TECHNICAL DOCUMENTATION

# Potential Climate Exposure 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 ***Potential Climate Exposure Rating (PCER)***. It explains the general approach, provides the assumptions and calculations made, justifies the methodology, 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 exposure: the Potential Climate Exposure Rating (PCER). As a "potential" measure of future climate exposure, we provide PCER for two time horizons – 2035 and 2050 – and include two categories:

- **Future physical exposure** consists of all damages 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 exposure** includes all financial costs that may arise from policies and technologies aimed at mitigating climate change (e.g., carbon taxes), changes in market preferences (e.g., lower demand for local flights in favour of rail commutes), and shifts in values and reputation (e.g., people may avoid companies that harm the environment).

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 measures are idiosyncratic to each company and, in most cases, not publicly known. However, the PCER allows for asset-specific adjustments to the underlying transition and physical exposure 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 PCER follows a forward-looking approach, considering the exposure to damages and costs stemming from climate change until two future horizons, 2035 and 2050. Compared to the Effective Climate Risk Rating (ECRR), it focuses on future physical damages and carbon costs under the most likely climate scenario[1], without a direct relation to companies' cash flows and value. Accordingly, PCER represents an "exposure" rather than a "risk" rating.
The calculation process of the PCER is summarised in Figure 1.

1. First, we calculate three company-level **exposure metrics** that specify the impact of transition costs and physical damages from today until 2035 and 2050, respectively.
    i. **Transition Exposure:** This metric measures two types of transition exposure:
        – ***Policy and technology exposure:*** This metric measures companies' exposure to carbon taxes and other policy actions that aim to reduce carbon emissions.

[1] ECI developed a methodology to calculate the probability of each climate scenario (Rebonato et al., 2025; more details on the approach can be found in the respective technical documentation). The most likely climate scenario is a worst-case scenario in which no transition efforts are made. This scenario also aligns with the Representative Concentration Pathways scenario RCP8.5, as developed by Van Vuuren et al. (2011).

For this, we calculate a Scope 1 and 2 (S1+2) carbon cost indicator as a product of companies' S1+2 intensities per revenue and the country-specific carbon tax (depending on a company's location).

– *Reputation and market preferences exposure:* This metric represents a proxy for companies' exposure to adverse risks from market preferences and demands, considering the carbon costs along the supply chain. Accordingly, we calculate a Scope 3 (S3) carbon cost indicator as a product of companies' S3 intensities per revenue and the country-specific carbon tax (depending on a company's location).

ii. Physical Damage Exposure: Based on the sum of expected damages from four hazards (floods, storms, wildfires, and heat stress), this metric measures the average percentage of total assets loss[2].

2. Second, we calculate three company-level **scores**, ranging from 1 to 100, with 1 representing the best and 100 the worst possible score:

   i. Transition Exposure Score: This score is calculated as the weighted average of the Policy and Technology Exposure Score and the Reputation and Market Preferences Exposure Score. Both of these scores are developed based on the percentiles of an asset's exposure metric within the distribution of the respective exposure metric values in the universe of infrastructure assets considered[3].

   ii. Physical Exposure Score: This score is calculated based on the percentiles of an asset's exposure metric within the distribution of the respective exposure metric values in the universe of assets considered.

   iii. Potential Climate Exposure Score: This score is calculated as the weighted average of the Transition Exposure Score and the Physical Exposure Score.

3. Finally, the **PCER** is calculated by rescaling the Potential Climate Exposure Score to a 1 (A) to 7 (G) scale, where 1 represents the best possible rating and 7 the worst . Additionally, we rescale the other exposure scores in the same way to retrieve a specific **Transition Exposure Rating** and **Physical Exposure Rating**.

[2] We calculate the damage from floods, storms, and wildfires as the percentage of total assets loss. For heat stress, we calculate "damage" as the percentage of revenue loss, as it relates to the direct impact of heat on the workforce's productivity (all details on the calculation of heat stress can be found in the respective technical documentation).

[3] 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).

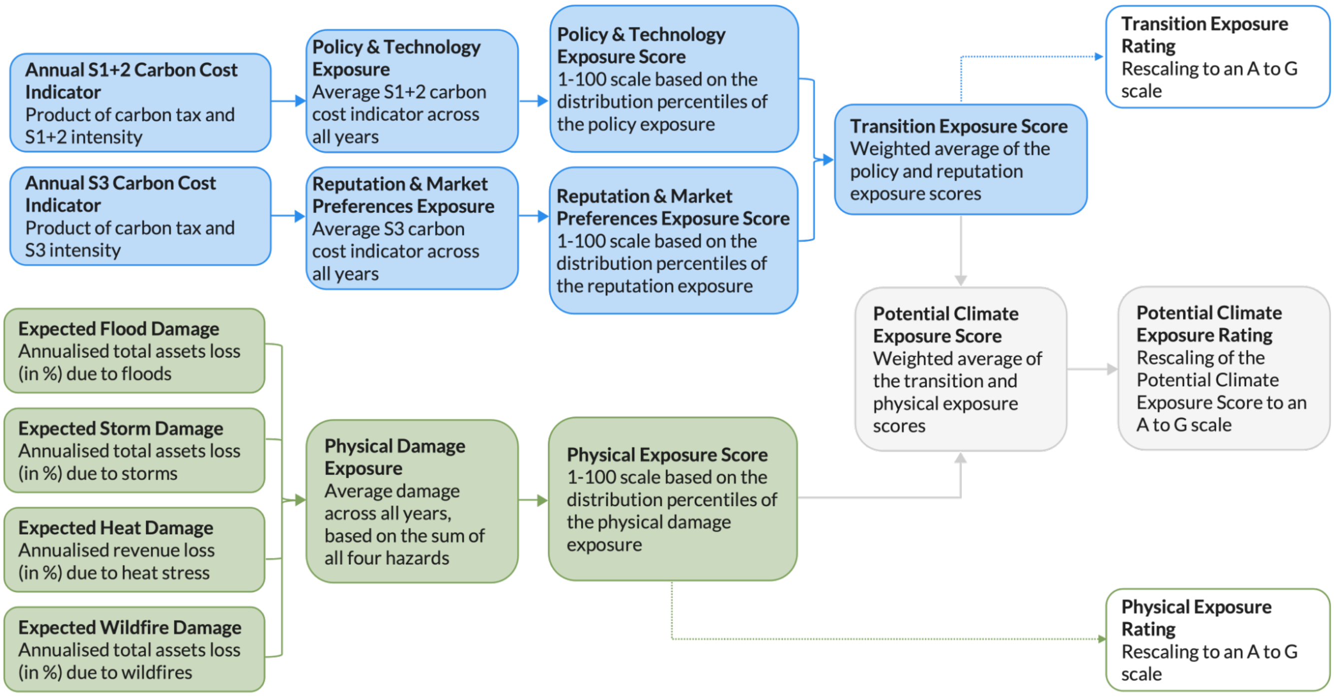


***Figure 1:*** *Illustration of the methodology for calculating the PCER*

Our **climate exposure model** translates the evolution of future climate impacts on revenue or total asset value into a single value by averaging the respective metric values over two time periods: from 2025 to 2035 and from 2025 to 2050. For this, the approach requires building indicators that represent costs relative to revenues and damages relative to asset size. These indicators provide measures that are comparable across assets, but do not involve complex financial models that consider a company's financial capacity. Before presenting the climate exposure model in more detail (Section 3), we clarify the data requirements needed (Section 2).

Rating a company implies the (pre-)existence of a **rating scale**. In the PCER context, we develop reference scales for each of the scores presented in Figure 1. Therefore, the next step in the methodology involves defining these scales, which we describe in detail in Section 4. Based on these reference scales, we can derive the various ratings, including the PCER, as described in Section 5. 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 effectiveness levels across various sectors. We explain the process in Section 6. Finally, Section 7 provides a specific example of the PCER calculation.

## 2. Data Requirements

The PCER relies on various inputs from each company included in the rating, as well as macroeconomic key variables as provided in climate scenario projections. Specifically, our climate exposure model uses the following information:

- **Company-specific information**, including the size, revenue, industrial activity, and physical address, among others
- **Carbon emissions**, *a minima* today (i.e., the year when the rating is calculated)
- **Exposure to physical risks**, including asset damages from floods, storms, and wildfires and revenue losses from heat stress
- **Key variables from climate scenarios**, including GDP, inflation, carbon emissions, and carbon tax

We use the required data to build our climate exposure model and develop PCER's three base metrics: the policy and technology, reputation and market preferences, and physical damage exposures.

# 3. Climate Exposure Model

The PCER is forward-looking, and its calculation incorporates the evolution of transition and physical exposure until two future horizons. The climate exposure model allows us to calculate an asset's exposure to climate risks related to policy and technology changes, reputation and market preferences, and physical damages up to 2035 and 2050.

## 3.1. Transition Exposure Metrics

### *3.1.1. Policy and technology exposure*

For each company, the policy and technology exposure is based on the S1+2 intensity per revenue.[4] However, a company's emissions are not sufficient to fully describe its exposure to policy and technology risks. Accordingly, we developed a carbon cost indicator as a product of S1+2 intensity per revenue and carbon tax – a country-specific proxy for policy actions aimed at reducing carbon emissions. We model each country's carbon tax based on theoretical projections of carbon taxes in climate scenarios. To calculate the final **policy and technology exposure**, we compute a company's average S1+2 carbon cost indicator across all years.

### *3.1.2. Reputation and market preferences exposure*

For each company, the reputation and market preferences exposure is based on the S3 intensity per revenue.[5] Again, a company's S3 emissions are not sufficient to fully describe its exposure to shifts in market preferences, especially along its supply chain. Accordingly, we build a similar carbon cost indicator as a product of S3 intensity per revenue and carbon tax – a country-specific proxy for policy actions along the supply chain and changed market behaviours. To calculate the final **reputation and market preferences exposure**, we compute a company's average S3 carbon cost indicator across all years.

[4] Details on how we estimate companies' S1+2 intensities per revenue can be found in the respective technical documentation.

[5] Details on how we estimate companies' S3 intensities per revenue can be found in the respective technical documentation.

## 3.2. Physical Exposure Metric

For each company, the physical damage exposure is based on the expected damage from floods, storms, wildfires, and heat.[6] For floods, storms, and wildfires, the expected damage is represented as the annual total asset loss (in percent), while damages from heat focus on the annual revenue loss (in percent). Since the expected heat damage is calculated differently from the expected damage from floods, storms, and wildfires, we rescale the heat damage by the typical size-to-revenue ratio $\beta$, calculated for each sector based on the average ratio across all countries and sectors. To calculate the final **physical damage exposure**, we compute a company's average damage across all years based on the sum of all potential damages from floods, storms, wildfires, and heat.

# 4. Identification of Reference Scales

In order to translate these metrics into a score (and eventually a rating), we require reference scales for each of the three scores that represent exposure to risks from policies and technologies, reputation and market preferences, and physical damages. We conduct the following methodological steps to identify reference scales for all scores:

1. For the average S1+2 and S3 carbon cost indicators, we first need to transform the variables by **taking the logarithm** base 10 to facilitate the score construction. For physical damages, variables are not modified.

2. Second, we **reduce sectoral imbalances** in the carbon cost indicators by employing 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[7], thereby avoiding the amplification of sector biases. The resulting distributions of such samples are more representative of the infrastructure asset class as a whole.

3. Last, we **define a reference scale** by considering the distribution percentiles of the respective populations, based on the actual universe of assets for physical exposure or the stratified bootstrap output. These percentiles constitute the reference scale against which we calculate the scores.

We perform the analysis on approximately 6,000 companies included in our infrastructure universe, for which we have all the necessary information to calculate their exposure to risks from policies and

[6] Details on how we estimate assets' expected damages from floods, storms, wildfires, and heat can be found in the respective technical documentations.

[7] 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).

technologies, reputation and market preferences, and physical damages.[8] The available data enable us to derive robust statistics and representative distributions of the three climate exposure scores.

## 5. Calculating Scores and Rescaling into Ratings

Based on the developed reference scales performed at the level of our infrastructure universe, we can now assign each company an exposure score for policy and technology, reputation and market preferences, and physical risks. Companies with the lowest exposure receive the lowest exposure score. For example, if a company's policy and technology exposure falls below the 1st percentile, we assign a score of 1; if a company's physical damage exposure falls between the 1st and the 2nd percentile, it receives a score of 2; and if the reputation and market preferences exposure falls above the 99th percentile, the company's score is 100.

Furthermore, we developed two additional exposure scores:

- Transition Exposure Score:
  This score is calculated as the weighted average of the exposure scores for policy and technology, as well as reputation and market preferences. For this, we define the weights based on the relative importance of the S1+2 carbon cost indicator to the S3 carbon cost indicator at the TICCS superclass level.

- Potential Climate Exposure Score:
  This score is calculated as the weighted average of the Transition Exposure Score and the Physical Exposure Score. For this, we define the weights based on the relative financial impact of physical and transition risks on the Net Asset Value (NAV) of companies today at a geo-sectoral level.[9]

Finally, we transform the transition, physical and potential climate exposure 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 1), based on a company's corresponding transition, physical, and potential climate exposure scores. Figure 2 presents the final PCER for 2035 and 2050.

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

[9] Here, we follow our methodology developed for pricing climate risks in the estimation of infrastructure assets' NAV (Jayles & Shen, 2024).

*Table 1: 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] |

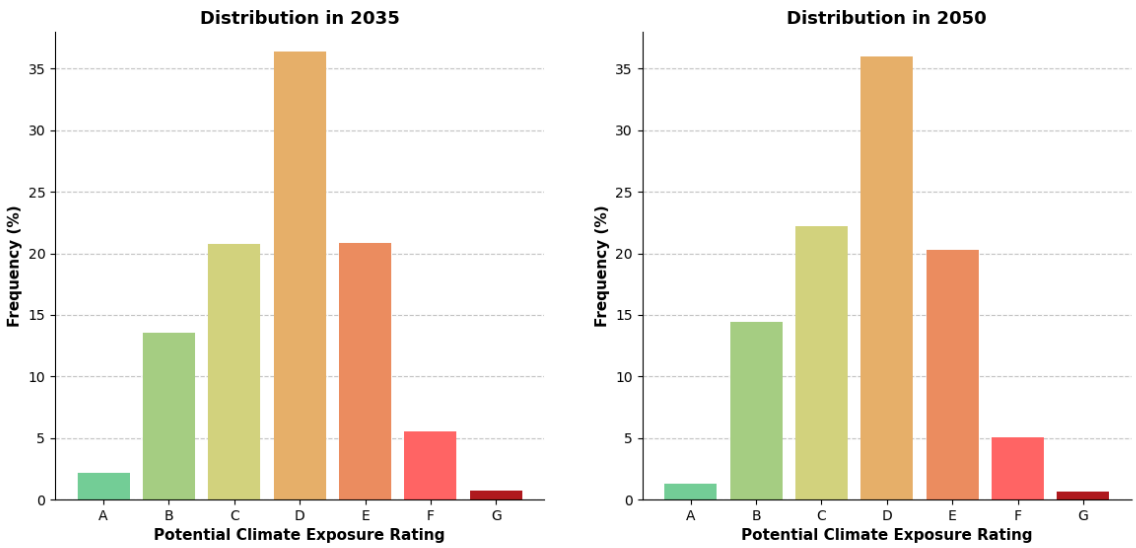


*Figure 2: Final PCER ratings for all assets in our infrastructure universe for the 2035 and 2050 time horizons*

## 6. Potential Adjustment Procedures of the PCER

Our models estimate companies' exposure to transition and physical risks, which is the basis for the corresponding PCER. 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[10], we can adjust the relevant metrics based on the technologies implemented and their effectiveness.

[10] 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.

## 6.1. 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 PCER 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.

## 6.2. Adjustments based on Decarbonisation Measures

To update the carbon intensities per revenue, companies must provide information on their latest revenues, emissions, and implemented decarbonisation measures (including supporting materials). Several cases may arise for companies interested in a reviewed PCER (see also Figure 3):

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

- *S1, S2, or S1+2 emissions are reported.*
  In this case, we replace our model-based S1+2 intensity estimation with the reported values and update the PCER accordingly. However, this does not apply to S3 emissions, as the calculation of which is too uncertain for us to trust reported values (Shrimali, 2022).

- *S1, S2, or S1+2 emissions are not reported, but decarbonisation measures are listed.*
  In this case, we use the ClimaTech database to evaluate the effectiveness of the implemented measures and adjust the PCER 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.
  This applies to S1, S2, and S3.

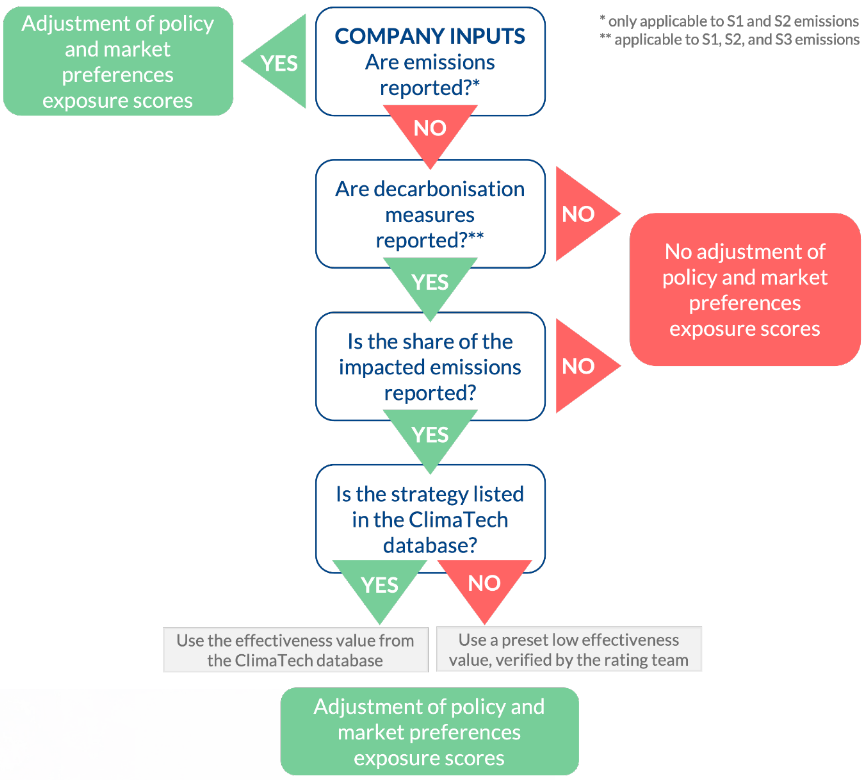


*Figure 3: Illustration of the process to adjust carbon intensities per revenue based on implemented decarbonisation measures*

### 6.3. Adjustments based on Resilience Measures

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[11], 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 to reduce the impact of such hazards. Again, in order to adjust the PCER, companies are required to provide information (and supporting materials) on their current resilience measures. 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.

## 7. Example of the Adjustment Process

To illustrate the rating process, including potential adjustments to the PCER, we use the example of Brisbane Airport in Australia. We refer to resilience information from the company's latest sustainability report (BAC, 2023) to demonstrate the adjustment process for physical risk exposure.

### 7.1. Initial Calculation of the PCER (Before Adjustments)

Table 2 shows Brisbane Airport's exposure to physical hazard events and the resulting Physical Exposure Rating under the most likely climate scenario for a 2050 time horizon before adjustments.

***Table 2:*** *Brisbane Airport's annual expected flood, storm, and wildfire damages (expressed in asset loss in %) and heat impact (expressed in revenue loss in %), as well as its Physical Exposure Rating (A-G)*

| Flood damage | Storm damage | Wildfire damage | Heat impact | Physical Exposure Rating |
|---|---|---|---|---|
| 1.93 | 0.46 | 0 | 0.5 | E |

[11] 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.

## 7.2. Adjustments for Resilience Measures

In this case, we can adjust the expected damages from flood and storm hazards[12] if the said company has implemented technologies that increase its resilience against such hazards. We relate each technology mentioned in Brisbane 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 3).

*Table 3: Implemented resilience technologies based on Brisbane 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.

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

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

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.

## 7.3. Recalculation of the PCER

Following Table 3, we can update the expected damage for each hazard separately, and hence the Physical Exposure Rating. In summary, we calculate the following damages after the adjustment process:

- The average annual expected flood damage of total asset loss (in percent) between 2025 and 2050 is reduced from 1.93 percent to 0.117 percent, which means that the resilience strategies reduced the expected flood damage by 94 percent.

- The average annual expected storm damage of total asset loss (in percent) between 2025 and 2050 is reduced from 0.46 percent to 0.17 percent, which means that the resilience strategies reduced the expected storm damage by 63 percent.

Table 4 provides an overview of the initially estimated and adjusted values needed to calculate the Potential Climate Exposure Rating for Brisbane Airport. Using the adjusted values, we can re-run the procedures presented in this document to recalculate Brisbane Airport's Physical Exposure Rating and the underlying hazard-specific ratings. We observe a significant improvement (from E to C) after adjusting for the implemented resilience technologies. This leads to an overall improvement of the Potential Climate Exposure Rating from E to C.

***Table 4:*** *Brisbane Airport's estimated and adjusted values of annual expected flood and storm damages (expressed in asset loss in %), as well as the respective exposure ratings*

| | Flood damage | Storm damage | Flood exposure rating | Storm exposure rating | Physical Exposure Rating | PCER |
|---|---|---|---|---|---|---|
| Estimated | 1.93 | 0.46 | G | E | E | E |
| Adjusted | 0.117 | 0.17 | E | D | C | C |

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