The Paris Climate Agreement as Benchmark for Buildings and Companies

D Piazolo

THM Technische Hochschule Mittelhessen, University of Applied Sciences, Wilhelm-Leuschner-Straße 13, 61169 Friedberg, Germany
daniel.piazolo@wi.thm.de

Abstract. The real estate market has a high obligation, but also many opportunities, to tackle climate change. The real estate sector is responsible for 40% of energy consumption and 36% of CO₂ emissions in the EU. The global temperature must not rise by more than 1.5° Celsius compared to pre-industrial times in order to avert serious consequences of climate change. 195 countries agreed on this target by signing the Paris Climate Agreement in 2015 and thus also set the legislative framework and the desired direction of development for societies, companies and buildings. The Paris Climate Agreement can be used to establish a benchmark by showing which development routes are necessary to be compliant with the Agreement. It can be examined which adjustments are necessary to limit maximum global warming to 1.5° Celsius. By matching specific properties against such a benchmark, it can be worked out which properties are at risk of no longer being usable/rentable because they cannot meet the expected increases in environmental regulations, CO₂ pricing, building standards and market expectations. This can be used to address transitory climate change risks.

Keywords. Benchmark, Real Estate, Sustainability, Paris Agreement, Climate Change

1. The Paris Agreement and the Consequences for the Real Estate Sector
The increase in CO₂ emissions has already led to rising temperatures and a change in the climate. The danger of dire consequences of further temperature rises is perceived by the public in many countries. Social pressure has mounted to push for a shift to a carbon-neutral economy with lower CO₂ emissions. Many governments have set ambitious climate targets, and at the international level, efforts are being stepped up for concerted action to tackle climate change. Following the agreement at the UN Climate Change Conference in Paris in 2015 and the country-specific strengthened commitments at the UN Climate Change Conference in Glasgow ("COP26 UN Climate Change Conference") in November 2021, government action will be significantly shaped by the necessary measures for climate protection. While only industrialised countries committed to the Kyoto Protocol of 1997, all relevant countries are involved in the Paris Agreement.

At the EU level, a very impressive momentum has developed with massive funding under the European Green Deal and extensive regulation through the EU taxonomy. The Green Deal is the central component of EU climate policy and is intended to enable the goal of European climate neutrality by 2050 or ideally by 2045. The EU Taxonomy Regulation contains criteria for assessing whether an
economic activity is environmentally sustainable. Thus, the degree of sustainability of investments can be derived.

There is also a high level of willingness among investors to address the issue. For example, some investors in the real estate industry now classify climate change as the greatest systematic risk. Companies are pushing the issue of climate change and adaptation through various initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), the Network for Greening the Financial System (NGFS) or the Net Zero Asset Owner Initiative.

The real estate sector not only has a special responsibility, but also a lot of potential for improvement, as 39 percent of global CO2 emissions come from this sector [1]. 11 percent of CO2 emissions result from construction activities or building materials. 28 percent of CO2 emissions are associated with the operation of real estate for building services, electricity, heating and cooling. Of the various approaches to reducing greenhouse gases, increasing energy efficiency is one of the most promising. As energy saving in buildings is of significant importance in the European Union's path towards climate neutrality, a critical assessment of the possible comparative analyses is highly relevant.

1.1 The Greenhouse

Without greenhouse gases, the earth's surface would only have a global average temperature of -18 °C and higher organised life would not have been able to develop on earth. Natural greenhouse gases, especially water vapour, reflect the thermal radiation emitted by the ground and raise the temperature on the Earth's surface to + 15 °C. Carbon dioxide (CO2) emissions have risen sharply since the beginning of industrialisation and the extensive use of fossil fuels around 1850. [2]

CO2 emissions are a common, though not ideal, placeholder for all anthropogenic greenhouse gas emissions, which include methane (CH4) or nitrogen oxides such as nitrous oxide (N2O), and have increased significantly due to human activities. For example, the concentration of CO2 has increased by 45 per cent since the beginning of the industrial revolution until 2022. In terms of the potential of greenhouse gases to cause global warming within 100 years, carbon dioxide accounts for 72 per cent, methane 18 per cent and nitrogen oxides 9 per cent. Nitrous oxide has a global warming impact 298 times greater than that of carbon dioxide over a 100-year period. Nitrogenous fertilisers in agriculture are mainly responsible for anthropogenic nitrous oxide emissions.

Since the real estate sector, as well as the other sectors, can contribute mainly to the reduction of carbon dioxide, the focus of legislation in cross-sectoral targets is mostly on CO2 levels. Despite the increasing focus on CO2, the levels of CO2 in the air have continued to rise sharply in recent years.

1.2 Risks connected to Climate Change

Climate change gives rise to two risk scenarios: Physical risks and transitory risks. Both groups of risks will occur, but they have different requirements on how to deal with them.

The physical risks of climate change refer to the already visible and still feared damage from extreme weather events. These include heat, droughts, heavy rainfall, floods, storms, etc. Depending on the regional conditions, resilience or the response options vary. With the increase in such extreme weather events, insurance against such damage becomes significantly more expensive or completely impossible. Financing options will also become more expensive or disappear.

Climate change will create further risks of conflict in the form of water shortages, famine and large-scale migration. Countries will brace themselves against these physical risks, but the higher the temperature rise due to climate change, the more likely even robust countermeasures will be overwhelmed.

The physical changes caused by climate change can be either event-driven ("acute") or long-term-driven ("chronic"). Disturbances in the ecological balance, such as soil quality, bio-diversity or the marine environment, are also partly classified as impacts of the physical risks of climate change.

Transitory risks, sometimes referred to as transition risks, include the costs and adaptation measures to adapt to the various impacts of climate change. These include the costs from conversion measures to reduce the impacts of climate change. Switching to alternative energy generation and expanding energy
storage options will have high costs. Transitory risks include the changes triggered by legislation in response to climate change. The aim of increasing CO2 prices is to create incentives in the market to reduce CO2 emissions. The shift in relative prices may result in certain business models, products or services no longer being competitive. This crowding out of activities with high CO2 emissions is deliberate, but it also means an increase in uncertainty, e.g. for long-term investment decisions such as real estate, as a possible significant increase in the CO2 price should not be ruled out.

Through legislation, there will increasingly be penalties or legal consequences for climate-damaging behaviour. There is a risk that this will make certain projects unprofitable. If it is regulated that, for example, rented flats must meet a minimum energy efficiency standard from a certain point in time, expensive modernisation measures may become necessary or these flats will become unrentable if the achievable market rent cannot cover the expected modernisation costs in a relevant period of time. Thus, in the medium term, energy-inefficient properties are at risk of being banned from use or letting. In addition to legal bans, high energy cost increases, restrictions on the apportionment of operating costs to tenants or changes in tenant preferences can lead to properties that are not up to date and harmful to the climate no longer being let. The criteria for a net zero CO2 building are set out in Table 1 [3]. Based on these criteria for buildings, it is also possible to define overall climate neutrality.

Table 1. Criteria of a net zero CO2 building

| Criterion                                                                 |
|---------------------------------------------------------------------------|
| Meets regionally set standards for energy efficiency                       |
| Uses 100% renewable energy from internal and external sources             |
| Includes both landlord and tenant energy needs                            |
| No use of fossil fuels on site and offsets remaining emissions            |
| Minimises CO2 emissions from (new) development and offsets remaining emissions |

For companies, transitory risks include the risk of losing reputation and not meeting the expectations of customers, their own employees or investors. If a company appears to no longer be operating in line with the times, it can quickly lose the support of key market players and the company's existence can be threatened.

Depending on the country, there are specific regulatory requirements to achieve the Paris Climate Agreement ("Nationally Determined Contributions - NDCs Paris Agreement"). The significant differences in CO2 emissions from electricity generation within the European countries, such as through the use of nuclear energy or hydropower, are included in the envisaged development paths. The reduction in the energy consumption of a property include the following necessary steps:

1. Operational changes
2. Improvement in Energy Efficiency
3. Modernisation
4. Decarbonisation in Heating
5. Use of Renewable Energy on Site

The remaining CO2 emissions of the building have to be offset.

To slow climate change, the focus is on further reducing CO2 and other greenhouse gas emissions. The share of greenhouse gases in the air, measured in CO2 ppm, has continued to rise worldwide. In contrast, greenhouse gas emissions in Germany have decreased significantly over the last 30 years since
1990 [4], although Germany continues to be one of the countries with very high per capita CO2 emissions.

In March 2021, the German Federal Constitutional Court had ruled that climate protection efforts must be distributed more fairly between current and future generations and that the German Federal Climate Protection Act of 12 December 2019 is incompatible with the fundamental rights of younger German citizens. As a result, the amendment to the Climate Protection Act tightened the specified greenhouse gas savings in the summer of 2021. For example, the targeted greenhouse gas reduction for the year 2030 was raised from 55 to 65 percent compared to 1990, and climate neutrality is to be achieved as early as 2045 and not only in 2050. In addition, binding greenhouse gas reduction targets have been set for the 20s and 30s for the individual sectors of energy, industry, transport, buildings, agriculture as well as waste management and other. The permissible emissions for the years 2021 to 2030 are significantly reduced. In this context, the energy and industry sectors must make the greatest reductions in the annually permissible quantities. The reason for this is that these two sectors have the highest emissions and the abatement costs are lower than for the other sectors. Renewably generated electricity can replace fossil fuels. The expansion of renewable energy supply is also crucial for the building sector and the other sectors to achieve the targeted emission reductions within these sectors.

In contrast, only the overall annual reduction targets are prescribed for the 30s, so that technical innovations in the near future can be considered when they are detailed at a later stage. It is expected that at the European level, in 2024, concrete decisions will be made on how climate protection is to be advanced. Thus, the specific reduction targets for the years 2031 to 2040 will then also be set at the German level. In 2040, a reduction of 88 percent of greenhouse gases relative to 1990 is to be achieved [5].

Annual reduction targets for the years 2041 to 2045 are to be set by 2032 at the latest and specified per sector by 2034 at the latest. After 2050, the target is net greenhouse gas removals from the atmosphere. This is to be achieved by expanding natural sinks such as forests and peatlands, which was newly included with targets in the 2021 amendment to the Climate Protection Act. This is intended to compensate for unavoidable greenhouse gas emissions, such as those from livestock farming and specific industrial processes.

In order to better compare between countries and sectors, convergence of the standards of the different climate challenge reporting initiatives is important. In addition to the EU taxonomy, this includes organisations such as the Global Reporting Initiative (GRI), Carbon Disclosure Project (CPD), Climate Disclosure Standards Board (CDSB) or Sustainability Accounting Standards Board (SASB).

2. **Benchmarking**

The collection of data on various aspects is often very helpful in order to obtain more accurate assessments of the possible impacts of decisions through comparisons. By benchmarking with databases that are as comprehensive as possible, but which fit well, statements can be derived on the relative ranking, but also on expected costs, revenues and returns. Even if the often-cited benchmarking quote “If you can't measure it, you can't manage it” is probably wrongly attributed to Peter Drucker and, according to the Drucker Institute, should not be understood as the sole management tool, it reflects an important component of an adaptation process: If something cannot be measured and evaluated, it is difficult to improve in this area. [6]

In the context of climate change and energy saving in real estate, benchmarking allows the derivation of improvement potentials, more accurate risk assessments and specific development paths. Challenges in benchmarking include ensuring the quality, timeliness and comparability of data. Once the aspects measured are more complex, it makes sense that verification and validation are undertaken. Incentives must also be in place to ensure that individual data providers are truthful in supplying their own information. In analyses of real estate portfolios, benchmark participants provide their own data in order to identify their own position and opportunities for improvement by comparing it with the collected information of all participants. This provides the incentive for truthful data delivery. However, if data is only provided after measures have been completed, the self-motivation for accurate collection may be
lower and quality assurance by the database provider must be increased. The quality of the delivered data can be improved by comparison with previous data deliveries and plausibility checks.

Depending on the parameters, it varies how time-critical the captured information is. But a high degree of topicality of the collected data increases the informative value of the benchmarking. Especially when creating databases in the context of publicly funded projects, it is important to create economic incentives to ensure that the benchmark data is updated even after the end of the funding. Therefore, an "institutionalisation" or "commercialisation" of the benchmarking approach is a sensible component of formerly state-funded initiatives.

Another challenge for benchmarking in real estate relates to data protection and different interests of the parties involved. In order to measure the total energy demand for a building, a landlord needs the consumption data of the tenants. However, depending on the tenancy agreement and legal regulations, tenants are not obliged or not sufficiently motivated to provide such personal data. Since modernisation measures reduce energy consumption and thus the tenant's "second rent", but do not necessarily increase the main rent, the landlord's incentive is limited to make energy-efficient improvements. Therefore, the willingness of tenants and landlords to provide the necessary data for benchmarking can be reduced.

2.1 New construction

The 2021 amendment to the German Climate Change Act also tightens the energy standards for new buildings and increases the subsidies for energy-efficient building renovations. At first, the draft bill of the amendment provided that half of the costs of the CO2 price should be borne by landlords and half by tenants, as it was argued that landlords decide on energy modernisation and the type of heating. However, it was argued that this would give landlords an incentive to select tenants according to their expected energy consumption, thus favouring singles over families with small children. Thus, in the amendment to the Climate Protection Act, the polluter pays principle continues to apply and tenants bear 100 per cent of the CO2 price, although a reduction in electricity prices is being sought through a change in the Renewable Energy Sources Act (EEG) levies.

For new buildings and extensively modernised properties, many certificates have been developed to confirm high energy efficiency and environmental compatibility. Among the established certificates known in Germany are LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Method and DGNB (German Sustainable Building Council). In the USA, in addition to LEED, there are also sustainability certificates from GPR (Global Property Research) and EDGE (Excellence in Design for Greater Efficiency). "Green Star" certificates are common in Australia and New Zealand. China has five sustainability certificates to make assessments depending on the building type. To cover country or sector-specific aspects, more than 50 certificates are offered worldwide. However, this makes cross-country comparison and benchmarking difficult, because the certificates cover different ecological aspects with quite different weighting. The expansion of the sustainability perspective from ecological aspects to social and economic ones increased the number of criteria to be evaluated and shifted the weightings. With the establishment of "green building" certificates, an attempt is being made to focus on the environmental component, but greenhouse emissions still usually have a relatively small weighting.

The certification confirms a snapshot. For a continuous optimisation of processes in order to avoid further emissions, ongoing recording makes sense. Especially with such a dynamic recording, there are possibilities for benchmarking between the data of different recording times and between different objects.

2.2 Refurbishment projects

In recent years, it has become clearer within the real estate industry that the desire of many institutional investors for "green", ESG-compliant new buildings often means more CO2 emissions than the conversion of old inefficient buildings. Converting old, polluting properties into modern, energy-efficient buildings is now often seen as more resource-efficient.
75% of buildings in Europe are energy inefficient. Most of today's buildings (between 75 and 90 percent) will still be in use in 2050. The annual renovation rate is about 1.2 percent. Yet investments in higher energy efficiency in real estate are often seen as low-risk and high-risk. The perception of high risk is related to unclear investment costs, uncertain financing options and payback periods that are considered long. Therefore, one strategy at the European level to achieve the ambitious energy savings target is to focus on existing buildings and to increase transparency regarding the return and the costs of building modernisation. It is important to direct private investment capital into energy-efficient forms of investment.

Returns on investment in energy efficiency in buildings are:
1. Reduction in energy costs
2. Higher comfort and better health parameters
3. Lower tenant turnover
4. Lower vacancy rates
5. Higher property values
6. Lower default rates on loan mortgages

While property energy efficiency upgrades can be shown to increase property values [7], many owners are reluctant to pay high upgrade costs, especially for older buildings.

An important component of the strategy to achieve the EU’s energy savings target by creating more transparency regarding the risks and returns of modernisation measures is the collection of comparative data. The De-risking Energy Efficiency Platform (DEEP) is a Europe-wide database that provides performance data for comparison purposes [8].

This should make it easier for owners, project developers and financiers to assess the risks and returns of energy efficiency investments. DEEP is an open source initiative to increase energy efficiency investments in Europe. The DEEP platform contains data on the financial performance (e.g. payback time of investments and savings) of about 7,800 building retrofit projects. The main objective of the platform is to collect enough data to provide users with statistically significant values to better understand the risks of energy efficiency projects. With this information, comparative analyses can be carried out in the context of benchmarking. The DEEP platform also includes data on healthcare properties, public buildings, education sector properties in addition to offices and multi-family buildings. The great advantage of the De-risking Energy Efficiency Platform is its open-source design as an EU-funded measure.

2.3. Operating properties

Climate change has different impacts on the users and the owners of a property. The tenant of a building has to deal with how the physical impacts of climate change will alter the expenditure and potential income from operating or using that specific (production) site. The owner has to deal with how these effects affect the value of the property or how much damage is caused by climate change. The owner also has to face the costs that arise in order to achieve emission reductions, either through policy or through their own decisions.

In most cases, the operators or tenants of a property bear the consumption-based costs of using that property. With the efforts of governments to set incentives to use resources more sparingly, energy costs will continue to rise in the coming years. With the gradual increase in CO2 pricing in Germany, the increase for heating costs for oil and gas consumption and also for electricity costs is foreseeable. Operating cost benchmarking has been available for a long time, but with the growing importance of climate protection, comparative analysis for CO2 emissions, waste and water consumption will become more important as the relative weights in costs shift there. The Building Energy Act also requires mandatory information on CO2 emissions for energy performance certificates. With an inventory of existing CO2 emissions, the savings from reduction measures can also be better estimated. Low energy and operating costs open up competitive advantages and leeway when setting rents. This is made possible by professional operating cost management, which often includes benchmarking.
2.4. Stranded assets
There are benchmarking possibilities for the future development of real estate, which are available as a tool free of charge thanks to EU Horizon 2020 funding [9]. CRREM (Carbon Risk Real Estate Monitor) aims to assess the risks associated with poor energy efficiency and high emissions at the individual property level so that strategies can be developed to decarbonise the portfolio. This involves setting a development path for specific building types in individual countries that is consistent with the goals of the Paris Climate Agreement. Development paths for the period up to 2050 are shown in order to be consistent with limiting maximum global warming to 2°C or to 1.5°C. The development path is then compared with such a benchmark. By comparing this with such a benchmark, it is possible to work out which properties are at risk of no longer being rentable and thus becoming stranded assets because they cannot meet the expected increases in CO2 prices, environmental regulations, building standards and market expectations. This addresses the transitory climate change risks through CRREM. A stranded asset has been overtaken by time and is of limited use. A building is at risk of becoming a stranded asset based on energy consumption relative to legal requirements and CO2 pricing if no retrofit is undertaken. In the CRREM project, property-specific decarbonisation and energy reduction pathways are shown by country, mapping an estimate of a building's climate impact over time. This considers that the decarbonisation of energy networks is progressing and that energy refurbishment or modernisation can significantly reduce the emissions of a property and thus avoid "stranding" [10].

In the CRREM tool, the positive effects of the energy modernisation of individual properties on the overall decarbonisation performance of the portfolio or the company can be analysed. The costs and CO2 emission changes of the refurbishment measures can also be compared with the operating cost savings. Through collaboration with various investors, associations and universities, the CRREM tool has been tested, improved and disseminated. According to the company, more than 2,200 properties with 12 million square metres of lettable space have been analysed using the CRREM approach. Investors and asset managers with a responsibility of 400 billion assets and management have used CRREM. Through a partnership with GRESB (Global Real Estate Sustainability Benchmark), a provider of ESG benchmark for real estate, the CRREM tool is also offered to GRESB's network of clients with commercial real estate portfolios. The tool will be integrated into the GRESB portal to enable GRESB clients to demonstrate compliance with the Paris Climate Agreement and transitory climate change risks.

2.5. Value at Risk approach for all properties
For the discussion of the Value at Risk, it is important to establish a common understanding for the risks connected to climate change. Storms, floods and droughts lead to high costs, although quantification is often limited. The amount of damage to buildings from extreme weather events covered by insurance in Germany amounts to an average of EUR 3 billion p.a. over many years. However, this does not include the uninsured damage and consequential effects such as un-insurability, loss of production, restrictions on use or leasing.

In order to assess risks, attempts are made to quantify the possible damage to properties using climate models for the respective natural hazards such as floods, hail or forest fires.

Three parameters are used in the climate models to estimate the risks to properties:
1. regional vulnerability by location
2. vulnerability of the property or land
3. restoration costs depending on the market value

The aim is thus to identify the risks over a wide area and to assess each natural hazard in monetary terms.

These three parameters are also used in the insurance industry's hazard models to quantify the expected costs of physical risks. In this context, the costs of extreme heat, in addition to crop losses, are
approximated by, among other things, the expenditure for cooling that is necessary when certain thresholds are exceeded.

Climate risks can be seen in the increasing disillusionment of young people who feel that the current generation of decision-makers is neglecting the dangers of climate change for future generations. Geopolitical upheavals and increasing health problems are also global risks that may be exacerbated by climate change.

It should be emphasised, however, that the attempt to quantify the risks of climate change shares the challenges of the limited availability of economic pricing of ecological values. The market value of Amazon can be calculated to the dollar on a daily basis, while the value of biodiversity in the Amazon cannot be priced and does not yet appear in national accounts.

In order to compare individual properties, but also entire portfolios, in terms of climate compatibility, it can be derived which anthropogenic temperature increase a building corresponds to. MSCI uses a "warming potential" methodology that compares properties with different warming scenarios (e.g. increase in global warming by 1.5°C, by 2°C, by 3°C, etc.). The CO2 intensity of a property (in kgCO2/m²/year), depending on type and location, is assigned to a warming potential on the basis of calibrated data [11].

Based on the best- and worst-case scenario of the UN Intergovernmental Panel on Climate Change (IPCC), the range of temperature increase is set between 1.3°C and 6°C. The temperature increase is then calculated as a percentage of the global warming potential. A 1.5°C increase in global warming corresponds to the net zero CO2 emissions target for the entire real estate sector in 2050. A 2°C increase in global warming in this methodology reflects the commitments agreed under the UN climate change agreements to limit global warming to a maximum of 2°C. Current average energy intensity of buildings and current fuel composition in electricity generation corresponds to an increase in global warming of more than 3.8°C, depending on the country.

A percentage deviation from certain climate policy targets can thus be derived per property, which MSCI refers to as value-at-risk. By combining the various assets on a weighted basis, the "warming potential" can be derived for a real estate portfolio or for a company. The advantage of this approach is the possible combination of properties in different regions that differ in climatic conditions, power generation and regulatory requirements for individual sectors. Thus, all buildings, whether new buildings, old buildings or refurbishment projects, can be brought together and analysed within the framework of benchmarking [12].

3. **Next steps**

Real estate is responsible for a significant share of climate-damaging CO2 emissions. Thus, real estate can also be a significant part of the solution to the climate crisis. However, it will not be very effective and thus meaningful if the real estate-related challenges are only analysed and addressed within the real estate sector.

Benchmarking is useful here, as it can be deduced in which sector CO2 emissions can be reduced with what effort and at what cost. In that respect, benchmarking is an important step in the route to climate neutrality of buildings. Thus, it makes sense to establish a development path for buildings that matches the goals of the Paris Climate Agreement to limit maximum global warming to 1.5°C.

Cross-sectoral tradable CO2 emission certificates and comprehensive CO2 pricing enable efficient adaptation to climate change and hopefully a high level of protection of society as a whole and also of real estate-linked assets from climate risks. In order to assess the risk of an installation, a rating should take into account all necessary factors according to the EU Rating Regulation. If climate change can have an impact on an investment, be it a financial instrument or corporate financing, this will ideally be included in the assessment of the probability of default in the rating assessment.

Special ESG ratings have become established in order to specifically assess sustainability risks. These are offered by some registered rating agencies as well as by other companies. However, general standards and uniform terms are not yet available, so that comparability and thus benchmark approaches
across different ESG ratings are only possible to a limited extent. Alignment with the EU taxonomy, which also needs to develop further in this area, will drive standardisation forward.

References
[1] Architecture 2030 2022 Buildings generate nearly 40% of annual global GHG emissions https://architecture2030.org/buildings_problem_why/
[2] 2 Degrees Institute 2022 Real-Time and Historical CO2 Levels www.co2levels.org
[3] Dean A 2021 Mapping out the pathway to net zero Nuveen Real Estate Presentation IPE Webinar
[4] Umweltbundesamt - German Federal Environment Agency 2021 Development of specific emissions of the German electricity mix in the years 1990-2020
[5] Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit - German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2021 Draft bill for a First Act to amend the Federal Climate Protection Act Berlin
[6] www.drucker.institute/thedx/measurement-myopia/
[7] Cajias M, Piazolo D 2013 Green Performs Better: Energy Efficiency and Financial Return on Buildings Journal of Corporate Real Estate 53 – 72
[8] EEFIG 2022 DEEP - De-risking Energy Efficiency Platform Energy Efficiency Financial Institution Group https://deep.eefig.eu
[9] Carbon Risk Real Estate Monitor 2022 www.crrem.eu/tool
[10] Spanner M, Wein J 2020 Carbon risk real estate monitor: making decarbonization in the real estate sector measurable Journal of European Real Estate Research 277-299
[11] MSCI 2022 Real Estate Climate Value-at-Risk (Climate VaR) - A Transparent Approach to Calculating Climate Value-at-Risk
[12] Piazolo D 2021 Klimarisiken und Benchmarking ESG im Immobilienbereich, ed T Veith, C Conrads and F Hackelberg (Freiburg: Haufe) pp 193-212.