Climate Risks: Naming Them and Following the Money

Module 4 Companion 1 of 6 lessons

For complete beginners. After this companion you will be able to name the three kinds of climate risk, explain how a storm on the other side of the world turns into a loss on a bank's books, and work out a climate-adjusted expected loss with a pencil.

The tragedy of the horizon

In 2015 the head of the Bank of England, Mark Carney, gave a speech that worried a room full of bankers. His point was simple. The serious damage from climate change arrives slowly, over decades, but the people who run banks, trade markets, and win elections are judged over a few years. So everyone has a reason to look away until it is too late. He called this the tragedy of the horizon.

The trouble is that the losses are not in the distant future any more. They are already landing. In 2023 the world lost around US$250 billion to natural disasters (Munich Re's figure for overall economic losses). When the 2011 floods swept through Thailand, the total economic damage was about US$46.5 billion, of which only about US$15 billion was covered by insurance. Read that last sentence again: most of the loss had no insurance behind it, so it fell on families, firms, and the banks that had lent to them. Climate losses are already financial losses, and the channels they travel can be named in advance.

Start Here: what you need to know first

A small set of words runs through every lesson. Learn these now and the rest reads easily. (If a word still feels slippery, that is normal; you will see each one used many times.)

a portfolio. A **portfolio** is the whole collection of loans or investments an institution holds, looked at together. A bank's **loan portfolio** (or **loan book**) is every loan it has made. The amount tied up in any single borrower or sector is called the **exposure** to that borrower or sector. We care about the portfolio because a shock that hits many loans at once (a flood across a whole farming region) is far more dangerous than one borrower failing on their own.

the credit-risk triad and expected loss. When a bank lends money it asks three questions about each loan. **PD**, the **probability of default**, is the chance the borrower fails to repay (for example a 5 percent chance, written 0.05). **LGD**, the **loss given default**, is the share of the money the bank would lose if that happens, after selling any collateral (for example 0.60, meaning it recovers 40 percent). **EAD**, the **exposure at default**, is how much is owed at that moment (for example 300 million). Multiplying the three gives the **expected loss**, the average amount the bank expects to lose on the loan: $\text{EL} = \text{PD} \times \text{LGD} \times \text{EAD}$. Climate risk raises PD (borrowers hit by disasters default more often) and LGD (flooded collateral is worth less), so it raises the expected loss.

collateral. **Collateral** is something of value a borrower pledges so the bank can seize and sell it if the loan is not repaid: a house behind a mortgage, machinery behind a business loan, land behind a farm loan. The **recovery value** is what the bank gets back by selling it. Climate damage matters because a flood or storm can destroy the very collateral that was supposed to protect the loan, so the bank loses more when it can least afford to.

idiosyncratic, systematic, and systemic risk. Risks come in three flavours that are easy to confuse. **Idiosyncratic** risk affects one borrower alone (a single factory burns down). **Systematic** risk affects many borrowers at once because they share a common cause (a region-wide drought hits every farm). **Systemic** risk is when trouble at connected institutions spreads through the financial system, like dominoes, turning one failure into many. Climate risk is dangerous precisely because it is systematic (it hits whole sectors and regions together) and can become systemic.

time horizons. A **time horizon** is how far into the future we are looking. Climate risk is split into **short** term (about 0 to 3 years), **medium** term (about 3 to 10 years), and **long** term (10 years and beyond). The trap, named the **tragedy of the horizon**, is that the worst climate damage lands in the long term, beyond the few years over which most banks, traders, and politicians are judged, so it is easy to ignore until it is too late.

carbon pricing. Governments make polluting cost money so that companies pollute less. A **carbon tax** charges a fixed price for every tonne of carbon dioxide emitted. An **emissions trading system** (ETS), also called cap-and-trade, sets a shrinking total limit on emissions and lets companies buy and sell permits within it, so the market sets the price. Either way, a company that emits a lot faces a new cost it did not have before. That new cost is the heart of **transition risk**.

acute and chronic hazards. Physical climate hazards come in two kinds. **Acute** hazards are sudden, violent events: a typhoon, a flash flood, a storm surge, a heatwave. **Chronic** hazards are slow, grinding changes: rising sea levels, salt creeping into farmland, gradually shifting rainfall and temperatures. Acute events cause sharp one-off losses; chronic changes slowly erode the value of land, crops, and property over decades. Both end up on a lender's books as losses.

The core idea 1: three kinds of climate risk

Climate risk is not one thing. To manage it you first have to sort it into boxes. There are three.

Physical risk is the damage done by the climate itself. It splits into the two kinds you just met: acute physical risk (sudden blows like a typhoon or a flash flood) and chronic physical risk (slow grinding changes like rising seas or salt creeping into farmland). A rice farm in the Mekong Delta of Vietnam faces both: a storm this year, and saltier soil every year.

Transition risk is the cost of the world moving away from fossil fuels. It is not caused by the weather; it is caused by our response to the weather. New rules, new taxes, and new technology can all turn something valuable into something worth much less. A coal power station is the classic example. The moment a government puts a serious price on carbon (through a carbon tax or an emissions trading system, the two tools you met above), that station becomes expensive to run, and the loan used to build it looks shaky. When an asset loses its value this way, before the end of its working life, we call it a *stranded asset*.

Liability risk is the risk of being sued or held responsible. If a company hid what it knew about climate damage, or kept polluting, courts may make it pay. For a bank, this can arrive second-hand: if a borrower is hit by a giant legal judgment, the borrower may no longer be able to repay.

Analogy

Think of a seaside hotel. Physical risk is the storm that floods the lobby. Transition risk is a new law banning beachfront building that halves the hotel's value overnight. Liability risk is a guest who sues after the flood. Three different dangers, one hotel.

The core idea 2: how a hazard becomes a loss

A flood in a province is a human tragedy. How does it become a number on a bank's books? Through what we call *transmission channels*. The most important one for a bank is the credit channel, and you already have the tools to understand it.

Recall the credit-risk triad. Every loan has a probability of default (PD), a loss given default (LGD), and an exposure at default (EAD), and the expected loss is their product. A climate hazard pushes on the first two. After a flood, more borrowers cannot pay, so PD rises. And the collateral behind those loans, the flooded farmland or the damaged factory, is now worth less, so the bank recovers less and LGD rises. Two of the three ingredients get worse at the same time, which is why climate losses can be larger than they first appear.

There are other channels (market prices fall, daily operations get disrupted, depositors withdraw cash), but if you remember only one, remember the credit channel: hazard raises PD and LGD, and the expected loss climbs.

This is also where the three flavours of risk you met earlier matter. A single flooded factory is idiosyncratic; the bank can shrug it off. But a flood that hits every farm in a region at once is systematic, and it can push a whole loan book into trouble together. That is what makes climate dangerous for a financial system, not just for one borrower.

The core idea 3: who is the risk material to?

Materiality is a plain word dressed up: it just means "does this matter enough to report and act on?" For a long time, firms asked only one version of the question, called **single materiality**: how does the outside world (including the climate) affect our money? This is the "outside-in" view.

Newer rules, especially in Europe, ask a second version too, called **double materiality**: not only how the climate affects us, but how we affect the climate and the people around us. This is the "inside-out" view. A bank doing double materiality has to look at the emissions it finances, not just the storms it is exposed to. Keep the two arrows in mind: outside-in (the world hits us) and inside-out (we hit the world). Double materiality means caring about both arrows.

The core idea 4: putting a number on it

Now we make it concrete. Start from the expected loss you already know:

$$\boxed{\mathrm{EL} = \mathrm{PD} \times \mathrm{LGD} \times \mathrm{EAD}.}$$

Climate risk nudges the pieces. A warmer world raises the chance of default, and physical damage lowers what the bank recovers. We can write a climate-adjusted version:

$$\boxed{\mathrm{EL}_{\mathrm{climate}} = \underbrace{\mathrm{PD}_{\mathrm{base}}\,(1 + \Delta T \cdot \beta)}_{\text{default rises with warming}} \times \underbrace{(\mathrm{LGD}_{\mathrm{base}} + \Delta\mathrm{LGD})}_{\text{recovery falls}} \times \mathrm{EAD}.}$$

Here ΔT is how much warmer the scenario is (say two degrees), and β is how sensitive this borrower's sector is to warming. A rice farm has a high β; an office software firm has a low one. Do not let the symbols scare you; the next box does it all with numbers.

Worked example, every step shown

A bank has lent \$300 million to farms in the Mekong Delta (this is the EAD). Today, with no climate stress, it judges the probability of default at PD $= 0.05$ (a 5 percent chance) and the loss given default at LGD $= 0.60$ (it would recover 40 percent).
Step 1, today's expected loss. EL $= 0.05 \times 0.60 \times 300 =$ \$9.0 million.
Step 2, warm the world by two degrees. Agriculture is sensitive, so $\beta = 0.35$. The default rate becomes PD $= 0.05 \times (1 + 2.0 \times 0.35) = 0.05 \times 1.70 = 0.085$ (now an 8.5 percent chance).
Step 3, damaged land recovers less. Flood damage adds 0.05 to the loss rate, so LGD $= 0.60 + 0.05 = 0.65$.
Step 4, the new expected loss. $\text{EL}_{\text{climate}} = 0.085 \times 0.65 \times 300 =$ \$16.6 million.
Read the result. The expected loss climbed from \$9.0 million to \$16.6 million, an increase of \$7.6 million, or about 84 percent, from the same loans. Nothing changed on paper except the climate assumptions. That jump is the whole point of Module 4.

Beyond this companion: see the lecture deck

Researchers go one step further and let the losses feed on each other. In a financial network, one bank's trouble becomes another's, so risk at institution i in the next period depends on shocks spreading from its neighbours j:

$$R_i(t+1) = R_i(t) + \sum_j w_{ij}\, \Delta V_j(t).$$

This is how an idiosyncratic shock can amplify into a systemic one (Battiston and colleagues, 2017). You do not need this formula to manage a loan book; the lecture deck covers it for those who want the research frontier.

Now you are ready

You now have the vocabulary the whole module reuses, and you can compute a climate-adjusted expected loss. Next, read **Handout Chapter 1**, which covers the same taxonomy, transmission channels, and materiality with more detail and a sector heatmap. Then watch **Lesson 1 (Deck L1)**. When the deck shows the systemic-risk network model, you will recognise it from the advanced box above.

Check yourself

1. Which of the three kinds of climate risk is a new carbon tax? *(Transition.)*
2. A flood damages a factory that secures a loan. Which two parts of the expected loss get worse? *(PD rises and LGD rises.)*
3. One farm fails versus every farm in a region fails: which is idiosyncratic and which is systematic? *(One farm is idiosyncratic; the whole region is systematic.)*
4. In the worked example, why did the expected loss almost double? *(Both the default rate and the loss given default rose at once.)*
5. Double materiality adds which arrow to the picture? *(Inside-out: how we affect the*

climate, not only how it affects us.)

Mini-glossary. *Stranded asset:* something that loses its value early because the world moved on (a coal plant after carbon pricing). *Transmission channel:* the path by which a hazard becomes a financial loss (the credit channel is the main one). *Materiality:* whether something matters enough to report and act on.

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or EACEA. Neither the European Union nor the granting authority can be held responsible for them.

Edition of September 2026. GREEN FINANCE micro-credential, Module 4 (Risk Management), Erasmus+ grant agreement 101237817. Licensed CC BY 4.0. Prepared by University of Twente (WP3). Published at https://digital-ai-finance.github.io/Green-Finance/teaching/module4/. Illustrative figures are representative, not audited. Generative AI was used as a writing and research assistant in preparing this module; the disclosure is printed in full in the module document and on the module page.