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Climate Risk Stress Testing

A Presentation to the American Bankers Association

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Meeting with you today

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Background

- Partner in Deloitte's Model Risk Management team
- 20+ years of experience providing services to financial services organizations
- Focuses on risk management policies, procedures, model validation and governance
- Co-leader of Deloitte's US Climate Risk team

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Background

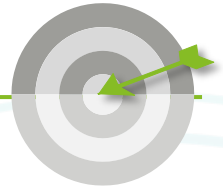
- Senior Manager in Deloitte's Model Risk Management team
- 10 years of experience with risk and modeling in the financial services industry
- Focuses on developing and validating models used for credit, market, and operational risk
- Member of Deloitte's US Climate Risk team

Climate Risk Stress Testing

A Presentation for Model Risk Managers

Presentation Agenda

Objectives

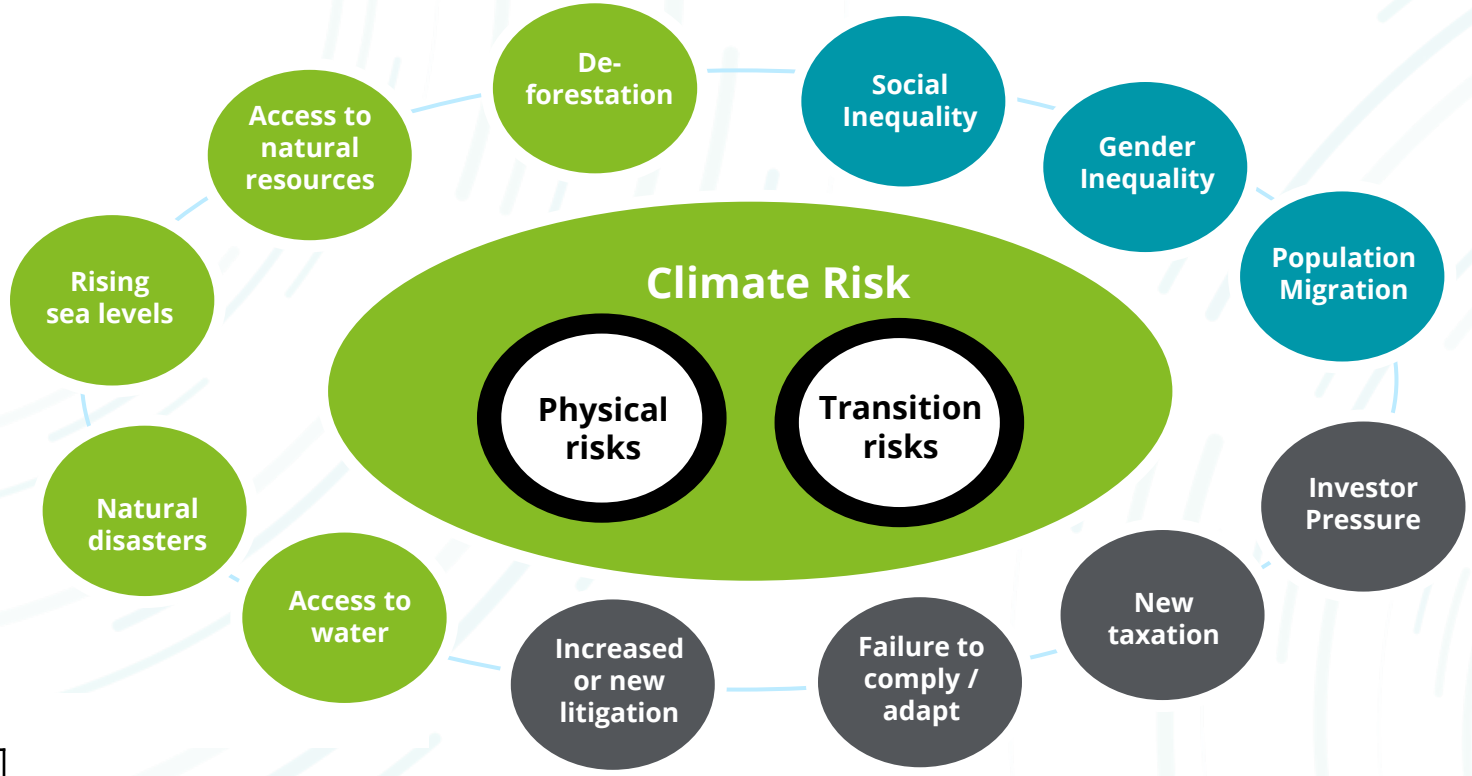


- Gain an **introductory understanding of climate risk management** at financial institutions
- Understand processes and methodologies used for **climate risk stress testing**
- Understand key climate risk **challenges & solutions** for risk managers

Climate Risk in Context

The Environment, Social, and Governance Landscape

Environment, **Social**, and **Governance** (ESG) themes in aggregate translate into a broad range of risks to financial institutions. These risks are often interdependent, latent, and difficult to quantify.



> *"For the first time in the history of the survey, climate-related issues dominated all of the top-five long-term risks by likelihood..."*
>
> *The Global Risks Report 2020, World Economic Forum*

Key: ESG risks

	Environment
	Social
	Governance

Regulatory & Industry Trends in Climate Risk

US Regulation (2019-2020)

A variety of US regulatory bodies begin to establish perspectives and adopt policies around managing climate risk.

Mar 2019

San Francisco **Federal Reserve Board (FRB) publishes economic letter** on monetary policy implications of climate risk.

Nov 2019

FRB hosts first-ever climate risk conference, "The Economics of Climate Change" to discuss quantifying the impact of climate change in the financial sector.

May 2020

SEC's Investor Advisory Committee approves a policy document related to **ESG disclosure.**

Sep 2020

New York State Department of Financial Services (NYDFS) expects Insurers to begin integrating climate-related risks into governance frameworks, risk management processes, and business strategies.

CFTC's Climate-Related Market Risk Subcommittee publishes report on impacts of climate risk to US financial markets.

Dec 2020

FRB Governor Lael Brainard delivers speech on climate change related challenges of the financial system titled "Strengthening the Financial System to Meet the Challenge of Climate Change."

2019 — 2020

Monthly climate risk regulatory developments in FSI *Link*

July 2019

Commodity Futures and Trading Commission (CFTC) establishes Climate-Related Market Risk Subcommittee.

Jan 2020

Securities and Exchange Commission (SEC) issues public statement on "Modernizing Regulation S-K: Ignoring the Elephant in the Room."

July 2020

San Francisco **FRB launches virtual seminar series** on the economics of climate change, including monetary, supervisory, and trade policy.

Oct 2020

NYDFS expands efforts to ensure financial services firms manage their financial risks from climate change.

Dec 2020

FRB announces that it has formally joined the Network of Central Banks and Supervisors for Greening the Financial System **(NGFS).** ★

Legend

★ Voluntary organization/initiative

Regulatory & Industry Trends in Climate Risk

US Regulation (2021)

Regulatory activity is accelerating, and although formalized policies have been limited, additional guidelines are expected to emerge.

2021

Jan 2021

FRB creates a new leadership committee focused on supervising the banking system for financial risks posed by climate change.

Jan 2021

Treasury Secretary Janet Yellen proposes new efforts by the Treasury to address climate risks in the financial system during her Senate confirmation hearing.

Jan 2021

SEC appoints a new senior policy advisor for Climate and ESG to oversee and coordinate the agency's efforts related to climate risk and other ESG developments, which are "issues of great significance to investors and the capital markets."

Feb 2021

The House Financial Services Subcommittee on Investor Protection features ESG disclosure in its hearing, "Climate Change and Social Responsibility: Helping Corporate Boards and Investors Make Decisions for a Sustainable World."

Feb 2021

FRB Governor Lael Brainard endorses mandatory climate risk disclosures for public companies and encourages climate-related scenario analysis as a helpful but distinct approach from the Fed's existing regulatory stress tests at banks.

Mar 2021

The SEC announces a newly created Climate and ESG Task Force in the Division of Enforcement to proactively identify ESG-related misconduct using "sophisticated data analysis to mine and assess information across registrants, to identify potential violations.

Mar 2021

The SEC's Division of Examinations announces its 2021 examination priorities, including plans to focus on climate risks "by examining proxy voting policies and practices to ensure voting aligns with investors' best interests and expectations.

Apr 2021

The SEC issues a risk alert for ESG investing.

Secretary Yellen appoints new Climate Counselor to oversee Treasury's coordination on climate-related financial risks across the US government and globally.

May 2021

Biden signs executive order which provides a framework for US agencies and regulators to adopt new climate risk measures.

Monthly climate risk regulatory developments in FSI *Link*

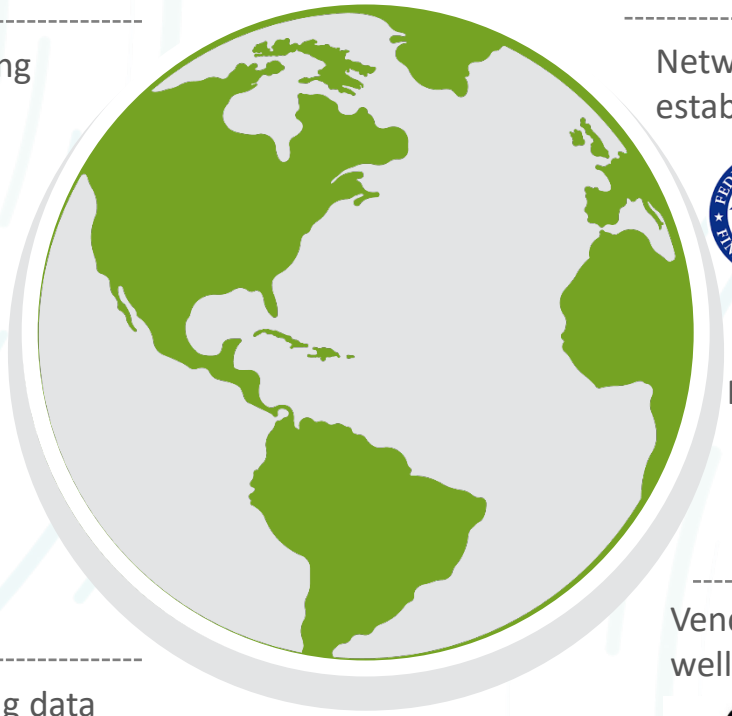
Regulatory & Industry Trends in Climate Risk

A global ecosystem

International Initiatives

Set standards for diverse set of climate topics including disclosures, regulation, and modeling methodologies

UNEP FINANCE INITIATIVE · IIF · TCFD · GRI · European Commission · PRI · SASB · NGFS · CDP



Regulatory Authorities

Network of global central banks and regional authorities establishing regulatory requirements for climate risk

FHFA · United States Federal Reserve System · European Central Bank · Bank of England · BANK OF CANADA / BANQUE DU CANADA

Rating Agencies

Rating agencies incorporate climate into credit analysis

S&P Global · Moody's · FitchRatings

Data Providers

Vendors providing data on physical and transition risks, as well as broader ESG metrics

2i · 427 · TRUCOST · SAM · Trucost ESG Analysis · MSCI · OS-C · Enerdata intelligence + consulting · THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

Research Institutes

Provide valuable climate science research, generating data and developing scenarios in collaboration with regulators

IIASA · ipcc INTERGOVERNMENTAL PANEL ON climate change · United States Global Change Research Program · eit Climate-KIC · Copernicus Europe's eyes on Earth

Climate Risk Dynamics

Risk Transmission Channels

Physical and transition risks manifest as business risks via micro and macro economic transmission channels.

Climate Risks

Physical Risk

- Chronic (e.g., temperature changes, sea level rise)
- Acute / catastrophic (e.g., heatwaves, floods)

Transition Risk

- Policy & regulation (e.g., carbon tax)
- Technological development (e.g., electric vehicles)
- Consumer preferences

Transmission Channels

Microeconomic

- Financial impact on individual households and businesses
- Business disruption
- Property damage & liabilities

Macroeconomic

- Unemployment
- GDP changes
- Capital depreciation

Business Risks

Financial Risk

- Credit
- Market
- Liquidity
- Operational

Non-Financial Risk

- Reputational
- Strategic
- Physical Security
- Model
- Compliance & Regulatory

Measuring Climate Risk

Use Cases for Climate Models

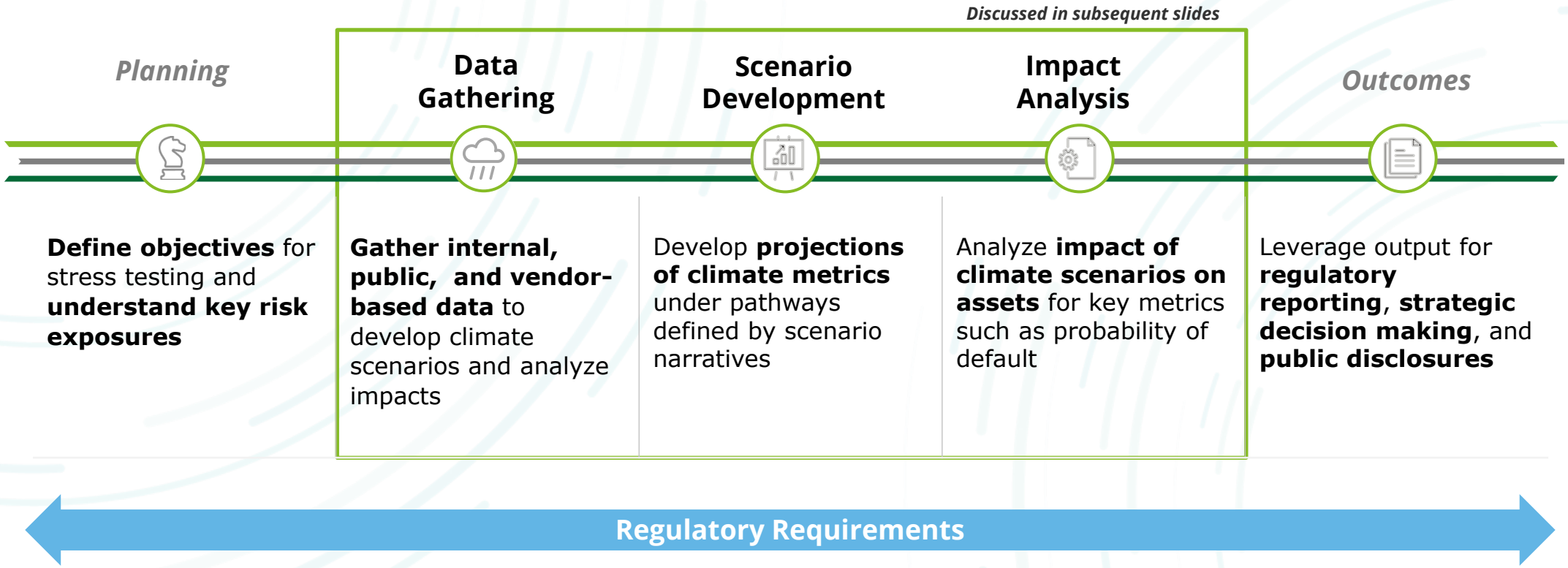
A variety of qualitative and quantitative approaches exist to identify and measure the potential impacts of climate risk based on the use case within an organization.

Use Cases for Climate Modeling	Modeling Methodology Highlights
Stress Testing *Discussed in subsequent slides* Climate scenarios may be developed to assess impact on business risk drivers for internal or regulatory stress testing	▪ Considers long-dated scenario narratives (i.e., 30-50 years) ▪ Focuses on credit risk, with some jurisdictions also considering market risk
Disclosures Internal and external disclosures (e.g., TCFD) typically require an analysis of climate risk impacts	▪ Consolidation of analysis across use cases (i.e., strategy & risk management) ▪ To date, typically based on high level analysis without formal modeling approaches
Strategic Metrics & Targets Sustainability commitments often include science-based targets related to Scope 1, 2, and 3 emissions	▪ Prescriptive accounting standards (PCAF) for scope 1, 2, and 3 definitions ▪ Reliance on publicly disclosed emissions with extrapolation across sectors
Credit Risk Management Analysis of climate risk is increasingly integrated into underwriting and credit portfolio management processes	▪ Climate factors considered in underwriting for standalone ESG ratings or within existing scoring framework ▪ Portfolio management focuses on PD impact via stress testing / scenario analysis
Other Other use cases include market risk, operational risk, and product strategy (e.g., asset management tools)	▪ Models used for investment portfolio to calculate metrics such as temperature alignment and climate VaR ▪ Banks may perform scenario analysis to understand operational risk associated with physical risk damage to key infrastructure

Climate Stress Testing

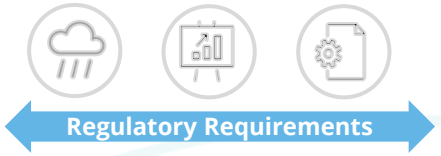
Process Overview

Although specific practices for climate risk stress testing are yet to be prescribed by regulatory authorities in the US, some banking institutions are preparing for stress testing by following the below steps:



Climate Stress Testing

Global Regulatory Perspectives



The NGFS is helping promote alignment in global regulatory practices, but significant uncertainty remains around adoption in the US. This is highlighted by comparing practices for the two jurisdictions to date with formalized requirements.

Comparison of Global Stress Testing Practices[1]

Jurisdictions with formalized requirements

	Bank of England	Banque de France
Participation	• Large banks and insurers	• Large banks and insurers
Timetable	• Launches June 2021, results Q1 2022	• Launched July 2021, aggregate results May 2021
Forecasting Horizon	• 2050 (with add on for 2050-2080 risks under "No Policy Action" scenario)	• 2050
Balance Sheet	• Static through 2050	• Static through 2025, dynamic from 2025-2050
Scenarios	• Physical and Transition Risks: Early, Late, and No Policy Action based on NGFS with additional macro variables provided by BoE	• Transition Risk: Orderly, Disorderly, and Immediate 1.5 based on NGFS with additional macro various provided • Physical risk: Based on "RCP 8.5" IPCC scenario
Reporting Metrics	• Credit Risk: Impairment charge • Market Risk: *Excluded*	• Credit Risk: Expected Credit Loss (ECL) • Market Risk: Revaluation of trading portfolio

1. Source: GRI-Climate-Change-Article_012621.pdf (garp.org)

Climate Stress Testing

Gather Climate Data

A combination of internal data related to asset characteristics and external climate scenario data is needed to perform climate risk stress testing.

Internal Data

Asset Attributes

- Asset portfolio information needed to assess credit and market risk (typically loan portfolio data):
  - Exposure ($)
  - Geography
  - Industry/Sector
  - Loan Maturity
  - Qualitative factors (e.g., business strategy)
- Operational risk assessment may require data on office locations, data centers, etc. to measure physical risk

Models & Metrics

- Business-as-usual metrics such as Expected Credit Loss may be used as baseline against stress scenarios
- Existing models and their input data (e.g., risk rating scorecards) may be leveraged for climate stress testing

Climate Stress Testing

External Data

- Regional scenario projections for chronic and acute physical risk, e.g.:
  - Mean temperature rise
  - Flood/rainfall discharge
  - Crop yields
  - Heatwaves

Physical Risk

- Sector scenario projections for transition risks, e.g.:
  - Emissions price (e.g., carbon tax)
  - Carbon dioxide removal
  - Investments in renewables
  - Land usage

Transition Risk

- Additional macroeconomic variables provided by regulators to supplement climate scenarios, e.g.:
  - GDP
  - Unemployment
  - Property prices

Macro-economic

Climate Stress Testing

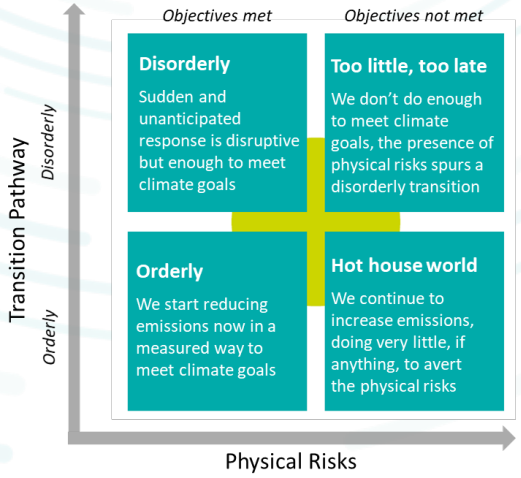
Develop Scenarios

Scenario Narratives

Organizational involvement: Low

- Context for developing scenarios
- Typically based on regulatory guidance but can be tailored

Scenario Narratives

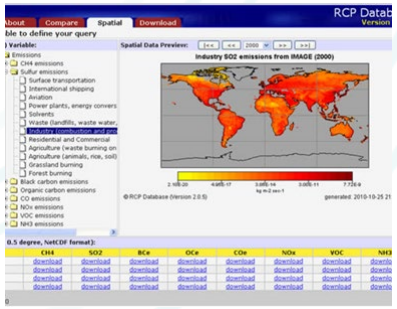


Climate Science Models

Organizational involvement: Low

- General Circulation Models (GCM) and Catastrophe models for physical risks
- Integrated Assessment Models (IAM) for transition risks

IPCC Pathways*



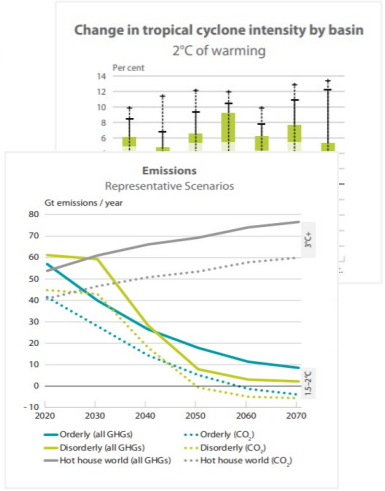
** Intergovernmental Panel on Climate Change (IPCC) open-source climate trajectories*

Climate Metric Forecasts

Organizational involvement: Med

- Climate data leveraged to build out global scenario narratives
- Collaboration between climate scientists and regulators
- Scenarios customized based on business needs and risks

Global NGFS GHG Scenarios

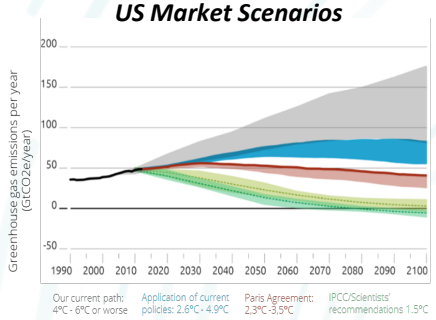


Sector downscaling

Organizational involvement: Med

- Global narratives scaled to regional/sector level
- Available from data vendors
- Potentially defined by US regulators in the future

US Market Scenarios

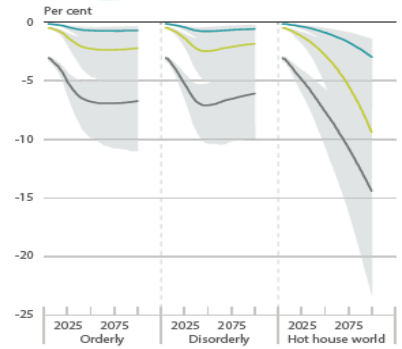


Scenario Expansion

Organizational involvement: Med

- Expand scenario to include relevant macro risk drivers
- Leverage combination of statistical techniques and experienced judgment

Variable Expansion



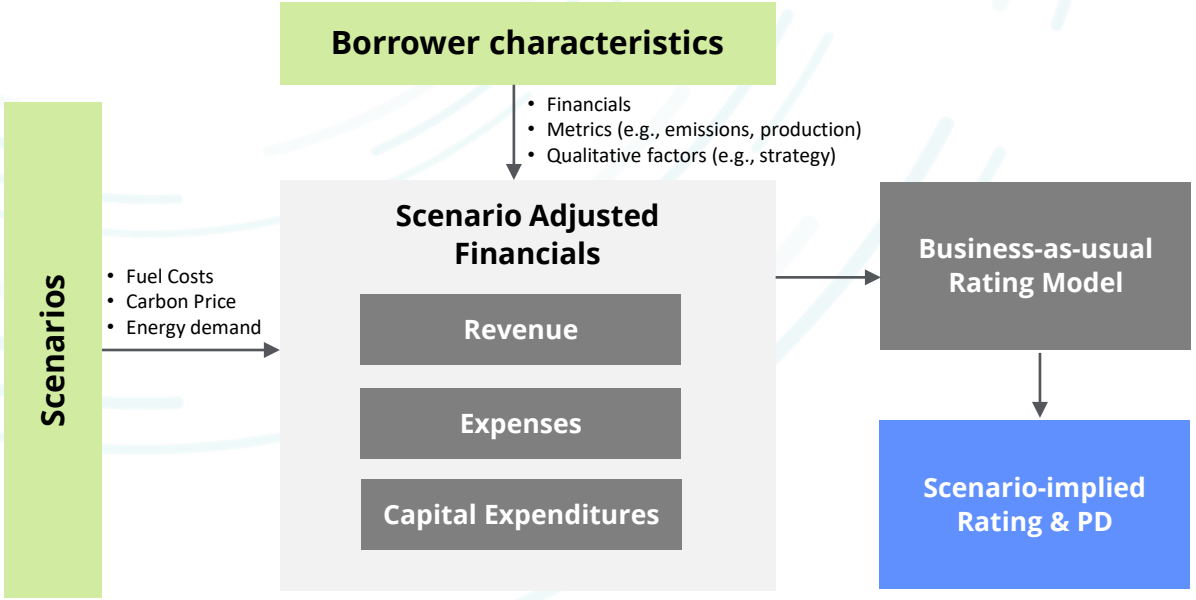
Climate Stress Testing

Analyze Impact

The United Nations Environment Program Finance Initiative (UNEP FI)[1] has developed a methodology for quantifying the impact of transition risks on wholesale exposures using a combination of bottoms-up and top-down modeling approaches.

Bottom-Up Module

1 Develop calibration points by calculating PD impact of climate scenarios for a sample of borrowers across homogeneous segments



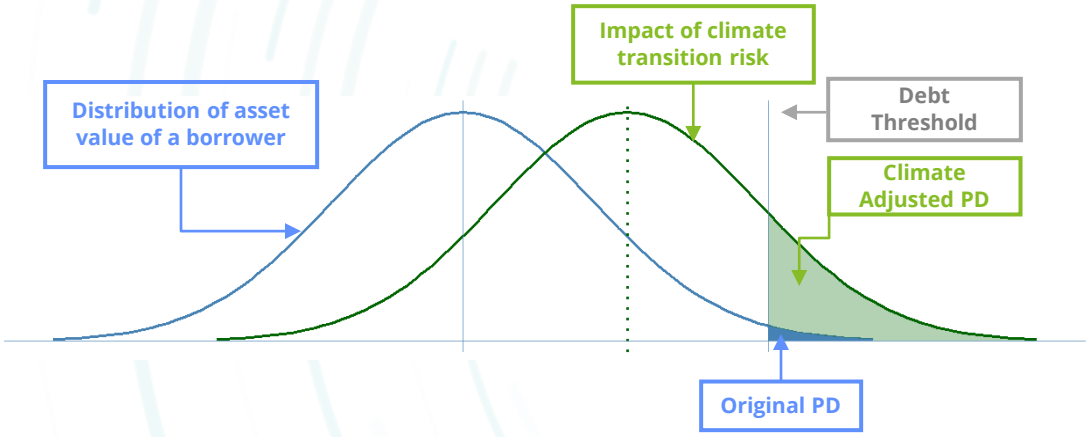
Top-Down Module

2 Extrapolate PD impact across portfolio by calibrating a modified Merton distance-to-default model

Merton Model

Climate credit quality adjustment

$$PD_i|c^* = \Phi[\Phi^{-1}(PD_{i,TTC}) - \frac{1}{\alpha_k} \cdot \sum_r (s_{j,k}^r \cdot f_k^r)]$$



1. Source: https://www.unepfi.org/wordpress/wp-content/uploads/2018/04/EXTENDING-OUR-HORIZONS.pdf

Climate Risk Modeling
Considerations for Risk Modelers

There are a number of challenges related to the development and validation of climate models, but modeling professionals can plan ahead to prepare for this work.

Climate Modeling Challenges

- Inherent model limitations due to long time horizons and limited data
- Early reliance on vendors for data and modeling
- Extensive scope of climate impacts across organization
- Evolving practices around modeling requirements and methodologies
- Cross-disciplinary skill required for model development and validation

Modeling Team Strategies

- Limitation management processes
- Benchmarking and assumptions testing
- Ongoing monitoring and recalibration

- Understanding of vendor landscape
- Existing processes for vendor validation
- Additional due diligence for data quality

- Stakeholder agreement for model pipeline
- Alignment of resourcing requirements

- Knowledge of range of industry practices
- Awareness of regulatory developments & industry initiatives

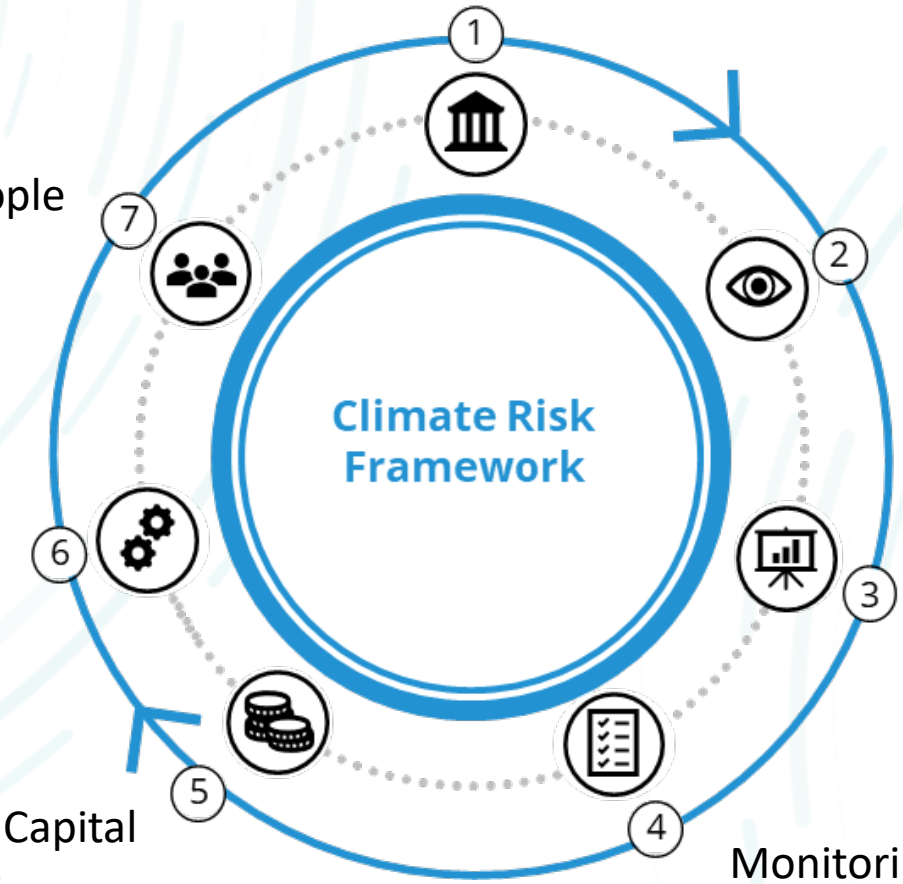
- Training of existing resources
- Resource acquisition or rotational programs
- Development of benchmark methodologies

Planning Considerations

- Coordinate with internal stakeholders to understand model inventory pipeline
- Begin training and development of talent to prepare for climate model validations
- Gain an understanding of "climate ecosystem" including vendors, regulators, and research institutes
- Develop benchmark methodologies for priority use cases within your organization

Climate Enterprise Risk Management (ERM) Components

Management of financial and nonfinancial risks derived from climate risks require careful updates to the ERM framework; leading firms have assessed key changes and requirements.



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Questions?