TECHNICAL DOCUMENTATION

Effective Climate Risk Rating

COVERING TRANSITION AND PHYSICAL RISKS OF INFRASTRUCTURE ASSETS
FORWARD-LOOKING TO THE HORIZONS 2035 AND 2050

Scientific Climate Ratings
An EDHEC Venture

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About Scientific Climate Ratings

Scientific Climate Ratings is a new venture born from EDHEC's Climate Finance applied research ecosystem. It delivers forward-looking ratings that quantify the financial materiality of climate risks for infrastructure companies and investors worldwide. Leveraging high-resolution geospatial data, proprietary climate risk models, and the world's largest financial dataset for infrastructure assets, Scientific Climate Ratings evaluates both transition risks (linked to the shift toward a low-carbon economy) and physical risks (arising from climate hazards such as floods, storms, heatwaves, and wildfires).

The ratings offer a dual perspective:

- Potential Climate Exposure Ratings assess current exposure to future climate risks under a "continuity" scenario, reflecting the most likely pathway based on today's global policies and trends.
- Effective Climate Risk Ratings go further by integrating climate risk data into financial valuation models across multiple scenarios — each weighted by its probability of occurrence — to estimate the financial effects of climate-related risks until 2035 and 2050.

While initially focused on infrastructure, Scientific Climate Ratings will soon extend its methodology to the listed equities segment, applying the same scientific rigor and forward-looking approach to a broader set of financial assets.

Scientific Climate Ratings aims to set a new standard in climate risk management — driving informed and responsible decision-making for a more resilient future.

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This document summarises the development of the ***Effective Climate Risk Rating (ECRR)***. It explains the general approach, provides background on climate scenarios and our climate modelling approach, justifies the data requirements, and presents the results. For detailed information on the specific physical and transition risks, please see the respective technical documentations.

All procedures were developed by the *EDHEC Climate Institute*, hereafter referred to as ECI or "we."

The EDHEC Climate Institute (ECI) developed a rating for infrastructure companies that reflects their sensitivity to present and future climate risks: the Effective Climate Risk Rating (ECRR). As an "effective" measure of future climate risks, we provide ECRR for two time horizons – 2035 and 2050 – and include two categories:

- **Future physical risks** consist of all financial costs and losses that companies may experience due to the increased severity and frequency of climate-related hazards (e.g., floods, storms, wildfires, and heat stress) caused by climate change.
- **Future transition risks** encompass all financial costs and losses that may arise from policies explicitly designed to mitigate climate change (e.g., carbon taxes), shifts in consumer preferences, and changes in societal values.

Our modelling approach includes estimating companies' carbon emissions and expected damages due to climate-related hazards. At this point, our estimations do not consider technologies that companies may deploy to reduce emissions or increase resilience to climate-related hazards in the future. Such strategies are idiosyncratic to each company and, in most cases, not publicly known. However, the ECRR allows for asset-specific adjustments to the underlying transition and physical risk indices by integrating contributed data from the rated company, subject to verification and validation by our team.

1. General Approach

The methodology for calculating the ECRR is similar to that of the Potential Climate Exposure Rating (PCER; for details, see its technical documentation) and follows a forward-looking approach, considering the risks posed by climate change until two future horizons, 2035 and 2050. Compared to the PCER, it more precisely reflects the financial materiality of physical and transition risks on companies' cash flows and value. Accordingly, ECRR represents a more effective "risk" rather than an "exposure" rating. The calculation process of the ECRR is summarised in Figure 1.

1. First, we calculate three company-level **risk metrics** that specify the impact of transition and physical risks on companies' Net Asset Value (NAV) from today until 2035 and 2050, respectively.
    i. **Transition Risk:** This metric measures the difference (in percent) in expected NAV with and without policy and market risk factors. It combines two types of transition risks:
        – ***Policy and technology risk:*** This metric measures the difference (in percent) in expected NAV with and without carbon costs, a product of carbon tax and Scope 1 and 2 (S1+2) emissions in each climate scenario.

– *Market preferences risk:* This metric measures the difference (in percent) in expected NAV with scenario-modelled revenues (and their evolution over time) compared to revenues that follow inflation. This approach aims to proxy when market preferences impact revenues in a positive (revenue exceeds inflation) or negative (inflation exceeds revenue) manner.

ii. **Physical Risk:** This metric measures the difference (in percent) in expected NAV with and without physical damage from floods, storms, wildfires, and heat stress.

iii. **Effective Climate Risk:** This metric combines the transition and physical risk metrics by calculating the sum of both metrics.

2. Second, we calculate three company-level scores, ranging from 1 to 100, with 1 representing the best possible score and 100 the worst: the **Transition Risk Score**, the **Physical Risk Score**, and the **Effective Climate Risk Score**. We calculate the scores based on the percentiles of the distribution of their respective risk metrics.

3. Finally, the **ECRR** is calculated by rescaling the Effective Climate Risk Score to a 1 (A) to 7 (G) scale, where 1 represents the best possible rating and 7 the worst. Additionally, we rescale the transition and physical risk scores in the same way to retrieve a specific **Transition Risk Rating** and **Physical Risk Rating**.

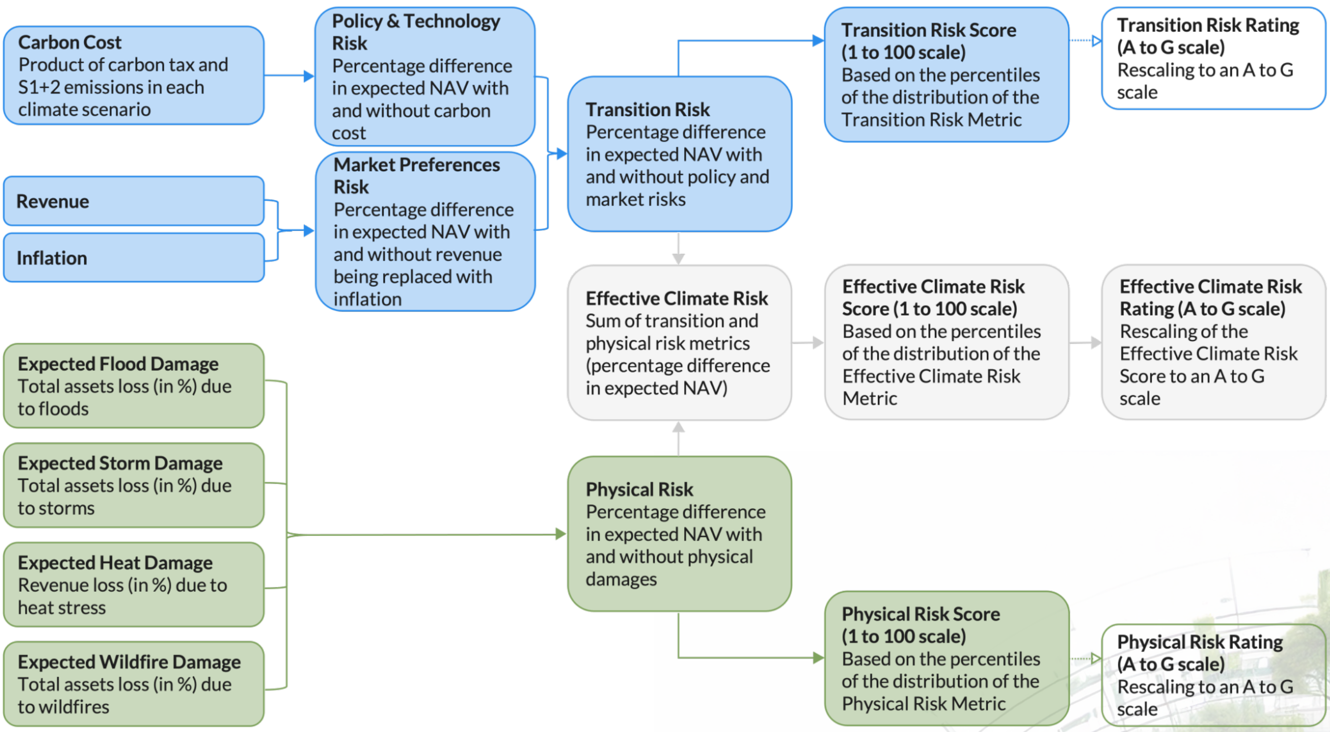

Figure 1: Illustration of the methodology for calculating the ECRR

The NAV is a central key figure when calculating the ECRR and the final output of ECI's **climate risk model**[1]. Since its publication in January 2024, the model has been enhanced with new features and improved calibration techniques, enabling more precise climate risk assessments. Before summarising the latest version of the climate risk model, which provides all the information needed to understand the NAV calculation (Section 4), we introduce the climate scenarios, their main characteristics, and assumptions (Section 2), and clarify the data requirements necessary for our climate risk model (Section 3).

Rating a company implies the (pre-)existence of a **reference scale**. In the ECRR context, the reference scale is expressed in NAV loss due to physical and transition risks. Therefore, the next step in the methodology involves defining these scales, which we describe in detail in Section 5. Based on these reference scales, we can derive the various ratings, including the ECRR, as described in Section 6. In some cases, we can adjust the ratings based on company-specific decarbonisation measures and resilience actions. For this, we utilise ECI's ClimaTech database, which provides decarbonisation and resilience strategies along with their respective effectiveness levels across various sectors. We explain the process in Section 7. Finally, Section 8 provides a specific example of the ECRR calculation.

2. Climate Scenarios

At the heart of the ECRR calculation, climate scenarios are projections of future climate change-influenced macroeconomic conditions based on various assumptions about greenhouse gas emissions, socioeconomic developments, and technological advancements. Overall, there are three main categories of scenarios:

a. In **Orderly Transition scenarios**, immediate and coordinated climate policies are applied, allowing for the containment of physical risks while avoiding heavy transition risks.

   i. **Net Zero** aims to reach net-zero emissions by 2050.
   ii. **Net Zero Transformation** drives growth through beneficial innovations.

b. In the **Disorderly Transition scenario**, carbon taxes are applied in 2030. To compensate for the delay while maintaining the goal of mitigating global warming, carbon taxes are introduced as a shock and increase sharply, entailing high transition risks.

   iii. **Delayed Transition** delays the net-zero transition to 2030.

c. In the **No Transition scenarios**, climate policies remain unchanged from their current state. Transition risks are low but come at the cost of high physical risks.

[1] The model, its assumptions, the associated results, and the underlying climate scenarios are described in detail in our methodological paper (Jayles & Shen, 2024).

i. **Climate Catastrophe** is a worst-case scenario in which no transition efforts are made.
ii. **Climate Distress** represents a subdued variation of the Climate Catastrophe scenario.
iii. **Baseline** includes pledges to counter climate change, but not more.

d. The latest **Slow and Constrained** scenario evolved in response to current political uncertainties and the lack of climate leadership and is situated at the interface of Disorderly and No Transition scenarios. Compared to the Delayed Transition scenario, governments act slowly and with less ambition, investments fall short, and climate actions are not sufficient to reach net-zero.

The following sections present the projections of key macroeconomic variables for each scenario employed in our climate risk model.

Additionally, ECI developed a methodology to calculate the probability of each climate scenario happening (Rebonato et al., 2025; see the respective technical documentation). Table 1 provides the probabilities associated with each scenario, listed in decreasing order of probability. Our climate risk model takes these probabilities into account when calculating future physical and transition risks.

Table 1: Probabilities associated with each of the climate scenarios (Rebonato et al., 2025)

Scenario	Probability (%)
Climate Catastrophe	78.0
Climate Distress	17.1
Baseline	3.4
Slow and Constrained	0.7
Delayed Transition	0.4
Net Zero Transformation	0.2
Net Zero	0.2

2.1. GDP and Inflation

Figure 2 shows the projections of GDP (left) and inflation (right) in the United States (USA) in all scenarios until 2050. There are important differences between the scenarios. In particular, GDP in the Climate Catastrophe scenario (dark red) is dramatically affected, with negative growth starting around 2040. In contrast, GDP continues to grow in the Net Zero (bright green) and Delayed Transition (blue) scenarios after a short decline when carbon taxes are introduced (in 2025 in Net Zero and in 2030 in Delayed Transition). The inflationary effects of carbon taxes are also clearly visible: After a sharp increase when carbon taxes are introduced, inflation decreases and balances at 2 to 3 percent after a few years. Climate Catastrophe (and to some extent Climate Distress) represents an exception where inflation starts to rise significantly after 2035.

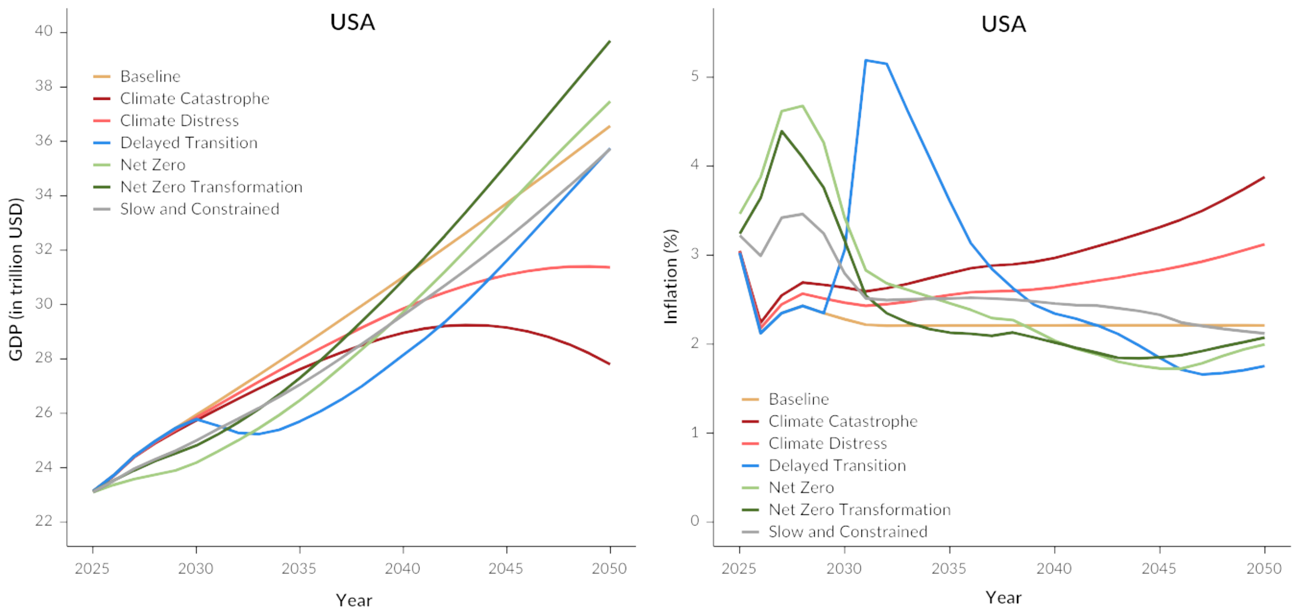

Figure 2: *GDP (left) and inflation (right) in the USA in the Orderly (green), Disorderly (blue), and No Transition (red) scenarios and in the Slow and Constrained scenario (grey).*

2.2. Carbon Taxes and Emissions

Carbon taxes are meant to discourage carbon emissions by making carbon-based activities less economically viable. An increase in carbon tax is thus expected to lead to a decrease in carbon emissions. Figure 3 shows projections of carbon tax (left) and carbon emissions (right) in the USA in all scenarios until 2050. The pattern follows the scenarios as described: no carbon tax in the No Transition scenarios (red), a delayed but high carbon tax in the Disorderly Transition scenario (blue), and an immediate but milder carbon tax in the Orderly Transition scenarios (green) as well as the Slow and Constrained scenario (grey). Correspondingly, emissions in Climate Catastrophe increase marginally until 2040, followed by a slight decrease due to the sinking macroeconomy under this scenario. If a carbon tax is introduced, carbon emissions correspondingly decrease steadily in the Orderly Transition scenarios and slightly sharper after 2030 in the Delayed Transition scenario.

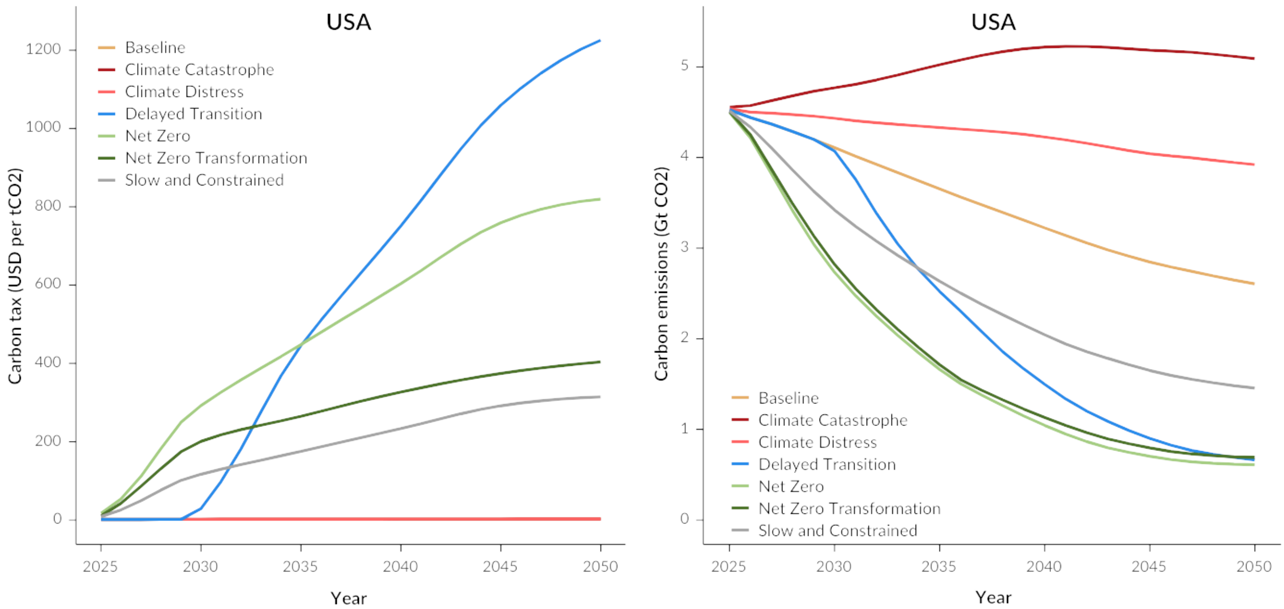

Figure 3: *Carbon tax (left) and carbon emissions (right) in the USA in the Orderly (green), Disorderly (blue) and No Transition (red) scenarios and in the Slow and Constrained scenario (grey).*

2.3. Interest Rates

As a key component of discount rates, interest rates play a significant role in our asset pricing model (SIPA, 2024). Figure 4 shows the projections of long- and short-term interest rates as well as term spread (i.e., the difference between long-term and short-term interest rates) in all scenarios. In all scenarios, short-term interest rates (top right) start at a high level (about 4.5%) before reaching about 3.5 percent shortly after 2025. From here, short-term interest rates remain at the same level until 2050 in all scenarios, except in Climate Catastrophe and Climate Distress, which experience slight increases in interest rates.

The long-term interest rates (top left) remain between 4 and 5 percent in all scenarios, although Climate Catastrophe and Climate Distress show a steady increase, especially after 2040, hinting toward even higher rates after 2050. In comparison, the Net Zero scenario exhibits a brief rise before levelling off at around 4 percent, whereas the Delayed Transition scenario displays a similar, but more pronounced and delayed, spike in long-term interest rates before stabilising at the same level in 2040.

Similar patterns can be observed for the term spread that rises sharply in the Orderly and Disorderly Transition scenarios before it decays. Only the Net Zero Transformation scenario remains relatively stable after the initial rise. For the Climate Catastrophe and Climate Distress scenarios, the pattern is reversed: The term spread declines around 2027 before it begins to rise in 2045 – a surge that can be expected to continue past 2050.

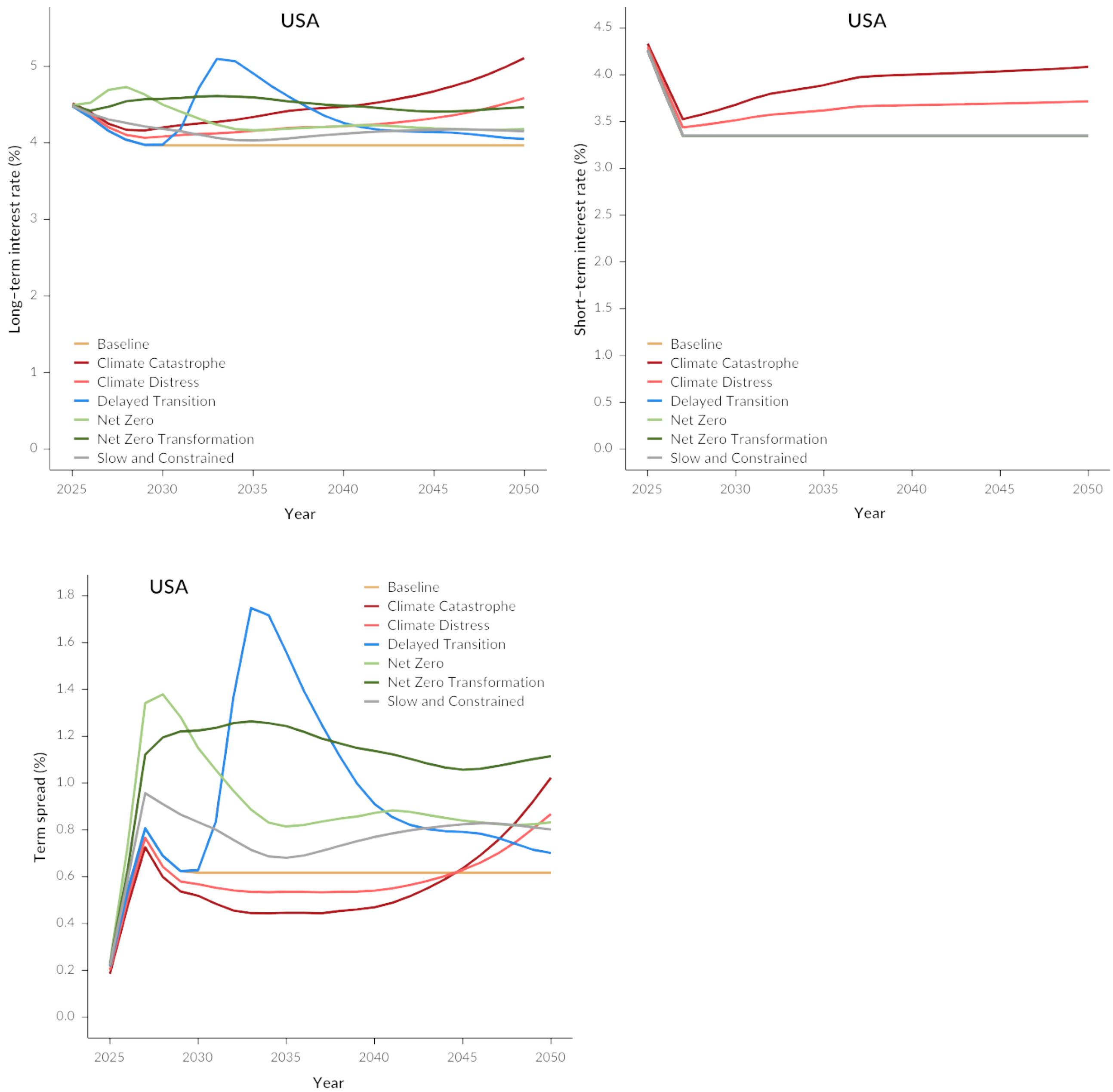

Figure 4: *Long-term interest rate (top left), short-term interest rate (top right), and term spread (bottom) in the USA in the Orderly (green), Disorderly (blue), and No Transition (red) scenarios and in the Slow and Constrained scenario (grey).*

3. Data Requirements

The ECRR relies primarily on the calculation of NAV, which requires – besides the macroeconomic key variables provided in the climate scenarios – various inputs from each company included in the rating.[2] Specifically, our climate risk model uses the following information:

[2] For companies who wish to be included, we collect these inputs through online questionnaires. Please get in touch with our data team for further information: contact@scientificratings.com

- **Financial information**, including revenue, size, equity premia, and age, among others
- **Carbon emissions**, *a minima* today (i.e., the year when the rating is calculated)
- **Exposure to physical risks**, including companies' physical address and industrial activity
  Based on this information, we assess the companies' exposure to floods, storms, wildfires, and heat (further detailed in the respective technical documentation).
- **Key variables from climate scenarios**, including GDP, inflation, carbon emissions, and carbon tax

We use the required data to build our climate risk model and develop ECRR's three base variables: the transition, physical, and effective climate risk metrics.

4. Climate Risk Model

The ECRR is forward-looking, and its calculation incorporates the evolution of transition and physical risks until two future horizons: 2035 and 2050. The calculation of NAV, a key variable in our climate risk model, relies significantly on the well-established infrastructure asset valuation approach developed by Scientific Infra & Private Assets (SIPA, 2024), which we introduce in Section 4.1. Subsequently, we outline the models that connect infrastructure financials to the macroeconomic variables of the climate scenarios (Section 4.2) and explain the impact of climate risks on companies' cash flows (Section 4.3). Finally, we present the metrics used to calculate companies' ECRR (Section 4.4). Figure 5 illustrates the functioning of the climate risk model, highlighting the dependencies between the key variables introduced in the following sections.

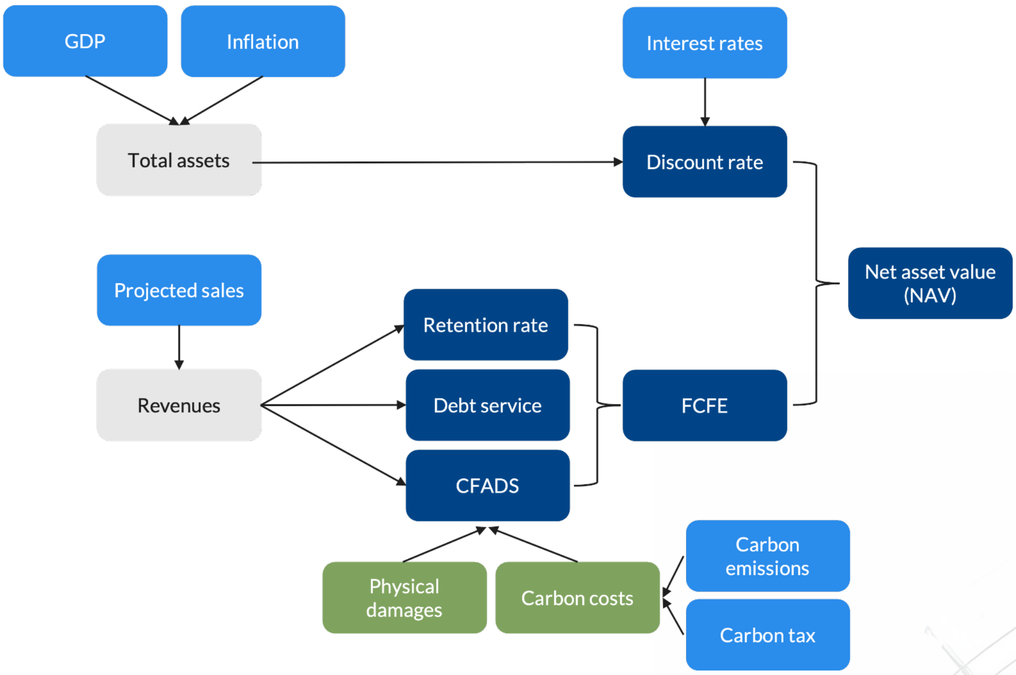

Figure 5: Schematic illustration of the climate risk model
The macroeconomic variables taken from climate scenarios are highlighted in light blue, and the asset-level climate risk variables (carbon costs and physical damages) are highlighted in green. For the financial variables, we differentiate between the input variables of SIPA's asset pricing model, highlighted in grey, and the calculated output variables in dark blue.

4.1. Infrastructure Asset Valuation Approach

When dealing with infrastructure assets privately held in institutional portfolios, market prices are not readily available. Therefore, we adhere to the guiding principles of the International Financial Reporting Standards (IFRS) 13 – a framework for fair value measurements (IFRS, 2025) – and of modern asset pricing theory (SIPA, 2024) to value unlisted infrastructure equity investments.

One of the most commonly used methods for this purpose is the discounted cash flow (DCF) approach, which equates the value of an investment at any time t to the sum of all future cash flows (i.e., dividends) generated from t + 1 until maturity (i.e., the end of the investment). Future cash flows are influenced by climate conditions, particularly climate hazards (physical risks), as well as measures implemented to mitigate the consequences of climate change (transition risks). In the context of the ECRR, we focus on a mid-term impact that is most relevant for investors and asset managers. Therefore, we compute a partial version of the NAV that includes cash flows up to 2035 and 2050, rather than up to the maturity date. We still refer to this variable as NAV, although it is not the Net Asset Value *stricto sensu*.

To account for the difference in the value of money between today and tomorrow, future dividends are discounted by a factor known as the discount rate, which is calculated as the sum of the risk-free rate and the equity risk premium.

Overall, the NAV for infrastructure assets is determined in each climate scenario by two factors: 1) the country's risk-free rate, sourced from each scenario's projections, and 2) the company's Cash Flow Available for Debt Service (CFADS), debt service, retention rate, and risk premium. SIPA's asset pricing model estimates these key financial variables through factor models. Furthermore, we can combine the NAV with the probability of future climate scenarios to calculate the **expected NAV**.

4.2. Scenario Projections of Companies' Key Financials

Two financial variables are central to the asset valuation approach: total assets (size) and revenues. In this section, we explain the models that underlie the future value estimates of these variables in all climate scenarios.

4.2.1. Model to project future total assets

Generally, infrastructure companies can be divided into two groups: project and corporate companies. Project companies, also known as special purpose vehicles (SPVs), are single-project or project-financed firms with a specific investment end date. In contrast, corporate companies hold multiple projects without a predefined investment end. Accordingly, time and age are more significant behaviour components for project companies than for corporate companies. On the other hand, we can reasonably expect the size of corporate companies to correlate more clearly to their countries' GDP than project companies, whose size and activities are essentially determined from the beginning. Because of these fundamental behaviour differences, these company types need to be modelled separately.

To project companies' total assets in each climate scenario, we must connect total assets to the corresponding climate scenario outputs. Therefore, we develop a model that relates total assets to macroeconomic factors, such as GDP and inflation, for which the climate scenarios provide projections until 2050.

We conduct a statistical analysis to identify the most significant macroeconomic factors influencing companies' total assets. We consider significant permutations of macroeconomic variables with various dummies: TICCS[3] sector classes, region (Americas, Asia, Europe, Oceania), geoeconomic exposure (global, regional, national, subnational), and business model (contracted, merchant, regulated). For this, we applied the Generalised Linear Model with Elastic Net Regularisation (GLMnet) approach, which is particularly suitable for selecting the most relevant predictors while avoiding overfitting and multicollinearity.

We find that inflation and total assets growth at time *t-1* are significant predictors of total assets growth at time *t* for both corporate and project companies. Moreover, a third factor influences total assets growth, albeit in different ways: While GDP growth affects corporates' total assets, a function of age impacts projects' total assets.

4.2.2. Model to project future revenues

Compared to total assets, for which we use regressions over historical data, we estimate companies' future revenues through a different variable: sector-level sales (gross output). We use these projections based on the assumption that companies' revenues grow at the same rate as the nominal sales of their respective sector and country.

As sales growth can result from two different factors, we cannot apply this relationship directly. We need to account for the fact that the sales growth in a given sector results either from a change in the price per unit of production (e.g., inflation or price variation upstream or downstream) or from a shift in production itself (i.e., if the sector has expanded or contracted), or from both. However, the production capacity of infrastructure companies is relatively fixed and typically operates at full capacity. We thus need to assume that companies cannot exceed their current production levels (i.e., the cumulative growth rate for production can only be negative or zero). Accordingly, we need to recalculate the revenue growth of individual companies by separating price movement from production growth, so that we can cap the cumulative production growth at zero. Armed with the revenue growth rate at the company level for every year until 2050 and in every climate scenario, we can project companies' future revenues.

[3] The Infrastructure Company Classification Standard (TICCS) provides investors with a frame of reference for approaching the infrastructure asset class. It offers an alternative to investment categories inherited from the private equity and real estate universe, which are less informative when classifying infrastructure investments (SIPA, 2025b).

It is important to note that the sales projections used in our calculations encompass all sectors, as classified by NACE, the statistical classification standard for economic activities in the European Community (Eurostat, 2023). Based on SIPA (2025b), which maps activities identified by NACE to TICCS, we can obtain sector-specific sales of all TICCS classes and subclasses. However, we included two further considerations in our revenue model: 1) In some instances, several NACE activities align to a single TICCS subclass, and 2) those activities can correspond to major or minor activities in the respective TICCS subclass. Accordingly, we calculate the weighted average sales and real sales growth for each TICCS subclass and across all corresponding NACE codes in a way that further prevents minor activities from outweighing major ones.

The projected values of total assets and revenues can then be used in the factor models for CFADS, debt service, retention rate, and risk premium for any climate scenario.

4.3. Direct Impact of Climate Risks on Companies' Cash Flows

In addition to the macroeconomic risks (represented in our model through the macroeconomic effects on total assets and revenues), infrastructure companies can experience losses due to their specific exposure to physical and transition risks, depending on the climate scenario. When a hazard event occurs, physical damages affect an asset's production capacities (i.e., its capacity to generate revenue) and increase the repair and replacement costs. Additionally, companies' operating costs increase when carbon taxes are introduced. We estimate both risks and describe how they impact an asset's cash flow.

4.3.1. Projections of physical risks

The physical risks associated with any given hazard (as of June 2025: floods, storms, wildfires, and heat) are quantified by two key parameters: (1) The **severity** indicates the extent of the impact a hazard has on an infrastructure asset and can be proxied by a damage factor (for floods and storms), damage probability (for wildfires), or the level of operational disruption (for heat stress). (2) The **frequency** represents the likelihood of a hazard to occur in a given year and can be derived through the inverse of the return period, probabilistic models, or climate scenario projections. Based on these key parameters, ECI developed various methodologies to calculate expected damages from floods, storms, and wildfires, as well as revenue loss due to heat stress (more details can be found in the respective technical documentations).

As both severity and frequency evolve over time, we project these changes to calculate future damages from climate hazards. For this, we rely on information from the Representative Concentration Pathways (RCP) scenarios.[4] We use two of those RCP scenarios that represent a

[4] On demand of the IPCC, the scientific community developed one of the first scenarios – the Representative Concentration Pathways – to explore the impacts of (future) greenhouse gas concentrations in the atmosphere on the climate (Van Vuuren et al., 2011). Future scenarios, like the ones developed by Oxford Economics or the Network for Greening the Financial System (NGFS), have been built based on those initial contributions.

moderate (RCP4.5) and a worst-case (RCP8.5) climate scenario for physical risks. We map the physical risk projections of these scenarios to our climate scenario data, as presented in Table 2.

Table 2: Correspondence between RCPs and climate scenarios used in our climate risk model

Climate Scenarios	RCP Scenarios
Climate Catastrophe	RCP8.5
Climate Distress	RCP8.5
Baseline	RCP8.5
Slow and Constrained	RCP4.5
Delayed Transition	RCP4.5
Net Zero Transformation	RCP4.5
Net Zero	RCP4.5

4.3.2. Projections of carbon emissions and carbon taxes

Most countries only tax companies for carbon emissions from operations (Scope 1 – S1) and purchased energy (Scope 2 – S2), leaving emissions from the broader value chain (Scope 3 – S3) untaxed. ECI's carbon intensity models estimate the S1+2 intensities per revenue for infrastructure companies in our universe of assets[5] (details can be found in the respective technical documentation). We assume that S1+2 intensity per revenue grows similarly to the ratio of country-specific emissions to GDP in each climate scenario. For the carbon taxes, we use the country-level projections in each climate scenario.

4.3.3. Impact of climate risks on CFADS

The additional costs associated with potential damages from climate hazards and carbon taxes are not included in the factor models (presented in Section 4.1), which are calibrated based on current economic and financial trends. However, these costs directly impact companies' cash flows, varying specifically by each company and scenario. Therefore, we reduce the CFADS based on these additional impacts.

4.4. Transition, Physical, and Climate Risk Metrics

The climate risk model allows us to calculate an asset's expected NAV today, incorporating cash flows up to a specific time horizon (here, 2035 and 2050), while also considering transition and physical risks. In this next step, we use the NAV as the central variable to define transition and physical risk metrics. We define risk as the relative loss in expected NAV between two conditions C and C_0, where C_0 is the reference condition.

[5] The Unlisted Infrastructure Universe is a database of tracked assets that represent the fair value- and risk-adjusted performance of the unlisted infrastructure asset class. It includes 9,100 unique infrastructure companies in the 27 most active national markets for infrastructure investors to define an investible universe of private infrastructure companies. These companies have a minimum of USD 1 million in total asset book value, are privately owned, and can be categorised using TICCS (SIPA, 2025a).

To estimate physical and transition risks, we further define the following relevant settings in our climate risk model that allow us to add or remove parts of the calculation and hence, test different (climate) conditions:

- **Risky condition C for policy and technology, market preferences, and physical risks:**
  NAV is calculated without any exclusions (i.e., we consider all impacts of carbon costs, market preferences, and physical damages).
- **Reference condition C_0 for policy and technology risks:**
  NAV is calculated without considering carbon costs (i.e., carbon tax is set to 0). The difference between C and C_0 calculates the potential losses due to carbon costs, which proxy policy and technology risks.
- **Reference condition C_0 for market preferences risks:**
  NAV is calculated with companies' revenue growth following inflation. The difference between C and C_0 calculates the potential losses or gains due to revenue performance (compared to inflation), which proxies market preference risks. Note that potential gains result in no risk, in which case the market preferences risk is set to 0.
- **Reference condition C_0 for transition risks:**
  NAV is calculated without considering carbon costs and replacing revenue growth with inflation. The difference between C and C_0 calculates the potential losses due to carbon costs and revenue performance, which proxy transition risks.
- **Reference condition C_0 for physical risks:**
  NAV is calculated without considering physical damage from climate hazards. The difference between C and C_0 calculates the potential losses due to hazard damages, which materialise in physical risks. Additionally, we define and calculate risks for each hazard (floods, storms, wildfires, heat stress). They follow the same definition and reference condition.

We use these definitions of transition risk (which combines risks from policy and technology and market preferences) and physical risk to rate infrastructure companies:

$$Policy\ \&\ Technology\ Risk = Risk_{Tax/\ No\ Tax}$$

$$Market\ Preferences\ Risk = Risk_{Revenue/\ Revenue=Inflation}$$

Both make up the transition risk metric:

$$Transition\ Risk = Risk_{Tax,\ Revenue/\ No\ Tax,\ Revenue=Inflation}$$

Together with the physical risk metric:

$$Physical\ Risk = Risk_{Damage/\ No\ Damage}$$

they both make up the effective climate risk metric:

$$Effective\ Climate\ Risk = Transition\ Risk + Physical\ Risk$$

5. Identification of Reference Scales

In order to translate these metrics into a score (and eventually a rating), we require reference scales that express expected NAV loss due to physical, transition, and combined climate risks. We conduct the following methodological steps to identify reference scales for the Transition Risk Score, the Physical Risk Score, and the Effective Climate Risk Score:

1. First, we **reduce sectoral imbalances** in the transition risk and effective climate risk metrics. For this, we perform a stratified bootstrap approach (Horowitz, 2019), which generates a larger population by sampling assets and including the same number of randomly selected companies from each TICCS superclass, thereby avoiding the amplification of sector biases. The resulting distributions of such samples are more representative of the infrastructure asset class as a whole. For the physical risk metric, the original distribution remains unchanged.

2. Second, we **define a reference scale** by considering the distribution percentiles of the respective populations, based on the actual universe of assets for physical risks or the stratified bootstrap output for transition and effective climate risks. These percentiles constitute the reference scale against which we calculate the scores.

We perform the analysis on more than 500 companies included in our infrastructure universe, for which we have all the financial information needed to calculate the NAV.[6] The available data enable us to derive robust statistics and representative distributions of the three climate risk scores.

6. Rescaling Scores into Ratings

Based on the developed reference scales, we can now assign each company a transition, physical, and effective climate risk score. Companies with the lowest risks receive the lowest risk score. For example, if a company's transition risk falls below the 1st percentile, we assign a score of 1; if a company's transition risk falls between the 1st and the 2nd percentile, it receives a score of 2; and if the transition risk falls above the 99th percentile, the company's score is 100.

Finally, we transform the transition, physical, and effective climate risk scores, ranging from 1 to 100, into ratings on a scale from 1 (A) to 7 (G). In line with standard practices in financial risk ratings, our final ratings aim to be symmetrically and close to normally distributed. Accordingly, we discretise these scores to ratings following an idealised repartition (as shown in Table 3), based on a company's corresponding transition, physical, and effective climate risk scores. Figure 6 presents the final ECRR for 2035 and 2050.

[6] We review and update the data annually to account for new assets added to the tracking list.

Table 3: Idealised distribution of ratings

Rating	Score interval
A	[1, 5)
B	[5, 17.5)
C	[17.5, 37.5)
D	[37.5, 62.5)
E	[62.5, 82.5)
F	[82.5, 95)
G	[95, 100]

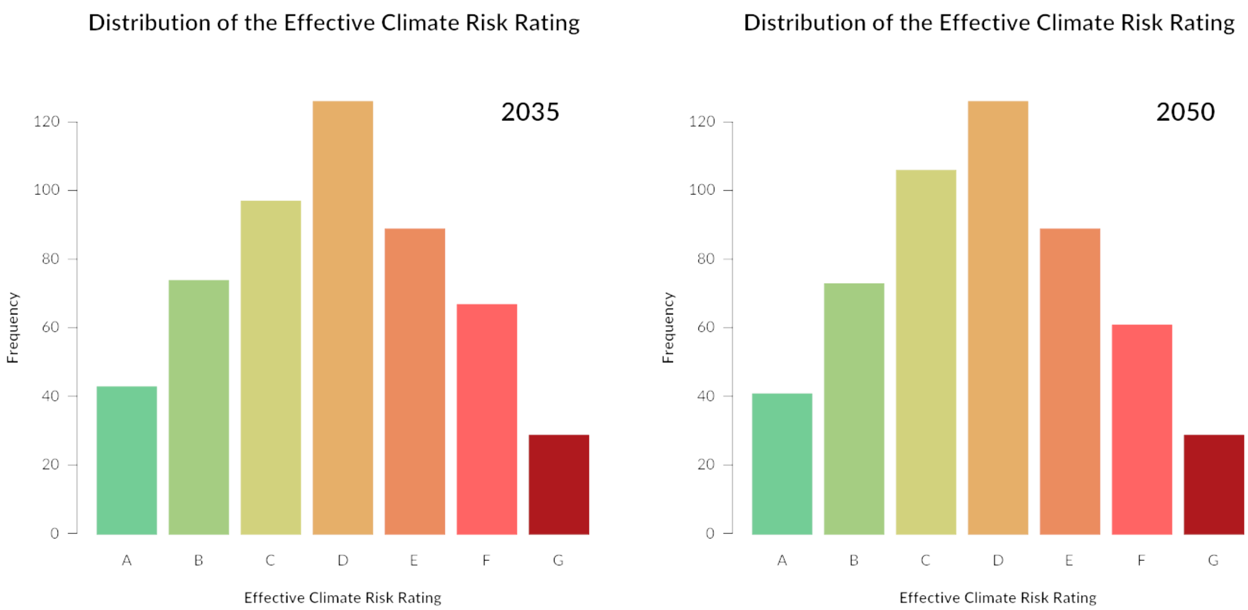

***Figure 6:** Final ECRR ratings for all assets in our infrastructure universe for the 2035 and 2050 time horizons*

7. Potential Adjustment Procedures of the ECRR

Our models estimate the financial impact of transition and physical risks on companies' NAV, which is the basis for calculating the ECRR. However, there may be characteristics unique to a company that our models, which focus on the systematic risk components, do not capture. For example, a company may implement technologies to reduce its emissions or exposure to specific hazards. In those cases, and at the request of the rated companies[7], we can adjust the relevant metrics based on implemented technologies as well as future strategy plans (until 2050) and their respective effectiveness.

[7] Companies requesting the revision of their metrics need to provide information demonstrating the technologies implemented to reduce their emissions, increase their resilience to climate disasters, or both. This information allows us to capture the company's idiosyncratic risk components.

7.1. ClimaTech – Database of Decarbonisation and Resilience Strategies

In order to specifically evaluate companies' climate strategies and implemented measures, we utilise the ClimaTech database to adjust their ECRR accordingly. **ClimaTech** is a comprehensive initiative designed to assess and evaluate infrastructure decarbonisation and resilience strategies in response to the increasing risks posed by climate change. The ClimaTech project distinguishes between decarbonisation and resilience strategies, both of which are crucial components in addressing climate risks for infrastructure assets (ECI, 2025).

- **Decarbonisation strategies** focus on reducing greenhouse gas emissions associated with infrastructure. These strategies aim to lower carbon footprints by employing technologies and practices that minimise the use of fossil fuels and enhance energy efficiency. For example, integrating renewable energy sources, like solar or wind power, and adopting low-carbon construction materials are key decarbonisation strategies.

- **Resilience strategies**, on the other hand, aim to mitigate the physical risks posed by climate change, such as floods and storms. These strategies ensure that infrastructure can withstand climate-related disruptions and continue functioning effectively in the face of extreme weather events. Resilience measures include building flood defences, improving structural integrity, and using fire-resistant building materials.

The ClimaTech database provides evidence-based assessments of these **strategies** and offers a detailed evaluation of their **effectiveness** across various infrastructure sectors. It serves as the largest global repository for decarbonisation and resilience measures, with a structured methodology based on scientific research and expert analysis. This enables stakeholders to make informed, data-driven decisions to future-proof their infrastructure investments against both transition and physical risks.

The ClimaTech database is pivotal to our adjustment procedure: If companies share their decarbonisation and resilience strategies, the database provides information on the extent to which our model-estimated emissions and expected damages can be reduced (effectiveness) for specific scopes, hazard types, and return periods.

7.2. Adjustments based on Decarbonisation Strategies

To update the carbon intensities per revenue, companies must provide information on their latest revenues, emissions, and implemented decarbonisation measures, as well as planned decarbonisation strategies and expected costs (OpEx, CapEx) up to 2050 (including supporting materials). Several cases may arise for companies interested in a reviewed ECRR (see also Figure 7):

- ***The company does not provide revenue information.***
  In this case, it is not possible to update the ECRR, as this information is required to adjust the carbon intensities.

- ***S1, S2, or S1+2 emissions schedules are reported.***
  If the ClimaTech team validates the credibility of the emissions schedules, we replace our model-based S1+2 intensity estimation with the provided values and update the ECRR accordingly.

- ***S1, S2, or S1+2 emissions are not reported, but decarbonisation measures and planned strategies are listed.***
  In this case, we use the ClimaTech database to evaluate the effectiveness of implemented measures and future strategies and to adjust the ECRR accordingly. Note that most decarbonisation technologies impact only parts of a company's total emissions. Accordingly, companies are required to specify the share of emissions that are impacted by the reported technology. Furthermore, we require the expected costs for future decarbonisation strategies.

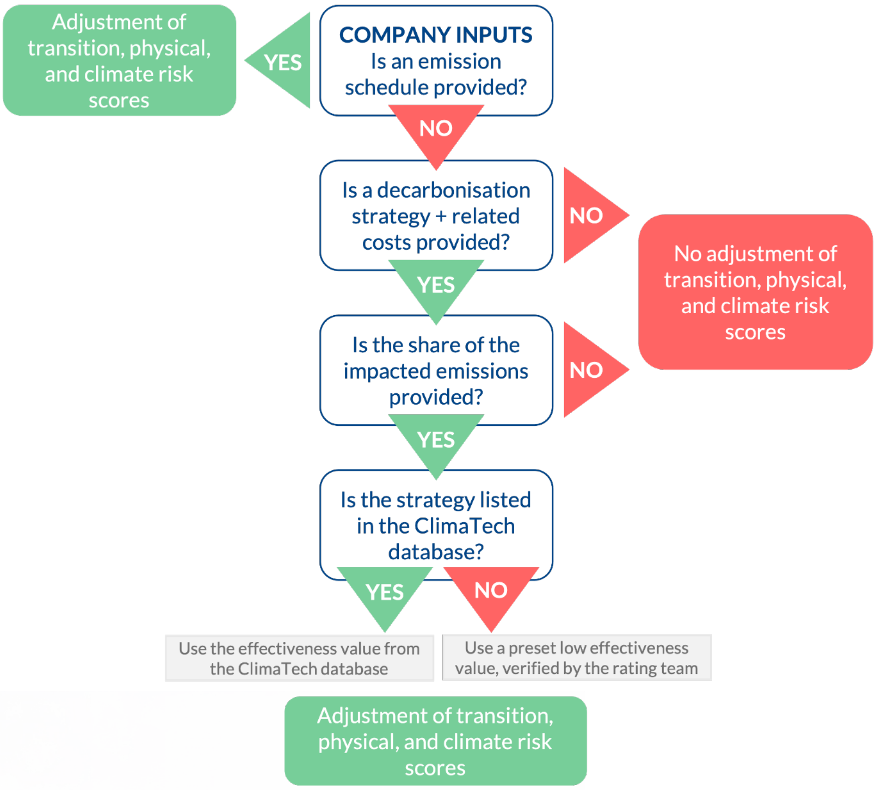

Figure 7: *Illustration of the process to adjust carbon intensities per revenue based on current and future decarbonisation strategies*

7.3. Adjustments based on Resilience Strategies

For the adjustment process based on resilience strategies, we consider the three most material types of hazard events in infrastructure: floods, storms, and wildfires (UNDRR, 2020). These hazard events can physically damage assets and are characterised by their return periods[8], which serve as a proxy for their severity (more details on these physical risks can be found in their respective technical documentation).

We update the expected damages from floods, storms, and wildfires for companies that have implemented technologies (or plan to do so in the future) to reduce the impact of such hazards. Again, in order to adjust the ECRR, companies are required to provide information (and supporting materials) on their current resilience measures and planned strategies. Additionally, we require the expected costs associated with the future implementation of these strategies. Similar to the adjustment of carbon intensities, we assess the effectiveness of resilience strategies and technologies for every relevant return period based on the ClimaTech database. After determining the effectiveness for all possible return periods, we can adjust the damages and calculate the total expected damage of each hazard as the integral over all possible return periods.

8. Example of the Adjustment Process

To illustrate the rating process, including potential adjustments to the ECRR, we use the example of an airport in Australia. We refer to resilience information from the company's latest sustainability report to demonstrate the adjustment process for physical risks.

8.1. Initial Calculation of the ECRR (Before Adjustments)

Table 4 shows the airport's physical risks based on the expected NAV for each hazard and the resulting Physical Risk Rating under the "expected" scenario[9] for a 2050 time horizon before adjustments.

Table 4: *The airport's expected flood, storm, wildfire, heat, and its combined physical risk metrics (expressed in NAV loss in %) as well as its Physical Risk Rating (A-G)*

Flood risk	Storm risk	Wildfire risk	Heat risk	Physical risk	Physical Risk Rating
31.9	10.1	0.01	0.4	36.5	F

[8] The return period estimates the average time interval between occurrences of a hazard event of a defined size or intensity. To obtain return periods, statistical estimates are first calculated for a range of all possible hazard events based on historical observations. If a particular hazard event value has a 1% frequency of occurrence, it has a one in a hundred probability of occurrence at any given year and is hence known as the 100-year return period.

[9] The "expected" scenario means that the respective metric outputs under each scenario have been weighted based on the scenario probabilities, as described in Section 2.

8.2. Adjustments for Resilience Strategies

In this case, we can adjust the expected damages from flood and storm hazards[10] if the said company has implemented technologies and plans future strategies that increase its resilience against such hazards. We relate each technology mentioned in the airport's sustainability report to the hazard and return period it is intended to protect against, as well as its corresponding level of effectiveness, based on the ClimaTech database (see Table 5). As the airport has already implemented these technologies, we do not need to consider additional costs in our cash flow estimations. The effectiveness of these technologies, and thus the damage reduction, applies today and in all future years.

Table 5: Implemented resilience technologies based on the airport's sustainability report

Resilience technology	Hazard	Type	Return period (years)	Effectiveness
Elevation	Flood	Inland + coastal	100 or less	80%
Flood barriers	Flood	Coastal	1,000 or less	80%
Flood barriers	Flood	Coastal	More than 1,000	2%
Natural infrastructure – habitat creation / restoration	Storm		50 or less	98%
Natural infrastructure – habitat creation / restoration	Storm		Between 50 and 1,000	Linear gradient
Natural infrastructure – habitat creation / restoration	Storm		1,000 or more	2%
Undergrounding	Storm		10,000 or less	20%
Undergrounding	Storm		More than 10,000	2%

Note: Based on ClimaTech's classification of resilience measures, we can link these technologies to specific hazards and protection levels (i.e., return periods for floods and storms), and associate an effectiveness level to each of them.

Each resilience technology mentioned in the table offers protection against different hazards. The level of protection depends on the magnitude of the hazard, which is determined by its return period. For instance, flood barriers offer a "step function" protection that only works below a certain threshold. Accordingly, such barriers are able to offer 80 percent protection against floods with a return period of 1,000 years or less. However, they are almost unable to protect (2% protection) against more severe floods with a return period of more than 1,000 years.

[10] As of June 2025, we do not adjust for resilience strategies that protect against heat stress.

Furthermore, a technology can supersede another one in its protection at certain return periods. For instance, natural infrastructure in the form of habitat creation and restoration offers decreasing protection against storms, from 98 percent protection against mild storms with a return period of 50 years or less, to only 2 percent protection against severe storms with a return period of 1,000 years or more. Accordingly, there is a return period between 50 and 1,000 years where natural infrastructure can only offer a level of protection of less than 20 percent. In those cases, the protection level will still remain constant at 20 percent because the additional undergrounding technology offers a 20 percent protection for storms with a return period of 10,000 years or less.

8.3. Recalculation of the ECRR

Following Table 5, we can update the expected damage for each hazard separately, and hence the Physical Risk Rating. In summary, we calculate the following risk metrics (expressed in NAV loss in %) after the adjustment process:

- The NAV loss attributed to flood damage between 2025 and 2050 is reduced from 31.9 percent to 1.7 percent, which means that the resilience strategies reduced the expected flood damage by 95 percent.

- The NAV loss attributed to storm damage between 2025 and 2050 is reduced from 10.1 percent to 2.3 percent, which means that the resilience strategies reduced the expected storm damage by 77 percent.

Table 6 provides an overview of the initially estimated and adjusted values needed to calculate the ECRR for the assessed airport. Using the adjusted values, we can re-run the procedures presented in this document to recalculate the airport's Physical Risk Rating and the underlying hazard-specific ratings. We observe a significant improvement in the Physical Risk Rating (from F to D) after adjusting for the implemented resilience technologies. This leads to an overall improvement in the ECRR from E to A.

Table 4: *The airport's estimated and adjusted values of flood, storm risk, and its combined physical risk metrics (expressed in NAV loss in %), as well as the respective risk ratings (A to G)*

	Flood risk	Storm risk	Physical risk	Physical Risk Rating	ECRR
Estimated	31.9	10.1	36.5	F	E
Adjusted	1.7	2.3	4.25	D	A

The ECRR is based on the total NAV loss resulting from both physical and transition climate risks. This total NAV loss is then compared to the NAV losses of other assets within the rated infrastructure universe to determine an asset's final rating. Additionally, physical and transition risks impact assets differently. For example, one asset might face significant physical risks due to its location but minimal transition risks, while another asset may have moderate exposure to both. When we combine these risks, the asset with moderate exposure in both areas may appear less risky overall than the one with extreme exposure to just one type of risk. Accordingly, the assessed airport received a significantly lower overall rating until resilience strategies were included to moderate the asset's physical risks.

These reasons can sometimes lead to results that seem counterintuitive. However, they accurately reflect the integrated impact of both risk types. It is a natural consequence of aggregating risks that affect assets in fundamentally different ways.

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