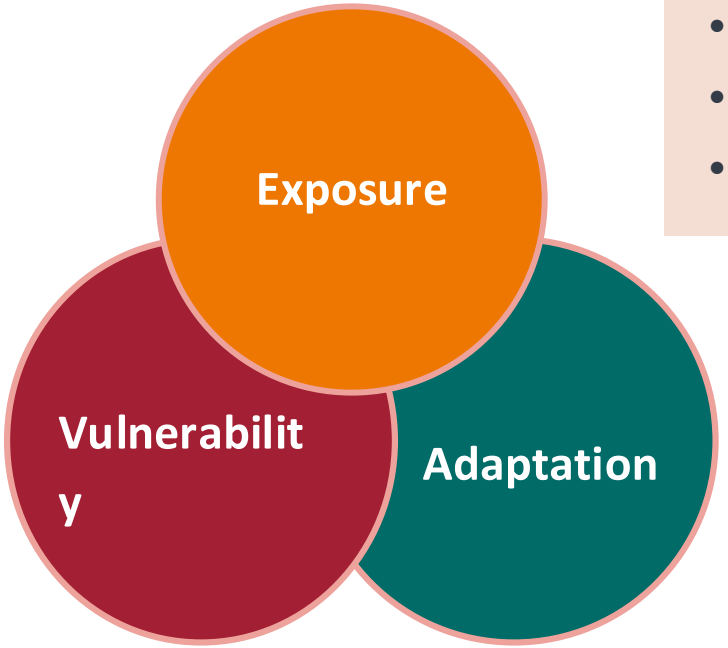
Framework Overview & Module Definitions



Module	Definition	Quantification Logic	Range
Hazard	Physical climate stressor.	IPCC / NGFS taxonomy	IPCC list item
Exposure	The degree to which economic value is geographically or operationally subject to a hazard.	Asset Concentration + Revenue Dependence + Asset Mobility Risk	0–10 (ordinal calibrated scale)
Vulnerability	The conditional loss severity given exposure.	Damage Severity + Recovery time	0–10 (ordinal calibrated scale)
Adaptation	Mitigation mechanisms reducing realized loss.	Engineering + Operations	0–10 (ordinal calibrated scale)
Financial Impact	Channel-adjusted expected loss.	Threshold rule	

Score Construction & Decomposition Logic

Very High	9.5
High	9.0
Med-High	7.5
Medium	6.0
Low-Med	4.5
Low	3.0
Very low	1.5



- **Asset Concentration:**Geographic clustering of assets in hazard-prone areas
- **Revenue Dependence:** Extent to which core revenue streams rely on climate
- **Asset Mobility Risk:**Ability to relocate or operationally adjust assets

- **Damage Severity:**Intensity of physical asset damage
- **Recovery Duration:** Time required for operational recovery

- **Engineering Resilience:**Built-in structural risk mitigation
- **Operational Preparedness:** Organizational readiness for disruption

Financial Impact & Materiality Logic

1. Core Formula: Effective Loss = Exposure × Vulnerability × (10 − Adaptation)

2. Financial Impact = Effective Loss × Sensitivity (for primary channel)

Transmission Channels:

- Revenue
- Asset value
- Insurance / financing
- Working capital
- Operating costs

Sensitivity (Financial Channel Transmission Weight):

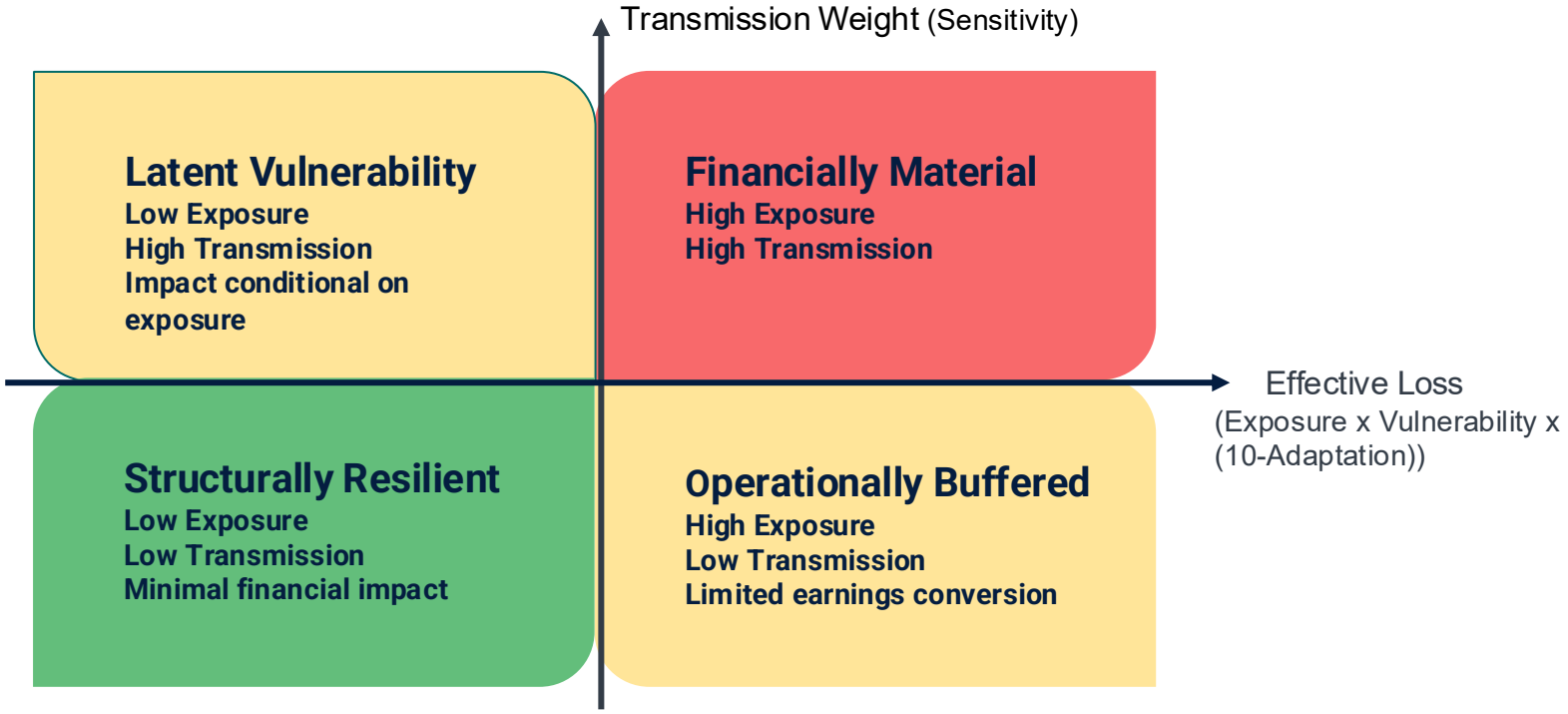
- the elasticity of primary channel to each climate risk.

3. Materiality Decision Rule: If Financial Impact Z-score > Threshold → Material

$$Z_i = \frac{FI_i - \mu_{sector}}{\sigma_{sector}}$$

Material if $Z_i \geq 1$

From Physical Exposure to Financial Impact



Framework Example:
Hurricanes on Oil, Gas & Consumable Fuels Sector

Hazard	Exposure (0 to 10)	Asset concentration	Revenue dependence	Asset mobility	Vulnerability (0 to 10)	Damage severity	Recovery time	Adaptation (0 to 10)	Engineering standards	Operational protocols	Rationale
Hurricane/ Typhoon	9.0	High	High	High	9.0	Very High	High	9.0	Very high	High	High exposure to tropical cyclones Risks to infrastructure and operations Potential for prolonged shutdowns Strong engineering and safety systems enhance resilience

Framework Example:
Hurricanes on Oil, Gas & Consumable Fuels Sector

Hazard	Financial Channels	Transmission Weight Rationale	Financial Channel Transmission Weight	Directness	Concentration	Effective Loss	Financial Impacts	Z-score	Material or not
Hurricane / Typhoon	**Asset Impact; Revenue Impact; Insurance / Financing Impact** Physical losses damage capital-intensive assets and disrupt production Shutdowns reduce revenue Repeated losses raise insurance premiums and financing costs	Multiple financial channels are affected Asset and revenue impacts dominate transmission Infrastructure damage and shutdowns drive immediate losses Transmission weight reflects maximum channel sensitivity	9	Very High (Asset damage and forced production shutdowns translate immediately into asset write-downs and revenue loss.)	High (Capital-intensive infrastructure is geographically concentrated in coastal and offshore regions.)	81	729	-0.2	**Not Material**

Adaptation & Resilience Framework Assessment Results

* Results are most robust for within-industry and cross-sector comparisons; cross-industry comparisons are intended as directional overviews.
* Sector-level insights reflect common asset types and business models, but hazard exposure ultimately varies by geography as well.

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Results Overview:
Where is risk concentrated?

Sector/Module	Exposure	Vulnerability	Adaptation	Sensitivity	Impact
Energy	7.1	6.2	7.2	6.7	825
Agriculture	6.3	8.1	4.4	8.1	2278
IT	6.8	5.7	7.2	4.7	550
Industrials	5.5	5.9	6.2	3.6	488
Communications	6.7	5.4	7.4	5.1	586
Utilities	6.6	7.9	7.8	7.6	998

Dominant Climate Hazards Within Industry

(Dominant hazard = highest mean financial impact across sector-level observations within each industry.)

Industry Exposure Summary

Industry	Hazards
Agriculture	Flood
Utilities	Wildfire
Energy	Sea-Level
IT	Drought
Industrials	Flood
Communications	Flood

Patterns → Risk Outcome

- **Flood → Fixed Assets → High Losses**
  - Asset-heavy sectors face concentrated damage from immobile infrastructure.
- **Networks & Coasts → Structural Risk**
  - Utilities and Energy amplify wildfire and sea-level shocks through interconnected systems.
- **Water Dependence → Operational Risk**
  - IT drought exposure reflects cooling-intensive data center operations.

Key Takeaway
Infrastructure rigidity and operational dependencies drives portfolio climate risks.

Exposure ≠ Impact: Example

	Energy – Extreme Heat	IT – Drought
Exposure	Medium High	Medium
Vulnerability	Medium	Medium
Adaptation	High	Low Medium
Financial Impact	Low Medium	Very High

Transmission Mechanism

Energy: Losses contained
- Strong engineering standards
- Redundant systems
- Fast recovery

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IT: Losses amplified
- Water-dependent cooling
- Limited local substitutes
- Downtime-sensitive revenue

Key Takeaway
Impact ≠ Exposure. Adaptation + Transmission drive loss.

Engagement Tool for Asset Owners

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Investor Engagement Questionnaire: Purpose & Use

Objective

- Provide a standardized **tool for assessing corporate preparedness for physical climate risks**
- Support structured, comparable investor engagement
- Translate framework results into actionable dialogue

Investor Engagement Questionnaire: Structure

Physical Risk Profile

- Hazard exposure
- Supply chain & market exposure
- Geographic concentration
- Historical losses

E.g. Are critical operations concentrated in regions that are highly sensitive to climate hazards?

Vulnerability & Ops

- Asset intensity
- Recovery capacity
- Supplier resilience

E.g. How resilient are core suppliers and logistics partners to physical climate risks?

Adaptation & Preparedness

- Adaptation plans
- Protective investments
- Stress testing

E.g. Does the company conduct regular internal stress testing for climate scenarios?

Financial & Strategy

- Revenue and asset impacts
- Insurance
- Board oversight
- Risk ownership
- Resilience strategy

E.g. Does the company have physical climate risk assessments?

Investor Engagement Questionnaire: Scoring & Interpretation Logic

Scoring Method

1. Each question scored on a 0 - 10 scale
2. Scores averaged by risk category
3. Results benchmarked by sector/industry peers

0-3: High Risk/Low Preparedness → **4-6: Moderate Preparedness** → **7-10: Strong Resilience**

How Investors Use This:
Identify priorities • Track progress • Benchmark peers

Conclusion

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Conclusion: From Risk Measurement to Action

1. **Framework:** A sector-specific framework that integrates hazard exposure, vulnerability, adaptive capacity, and financial transmission to assess physical climate risk.

2. **Finding:** Financial materiality is driven by structural and operational factors rather than exposure alone. Dominant hazards varying systematically across industries.

3. **Application:** A standardized engagement tool that enables asset owners to benchmark preparedness and conduct targeted, financially grounded dialogue with issuers.

Key Insights to Takeaway

Physical exposure is widespread, but financial impact is uneven.

Structural design drives loss amplification.
Networks, fixed infrastructure, and water dependence convert shocks into earnings risk.

Adaptation determines realized impact.
Engineering standards and resilience capacity buffer, or amplify, exposure.

Climate risk is sector-specific, and engagement must be too.
Risk is sector-specific; generic scoring misses material drivers.

Appendix

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Background & Current Challenge

Background

- **Major natural disasters are increasing.**
- **Physical climate risks** (floods, heat, drought, storms) are affecting asset values, supply chains, insurance, and credit risk across sectors.

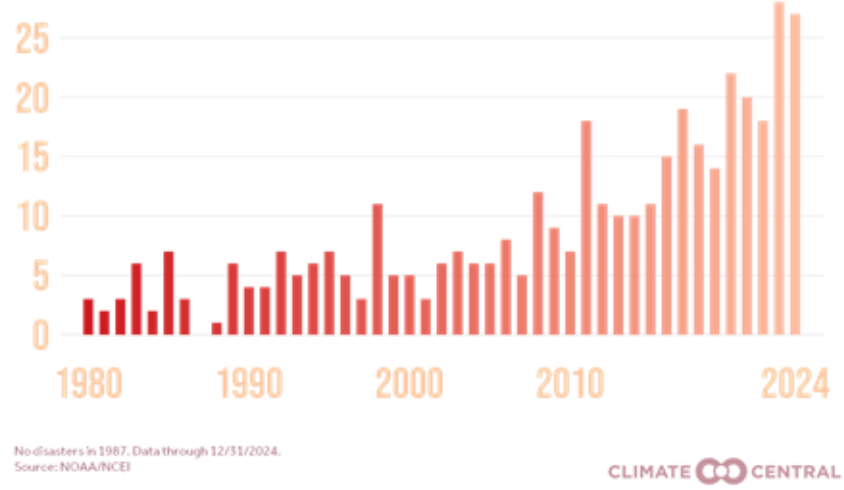
Current Challenge

Despite rising physical risks:

- **Limited sector-specific assessment tools**
- **Strong focus on mitigation, limited focus on adaptation**
- **Fragmented and non-comparable data**

→ Limits investors' ability to integrate physical risk into portfolio and stewardship decisions.

U.S. Billion-Dollar Disasters: Annual Number of Events



Dominant Climate Hazards Within Industry

(Based on mean financial impact score)

Industry	Flood	Wildfire	Heat	Drought	Storm	Sea-Level
Agriculture	3339	—	2268	2160	2088	—
Utilities	1124	1724	608	845	681	1116
Energy	584	612	396	—	662	2106
IT	609	—	449	2268	236	—
Industrials	772	—	688	—	609	—
Communication Services	795	593	276	—	621	—