Discovery Exercises

Module 4, Lesson 1: Climate Risks and Taxonomy

Foundation level. Two pre-class and two in-class activities. Full worked solutions are at the back: try each activity before you check.

Four activities open the ideas of Lesson 4.1 before, and during, the lecture. The two pre-class tasks take 15 to 20 minutes each and you do them alone. The two in-class tasks take 5 to 10 minutes and you do them with others. Nothing here is graded; the point is to think first, then compare your thinking with the worked solution. The lesson idea is simple to state: before you can manage a climate risk you must classify it, and different classes of risk behave in completely different ways.

PRE-CLASS Sort ten hazards into the right box

15 to 20 min, work on your own, pen and paper

Based on: guided discovery (Mayer 2004)

Climate risk splits into three categories. **Physical risk** comes from the climate itself and is either *acute* (sudden events: typhoons, floods, wildfires, heatwaves) or *chronic* (slow shifts: sea-level rise, sustained temperature change, altered rainfall). **Transition risk** comes from the move to a low-carbon economy (carbon taxes, technology change, shifting demand, reputation, investor behaviour). **Liability risk** comes from the courtroom (lawsuits against emitters, failure to adapt, and greenwashing, meaning enforcement against misleading green claims). A memory aid you will discover below: physical risk rises with *warming*; transition risk rises with *policy ambition*.

1. Put each of these ten items into exactly one of the three categories (physical acute, physical chronic, transition, or liability). Write the label next to each.

(a) A carbon tax of $75 per tonne	(f) Saltwater creeping 50 km up a delta
(b) A typhoon flooding 800 factories	(g) A court ordering a 45% emissions cut
(c) A coal plant retired 10 years early	(h) A lawsuit over a misleading “green” fund
(d) A five-month drought cutting rice yields	(i) Electric vehicles making a car-engine plant obsolete
(e) A slow rise in average sea level	(j) A flash flood destroying a warehouse

2. Two of your ten items are the *same* hazard type but on different timescales (one is sudden, one is slow). Which two, and what is the general rule that separates “acute” from “chronic”?

3. Look only at your transition items. What do they have in common that none of the physical items share? State the one-sentence rule you have just found.

Your attempt (before you check the solution at the back):

PRE-CLASS How much extra can a warmer climate cost a bank?

15 to 20 min, work on your own, pen and paper (optional spreadsheet stretch)

Based on: productive failure (Kapur 2008)

Try this *before* the lecture shows you the formula. A bank measures the yearly **expected loss** on a loan book as three numbers multiplied together: the **probability of default** PD (the chance a borrower fails to repay), the **loss given default** LGD (the fraction of the loan not recovered if they do), and the **exposure at default** EAD (the money at stake). So Expected loss = PD × LGD × EAD.
A Vietnamese bank has a $300M agricultural loan book in the Mekong Delta. Today: PD = 5.0%, LGD = 60%.

1. Compute today's expected loss (in dollars). Write your working.
2. Now a warmer climate (a plus 2 degrees Celsius future) is expected to push the PD up to 8.5% and the LGD up to 65% (worse crops mean more defaults, and flood-damaged land recovers less). Recompute the expected loss. Do not look for a formula yet, just multiply the new numbers.
3. By how many dollars, and by what percentage, did the expected loss rise? Before you were taught any "climate adjustment", you have just measured one. In one sentence, say which of the two changes (the PD rise or the LGD rise) did more of the damage, and why you think so.

Your attempt (before you check the solution at the back):

Optional stretch

Build a spreadsheet with columns PD, LGD, EAD, and Expected loss (the product of the three). Put the baseline row and the plus 2 degrees row in it. Then add a third row for a hotter plus 3 degrees future of your own guess (say PD = 11%, LGD = 68%) and see how fast the loss grows. Is the jump from baseline to plus 2 the same size as the jump from plus 2 to plus 3, or is it accelerating?

IN-CLASS Which sector is the bank's biggest climate headache?

5 to 10 min, think-pair-share

Based on: predict then reveal, testing effect (Roediger and Karpicke 2006)

Every sector faces a *different* mix of climate risk. A bank cannot use one single "climate score" for the whole book. In this activity you predict the pattern before your instructor reveals the lesson's sector table.

1. **Predict (1 minute, on your own).** For each sector below, write H, M, or L for how big you think its *physical* risk is, and H, M, or L for its *transition* risk:

Sector	Physical risk (H/M/L)	Transition risk (H/M/L)
Agriculture	_____	_____
Energy (fossil fuels)	_____	_____
Technology (software)	_____	_____

2. **Pair (2 minutes).** Compare with a neighbour. Where do you disagree? Agree on one sentence explaining why agriculture and energy have *opposite* risk profiles.
3. **Share and reveal.** Your instructor now shows the sector table. Were you right? What is the one rule about *why* a single climate score is misleading?

IN-CLASS Is natural gas "green"? A taxonomy stand-off

5 to 10 min, small groups of 3 to 5

Based on: data and case interrogation, active learning (Freeman et al. 2014)

A **taxonomy** is an official list that classifies economic activities as green, transition (sometimes called "amber"), or not eligible. It decides what can be funded as sustainable. The catch: countries disagree about where to draw the line, and the disagreement moves billions of dollars. Use these lesson facts: transition risk includes *policy and legal* risk (rules can change what an asset is worth), and the EU Carbon Border Adjustment Mechanism (a border charge on carbon-heavy imports) is phasing in from 2026.

From the case study: ASEAN-wide taxonomy harmonization (case study 9)

ASEAN taxonomies do not agree on natural gas. Thailand's taxonomy (Phase 1 published June 2023, Phase 2 May 2025) uses a green / amber / red traffic-light scheme and classes natural gas as amber, a transition fuel, which matters for its large gas-based power sector. Vietnam's Green Taxonomy (Decision 21/2025, issued July 2025) is a binary green-eligibility list of 45 project types and does not treat gas as green in the taxonomy itself. Coal is excluded (not green) in both. Green-bond issuance has been observed to move by roughly plus 30 to 40 percent in response to taxonomy classification.

1. **Vote first (no arithmetic).** As a group, which *class* of climate risk (physical, transition, or liability) does a "gas is amber vs gas is not green" disagreement mostly create for a bank that has already lent to a gas power plant? Agree on one answer.
2. **Now reason it through.** A bank lent $500M to a gas plant assuming the plant counted as a transition (fundable) asset. A stricter taxonomy later reclassifies gas as not eligible. List two concrete ways this raises the bank's risk (think about who will still lend, and what the plant is now worth).
3. Given that green-bond flows move 30 to 40 percent with classification, explain in one sentence why a country with a big gas sector (Thailand) and a country phasing gas down (Vietnam) rationally choose *different* taxonomies.

Full Solutions

Try each exercise on your own before you read its solution.

Solution: Sort ten hazards into the right box

1. Classification: (a) transition (policy and legal, a carbon tax); (b) physical acute (a typhoon and flood); (c) transition (technology and policy, early coal retirement is a stranded asset); (d) physical chronic (a sustained drought cutting yields); (e) physical chronic (slow sea-level rise); (f) physical chronic (saltwater intrusion, a slow shift); (g) liability (a court order); (h) liability (greenwashing enforcement); (i) transition (technology, electric vehicles); (j) physical acute (a flash flood).
2. The two same-hazard-different-timescale items are (e) slow sea-level rise (chronic) and (j) a flash flood (acute), both are water, or you may pair (d) chronic drought with (b) an acute flood. The rule: **acute** risk is a sudden, event-driven shock; **chronic** risk is a slow, permanent shift. Acute damage can in principle be insured; chronic shifts are largely uninsurable and need portfolio-level strategy.
3. Every transition item (a, c, i, and the reputational or behavioural ones) is driven by human *choices*, that is, by policy, technology, and markets, not by the weather. Discovered rule: physical risk rises with warming, but transition risk rises with policy ambition, so a faster, stricter transition means *more* transition risk, not less.

Common misconception. That coal plants retired early are a physical risk. They are a *transition* risk (a stranded asset): the plant still works, but policy and cheaper technology destroy its value. Physical risk would be the plant being flooded.

Solution: How much extra can a warmer climate cost a bank?

The general identity the lecture will show you is the climate-adjusted expected loss, $EL = PD \times LGD \times EAD$, with the PD and LGD raised for the climate scenario.

1. Baseline: $0.05 \times 0.60 \times \$300\text{M} = \$9.0\text{M}$.
2. Plus 2 degrees: $0.085 \times 0.65 \times \$300\text{M} = \$16.575\text{M}$, round to \$16.6M.
3. The loss rose by about \$7.6M, an increase of about $7.6/9.0 \approx 84\%$. The PD did more of the damage: it rose by 70% (from 5.0 to 8.5), while the LGD rose only about 8% (from 60 to 65), so the PD change is the larger multiplier on the result.

Common misconception. That a modest-sounding warming (plus 2 degrees) can only cause a modest loss. Because the effects multiply, an 84% jump in expected loss follows from what looks like a small temperature change. Across a whole multi-sector book the added climate loss can reach 30 to 50 percent of the baseline.

Solution: Which sector is the bank's biggest climate headache?

Using the lesson's sector table: Agriculture is **physical** High, transition Medium (weather destroys crops; some carbon and input-cost pressure). Energy (fossil fuels) is physical Medium but transition **Very High** (carbon taxes, stranded assets, and technology shifts hit it hardest). Technology (software) is Low on both.

Why they are opposite: agriculture is exposed to the *weather* (physical), while fossil energy is exposed to *policy and technology* (transition). The one rule: because sectors face different *kinds* of climate risk, a single climate score hides the real exposure, so a bank must assess each

sector on both the physical and the transition dimension.

Common misconception. That the "dirtiest" sector must be the highest risk on every dimension. Fossil energy is highest on transition risk but only medium on physical risk, whereas agriculture is the reverse.

Solution: Is natural gas "green"? A taxonomy stand-off

1. It is mostly a **transition** risk, specifically the policy-and-legal channel: a rule change (the taxonomy reclassification), not the weather or a lawsuit, is what changes the asset's standing.
2. Two concrete ways the risk rises: (i) fewer lenders and investors will refinance a plant that no longer counts as green or transition, so the bank may be unable to roll the loan and the cost of funding it rises; (ii) the plant becomes a potential *stranded asset*, its resale and collateral value falls, so if the borrower defaults the bank recovers less (a higher LGD).
3. A country with a large gas sector (Thailand) gains by counting gas as amber, so that its gas-to-renewables path stays fundable, while a country phasing gas down (Vietnam) loses little by excluding gas and gains stricter "green" credibility, so each rationally draws the line where its own energy mix lies.

Common misconception. That a taxonomy is a neutral technical list. Where the line is drawn is a policy choice with large capital-flow consequences: green-bond flows move 30 to 40 percent with classification, so the "gas" decision alone redirects billions.

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