Lesson 4.5

Climate Stress Testing

Design, Execution, and Supervisory Practice

Module 4: Green Finance Risk Management

GREEN FINANCE micro-credential

Erasmus+ CBHE 101237817

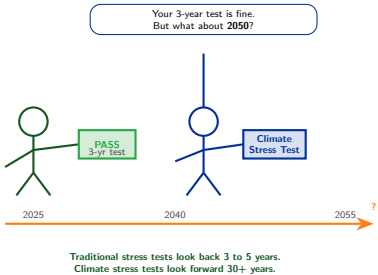
Your 3-Year Test Is Fine, But What About 2050?

[FOUNDATION]

Situation: Banks routinely pass supervisory stress tests with 3 to 5 year horizons. Capital ratios hold. The board is satisfied.
Complication: Climate risk unfolds over 30+ years. Physical damage intensifies non-linearly. Transition shocks cluster around policy tipping points. No historical precedent exists.

- Traditional tests use **backward-looking** data
- Climate needs **forward-looking** scenarios (30+ years)
- Deep uncertainty replaces parametric distributions

"The real question is not whether you survive the next recession; it is whether you survive the next three decades."



Traditional stress tests look back 3 to 5 years. Climate stress tests look forward 30+ years.

From Portfolio Exposure to the Full Balance Sheet

[FOUNDATION]

Portfolio Exposure Measured (Lesson 4.4)

- Financed emissions **calculated** using PCAF attribution
- Portfolio WACI **benchmarked** against sector averages
- Climate Value-at-Risk **estimated** under NGFS scenarios
- Vietnam agriculture-coal **inversion** revealed: physical risk > transition risk

"We know how much we could lose. But can the bank absorb the loss?"

Now Stress the Balance Sheet (Lesson 4.5)

- Apply CVaR to the **full balance sheet** via transmission channels
- Design a **climate stress test** with 5 building blocks
- Estimate **post-stress capital adequacy** (CAR impact)
- Learn from **ECB, BoE, and BOT** supervisory exercises

Key Insight

L4.4 told you **how much you could lose**. L4.5 asks: **can the bank absorb the loss?**

CVaR is the input. Capital adequacy under stress is the output.

Road Map: From Scenario Losses to Capital Adequacy

Section	Slides	Central Question
Introduction	1 to 4	Why can't traditional stress tests capture climate risk?
Context	5 to 9	What are the building blocks of a climate stress test?
Challenge	10 to 15	How do you model transmission channels and capital impact?
Analysis	16 to 24	What do supervisory stress tests reveal at PhD depth?
Resolution	25 to 30	What does the Thai BOT pilot teach us?
Summary	31 to 33	What should you remember?

The lesson follows a **case-based** arc: we open with a risk manager whose 3-year test passes but whose 30-year outlook is untested, build the five design elements of a climate stress test, work through transmission channels and capital impact at intermediate level, deepen to PhD-level bottom-up models and second-round effects, and resolve with the BOT Thailand pilot, where physical risk dominates transition risk.

Lesson 4.5 of 6 in Module 4. Foundation level with Intermediate and PhD extensions.

What Is a Climate Stress Test?

[FOUNDATION]

Definition: A climate stress test assesses whether a financial institution can **absorb climate-related losses** while maintaining **regulatory capital requirements**: under plausible but severe climate scenarios.

Unlike traditional stress tests that extrapolate from historical crises, climate stress tests must model **unprecedented** events over **decades**, not quarters.

Core Question

Can the institution absorb climate-related losses while maintaining regulatory capital?

Traditional vs. Climate Stress Tests

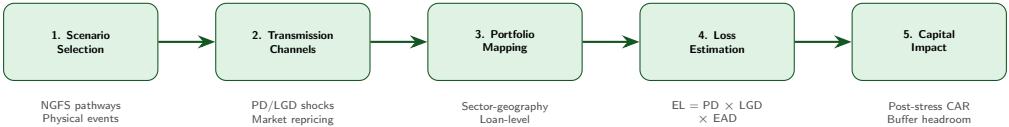
Dimension	Traditional	Climate
Horizon	3 to 5 years	30+ years
Uncertainty	Parametric	Deep
Data	Historical	Novel/proxy
Scope	Single institution	Economy-wide

- **Deep uncertainty**: no reliable probability distribution
- **Novel data**: flood maps, carbon prices, biodiversity indices
- **Economy-wide**: sectoral shocks cascade across balance sheets

Can the institution absorb climate-related losses while maintaining regulatory capital?

Five Design Elements of Every Climate Stress Test

[FOUNDATION]

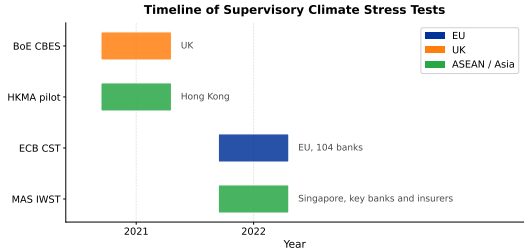


- **Scenario Selection:** NGFS (Orderly, Disorderly, Hot House) or bespoke physical events (flood, drought)
- **Transmission Channels:** How scenarios translate into credit, market, and operational risk parameters
- **Portfolio Mapping:** Assigning exposures to sectors and geographies affected by each scenario
- **Loss Estimation:** Computing expected loss ($EL = PD \times LGD \times EAD$) under stressed parameters
- **Capital Impact:** Determining whether post-stress capital ratio exceeds regulatory minimums

Common to every climate stress test, whether ECB, BoE, or ASEAN.

Which Regulators Have Conducted Climate Stress Tests?

[FOUNDATION]



Each exercise is placed at the year its source states: Bank of England 2021 CBES, HKMA pilot launched January 2021, ECB 2022 climate risk stress test, MAS 2022 Industry-Wide Stress Test. Source: ECB Banking Supervision, press release, 8 July 2022: Banks must sharpen their focus on climate risk, ECB supervisory stress test shows.
https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

Major Supervisory Exercises

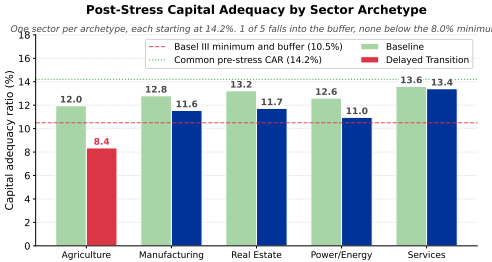
- **ECB 2022:** 104 significant banks, 3 NGFS scenarios + physical events
- **BoE CBES 2021:** 19 banks/insurers, exploratory (no capital consequences)
- **HKMA 2021:** 27 banks, one physical and two transition scenarios
- **MAS 2022:** selected key banks and insurers, in the Industry-Wide Stress Test
- **BOT:** flood scenario for Bangkok built with the World Bank

A 2022 FSB and NGFS survey counted 67 climate scenario exercises by financial authorities, 35 of them completed.

The FSB and NGFS counted 67 climate scenario exercises by financial authorities in 2022.

How Do You Read a Stress Test Output?

[FOUNDATION]



Assumed teaching example, not measured data: Illustrative bank, not a real institution. Source: BCBS, Basel III: A global regulatory framework for more resilient banks and banking systems (rev. June 2011), para 64.

https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

Reading the Output

- The output is a single number: **post-stress CAR**
- Regulatory minimum (Basel III): **10.5%** (8% + 2.5% conservation buffer)
- Pre-stress: all 5 banks above 10.5%
- Net Zero scenario: all survive with 1 to 3pp headroom
- Hot House scenario: **2 of 5 breach** the 10.5% threshold

Interpretation

A bank breaching 10.5% must restrict dividends, raise capital, or reduce exposures. The stress test forces the conversation *before* the crisis.

The stress test output is a single number: post-stress CAR.

Top-Down or Bottom-Up: Which Approach?

[FOUNDATION]

Top-Down Approach

- Aggregate **sectoral shocks** applied uniformly
- Supervisor designs **uniform scenarios**
- Faster, comparable across banks
- Used in **around half** of the exercises the FSB surveyed in 2022

Advantage: Cross-bank comparability. The regulator controls the narrative.

Bottom-Up Approach

- Granular **loan-by-loan** analysis
- Banks use **own internal models**
- More accurate, captures portfolio specifics
- Used by: **BoE CBES, MAS 2022**

Advantage: Portfolio-specific insights. The bank owns the analysis.

Best Practice

Use **both**: top-down for system-wide comparability, bottom-up for institutional granularity.

Top-down for comparability, bottom-up for granularity.

How Does Climate Risk Transmit Through Credit?

[INTERMEDIATE]

PD Adjustment Under Climate Stress

$$PD_{climate} = PD_{base} \times (1 + \text{stress_multiplier})$$

where the stress multiplier is calibrated from scenario variables: carbon price exposure, flood frequency, drought severity, regulatory stringency.

Worked Example: Thai agriculture sector under Delayed Transition.
$PD_{base} = 5\%$. Stress multiplier from flood frequency increase $= 0.80$.
$PD_{climate} = 5\% \times (1 + 0.80) = \mathbf{9.0}\%$

LGD Adjustment Under Physical Damage

$LGD_{climate} = LGD_{base} + \Delta_{physical}$
Thai agriculture: $LGD_{base} = 45\%$. Flood damage uplift $\Delta = +20$pp. $LGD_{climate} = \mathbf{65}\%$.
The multiplier approach assumes proportional scaling. More sophisticated models use logit transformations (see Slide 16).

Transmission channels convert scenario variables into PD and LGD adjustments.

How Do Market and Operational Risks Transmit?

[INTERMEDIATE]

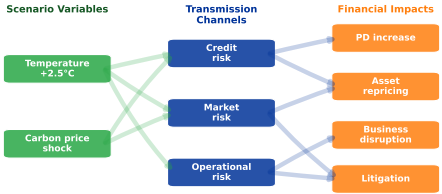
Market Risk Transmission

- **Equity repricing:** coal stocks −40%, oil −20 to 30% under Net Zero
- **Credit spreads:** high-carbon bonds +50 to 200bps
- **Real estate:** flood-zone properties −10 to 30%
- **Sovereign:** commodity-dependent nations downgraded

Operational Risk Transmission

- **Supply chain:** physical disruption to borrower operations
- **Compliance:** new disclosure requirements, taxonomy alignment
- **Litigation:** climate lawsuits up +300% since 2015

Climate Risk Transmission Channels



Concept schematic: arrows show connections, not magnitudes. Assumed teaching example, not measured data: Teaching scenario anchor, not a projection.
https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

Climate risk transmits through credit, market, and operational channels simultaneously.

Computing Expected Loss Under Climate Stress

[INTERMEDIATE]

Expected Loss Formula: $EL = PD \times LGD \times EAD$

Worked Example: 5-Sector Thai Bank (THB billions, Delayed Transition Scenario)

Sector	EAD	PD_{base}	$PD_{climate}$	LGD_{base}	$LGD_{climate}$	EL_{base}	$EL_{climate}$
Agriculture	100	5.0%	9.0%	45%	65%	2.25	5.85
Manufacturing	120	3.5%	5.3%	40%	50%	1.68	3.18
Real Estate	80	2.8%	4.5%	35%	55%	0.78	1.98
Power/Energy	60	4.0%	7.2%	40%	45%	0.96	1.94
Services	140	2.0%	2.5%	30%	32%	0.84	1.12
Total	**500**					**6.51**	**14.07**

Climate stress **doubles** expected losses from THB 6.5B to THB 14.1B. Agriculture contributes 42% of incremental climate losses despite being only 20% of EAD. The static balance sheet assumption keeps EAD fixed, no deleveraging during the scenario horizon.

Climate stress adjusts PD and LGD while EAD remains fixed (static balance sheet).

What Happens to Capital Adequacy?

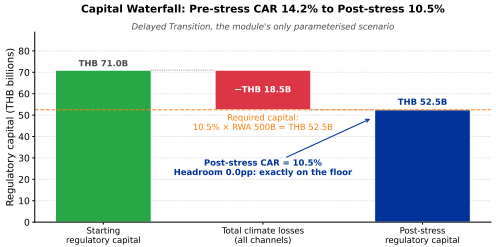
[INTERMEDIATE]

Post-Stress Capital Ratio

$$CAR_{post} = \frac{RegCapital - ClimateLosses}{RWA}$$

Worked Example:
Regulatory capital = THB 71B
RWA = THB 500B
Pre-stress CAR = 71/500 = 14.2%
Climate losses = THB 18.5B
Post-stress CAR = (71 − 18.5)/500 = **10.5%**
Headroom above minimum: **0pp**
On the regulatory threshold.

$\Delta CAR = -3.7$pp. If losses reach THB 19B, the bank breaches. Capital actions required.



Assumed teaching example, not measured data: Illustrative bank, not a real institution. Source: BCBS, Basel III: A global regulatory framework for more resilient banks and banking systems (rev. June 2011), para 64.

https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

If post-stress CAR falls below 10.5%, the bank must act.

How Do You Fill the Data Gaps?

[INTERMEDIATE]

Data Quality Hierarchy

1. **Borrower-level data**: GHG emissions, physical location, asset condition. Available for $<10\%$ of ASEAN portfolios.
2. **Sector-geography proxies**: average PD/LGD by sector and province. Most common in practice.
3. **Sector averages**: national sector-level PD multipliers. Coarser but available.
4. **Expert judgment**: calibrated opinion for data-dark segments. Last resort.

ASEAN-Specific Challenges

- **SME dominance:** 80%+ of borrowers are SMEs with no emissions disclosure
- **Disconnected maps:** flood/drought maps not linked to bank loan books
- **Proxy divergence:** different proxy methods yield 2 to 5$\times$ different PD shocks
- **Insurance data:** claims history not shared with prudential regulators

Implication

Data gaps force conservative assumptions, which *overstate* losses and *undermine* credibility. Closing gaps is a strategic investment.

Data gaps are the binding constraint for ASEAN climate stress testing.

Worked Example: A Thai Bank Under Delayed Transition

[INTERMEDIATE]

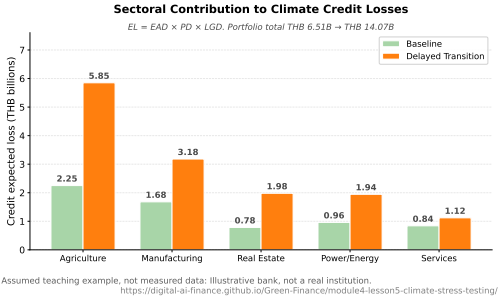
Bank Profile

- Total assets: THB 500B
- 6 sectors: agriculture, manufacturing, real estate, power, tourism, services
- Scenario: **Delayed Transition** (NGFS): abrupt policy shift in 2030s

Results Summary

Metric	Value
Total climate losses	THB 22B
Largest contributor	Agriculture (45%)
Pre-stress CAR	15.1%
Post-stress CAR	12.3%
Headroom above 10.5%	1.8pp

The bank survives but with minimal headroom. Agriculture and power combined account for 70% of losses.



This worked example is the template for the Quantitative Lab.

Loan-Level PD Models with Climate Covariates

[PhD]

Bottom-Up Credit Risk Model

$$\text{logit}(PD_i) = \alpha + \beta_1 \cdot \text{FinancialRatios}_i + \beta_2 \cdot \text{ClimateCovariate}_i + \varepsilon_i$$

Climate Covariates

- Flood frequency (events/decade at borrower location)
- Drought index (Palmer severity, province-level)
- Carbon price exposure (% revenue from carbon-intensive activity)

Estimation Results (Thai Agriculture)

Covariate	β	t-stat
Flood frequency	0.45	3.8
Drought index	0.32	2.6
Carbon price exp.	0.18	1.9

Marginal Effects

- One unit increase in flood frequency $\Rightarrow$ +2.1pp PD
- One unit increase in drought severity $\Rightarrow$ +1.5pp PD
- Physical covariates dominate transition exposure for Thai agriculture

PhD Insight

The logit specification constrains $PD \in [0, 1]$ and enables marginal effect decomposition. The multiplier approach (Slide 10) is a simplified shortcut.

PhD: Loan-level PD models with climate covariates provide granularity that top-down approaches miss.

Modeling LGD Under Physical Damage

[PhD]

Collateral-Based LGD Under Climate Stress

$$LGD = 1 - \frac{CollateralValue_{stressed}}{EAD}$$

where $CollateralValue_{stressed} = CollateralValue_{base} \times (1 - DamageFraction)$.

Damage Fractions by Asset: Hazard

Collateral	Hazard	Damage
Ag. land	Flood (1m+)	40 to 70%
Commercial	Typhoon Cat 3	10 to 30%
Residential	Sea-level rise	15 to 50%
Industrial	Drought (water)	5 to 20%

Insurance Offset

$LGD_{net} = LGD_{gross} \times (1 - InsuranceCoverage)$

ASEAN Insurance Gap:

- Agriculture: 5 to 10% coverage
- Commercial property: 30 to 50% coverage
- Residential: 10 to 25% coverage

For Thai agriculture: $LGD_{gross} = 70\%$, insurance 8%.
$LGD_{net} = 70\% \times 0.92 = 64.4\%$. Insurance barely moves the needle.

The ASEAN insurance gap amplifies losses dramatically.

Static vs. Dynamic Balance Sheet Assumptions

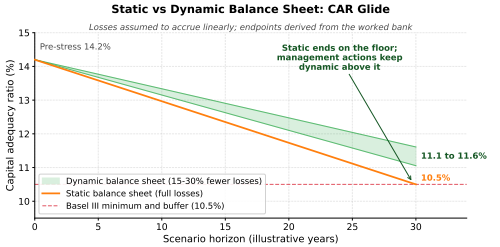
[PhD]

Two Modeling Philosophies

Static Balance Sheet
Portfolio frozen at start. No rebalancing, no divestment, no new lending. ECB 2022 approach. Conservative and comparable.

Dynamic Balance Sheet
Banks rebalance, divest high-risk sectors, raise capital, adjust pricing. Realistic but rarely used for core supervisory projections.

- Dynamic reduces losses by **15 to 30%** vs. static
- ECB and BoE CBES both used **static (fixed)** balance sheets for core projections
- BoE: firms' responses **may mitigate** some of the projected losses
- Whether to allow dynamic rebalancing remains debated



Assumed teaching example, not measured data: Illustrative management actions, not a modelled or supervisory result; Illustrative bank, not a real institution. Source: BCBS, Basel III: A global regulatory framework for more resilient banks and banking systems (rev. June 2011), para 64.
https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

Both the ECB and the BoE CBES used static (fixed) balance sheets for their core loss projections.

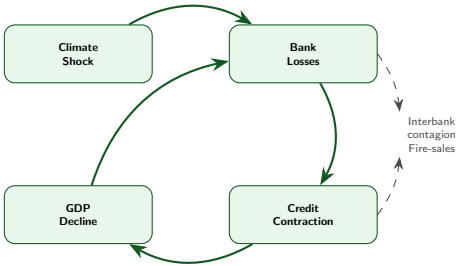
Second-Round Effects: When Losses Amplify Themselves

[PhD]

Feedback Amplification

- **First-round:** Direct PD/LGD/market losses from climate shocks
- **Second-round:** Losses cause credit contraction → GDP decline → more defaults
- **Contagion:** Interbank exposures, fire-sales of stranded assets

- Relies on network topology of interbank market
- Most supervisory exercises **ignore** second-round effects



Most supervisory exercises ignore second-round effects, systematically underestimating total losses.

ECB 2022: The Largest Climate Stress Test Ever

[PhD]

Design

- **Scope:** 104 significant banks; 41 provided loss projections
- **Scenarios:** 3 NGFS long-term + drought/flood short-term
- **Method:** Static balance sheet except the 30-year paths
- **Status:** Exploratory, no direct capital consequences

Key Findings

- Total losses: EUR 70B ($\sim$0.3% of total assets)
- Highest-exposed (fossil): CAR decline $-$**1.5 to** $-$**3.0pp**
- Highest physical risk: CAR decline $-$**0.5 to** $-$**1.5pp**

Critical Assessment

- Losses look **modest**: EUR 70B across the 41 banks that projected
- Static balance sheet **overstates** losses (no adaptation)
- But also **understates**: no economic downturn in the scenarios, preliminary data, no supervisory overlays
- Data quality: only 40% of banks could provide granular sectoral breakdowns

ECB's Own Conclusion

"For a number of reasons this estimate significantly understates the actual risk."

Largest climate stress test conducted to that point: 104 significant banks.

BoE CBES: A Counterparty-Level Climate Exercise

[PhD]

Design

- **Scope:** 19 banks and insurers
- **Scenarios:** Early Action, Late Action, No Additional Action
- **Method:** Bottom-up, counterparty-level, fixed (end-2020) balance sheet
- **Feature:** Firms reported their responses, quantitative and qualitative

Key Findings

- Total projected losses: GBP 225B over 30 years
- **Late Action** worst: abrupt transition shock in 2030s
- 10 to 15% of corporate lending at heightened risk
- Not used to set capital requirements related to climate risk

What Made CBES Different

- **Management actions:** firms gave quantitative and qualitative responses; balance sheets stayed fixed
- **Bottom-up:** each bank used own models, own data
- **Second round:** a further submission explored firms' responses in depth
- **Late Action paradox:** delay reduces near-term costs but increases long-term tail risk

Key Lesson

Early orderly transition is the *least costly* path. Delay creates a bigger shock when policy eventually arrives.

The CBES held balance sheets fixed at end-2020 and set no capital requirements.

Climate Stress Testing Across ASEAN

[PhD]

ASEAN Supervisory Exercises

Regulator	Year	Scope	Method
BOT		Thai banks	Flood scenario
MAS	2022	Key banks, insurers	IWST
BSP	2024	Philippine	Physical
HKMA	2021	27 banks	Phys. + trans.

- **BOT:** 41% of corporate lending in high flood-risk districts
- **MAS:** climate scenario inside its 2022 IWST
- **BSP:** Typhoon and sea-level rise scenarios planned
- **BNM:** Malaysia pilot phase, palm oil sector focus

Supervisory Climate Stress Tests: Qualitative Comparison

	Scope	Granularity	Horizon	Disclosure	Capital consequences
ECB CST 2022	High	Med	High	Med	Low
BoE CBES	Med	High	High	High	Low
BOT flood scenario	High	Low	High	Low	Low
MAS industry	Med	High	High	Med	Low

Assumed teaching example, not measured data: Module's qualitative reading of published exercise design, not an external rating.

https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

The Bank of Thailand asked banks to use the World Bank's flood scenarios.

The Limits of Current Climate Stress Tests

[PhD]

Acharya et al. (2023): Three Calls

1. **Transition as policy:** Treat many transition risks as dynamic policy choices.
2. **Feedback loops:** Incorporate feedback between climate change and the economy.
3. **Compound risk:** Explore scenarios in which climate risks co-occur with other risks.

They also discuss **market-based** climate stress tests, built from publicly available data, as a complement to existing frameworks.

ECB 2022: Four Reasons It Understates

- **No downturn:** The scenarios carry no economic downturn
- **Early data:** Data and modelling are at a preliminary stage
- **No overlays:** No supervisory overlays were applied
- **Partial scope:** Exposures in scope are around one-third of the total

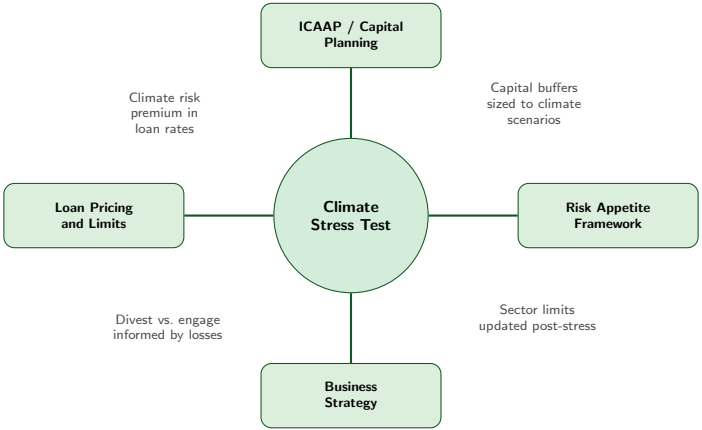
Implication

The ECB reads its 30-year loss projections as a *qualitative yardstick* for the direction of travel.

Acharya et al. (2023) on scenario design; ECB (2022) on its own estimate.

Integrating Climate Stress Tests into Enterprise Risk Management

[PhD]



The stress test is most valuable when it is not a compliance exercise but a **strategic management tool**. ICAAP integration means capital buffers are sized to climate scenarios. Risk appetite limits are updated with stressed sectoral concentrations. Loan pricing incorporates the climate risk premium. Business strategy distinguishes "divest" from "engage and transition."

Most valuable when integrated into capital planning and strategic decision-making.

Case Study Anchor: Thailand 2011 Floods

[FOUNDATION]

The Event

The 2011 Thailand floods were the **costliest flood in Asian history** at the time. Monsoon rains from July to December inundated central Thailand, including major industrial estates north of Bangkok.

- Duration: 5 months (July to December 2011)
- 800+ factories in 7 industrial estates flooded
- Global supply chains for hard drives and automotive parts disrupted

The World Bank and BOT flood scenario is informed by the 2011 floods; the question is: what happens when 2011-level floods become more frequent?

Key Statistics

Metric	Value
Total damages	$46.5B
Insurance payouts	$12B
GDP impact	−3.7%
Manufacturing output	−28% (Q4)
Industrial estates flooded	7 of 56
Factories affected	800+
Jobs disrupted	660,000

The $46.5B in damages versus $12B in insurance payouts reveals a **75% protection gap**, amplifying banking sector losses.

Costliest flood in Asian history at the time; it informs the World Bank and BOT flood scenario.

BOT: A Purpose-Built Climate Stress Test for Thailand

[FOUNDATION]

Framework Design

- **Scenarios:** 3 NGFS pathways (Net Zero, Delayed Transition, Hot House World)
- **Horizon:** Out to 2050
- **Risk types:** Physical + transition, assessed jointly
- **Method:** Top-down, sector-level aggregation
- **Balance sheet:** Static (frozen at the start)

Status: Pilot / exploratory. No direct capital consequences.

Thailand-Specific Modules

- **Agriculture:** ∼8 to 9% of GDP, rice/cassava/rubber. Flood and drought PD multipliers calibrated from 2011.
- **Tourism:** 12% of GDP. Coastal physical risk (sea-level rise, coral bleaching).
- **Manufacturing:** Industrial estate flood exposure. 2011 damage curves rescaled.
- **Coal phase-out:** Limited direct exposure but transition risk to power sector lending.

Purpose-built for Thailand's agriculture-heavy, flood-prone, tourism-dependent economy.

Purpose-built for Thailand's agriculture-heavy, flood-prone profile.

Scaling 2011 to 2050: Hot House World Projection

[INTERMEDIATE]

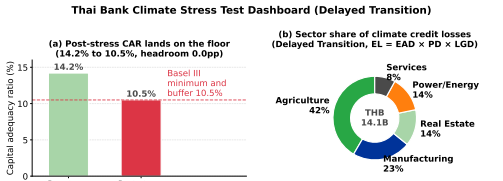
Calibration Logic

- 2011 flood: heaviest in about 50 years of records
- Under Hot House 2050: assumed about 2.5× more frequent (climate models)
- Assumed frequency multiplier: 2.5×
- Severity uplift: 1.3× (heavier rainfall per event)

PD Shock Scaling

Assumed sector NPL shock: +0.9pp
Frequency scaling: ×2.5
Severity uplift: ×1.3
Hot House PD shock: $0.9 \times 2.5 \times 1.3 = +\mathbf{2.9}$pp

This is applied to the agriculture and manufacturing sectors. Services and tourism receive smaller multipliers (1.5× and 2.0× respectively).



Assumed teaching example, not measured data: Illustrative bank, not a real institution. Source: BCBS, Basel III: A global regulatory framework for more resilient banks and banking systems (rev. June 2011), para 64.

https://digital-ai-finance.github.io/Green-Finance/module4-lesson5-climate-stress-testing/

Illustrative calibration from the 2011 floods, projected under Hot House World.

BOT Results: Capital Impact Under Three Scenarios

[INTERMEDIATE]

Bank Profile: THB 600B total assets

Hot House World (Worst Case)

Sector	Losses (THB B)
Agriculture	15
Manufacturing	7
Real Estate	4
Other (power, tourism, services)	2
Total	**28**

Pre-stress CAR: **16.2%**. Post-stress CAR: **12.8%**. Headroom: 2.3pp above 10.5%.

Net Zero (Best Case)

Total losses: THB 19B. Post-stress CAR: **14.1%**. Headroom: 3.6pp.

Delayed Transition (Middle)

Total losses: THB 22B. Post-stress CAR: **13.5%**. Headroom: 3.0pp.

Key Insight

- Hot House is **worse** than Net Zero for Thailand
- Physical risk (floods, droughts) dominates transition risk (coal phase-out)
- Agriculture alone accounts for **54%** of Hot House losses

NGFS

The NGFS counts Asia among the regions most vulnerable to physical risks.

Hot House is worse than Net Zero for Thailand: physical risk dominates.

Evaluating the BOT Exercise: Strengths and Gaps

[INTERMEDIATE]

Strengths

- **NGFS-aligned:** Uses internationally recognized scenarios for comparability
- **Historical calibration:** scenario informed by the 2011 floods
- **Agriculture modules:** Purpose-built for Thailand's economic structure
- **ASEAN coordination:** Shares methodology with MAS and BSP

Gaps to Close

- **Static only:** No dynamic balance sheet, overstates losses
- **No second-round:** Interbank contagion and GDP feedback excluded
- **Insurance excluded:** Protection gap not modeled explicitly
- **Aggregate disclosure:** Bank-level results not published
- **No capital consequences:** Purely exploratory, no regulatory teeth

Assessment

Strong first step. **Five gaps to close by 2030** to reach BoE-level maturity: dynamic BS, second-round effects, insurance integration, granular disclosure, and capital consequences.

Comparable to ECB 2022 in maturity level. Five gaps define the roadmap.

Five Gaps That Define the ASEAN Capacity Building Agenda

[FOUNDATION] **[INTERMEDIATE]**

1. **Data infrastructure**: Build centralized borrower-level emissions databases linked to loan books. *Fix:* National green data registries (Vietnam SBV, BSP pilots).
2. **Methodology harmonization**: Different proxies yield 2 to 5$\times$ different PD shocks across jurisdictions. *Fix:* ASEAN-wide stress test protocol via NGFS coordination.
3. **Physical risk modeling**: Flood maps, drought indices, and sea-level projections are not integrated into bank risk systems. *Fix:* GIS-linked risk platforms (Thai Geo-Informatics pilot).
4. **Dynamic balance sheets**: All ASEAN exercises use static assumptions. *Fix:* Phase in dynamic modules by 2028, following BoE CBES template.
5. **Second-round effects**: No ASEAN exercise models interbank contagion or fire-sales. *Fix:* Agent-based network models (research collaboration with ECB).

These five gaps form a natural **capacity building roadmap**: from data (foundational) to network modeling (advanced). Each gap corresponds to a concrete deliverable in WP3 of this project.

These five gaps define the capacity building agenda for ASEAN climate stress testing.

Seven Concepts to Remember

[FOUNDATION]

Key Takeaways

1. Climate stress tests use **30+ year** horizons under deep uncertainty, no historical precedent
2. Five design elements: scenario, transmission, mapping, loss, capital
3. Transmission channels convert scenarios into **PD/LGD shocks** via credit, market, and operational risk
4. **Post-stress CAR** is the single most important output
5. ECB, BoE, HKMA and MAS ran exercises; the BOT used World Bank flood scenarios
6. Physical risk dominates transition risk for **agriculture-heavy ASEAN economies**
7. Data gaps and static assumptions are the **binding constraints**

Where This Leads

- **Lesson 4.6:** ASEAN Climate Vulnerability: country-level risk profiles for Vietnam, Thailand, Philippines
- **Module 5:** Green Reporting, TCFD/ISSB disclosure of stress test results

Lessons 4.1 to 4.5 Arc

Lesson	Core Output
4.1	Risk taxonomy
4.2	TCFD/TNFD frameworks
4.3	NGFS scenario analysis
4.4	Carbon metrics, CVaR
4.5	**Capital adequacy under stress**

Next: Lesson 4.6, ASEAN Climate Vulnerability.

From “We Pass” to “We Survive, Barely”

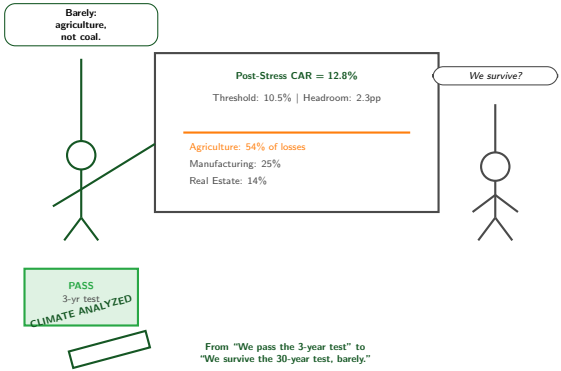
The Pedagogical Arc

Slide 2: the risk manager held a **“PASS”** certificate for the 3-year traditional stress test. The regulator asked: *“But what about 2050?”*

Now: the risk manager has run the full climate stress test. Post-stress CAR = 12.8%. The bank survives, **barely**. Agriculture, not coal, is the vulnerability.

- The 3-year test said: **PASS**
- The 30-year test says: **SURVIVE, BARELY**
- The difference: **agriculture physical risk**

“From ‘We pass the 3-year test’ to ‘We survive the 30-year test, barely.’”



Original illustration. From “We pass the 3-year test” to “We survive the 30-year test, barely.”

Key References

Institutional References

- ECB (2022). *2022 Climate Risk Stress Test*. European Central Bank.
- BoE (2022). *Results of the 2021 Climate Biennial Exploratory Scenario (CBES)*. Bank of England.
- UNEP FI (2024). *Climate Risk Stress Testing for Banks: A Practical Guide*. United Nations Environment Programme Finance Initiative.
- BOT (2024). *Climate Risk Assessment of the Thai Banking System*. Bank of Thailand.

Supplementary

- NGFS (2024). *Climate Scenarios for Central Banks and Supervisors* (4th vintage).
- MAS (2022). *Information Paper on Environmental Risk Management*.

Academic References

- Acharya, V., Berner, R., Engle, R., Jung, H., Stroebel, J., Zeng, X. & Zhao, Y. (2023). Climate stress testing. *Annual Review of Financial Economics*, 15, 291 to 326.
- Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. & Visentin, G. (2017). A climate stress-test of the financial system. *Nature Climate Change*, 7, 283 to 288.

All references open-access or available through university libraries.

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Use of generative AI

Generative AI was used as a writing and research assistant in preparing this module. The tool was Claude (Anthropic), versions Opus 4.8, Opus 5 and Opus 5.5, used from July 2026 to 8 October 2026. Its use was confined to the following purposes:

- idea generation and brainstorming on module structure and worked examples;
- language editing of author-specified content;
- literature classification and organisation of the reading list;
- coding assistance for the chart, data-processing, and document-build scripts;
- checking recorded numbers and quotations against their published sources;
- interactive literature searching using AI-enhanced search tools.

The authors specified and reviewed the content of this module. Every cited source was checked against the original publication, and every figure states its provenance on its own face, distinguishing sourced values from derived values and from illustrative teaching assumptions. The authors remain fully responsible for the originality, accuracy, integrity, references, and conclusions of the material.

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