Lesson 4.3

Scenario Analysis and Climate Modeling

NGFS Pathways to Integrated Assessment Models

Module 4: Green Finance Risk Management

GREEN FINANCE Professional Certificate

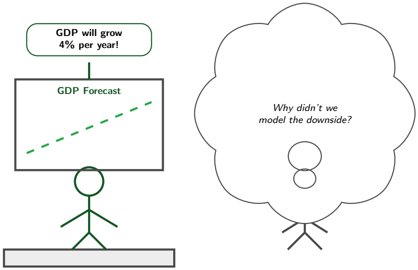
Erasmus+ CBHE 101237817

Why Did One Forecast Fail an Entire Banking System?

[FOUNDATION]

Situation: A central bank economist presents the annual outlook: "GDP will grow 4% per year through 2040." The board approves all lending targets.
Complication: A climate-driven drought collapses agricultural output. GDP contracts 3%. The board asks: "Why didn't we model the downside?"
Question: What is the cost of relying on a single forecast when climate-economy interactions are deeply uncertain?

- Single forecasts create **false confidence**
- Climate-economy interactions have deep uncertainty
- Scenarios explore multiple futures because the true path is unknowable



A single forecast gave the illusion of certainty.

Deep uncertainty means we cannot assign probabilities to climate pathways – so we explore multiple futures instead of predicting one.

What Changed Between Lesson 4.2 and This Lesson?

[FOUNDATION]

Frameworks Established (Lesson 4.2)

- TCFD **requires** scenario analysis as part of risk assessment
- Risk Management pillar demands quantitative inputs
- But *how* to run scenarios was left as a pointer to Lesson 4.3
- Frameworks tell you **what** to do, not **how** to do it

"We know we need scenario analysis. But which scenarios? What tools? What outputs?"

Now Model the Future (Lesson 4.3)

- Build the actual scenarios using **NGFS pathways**
- Choose the right scenarios for **ASEAN portfolios**
- Calibrate **financial impacts** from scenario variables
- Generate quantitative outputs: fan charts, sensitivity analysis

Key Insight

Lesson 4.2 told you **what** is required. Lesson 4.3 teaches you **how** to do it.

TCFD mandates scenario analysis. This lesson gives you the tools to execute it.

Road Map: From Scenarios to Financial Impact

Section	Slides	Central Question
Introduction	1–4	Why scenarios instead of forecasts?
Context	5–9	What are the NGFS and IEA scenario frameworks?
Challenge	10–15	How do scenarios translate to financial impact?
Analysis	16–24	How do IAMs model climate-economy interactions?
Resolution	25–30	What does this look like for Philippine typhoon risk?
Summary	31–33	What should you remember?

The lesson follows a **case-based** arc: we open with a real scenario failure, show why multiple scenarios are needed, walk through NGFS and IEA frameworks as analytical tools, introduce IAMs at PhD depth, and resolve with the Philippine typhoon exposure worked example and ASEAN scenario comparison.

Lesson 4.3 of 6 in Module 4. Foundation level with Intermediate and PhD extensions.

Why Scenarios Instead of Predictions?

[FOUNDATION]

Three Reasons Predictions Fail

- **Non-linear dynamics:** tipping points, feedback loops, cascading failures make linear extrapolation unreliable
- **Policy dependence:** outcomes depend on choices not yet made – carbon pricing timelines, phase-out commitments, technology subsidies
- **Deep uncertainty:** we cannot assign meaningful probabilities to 30-year climate-economy outcomes

What Scenarios Provide Instead

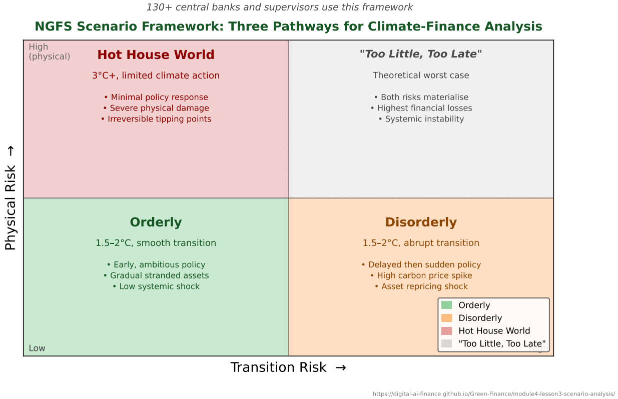
- **Structured exploration** of plausible futures – not a single predicted path
- **Stress testing** of portfolios against multiple pathways simultaneously
- **Vulnerability identification** – which exposures are fragile across all scenarios?
- **Robust strategies** that perform adequately across multiple futures

Key Insight

Scenarios are not predictions. They are structured explorations of plausible futures designed to reveal vulnerabilities.

The key distinction: predictions claim to know the future; scenarios explore what MIGHT happen to reveal what you should prepare for.

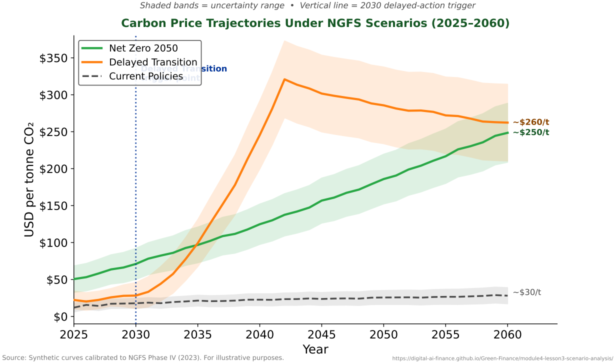
[FOUNDATION]



- All scenarios limiting warming to 2°C involve **transition risk** – smooth or as a shock
- The only scenario **without** transition risk is Hot House World – catastrophic physical risk
- **No "business as usual" without consequences**: every pathway involves transition costs or physical damages

The NGFS framework was adopted by 130+ central banks and supervisors. It is the de facto standard for climate scenario analysis in finance.

[FOUNDATION]



- The Delayed Transition creates a carbon price **shock** around 2030 – the financial impact is concentrated in a short window
- Current Policies is **not** a “safe” scenario – it shifts the cost to physical damages later
- For portfolio stress testing, the Disorderly scenario is typically the most **financially severe** for transition-exposed sectors

The Delayed Transition scenario is the most financially disruptive – not because it is the worst climate outcome, but because the adjustment is compressed.

What Do IEA Scenarios Add?

[FOUNDATION]

IEA Three Scenarios

- **Net Zero Emissions by 2050 (NZE):** all energy pledges met plus additional action to reach net zero
- **Announced Pledges Scenario (APS):** only existing government commitments honored
- **Stated Policies Scenario (STEPS):** only policies currently in force – no new commitments

How IEA Complements NGFS

Dim.	NGFS	IEA
Focus	Macro-financial	Energy-sector
Users	Central banks	Policymakers
Detail	GDP, carbon price	Fuel mix, invest.
Horizon	2100	2050

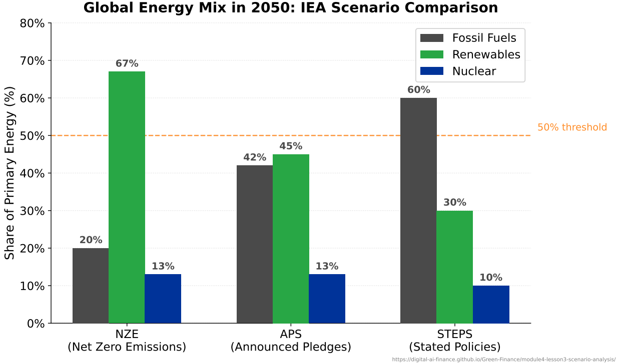
Key Insight

Use NGFS for macro-financial scenarios; use IEA for energy-sector detail. Together they cover the full landscape.

Use NGFS for macro-financial scenarios; use IEA for energy-sector detail. Together they cover the full climate scenario landscape.

How Does the Energy Mix Change Across Scenarios?

[FOUNDATION]

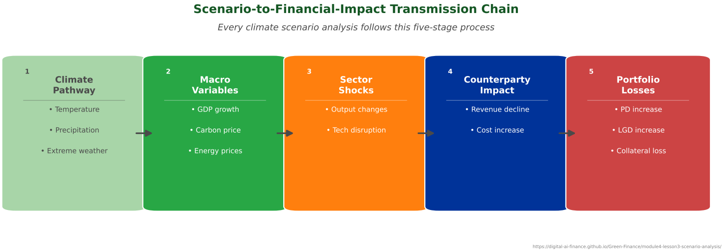


- Under NZE, fossil fuels are a **minority** energy source by 2050 – massive stranded asset risk for fossil-fuel-exposed portfolios
- Under STEPS, fossil fuels still **dominate** – massive physical risk from continued warming above 3°C
- The difference between NZE and STEPS is $130+ trillion in cumulative energy investment by 2050 (IEA, 2024)

The energy mix under NZE vs STEPS represents two fundamentally different worlds for fossil-fuel-exposed portfolios.

How Do Scenarios Become Financial Losses?

[FOUNDATION]



- This five-stage chain is the **analytical backbone** of all climate scenario analysis in finance
- Each stage requires different data: climate models → macroeconomic models → sector models → credit models
- The chain shows **where** uncertainty compounds: small input variations amplify through each stage

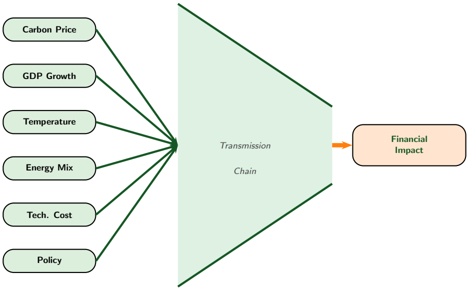
Every climate scenario analysis in finance follows this chain: scenario -¿ macro variables -¿ sector shocks -¿ portfolio losses.

What Are the Key Variables That Drive Financial Impact?

[FOUNDATION]

Six Key Scenario Variables

Variable	Financial Channel
Carbon price	Cost of emissions → margin compression
GDP growth	Aggregate demand → credit quality
Temperature	Physical damage frequency and severity
Energy mix	Stranded assets vs green investment
Technology cost	Competitive advantage shifts
Policy stringency	Regulatory compliance costs



Arrow thickness in practice: GDP and carbon price typically have the largest impact on portfolio-level results.

These six variables are the minimum inputs for any credible climate scenario analysis. Most NGFS scenarios provide all six.

How Do You Navigate the NGFS Scenario Explorer?

[INTERMEDIATE]

Step-by-Step Guide

1. **Go to** `data.ene.iiasa.ac.at/ngfs`
2. **Select scenario family:** Phase IV (2024 vintage)
3. **Choose model:** REMIND-MAgPIE recommended for ASEAN due to regional granularity
4. **Select region:** Southeast Asia or individual countries
5. **Choose variables:** GDP, carbon price, temperature, energy mix
6. **Download CSV** for analysis in Python or Excel

Available Variable Categories

Category	Key Variables
Macro	GDP, population, employment
Energy	Primary energy, electricity
Emissions	CO_2, CH_4, total GHG
Prices	Carbon price, energy prices
Land use	Forest cover, agriculture
Climate	Temperature, sea level

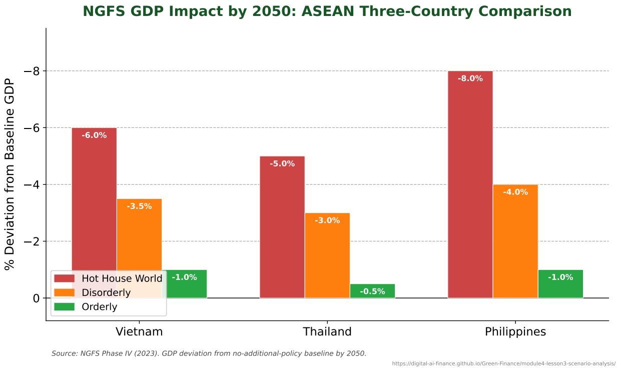
Key Insight

The NGFS Scenario Explorer is **free and open-access**. All data used in the Quantitative Lab comes from this tool.

Intermediate: The NGFS Scenario Explorer is free and open-access. All data used in the Quantitative Lab comes from this tool.

Which NGFS Scenarios Matter Most for ASEAN Portfolios?

[INTERMEDIATE]



- Physical risk **dominates** for ASEAN under Hot House World due to typhoon, flood, and heat exposure
- The Philippines is **most vulnerable** across all scenarios due to geographic exposure
- For ASEAN emerging markets, the Disorderly scenario is **less severe** than Hot House World – opposite of developed-market portfolios

Intermediate: For ASEAN, Hot House World is the worst scenario – the opposite of developed markets where Disorderly is most disruptive.

Why Does ASEAN Differ from Developed-Market Scenario Results?

[INTERMEDIATE]

Developed Markets

- **High transition risk:** fossil fuel assets, heavy industry, carbon-intensive exports
- **Lower physical risk:** temperate climates, resilient infrastructure, comprehensive insurance
- **Disorderly scenario is worst:** concentrated transition shock hits large carbon-exposed sectors

ASEAN Markets

- **Lower transition risk:** less fossil-fuel-dependent exports, emerging green potential
- **High physical risk:** tropical exposure, typhoons, flooding, agriculture-dependent economies
- **Hot House World is worst:** unmitigated physical damages overwhelm transition costs

Key Insight

Scenario analysis is not one-size-fits-all. The scenario that stresses a European portfolio the most is different from the scenario that stresses an ASEAN portfolio the most.

Intermediate: ASEAN's scenario profile flips the developed-market pattern. Physical risk dominance is the defining characteristic.

How Do You Translate Scenario Variables to Loan-Level Impacts?

[INTERMEDIATE]

The Calibration Challenge

NGFS provides **macro** variables (GDP, carbon price), but banks need **micro** impacts (PD for a specific borrower).

Three-step calibration:

1. Map macro variable to **sector output shock**
2. Map sector shock to borrower-level **PD shift** using elasticity
3. Map physical damage to **LGD adjustment** via collateral revaluation

Worked Formula Example

The sector sensitivity model:

$$\Delta PD_{sector} = \beta_{sector} \times \Delta GDP_{scenario}$$

where β_{sector} is the sector sensitivity coefficient.

Example: Agriculture in Philippines under Hot House World:
$\Delta GDP = -8\%$, $\beta_{agriculture} = 1.5$
$\Delta PD_{agriculture} = 1.5 \times 8\% = 12\%$ increase in default probability.

Key Insight

The hardest step is calibrating the macro-to-micro translation. Sector sensitivity coefficients (β) are the critical link.

Intermediate: The hardest step in scenario analysis is calibrating the macro-to-micro translation. Sector sensitivity coefficients are the critical link.

Can You Walk Through a Sectoral Shock Calibration?

[INTERMEDIATE]

Philippine Bank Portfolio

Sector allocation:

- Agriculture: 25%
- Manufacturing: 20%
- Real Estate: 15%
- Energy: 10%
- Services: 30%

Disorderly scenario for Philippines:

- Carbon price spike to \$150/tCO_2 by 2035
- GDP deviation: −4% from baseline
- Temperature pathway: +2.1°C

Sector-by-Sector PD Adjustment

Sector	ΔPD	Driver
Agriculture	+8%	Physical + transition
Energy	+15%	Transition dominated
Manufacturing	+5%	Energy cost pass-through
Real Estate	+3%	Physical: flood risk
Services	+2%	GDP elasticity

Portfolio-weighted PD increase:
$0.25 \times 8 + 0.20 \times 5 + 0.15 \times 3 + 0.10 \times 15 + 0.30 \times 2 = \mathbf{5.55\%}$

Intermediate: This worked example is the core exercise of the Quantitative Lab. Students replicate it for Vietnam and Thailand.

How Do You Adjust LGD for Physical Damage Scenarios?

[INTERMEDIATE]

LGD Climate Adjustment

Standard LGD assumes normal collateral recovery. Climate-adjusted LGD accounts for:

1. Physical damage to collateral (flood, typhoon)
2. Reduced market value in high-risk zones
3. Insurance coverage gaps

Formula:

$$LGD_{climate} = LGD_{base} + (1 - Ins) \times Damage$$

where Ins = insurance coverage rate and $Damage$ = physical damage rate.

Worked Example: Philippine Agriculture

Agricultural loan in Philippine typhoon corridor:

Parameter	Value
LGD_{base}	45%
Insurance coverage	30%
Physical damage rate (Hot House)	25%

Calculation:
$LGD_{climate} = 45\% + (1 - 0.30) \times 25\% = 62.5\%$
Impact: 17.5 percentage point LGD increase.

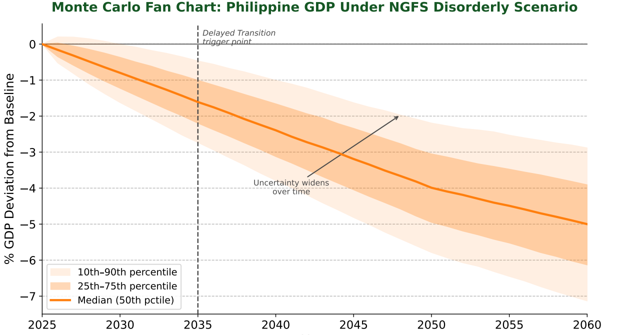
Key Insight

LGD adjustment for physical risk is often the **largest single impact** for ASEAN portfolios – larger than PD shifts.

Intermediate: LGD adjustment for physical risk is often the largest single impact for ASEAN portfolios, larger than PD shifts.

What Do Monte Carlo Fan Charts Show About Uncertainty?

[INTERMEDIATE]



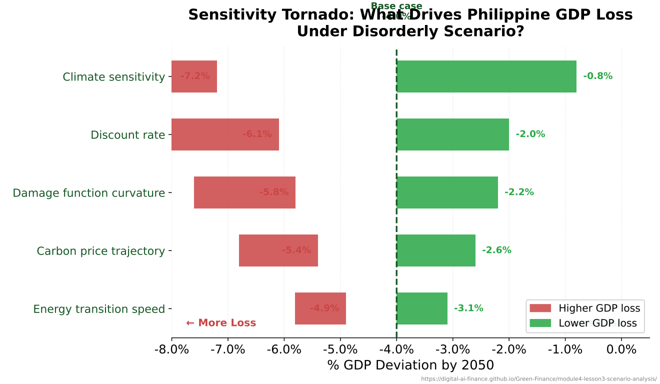
Source: Illustrative simulation calibrated to NGFS Phase IV (2023) Disorderly scenario. 10,000 Monte Carlo paths; geometric random walk with scenario-consistent drift.

https://digital-ai-finance.github.io/Green-Finance/module4-lesson3-scenario-analysis/

- The central path is **not a prediction** – it is the median of 10,000 simulated paths
- The 10th–90th percentile range (−1% to −8%) shows the true uncertainty
- Risk management should focus on the **tails**, not the center – what happens in the worst 10% of outcomes?

Intermediate: Fan charts are the standard visualization for scenario uncertainty. The width of the fan is the message, not the central path.

[INTERMEDIATE]



- Climate sensitivity – a physical science parameter – has the **largest impact** on financial outcomes
- The discount rate – a pure economics choice – is **second most important**
- Policy variables (carbon price, transition speed) matter **less** than physical fundamentals

Intermediate: The tornado diagram reveals that scenario results depend more on physical science and discounting choices than on policy assumptions.

What Are Integrated Assessment Models (IAMs)?

[PhD]

The engines behind NGFS scenarios

Integrated Assessment Models: A Comparative Overview

	Scope	Resolution	Key Sectors	Damage Function	Temp Range	Primary Strength
DICE	Global	Aggregate	All (simplified)	Quadratic	1.5 – 6°C	Intuition & pedagogy
REMIND-MAgPIE	Regional (12 regions)	Detailed	Energy + land use	Sector-specific	1.5 – 4°C	ASEAN granularity
GCAM	Regional (32 regions)	Detailed	Energy + water + land	Implicit	1.5 – 4°C	Technology richness
MESSAGE	Global / Regional	Detailed	Energy systems	IAM-dependent	1.5 – 4°C	SDG integration

Economics-based (DICE)   Engineering-based IAMs

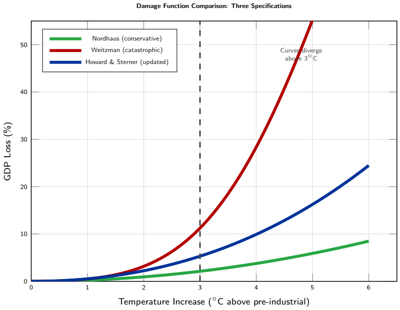
https://digital-ai-finance.github.io/Green-Finance/module4-lesson3-scenario-analysis/

- No single IAM is "correct" – each makes different assumptions about technology, economics, and damage
- NGFS scenarios are generated by **running** these IAMs under different policy assumptions
- DICE is simplest (good for intuition); REMIND-MAgPIE is most detailed (good for ASEAN analysis)

PhD: IAMs are the engines behind NGFS scenarios. Understanding their assumptions is essential for interpreting scenario results critically.

How Do IAM Damage Functions Shape Financial Outcomes?

[PhD]



The Damage Function

$$D(T) = \frac{\alpha T^2}{1 + \beta T^2}$$

where D = damage as fraction of GDP, T = temperature increase above pre-industrial, α and β are calibration parameters.

At $T = 4^\circ$C:

- Nordhaus: $\sim$4% GDP loss
- Howard & Sterner: $\sim$14% GDP loss
- Weitzman: $\sim$25%+ GDP loss

Key Insight

The choice of damage function can change the estimated financial impact by **3x or more** at the same temperature.

PhD: The damage function is the single most contested component of IAMs. Different functional forms yield dramatically different financial impact estimates.

Why Does the Discount Rate Matter So Much?

[PhD]

Stern: Low Discount Rate

- $\delta = 1.4\%$ (near-zero pure time preference)
- Future generations matter almost as much as current
- Result: SCC $\approx$ \$85/tCO_2 (2007), $\sim$\$200+ in 2024 terms
- Implication: urgent, aggressive action justified now

Argument: It is ethically indefensible to value a person born in 2060 less than a person born today. Climate damages are intergenerational – the discount rate must reflect this.

Nordhaus: Market Discount Rate

- $\delta = 4.5\%$ (market-observed rate)
- Future benefits heavily discounted
- Result: SCC $\approx$ \$35/tCO_2 (2017 estimate)
- Implication: gradual, cost-optimized transition preferred

Argument: The discount rate should reflect actual returns on investment. A dollar invested today at market rates creates more value than a dollar saved from climate damage in 2060.

Key Data

The discount rate choice alone accounts for a **2–5**$\times$ difference in the social cost of carbon – and by extension, in the financial impact of climate scenarios.

PhD: The Stern-Nordhaus debate is fundamentally about ethics, not economics – how much weight do we give to people not yet born?

What Are the Strongest Critiques of IAMs?

[PhD]

Weitzman (2009): Fat-Tailed Risk

- IAMs assume **thin-tailed** damage distributions, but climate tipping points create **fat tails**
- Even a small probability of catastrophic warming (6°C+) should dominate cost-benefit analysis
- The "dismal theorem": under fat tails, expected damages are **infinite**, making standard cost-benefit analysis meaningless

"The economics of catastrophic climate change is not about the most likely outcome, but about what happens in the tails."

Pindyck (2013): False Precision

- IAMs create an **illusion of precision** with deeply uncertain parameters
- Damage functions are essentially **guesses** calibrated to limited historical data
- IAMs tell us nothing useful about optimal policy because they are **sensitive to arbitrary assumptions**

"These models can be used to obtain almost any result one desires."

Despite These Critiques

IAMs remain the **best available tool** for structured scenario analysis – the alternative is no quantitative framework at all.

PhD: Weitzman argues IAMs systematically underestimate tail risk. Pindyck argues they create false precision. Both are right – and IAMs are still indispensable.

How Does the Discount Rate Change Everything for ASEAN?

[PhD]

ASEAN-Specific Considerations

- Emerging markets face **higher discount rates** (5–8%) due to country risk premium
- Climate damages hit ASEAN **disproportionately** (physical risk dominance)
- **Paradox:** high discount rate makes future damages look small in present value
- **But:** ASEAN's damages arrive **sooner** – typhoons and flooding are near-term, not 2100 phenomena

Numerical Example: Philippines Agriculture

PV of 2025–2060 climate damages:

Discount Rate	PV of Damages
$\delta = 1.4\%$ (Stern)	\$42 billion
$\delta = 4.5\%$ (Nordhaus)	\$18 billion
$\delta = 7.0\%$ (emerging market)	\$11 billion

Key: Near-term damages (2025–2035) are **minimally affected** by discounting. The discount rate debate matters less for ASEAN than for developed markets because physical risk damages arrive in the near term.

PhD: The discount rate matters less for ASEAN than for developed markets because physical risk damages arrive in the near term, not in 2100.

Case Study: How Do Typhoons Reshape Philippine Bank Portfolios?

[FOUNDATION]

The Philippines experiences **20+ typhoons** annually. Climate models project intensity increases of **10–30%** by 2050. Super Typhoon Haiyan (2013) caused $12.9 billion in damages and affected 14.1 million people.

Question: How do we model agricultural loan default rates under NGFS Hot House and Disorderly scenarios, incorporating projected typhoon intensity increases?

Philippines Climate Exposure	**Value**	**Source**
Annual typhoon frequency	20+ storms	PAGASA
Super Typhoon Haiyan damage (2013)	$12.9 billion	EM-DAT
Agricultural share of GDP	10%	World Bank
Agricultural lending share of bank portfolios	15–20%	BSP
Insurance penetration	∼5%	Insurance Commission PH
Projected intensity increase by 2050	10–30%	IPCC AR6

ASEAN Case Study: The Philippines is the world's most typhoon-exposed major economy. Climate scenarios project this risk will intensify.

What Data Do We Need for the Philippine Scenario Analysis?

[FOUNDATION]

Step-by-Step Data Sources

1. **NGFS Scenario Explorer:** Philippines GDP, temperature, carbon price under Hot House and Disorderly
   Free, download CSV
2. **EM-DAT database:** Historical typhoon damage data
   Free, register at emdat.be
3. **BSP Reports:** Agricultural loan portfolio data
   Public, bsp.gov.ph

Additional Sources

4. **IRRI Studies:** Crop yield sensitivity to typhoon intensity
   International Rice Research Institute
5. **Insurance Commission PH:** Insurance penetration by province
   Annual report, insurance.gov.ph

Design Choice

All data sources are **freely available and open-access** – a deliberate design choice for ASEAN capacity building.

All data sources for this case study are freely available and open-access – a deliberate design choice for ASEAN capacity building.

How Does Typhoon Intensification Change Default Rates?

[INTERMEDIATE]

Intensity Projections

Under NGFS scenarios:

- Hot House World: +25% intensity by 2050 (RCP 8.5 equivalent)
- Disorderly: +15% intensity (RCP 4.5 with late transition)

Key relationship:

$$Damage \propto WindSpeed^3$$

A **cubic** relationship – a 25% intensity increase implies ∼95% more damage:

$$1.25^3 = 1.953$$

Default Rate Calibration

Current agricultural NPL rate in typhoon-affected areas: ∼8%.

Hot House (+25% intensity):

- Damage multiplier: $(1.25)^3 \approx 1.95$
- Projected NPL: $8\% \times 1.95 \approx$ **15.6%**

Disorderly (+15% intensity):

- Damage multiplier: $(1.15)^3 \approx 1.52$
- Projected NPL: $8\% \times 1.52 \approx$ **12.2%**

Combined with crop yield decline from heat stress: +2–3% additional default rate increase.

Intermediate: The cubic wind-damage relationship means small increases in typhoon intensity produce large increases in financial losses.

What Does the 3-Country Scenario Dashboard Look Like?

[INTERMEDIATE]

Vietnam

Metric	Value
ΔGDP (HHW)	-6%
ΔGDP (Dis.)	-3.5%
Agric. ΔPD	$+7\%$

Key vulnerabilities:

- Garment exports (transition)
- Mekong Delta agriculture (physical)

Thailand

Metric	Value
ΔGDP (HHW)	-5%
ΔGDP (Dis.)	-3%
Agric. ΔPD	$+6\%$

Key vulnerabilities:

- Tourism (physical)
- Automotive (transition)

Philippines

Metric	Value
ΔGDP (HHW)	-8%
ΔGDP (Dis.)	-4%
Agric. ΔPD	$+12\%$

Key vulnerabilities:

- Agriculture + typhoons (physical)
- BPO services (low exposure)

Cross-Country Observation

All three countries share **physical risk dominance**, but sector vulnerabilities differ. The Philippines is most exposed across all scenarios.

Intermediate: The Quantitative Lab produces this 3-country x 3-scenario dashboard. Students download NGFS data and generate it themselves.

Worked Example: Building the Fan Chart for Philippine Agriculture

[INTERMEDIATE]

Monte Carlo Setup

1. Draw 10,000 samples from NGFS Disorderly central path $\pm$ uncertainty
2. Add typhoon intensity stochastic shock (lognormal, calibrated to historical Haiyan-class events)
3. Convert to agricultural PD via sector sensitivity coefficient $\beta = 1.5$
4. Plot percentile bands at 10th/25th/50th/75th/90th

Key output: The 90th percentile tail shows agricultural NPL could reach **22%** under worst-case Disorderly + extreme typhoon year by 2045.

Python Pseudocode

```
np.random.seed(42)
n_sims = 10_000
years = np.arange(2025, 2061)

# Base GDP paths with uncertainty
base = ngfs_disorderly_path()
noise = np.random.normal(0, sigma,
    (n_sims, len(years)))
gdp = base + noise.cumsum(axis=1)

# Add typhoon shocks
typhoon = np.random.lognormal(
    mu_haiyan, sig_haiyan, ...)
gdp_shocked = gdp - typhoon

# Convert to PD via beta
pd_paths = beta * abs(gdp_shocked)

# Plot percentile fan chart
for p in [10, 25, 50, 75, 90]:
    ax.fill_between(...)
```

Intermediate: This is the exact code logic students implement in the Quantitative Lab Python notebook.

What Are the Key Gaps in ASEAN Scenario Analysis?

[FOUNDATION] [INTERMEDIATE]

Four Gaps Identified

1. **Data granularity:** NGFS provides country-level data but bank portfolios need province-level or borrower-level granularity
2. **Physical risk modeling:** NGFS scenarios focus on transition risk variables; physical damage projections require downscaled climate models (CMIP6)

Four Gaps (continued)

3. **Correlations:** extreme weather events are correlated across sectors (typhoon hits agriculture AND real estate AND infrastructure) but standard tools treat sectors independently
4. **Tail risk:** Standard scenario percentiles (10th–90th) miss the 1-in-100 catastrophic events that drive the largest losses

What Would Close These Gaps?

- Downscaled climate models for ASEAN provinces
- Copula-based correlation structures for multi-sector shocks
- Extreme value theory for tail risk estimation

These four gaps define the frontier for ASEAN climate scenario analysis – and potential PhD research topics.

Seven Things You Now Know About Climate Scenario Analysis

[FOUNDATION]

Seven Key Concepts

1. Scenarios are **structured explorations**, not predictions
2. NGFS provides **three scenario families**: Orderly, Disorderly, Hot House World
3. IEA scenarios **complement NGFS** with energy-sector detail
4. The scenario-to-financial-impact chain has **five stages**
5. Monte Carlo methods quantify scenario **uncertainty** via fan charts
6. IAMs are the **engines** behind NGFS scenarios
7. The Philippines typhoon case shows how **physical risk dominates** ASEAN scenario results

Where This Leads

Lesson	Builds On
4.4	*Carbon metrics*: measuring what scenarios identify
4.5	*Stress testing*: applying scenarios to bank balance sheets
4.6	*Data & tech*: operationalizing scenario analysis at scale

Five questions to assess scenario capability:

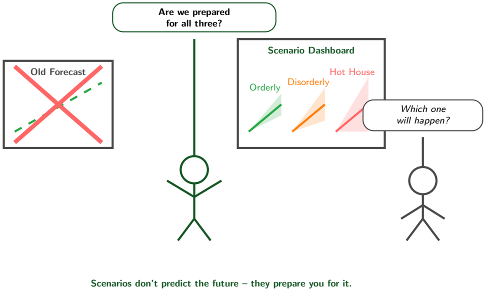
1. Does the institution use NGFS scenarios?
2. Are scenarios calibrated to local conditions?
3. Is the macro-to-micro translation documented?
4. Are uncertainty bands quantified?
5. Is scenario analysis integrated into ERM?

Lesson 4.3 complete. Next: Lesson 4.4 – Carbon Metrics and Climate Value-at-Risk (quantifying portfolio exposure).

The Pedagogical Arc

- We began with an economist who relied on a single GDP forecast and was blindsided – **no scenarios, no uncertainty**
- We end with the same economist presenting three fan charts to the board – structured, quantified, prepared

Remember: Scenarios do not predict the future. They provide the **structured exploration** to reveal vulnerabilities – turning a single forecast into a portfolio of prepared responses.



Original illustration. The pedagogical arc of Lesson 4.3: from 'Give me THE forecast' to 'Show me what we should be prepared for.'

Key References

Institutional References

- NGFS (2024). *NGFS Climate Scenarios for Central Banks and Supervisors – Phase IV*. Network for Greening the Financial System.
- IEA (2024). *World Energy Outlook 2024*. International Energy Agency.
- ADB (2023). *Climate Risk and Adaptation in the Philippines Financial Sector*. Asian Development Bank.

Academic References

- Nordhaus, W. (2017). Revisiting the social cost of carbon. *PNAS*, 114(7), 1518–1523.
- Weitzman, M. (2009). On modeling and interpreting the economics of catastrophic climate change. *Review of Economics and Statistics*, 91(1), 1–19.
- Howard, P. & Sterner, T. (2017). Few and not so far between: A meta-analysis of climate damage estimates. *Environmental and Resource Economics*, 68(1), 197–225.
- Pindyck, R.S. (2013). Climate change policy: What do the models tell us? *Journal of Economic Literature*, 51(3), 860–872.

All references are open-access or available through university libraries.