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CLIMATE CHANGE IMPLICATIONS FOR REAL ESTATE PORTFOLIO ALLOCATION - BUSINESS AS USUAL OR GAME SHIFT?

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Climate Change Implications for Real Estate Portfolio Allocation
- Business as usual or game shift?

Prof. Dr. Sven Bienert *MRICS REV*

This work was supported by ULI

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- Fostering collaboration within and beyond ULI's membership through mentoring, dialogue, and problem solving;
- Exploring issues of urbanization, conservation, regeneration, land use, capital formation, and sustainable development;
- Advancing land use policies and design practices that respect the uniqueness of both built and natural environments;
- Sharing knowledge through education, applied research, publishing, and electronic media; and
- Sustaining a diverse global network of local practice and advisory efforts that address current and future challenges.

Established in 1936, the Institute today has nearly 40,000 members worldwide, representing the entire spectrum of the land use and development disciplines. ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

About the Author

Sven Bienert is professor of sustainable real estate at the University of Regensburg and ULI Europe's visiting fellow on sustainability. Since 2013, he also has been managing director of the IRE|BS International Real Estate Business School at the University of Regensburg, Europe´s largest center for real estate education.

Prof. Bienert graduated with degrees in real estate economics and business administration and wrote his PhD thesis on the "Impact of Basel II on real estate project financing". He has been conducting research in the field of sustainability since 2005, initiating various projects such as ImmoValue, the IBI-Real Estate benchmarking institute, RentalCal and ImmoRisk.

Since April 2010, Prof. Bienert has been head of the IRE|BS Competence Center of Sustainable Real Estate at the University of Regensburg, where his recent research has focused on "green pricing" and the impact of extreme weather events on property values, among other topics. His research has received several national and international prizes, and his papers have been published in numerous leading international real estate journals. Prof. Bienert is the author and editor of several real estate books.

Prof. Bienert combines academic knowledge with practical private sector experience, having held management positions in a number of leading real estate consulting companies. In 2010, he became founder and managing director of Probus Real Estate GmbH in Vienna, which manages a €2.1 billion commercial real estate portfolio with properties across central and eastern Europe (CEE) and southeastern Europe (SEE).

We thank especially Daniel Niebur who supported to carry out the survey and analysis.

Contents

1. Executive Summary

The ULI study "Extreme weather events and property values – Assessing new investment frameworks for the decades ahead" (April 2014)[1] dealt intensively with the impact of climate change and especially of extreme weather events on individual properties. In this context, besides identification, the assessment and quantification of risks was also described. The study came to the conclusion that the sector is still relatively passive with regard to the financial risks that climate change might trigger and that "The financial uncertainties caused by extreme weather are being considerably underestimated by real estate investors. Until recently, their portfolio allocations have rarely taken into account the science of climate change." Building on the results at the level of individual properties, the implications at the portfolio level and with regard to strategic asset allocation (SAA), need to be analyzed. For this reason, a survey amongst CEOs of leading investors and asset managers was conducted on global scale, starting in 2014 and continuing until Mid-2015. The survey covered more than €428 billion of assets under management and more than 50 participants (only executive level) participated.

Key elements of survey results:

Top 5 climate-change-related impacts which influence Real Estate Investments TODAY

* 80% of the survey participants argue that higher operational costs and changing technological requirements due to climate change have at least a moderate influence on their real estate investments today.

* Increasing regulations (e.g. related laws regarding energy savings) also have significant impact on current real estate investment decisions (72% of participants expect at least a moderate influence).

* The migration of people and higher construction costs of buildings due to climate change adaptation, also significantly affect the real estate investments of participants (the majority of the participants find at least a moderate influence).

* Rising sea levels, food security, deterioration of air quality and water shortages are not yet an issue for most of the participants.

Top 5 climate-change-related impacts that are expected to increase in the FUTURE

* During the next decade, many negative implications / developments for real estate investments due to climate change are expected. More than 2/3 of the stated criteria are of high relevance for investors during this time frame.

* Increasing regulation (88%), changing technological requirements (82%), higher operational costs (67%), higher construction costs due to adaptation (65%) and rising fuel prices (63%) are the Top 5 climate-change-related impacts that are expected to increase within the next ten years.

[1] Bienert, Sven. Extreme Weather Events and Property Values: Assessing New Investment Frameworks for the
Decades Ahead. London: Urban Land Institute, 2014.

* In the long term (31 to 50 years), rising sea levels (22%), water shortages (16%), food security (16%), deterioration in air quality (8%) and other resource shortages (8%) are most commonly expected to have an increasing impact on real estate investment decisions.

Climate change risk assessment for real estate portfolios

* Only five out of 50 participants (10%) perform climate-change risk assessment in a substantial manner. 18% of the investors that took part in the survey partially assess the risks of climate change, while 25% only conduct climate-change risk assessment rudimentarily. 47% of investors do not assess climate-change risks at all.

* If investors perform climate-change risk assessments for a portfolio, mostly sustainable due diligence for new acquisitions are conducted (89% of participants did this for at least 26% of their portfolio). Measurement of Key Performance Indicators and sustainability due diligence for existing buildings are also quite widely used instruments.

* Although scenario and sensitivity analysis may be the most suitable instruments for assessing the risks of climate change for real estate portfolios, most of the investors do not use these tools for their climate-change risk assessments. Only two participants perform sensitivity analysis for 26% to 75% of their portfolios. Scenario analysis is only used by one of the investors for more than 75% of the real estate portfolio.

* 30% of the participants do not plan to start or increase their climate-change risk assessment activities in the next two years. 14% plan to do so in substantial manner, while 28% plan to start or increase their respective activities partially. Another 28% plan to do so in a rudimentarily manner.

* While roughly half of the market participants at the board level deal intensively with the topic of climate change as a major factor for their strategic orientation, for 50%, this has not been the case so far.

Conclusions drawn from climate change risk assessments by investors

* The decision not to invest in properties with an insufficient risk profile (high risk and fairly low return perspectives) is most likely made on the basis of the climate change risk assessment (Score 3,64 of 5), followed by divestments of properties with high risks (3,17) and intensified adaptation measures for existing properties (3,04).

* For most multi-asset investors, changes in the share of real estate assets are not an issue.

* When it comes to retrofitting measures for the existing stock, only certification and energy efficiency measures score high when it comes to a complete roll-out. Most retrofitting measures that are carried out for more than 75% of the existing properties focus on improving energy efficiency (22%), waste management (18%) and water efficiency (10%). However, 55% of the investors do not carry out resilience-improvement measures regarding extreme weather events.

* One third of the market participants do not care at all about more complex aspects like green procurement or green leases. What is encouraging is the fact that there are nevertheless also a lot of early adaptors: more than 1/3 stated for almost all measures, that they are at least working on aspects like green procurement, green leases etc. for up to 1/3 of their entire portfolio. However; it can generally be stated that measures and coverage regarding retrofitting measures besides certification and energy are lagging behind. In order to support achieving the objectives set out in the INDCs, the sector needs to increase awareness, clarify the pay-off and speed up retrofitting investments.

* 27 % of respondents state that adaptation measures are not yet part of their regular CAPEX-budgeting process

Market impacts of climate change

* 43% of the investors observe a grey discount on conventional (non-green) real estate. One third of the participants state that green value premiums for green buildings are paid by the market players. Just under a quarter of the investors state that the climate change risks are already considered sufficiently by the market.

* The market still views split-incentives between tenant and landlord, as well as insufficient information, as the main market barriers. According to the survey participants, the main market barrier for a faster uptake of green retrofit technology is the investor-user-dilemma (Score 4,02 of 5), followed by high transaction costs for green technology (3,54) and the issue of imperfect information (3,49). However, inadequate service levels (2,77), inadequate access to financing (2,75) and high discount rates on green technology (2,56) are least relevant for a faster uptake of green technology.

Climate Winner / Climate Loser

* 61% of the survey participants expect Western and Northern Europe to be a “Climate Winner”. On the one hand; 28% have the opinion that no region will benefit from climate change.

* On the other hand, 24% do not expect any region to be a “climate loser”. 17% of the survey participants regard South Asia / Oceania as a “Climate Loser”, followed by Central and East Asia (15%), Sub-Saharan Africa (13%) and North America (11%).

Climate Change impacts

* According to the expectations of the survey participants, especially Europe will have to face the issue of rising temperatures (67%). Western and Northern Europe will also have to deal with more precipitation (64%), while for Southern Europe, an increasing number of drought periods is expected (56%).

* Regarding North America, 78% of participants expect a higher risk for coastal regions, due to severe storm events. Besides these events, rising temperature and more precipitation will also be an issue (62% / 60%). Only 40% of the participants expect rising sea levels to be an issue.

2. Evaluation of survey results, conclusions & recommendations

* Terminal values at risk: Intended short-term investment horizons and limited holding periods might be misleading, since terminal values are in any case potentially affected by climate change. Regulation, technology and Opex are most relevant today and will be so over the next decade. Temperature, sea level and extremes are expected to impact on investment from 2025 onwards. *Investors should more closely question impacts on values in 20 years onwards. In that respect, not only is direct climate change impact crucial, but also carbon footprinting and stress testing portfolios for substantial carbon constraints.*
* Long-term investment perspective for real estate, *but* long-term climate effects still tend to be ignored: Long holding periods (42 % > 10 years) contrast with the typical considerations and investment horizons for real estate investments (only 25 % > 10 years). This mismatch can lead to structural neglect of the long-term risk potential regarding the evaluation of properties. *Some investors should question whether their analysis of assets is aligned with their typical holding periods. Since most cash flow projections end after 10 years with an estimated terminal value, this might not be the case.*
* Risks due to climate change are in most cases not assessed sufficiently: – only five out of 50 participants perform climate change risks in a substantial manner. 72 % of the investors at present ignore these risks. Most participants do not intend to change this approach in next few years. Common "Tools" are generally understood and used – like Sustainability Due Diligence and KPIs, *but* strategic planning approaches like scenario analysis are almost totally lacking! This is due to the lack of awareness of long-term consequences, including the functional chain. *Investors must integrate special climate risk assessment knowhow (potentially via NatCatSERVICE[2] or other providers etc.) into their own analysis (PM-Software, Due Diligence, Insurance analysis, asset and portfolio valuation etc.) – especially since existing methods and tools are becoming more and more mature![3] Their capability to address risks due to climate change is becoming increasingly important, also for the selection of asset managers. These aspects should be integrated into Investment Management Agreements (IMAs) accordingly.*
* Huge gap between participants with high awareness and laggards: Staffing for sustainability-agenda – even for major institutional investors – is not sufficient. Furthermore, an awareness of the fundamental relationships is still distinctly improvable. For example, over 40 % of investors stated that a Green building label is equivalent to low vulnerability and high resilience with regard to climate change, whereas this is not the case. *More board attention and more dedicated employees would automatically enable companies also to work on sustainability investments and strategies beyond the "ordinary" quick fixes like certification or energetic retrofitting.*
* Watch potential "winner" and "loser" regions: *Do **not** invest in regions that are heavily affected in the future **and** have limited public resources for and awareness of this topic (high vulnerability and limited adaptation are a bad combination). Screen portfolios for highly vulnerable properties in regions with significant extremes, and either exit or adapt.*
* Strategic planning needed: *Investors must read and process climate reports for strategic planning of business.[4] They should also focus on indirect and consequential effects! It makes sense to plan with a scenario analysis for a 2 or 4 degree temperature rise.*

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[2] Link: Munich Re - http://www.munichre.com/en/reinsurance/business/non-life/natcatservice/index.html

[3] PRI, Integrated analysis, 2013, p.3ff and p.34 f

[4] Guyatt, 2011, p. 9: "Initial actions could include the following: introduce a climate risk assessment into ongoing strategic reviews".

* Identify low-risk and low-carbon investments: Carbon risk assessments and an active focus on low carbon assets is still in its early stages in the real estate industry. *Investors should more closely analyze and manage climate risks and opportunities in their portfolios, as well as invest in low-carbon solutions.*

3. Background information regarding strategic asset allocation

Various reports evaluate the amount of losses the real estate industry might face due to climate change. For example, there are estimates for the US that coastal property worth up to 106 billion dollars are likely to be below sea level by mid-century and up to 106 billion dollars by the end of the century.[5] Since a rising sea level is just one of the effects, and the US represent only one world region, it is obvious that climate change is a major threat for the global property industry. With a significant warming of 3 K, approximately 1.1% of the global land area and 7 % of the population would be affected.[6]

Lloyd's, in collaboration with the Cambridge Centre for Risk Studies at the University of Cambridge Judge Business School recently published an analysis of the potential impact on the economic output of 301 of the world's major cities from 18 manmade and natural threats.[7] In their City Risk Index, the potential losses from flooding events totaled over $432 billion, 43 per cent of which was concentrated in the Top 20 affected cities globally. These included 5 major real estate markets in the US (Los Angeles, NY, Houston, Chicago, and San Francisco) and 3 in Europe (London, Paris, and Bern).

Zillow also recently released a more granular look at the impact of sea-level rise on homes across the U.S.[8] Using flooding projections from the National Oceanic and Atmospheric Administration, they found that by 2100, almost 1.9 million homes worth a combined $882 billion are at risk of being underwater by 2100. The concentration of property loss in certain markets along the coasts is extreme. Their bottom-line conclusion: "Left unchecked," the study concluded, "it is clear that the threats posed by climate change and rising sea levels have the potential to destroy housing values on an enormous scale."

Real estate investments are heavily exposed to climate change.

The "COP 21" World Climate Conference (21st Conference of the Parties to the United Nations Framework Convention on Climate Change) provided a powerful reminder of the relevance of sustainable economic activity and the fact that *there is truly no alternative*. On 12 December 2015 in Paris, 195 nations agreed on a new comprehensive climate protection agreement. The main goals are to limit the increase in global temperature from pre-industrial levels to well below 2 degrees Celsius – ideally to 1.5 degrees – and to achieve greenhouse gas emissions neutrality in the second half of this century. To ensure the achievement of these goals, all participating nations will define national targets and provide status reports on each successful implementation. The purpose of these so-called "Intended Nationally Determined Contributions" (INDCs) is to improve transparency in the pursuit of a decarbonised global economy.[9]

Furthermore, United Nations' World Urbanization prospects state that urbanization and population growth will possibly add yet another 2.4 billion people to urban populations by mid-century. Since the real estate sector already adds up to 30% of GHG emissions, an additional increase implies that emissions resulting from the real estate industry might even

[5] Gordon et al, Risky business, 2014, p.3ff
[6] Marzeion/Levermann, 2015, p.1
[7] http://www.lloyds.com/cityriskindex/
[8] http://www.zillow.com/research/climate-change-underwater-homes-12890/
[9] United Nations: Adoption of the Paris Agreement, Conference of the Parties, Twenty-first session, FCCC/CP/2015/L.9/Rev.1, Paris 12.12.2015, p.1ff.

continue to grow. It can be expected that a stringent goal-setting, in combination with the inevitably ongoing urbanization, will accelerate the need for further adaptation and mitigation within the real estate sector and individual market participants.

COP21 sets the scene – decarbonization and continuous global warming go hand in hand

The building and real estate industry is, on the one hand, one of the major producers of greenhouse gas emissions and thus a contributing factor to climate change.[10] On the other hand, climate change creates numerous potential risks[11] for the industry, which could have an impact on investment decisions relating to the portfolio management of institutional investors. Due to severe damages related to events like Superstorm Sandy, real estate investors are increasingly taking note of climate risks and many are taking steps to integrate these risks and climate-related investment opportunities into their decision making processes.[12]
An integration of ESG-factors within risk management is starting to focus more on the quantification of impacts on portfolio-performance and strategic asset allocation (SSA).[13] In contrast to more day-to-day portfolio-selection and optimization activities, SAA is presently aiming to determine the long-term asset allocation and therefore enables high-level decisions on asset classes and regions, in order to achieve long-term company objectives. The tools and methods applied here are therefore different from those used for portfolio structuring (e.g. allocation to asset weightings, investment styles and sectors, asset manager selection). To date, many investors tend to rely on a more bottom-up integration of the implications climate change might have on their real estate portfolio. They tended to invest in adaptation or certified properties whenever the opportunity arises. However systematic risks for specific markets or regions will only be identified by also adopting a top-down view. Only then can changes in the underlying determinants of real estate risk and return structures, unexpected adjustments for more large-scale events like hazards and overall market risk be identified.

Asset analysis in need of new approaches – historical quantitative analysis will not capture future changes

Conventional methods of modeling the strategic asset allocation (as a key element of portfolio management process, accounting for up to 90% of the variation in portfolio returns) do not account for climate change risk in most cases. Traditional tools and models rely strongly on the derived implications based on historical quantitative analysis. In contrast of course, most of the risk related to climate change involves forward looking data and studies which are often only available in a more qualitative form. To obtain a clear view on possible outcomes of future performance, the uncertainty in and fundamental shifts of the real estate industry must be captured with scenario analysis or other appropriate tools. Accordingly, investors have to use new tools to more precisely integrate and model systemic risks like climate change. Historic data and a focus on volatility will be not sufficient to capture this “new” investment environment. Long-term asset value can only be protected if risks are identified and integrated into scenarios and simulations of future climate change. Since the links between manmade emissions, rising GHG concentration and climate change are not yet fully understood, potential impacts on assets and regions remain highly uncertain.

[10] BMUB, 2014, p.3.
[11] Lutz, 2004, p.82. / Gabler, 2014.
[12] UNEP FI, RPI, 2012, p.6
[13] UNEP FI - Property Working Group, 2012, p.7.

Figure 1: Framework for climate change risk management

Source: *Own illustration referring to ECA, 2009, p.*

ULI's *Guide for Assessing Climate Change Risk* highlights that understanding risks can result in better methods for addressing and mitigating these risks, as prevention can be more cost-effective than recovery after disaster.[14]

Assessment of these risks is the second step in the risk management process, after identification. Risk assessment can be used as a basis for developing appropriate control measures for portfolio management and for strategic asset allocation.[15] A distinction must be made between quantifiable and non-quantifiable information. The quantifiable risks are evaluated using key indicators. However, data that is not directly quantifiable has to be evaluated indirectly, for example using a scoring model[16], or must first be converted into scalable values.

From the investor perspective, the structured and regular monitoring of sustainable features of buildings and the resulting key indicators and KPIs are essential for establishing a practice-based portfolio management model (*inside dimension*). In addition, it is important to define basic data that is needed to assess the general parameters of asset locations (*outside dimension*).

Strategic allocation based on inside and outside analysis.

Sustainability-orientated key indicators at the property level (inside dimension) are by now "common sense" and to a great extent a market standard. As a reference point for sustainability controlling, the KPIs and structural guidelines of the specialized organizations like *MSCI*, the *Green Rating Alliance* (*GRA*) and the *ULI Greenprint Center* – as well as

[14] ULI, 2015. .
[15] Wiedenmann, 2005, p.23
[16] Gondring, 2008, p.628

GRESBE[17] are applied at the portfolio level. Data sets for ongoing monitoring of the portfolio are also available from UNEPFI.[18] The figures are to a great extent aligned with the standards set out by the m. *Gobal reporting initiative* (*GRI*) (for sustainability reporting on company level) and the *Carbon Disclosure Project* (*CDP*). The institutions all have defined KPIs for the real estate sector and a huge amount of supporting material to enable data gathering and analysis. In addition; the industry bodies like Z*IA*, *EPRA*[19], *INREV*[20], as well as the *European Federation of Financial Analysts Societies* (*EFFAS*) have developed guidelines for ESG-Controlling.

The former "*Greenprint Foundation*" was turned into the "*ULI Greenprint Center*" in 2011 – an international association of real estate investors set up to improve the environmental performance of the real estate market. This improvement in performance is achieved by measuring and benchmarking the CO2 emissions and consumption data of individual properties and subsequently aggregating the information. Benchmarking software has been developed for this purpose and provided to the members. Since its foundation, the ULI network has expanded its activities and covers as many as 150 funds and over 3,000 properties. Yearly investigations are carried out to observe typical consumption levels, such as water, energy and waste, looking in detail at the user and the features of the observed property. The data is not audited, but is submitted by participants and then subjected to plausibility checks. The raw data is regularly aggregated into key indicators, which provide the information basis for sound decision-making. In this context the term "Key Performance Indicators" (KPIs) is often used. Thus, the main objective is to evaluate information considered to be a determining factor for an asset's sustainability.

Set of KPIs enables bottom-up asset analysis.

Current studies have found that as many as ¾ of all real estate investors and companies actively use sustainability KPIs in their capital market communication. The greatest importance is attached to primary and final energy demand – and thus indirectly, to greenhouse-gas-relevant values and the issue of energy efficiency. One specific KPI most frequently mentioned is the annual site-specific heat energy consumption of the properties, expressed in kWh/m². Market players, for example, report at the company level on annual CO2 intensity per customer visit (commercial real estate portfolio holders) or on annual CO2 intensity per office worker (office real estate portfolio holders).

One major challenge for the companies is the quality of their data and being able to guarantee its consistency in relation to other market players. However, to determine individually appropriate management values for real estate portfolio management, it is paramount that results be comparable. In order to ensure such comparability, it is also important to use identical reference values for properties or, if appropriate, to make necessary corrections in the form of additions and deductions. When comparing consumption, it is particularly important for measurements to be standardized. This includes adjustments regarding the usage intensity of an asset, climate impact, vacancy rate and operation and usage time. There are already several guidelines for this area, but as yet, no consistent, internationally recognized standard. Another example of the complexity of deriving meaningful results is the fact that, to

[17] Gresbe, 2015, p.2ff
[18] UNEPFI, 2014, p.17
[19] "Best Practice Recommendations on Sustainability Reporting" (BPRSP)
[20] INREV Sustainability Reporting Recommendations

derive useful data on greenhouse gas emissions, the respective energy source has to be taken into account.

Rising need for information on the C02-footprint of properties.

In the past few years, especially carbon asset risk (CAR) has gone from an expert topic discussed at scientific conferences, to an essential consideration of institutional investors around the world. Major market participants reveal a clear trend of reducing their exposure to effected assets and their overall footprint.[21] Companies can run an analysis using quantitative methods (e.g. estimation of carbon footprint, as well as stress-testing their portfolios for significant carbon constraints)[22] and an increasing number of private companies already set internal carbon prices.[23] This is also due to the fact that considerable progress in carbon pricing has been made during the last decade – regardless of the currently low prices. Today, more than 40 national and approximately 20 subnational jurisdictions (reflecting 25 % of global GHG-emissions) are setting a price on carbon.[24]

It looks very likely that priority will be given in future to making the so-called "carbon footprint" of individual properties more transparent. On this basis, targets will be set to reduce greenhouse gas emissions accordingly. In the upstream stages of the value-added process, the issue of grey energy, i.e. consumption and accompanying emissions, will presumably become more relevant. Intensified debate within the industry regarding “Low Carbon Assets” and “Unburnable Carbon” will speed up this development.[25] Markets have just begun to factor in the long-term shift to a low-carbon-economy into valuation models and capital allocation. For instance, current investments in clean energy account for $250 billion per year. Experts have estimated that limiting the increase in global temperature to two degrees Celsius would require on average, additional investments in clean energy of at least $1 trillion per year between now and mid-century.[26]

Properties cannot be moved – choice of location matters in the light of changing climate.

Besides the inside-dimension, the assessment of environmental and other context factors of the portfolio must also be carried out (outside dimension). The external conditions cannot be controlled or influenced by the investor, which reveals the compelling need for more focused analysis on this subject in the light of climate change.

[21] Carbon Asset risk, 2015, p.5ff: for ex. “The divestment by the Norwegian sovereign wealth fund of coal companies deriving above 30% of revenue (from fossil fuel businesses) potentially leaves 122 companies to be sold.” // Unburnable Carbon 2013: Wasted capital and stranded assets, 2013, p.2ff
[22] Carbon Asset risk, 2015, p.8 // Global Investor Survey, 2013, p.7: “83% of respondents are utilising a combination of qualitative and quantitative data, with 17% solely using qualitative inputs. Quantitative data is being used by most respondents for the investment analysis of valuations and for engagement purposes.“
[23] The World Bank, Kossoy, Peszko, Carbon pricing watch, 2015, p.4
[24] The World Bank, Kossoy, Peszko, Carbon pricing watch, 2015, p.1ff
[25] RICS Europe Sustainability Task Force (editor), 2013, p.18.
[26] Global investor statement on climate change, 2015, p.1

In order to assess the impacts of climate change on investment, a differentiation can be made between three main aspects, according to a concept first suggested by *Mercer*, namely the so-called "TIP"-risk-assessment -concept:[27]

- Technology (T) – the rate of progress and investment flows into technology related to sustainability, low carbon and efficiency, impacting on the pay-off of these properties (e.g. innovation rate, consumer preferences)
- Impacts (I) – negative implications due to climate change (e.g. extreme weather events, rising sea level etc., and also consequences like migration and reduced economic activity in certain regions)
- Policy (P) – intensity and timing of climate policies also affecting changes in the cost of carbon and emissions levels, as well as increasing or reducing the need for adaptation (e.g. global commitments, regional/EU regulation, national regulation)

Whereas "policy" and "technology" are not the focus of this paper, external impacts will be discussed in detail, and are also an essential part of the survey.

IPCC describes in detail the various climate-related risks and potential differences with regard to regions.[28] Their experts also stress that urban areas and the built environment are severely (negatively) effected by climate change. Especially the need for clear governance and smart policy, in order to ensure more resilience for the real estate industry, is highlighted. [29] Other institutions like the *World Bank* have also published reports analyzing in detail how regions and sectors might be affected.[30] These reports also focus explicitly on the complex functional chains which are of crucial relevance in order to derive strategic decisions.

Various country rankings analyze vulnerability, adaptation and climate risks.

Many organizations and researchers have already developed tools and methods for analysing countries with regard to their individual vulnerability. The reinsurance companies *Munich RE* and *Swiss RE,* in cooperation with the *Centre for Research on the Epidemiology of Disasters* (CRED), the *United Nations Development Programme* (UNDP), the *Asian Disaster Reduction Center* (ADRC), as well as the *International Strategy for Disaster Reduction* (ISDR), already in 2007, developed a consistent terminology and hierarchy for natural hazards.[31] Their tools, like catastrophe models (CAT), are highly efficient software that can predict average financial losses for properties, caused by hazards. [32] Forecasts are based on predictive data from global and regional circulation models that determine sea-level rises, temperature rises, and other aspects of climate change using complex statistical methods. Input data also accounts for different scenarios regarding levels of GHG emissions, urbanization, population growth and industry output. Companies like UBS have developed their own rating system[33] to tackle ESG

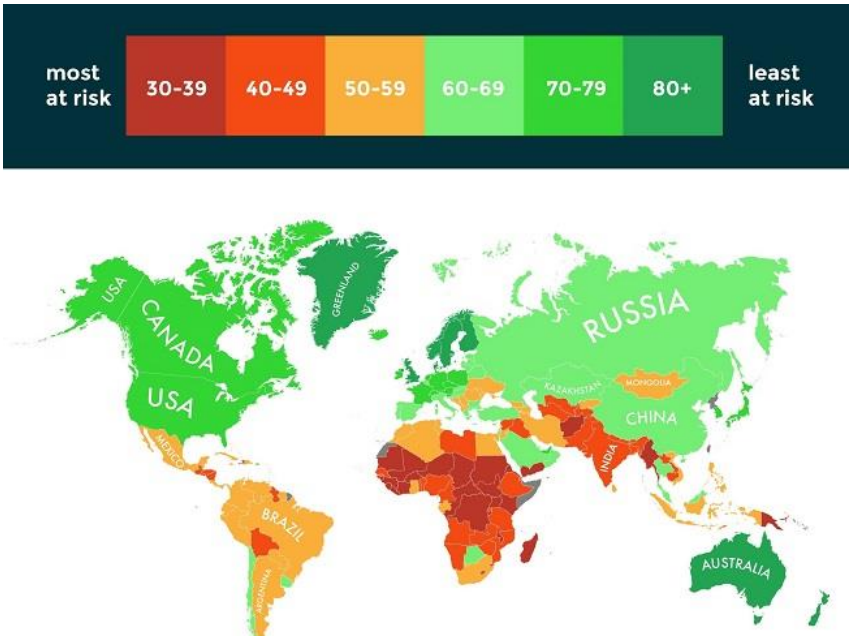
[27] Guyatt, 2011, p.12; p.28
[28] IPCC, 2014, p.12f and 27ff
[29] IPCC, 2014, p.18
[30] World Bank, 2014, p.12: "The data show that dramatic climate changes, heat and weather extremes are already impacting people, damaging crops and coastlines and putting food, water, and energy security at risk."
[31] Munich RE, 2011.
[32] ULI, 2013, p.12
[33] UNEP FI, RPI, 2012, p.18

risks; and Sonae Sierra has also undertaken an analysis to evaluate the potential impact of climate change on their assets.[34]

Often, data input for three critical problems is used, namely increasing weather-related disasters, a rise in the sea-level, and loss of agricultural productivity. [35] Investors can meanwhile also rely on a growing number of indices, which evaluate in a structured form, the areas of vulnerability, adaptive capacity and as a result, the resilience of countries.[36] The most relevant indices are: the *Climate change Risk Index* (*CRI*); *WorldRiskIndex* (*WRI*); *Notre Dame Global Adaptation Index* (*ND-GAIN*); *Center for Global Development* (*CGDev*); *Climate vulnerability Monitor* (*DARA*), *Climate change vulnerability index* (*Verisk*).

The *Notre Dame Global Adaptation Index* (ND-GAIN) analyses "which countries are best prepared to deal with global changes brought about by overcrowding, resource-constraints and climate disruption."[37] The results are based on the aggregated scores of many different indicators. The overall score reflects the country's vulnerability to climate-related extreme weather and also the respective readiness to adapt to the identified challenges. It must be stressed that to date, there is no consensus regarding concepts and metrics in the context of climate change risk indices. The input of each index, data gathered, underlying framework and so on, still vary to a great extent. Nevertheless, studies that compare the indices, stress that the most vulnerable identified countries are more or less the same.[38]

Figure 2: Notre Dame Global Adaptation Index (2015)

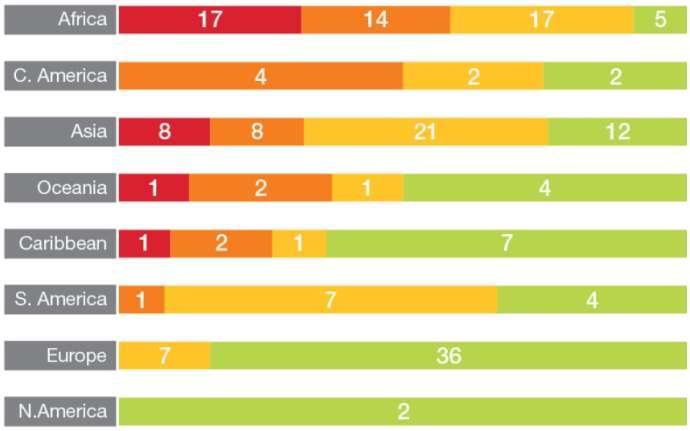


Source: *Eco Experts, visualizes 2015 data from the University of Notre Dame's Global Adaption Index*

[34] UNEP FI, RPI, 2012, p.22
[35] Wheeler, 2011, p.2ff
[36] Miola et al, 2014, p.23ff
[37] ND Gain Index, Notre Dame Global Adaptation Index Methodology in Brief, 2015, p.1ff
[38] Colombo et al, 2013, p.1ff: According to all analyzed indices, the most seriously affected countries are Afghanistan, Angola, Cambodia, Laos, Madagascar, Mauritius, Myanmar and Niger.

All results so far stress that regardless of the fact that climate change was caused by rich, technologically advanced nations in the first place, the poorest nations are likely to be the most severely affected. The majority of European and North American countries are relatively better prepared and also less vulnerable to the negative implications of climate change, while many states in Africa, Asia and also the Middle East face a dangerous combination of relatively high vulnerability and limited preparation.[39] It should be noted, however, that countries doing well in these rankings will also face significant losses. Besides the figures we already stated for the US in our introduction, the cost of adaptation to rising sea levels could amount to more than $1 trillion, according to the U.S. EPA's sea-level experts. Also, other experts stress that it would be quite wrong to assume that rich countries will be not affected by climate change.[40]

Figure 3: Regional breakdown of vulnerability



Source: *Verisk, Climate Change Vulnerability Index 2016*

Economic analysis has clearly shown that climate change has a potential impact on GDP, future growth rates, interest rates, inflation, agricultural production and asset values. All applied frameworks quantify the "total climate risk" of the region analyzed. This impact increases significantly beyond 2050 and will be the driving force behind investment risks – especially in the BAU-scenarios.[41] Already over the coming 20–30 years will investment risk result from increased uncertainty regarding new technology, physical impacts and the details regarding regional and global climate polices.[42]

Latest research closes the gap between climate risk and economic impact – making it easier for real estate investors to anticipate pricing effects.

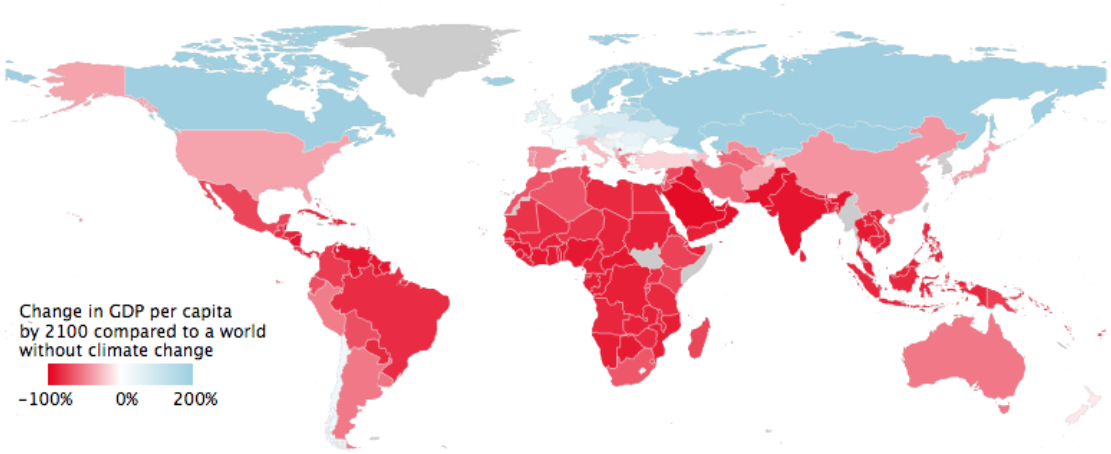
A sound approach to combining data from the areas of vulnerability and adaptive capacity is the model developed by *Grosvenor*.[43] Vulnerability is measured related to climate, resource capacity, infrastructure and other factors. Adaptive capacity relates, for example, to governance, funding and planning systems. Good scores in both segments are the basis for a

[39] See also ECA, 2009, p.11
[40] Burke et al, 2015, p.238
[41] BAU: Business-as-usual.
[42] ECA, 2009, p.11
[43] Grosvenor, 2014, p.5ff

resilient city or region.[44] The authors point out that there clearly *is* a link between resilience and property market risk. Yields in the least resilient cities were substantially higher on a long-term average, than in places that turned out to be very resilient.[45]

Research on the impact of climate change on economic activity appears inconsistent. The latest studies show that overall economic productivity is nonlinear with respect to temperature, regardless of the state of development, region of the country or focus of the value chain. In essence, historical long-term data reveals that productivity is about to peak at an annual average temperature of 13 degrees Celsius. At higher temperatures, output is declining strongly. In other words, if economic activity is dependent on temperature, climate change does indeed matter. BAU[46]-scenario and severe warming would impact on the global economy by decreasing average global incomes by 23% until 2100. [47] Furthermore, global inequality would become even more severe than it is now.[48]

Figure 4: Change in global GDP by 2100 (RCP8.5)

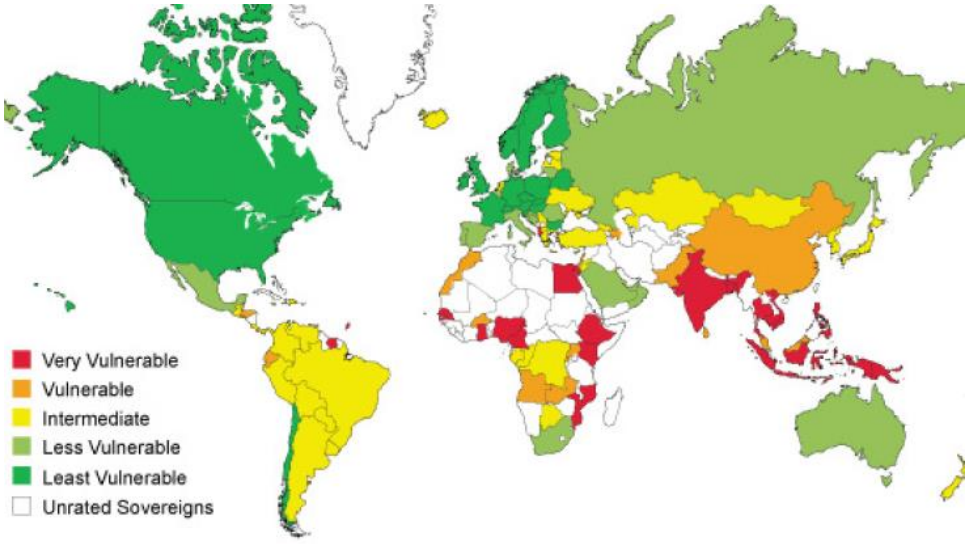


Source: *Burke et al, 2015, p. 238*

Also, according to *rating agencies*, climate change is likely to be one of the most relevant factors impacting on sovereign creditworthiness in the second half of this century. This is due to the impact climate change will have on public finance, economic activity, migration and other channels affecting country ratings. Since it is generally expected that poorer countries are least resilient, it is also likely that lower rating categories will be hit most severely.[49]

[44] See also Arup & Partners, City Resilience Framework, 2014, p.3ff
[45] Grosvenor, 2014, p.10
[46] BAU: Business-as-usual.
[47] Burke et al, 2015, p.238: best estimate, SSP5.
[48] Burke et al, 2015, p.237: "In 2100 we estimate that unmitigated climate change will make 77% of countries poorer in per capita terms than they would be without climate change…. In our benchmark estimate, average income in the poorest 40% of countries declines 75% by 2100 relative to a world without climate".
[49] Mrsnik Marko et al, Standard & Poors, 2015, p.2ff

Figure 5: Potential negative implications of climate change for country ratings



Source: *Standard & Poor´s, 2014*

Using scenario analysis, it makes sense to depict the bandwidth of potential outcome. The results can range from different regional reactions regarding climate change, delayed action due to a lack of political will, all the way to climate breakdown. Clear forecasts regarding the impact on property investments are difficult to make. In any case, the risk of more severe and intensive extreme weather events with catastrophic outcomes will rise – especially in the second half of this century.[50] The cross-city-quality-of-life literature suggests that regions affected negatively by climate change will (due to a lower quality of life and related migration) face declining property prices. *Kahn* is one of the researchers who carried out a hedonic pricing model in order to estimate impacts for the US (cross-county hedonic home price regression).[51] In essence, these models are able to derive figures for the demand side of the equation.

The implications of changing climate must not only take into account the (most relevant) changes on the demand side and aspects of resilience, but also more operative changes, due to increases or potential decreases in operating expenses.[52] Therefore, the issue must be also tackled on a micro level, in order to analyze how property performance is linked to defined locations, asset type and occupant behavior.

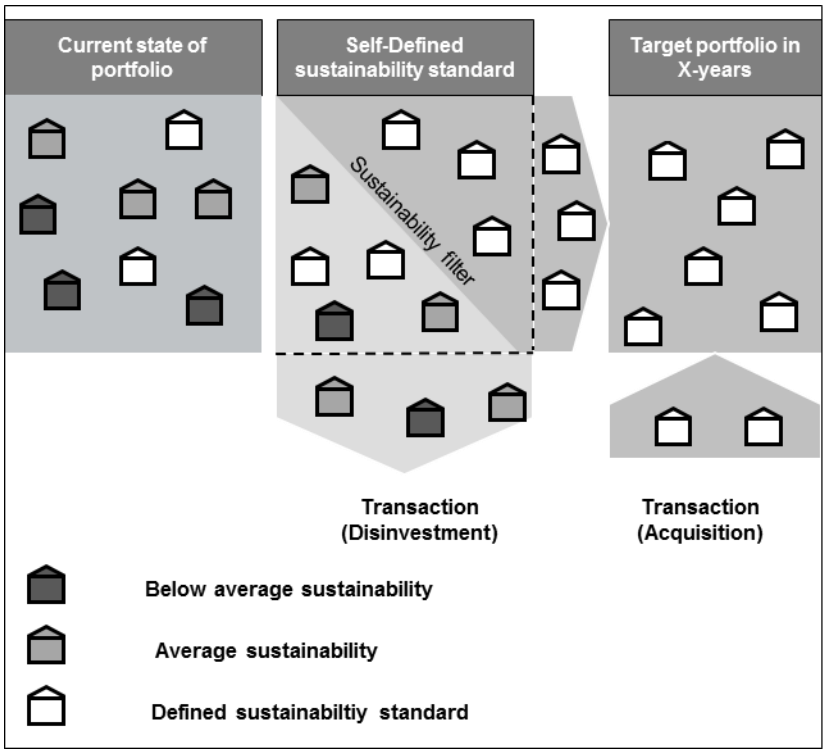
Location and property scores might lead to portfolio changes.

Depending on the property and location-specific results, different norm-strategies regarding the analyzed portfolio may then be applied and lead to shifts that must be executed in day-to-day portfolio management. One result may be disinvestment in certain regions or investments in regions where the investor has not been active to date. Also, massive investments in

[50] Guyatt, 2011, p. 9
[51] Kahn, 2009, p. 11f
[52] RICS, 2011, p. 6

adaptation - with regard to (higher) energy efficiency or (improved) resilience – might be an outcome.

Figure 6: Portfolio-reallocation in the light of climate change



Source: *Own graph according to IVG, 2012, p.15*

4. Study setup and research questions

a. Methodology and setup

We focused mainly on real estate investments, but did also pose the question of whether participants would shift their overall portfolio mix towards other asset classes or – in the light of climate change – might even increase the share of real estate within their overall asset allocation.

The guiding research questions we addressed are:

- What investment risks and climate-change-related aspects must real estate investors take into consideration as part of their strategic decision-making processes?
- Do they perceive the relevant actions as changing over time?
- What impacts do investors think climate change could have on their assets across regions?
- What actions are institutional investors taking today and are they in line with climate projections?
- What tools and methods do real investors rely on?

Essentially, we looked at what risks arise for real estate portfolios, from the perspective of real estate practice, as a result of climate change. We also considered whether, and if so, how the respective risks are assessed within each company's risk management system. Furthermore, participants were able to provide information on what conclusions they had drawn from their risk assessment and what adjustments they had undertaken with regard to climate change and investment strategy. Information was also gathered on impressions of the general market reaction and the future development of climate change.

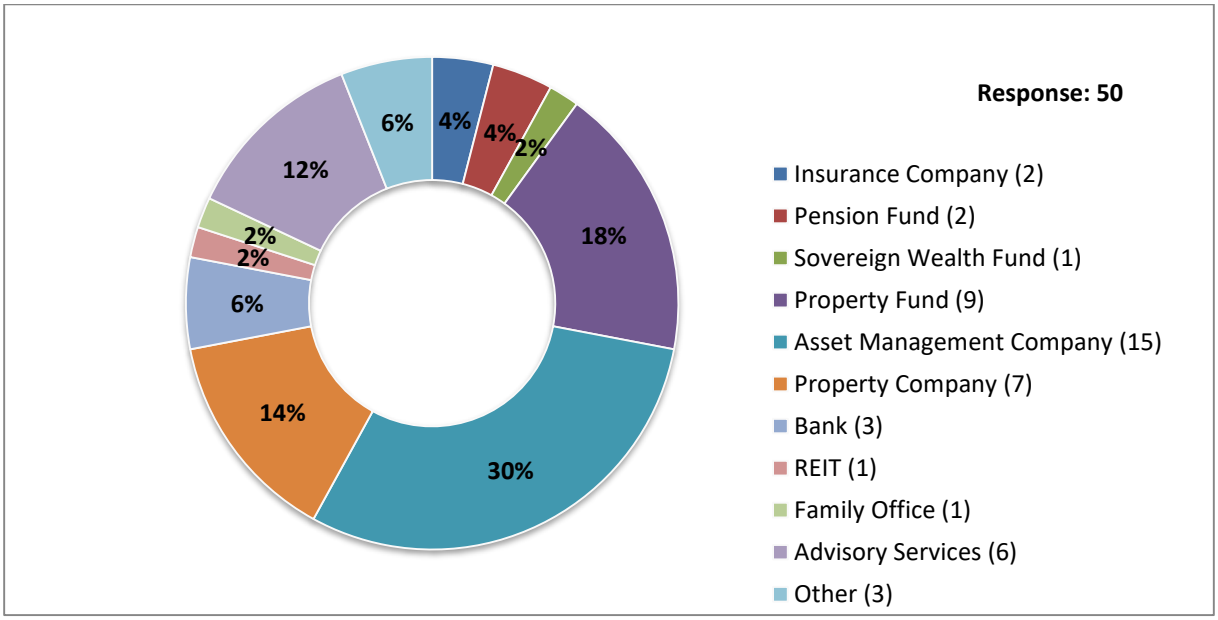
The survey comprised 22 questions altogether. For the purposes of an optimal interpretation of the responses, only closed or half-open wordings were used for the questions. Most were multiple-choice questions that allowed one or several responses, depending on the question. A so-called matrix of potential responses was also partly used, whereby several aspects were asked about simultaneously, but only one response per aspect was possible. Participants were also able to comment voluntarily on their answers in, order to enable further interpretation.

In order to judge whether real estate results are promising or lagging behind other asset classes, we also include insights from other sector studies in boxes after the respective question of this study.

b. Participating investors & portfolio allocation

The first four questions provided a general classification of the investors. Only executive-level, leading worldwide investors and portfolio managers were addressed. In total, 50 usable and completed questionnaires were returned between June 2014 and mid-2015. First, investors were asked what segment matches best with their core activities (Question 1). Participants reflected on the whole range of institutional investors. Corporates who hold the properties for their own use were excluded.

Figure 7: Question 1 – Main business activity of survey participants

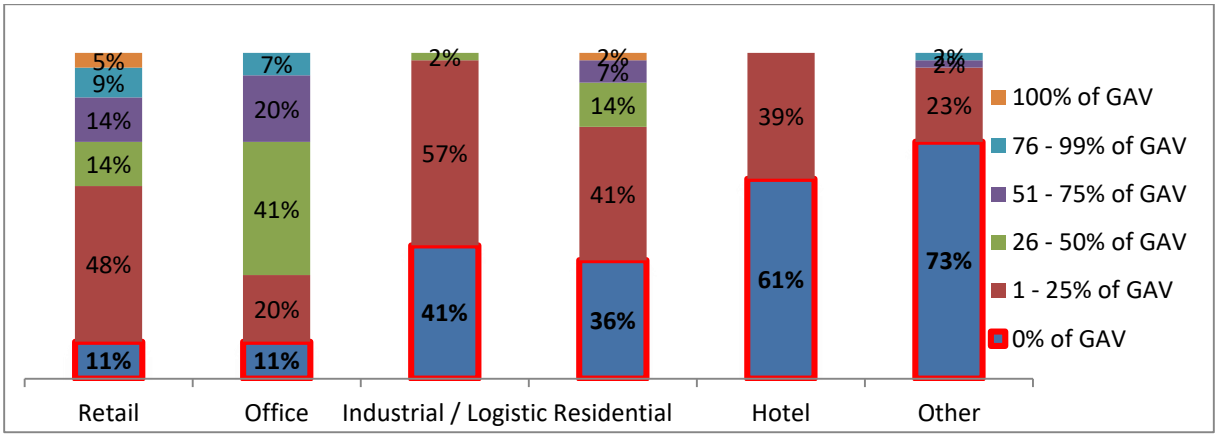


Source: *Prof. Sven Bienert MRICS REV*

According to their own statements, assets under the management of survey participants value approx. €430 Bio. (Gross Asset Value, Question 3). The average stock managed by participants in the questionnaire is therefore on average below €10 Bio. The results reflect answers for 91 % of all "Assets under Management" held by survey participants. When answering the questions (Question 2), only four investors within the sample stated that they were referring to a specific fund they manage.

A broad range of use types were covered in the survey. The majority of participants invested in office properties (89%), followed by retail assets (89%) and residential (64%). Other use types like industrial- and logistics, as well as hotels, were, as expected, of lesser importance (Question 4).

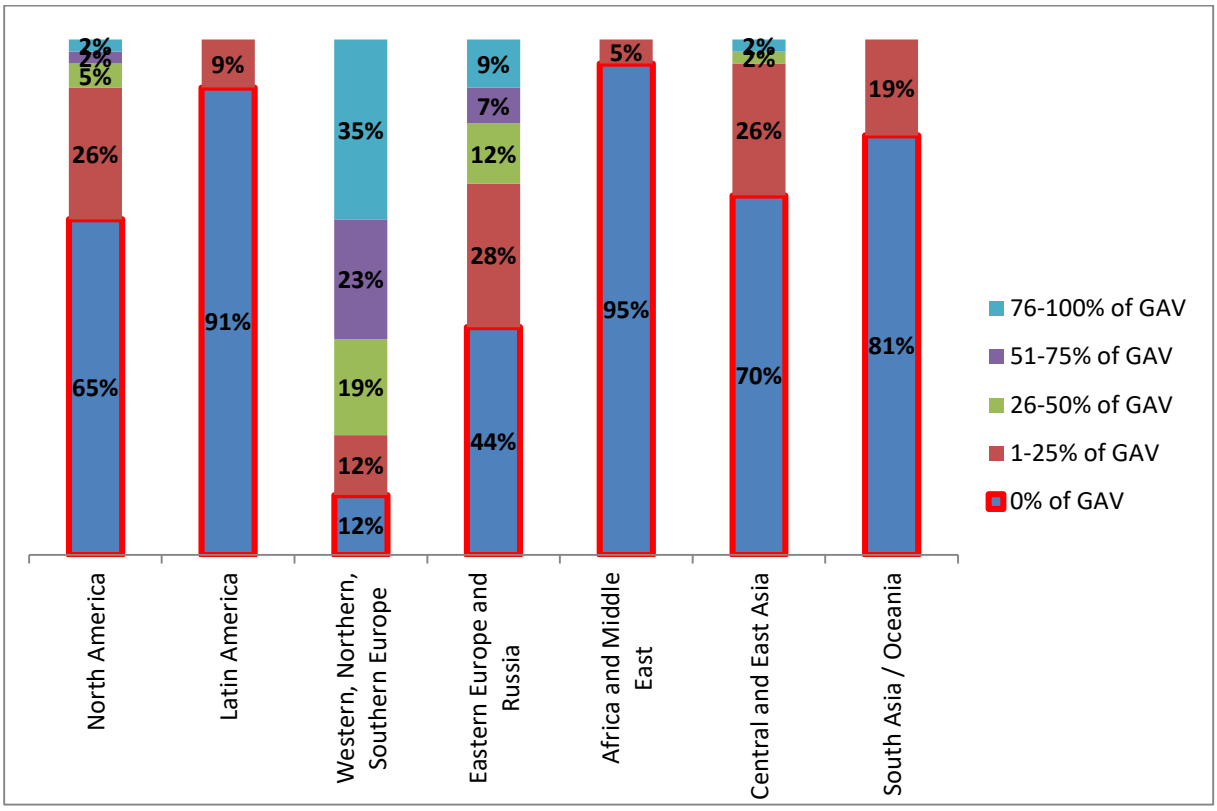
Figure 8: Question 4 – What is the asset allocation of your direct real estate portfolio?



Source: *Prof. Sven Bienert MRICS REV*

The bulk of investors were invested in north-, west- and southern-Europe (88%) as well as CEE and Russia (56%). Taking this into account, the feedback might be biased and focuses on investors with the main investment region in Europe.

Figure 9: Question 6 – Which regions are included in your direct portfolio?

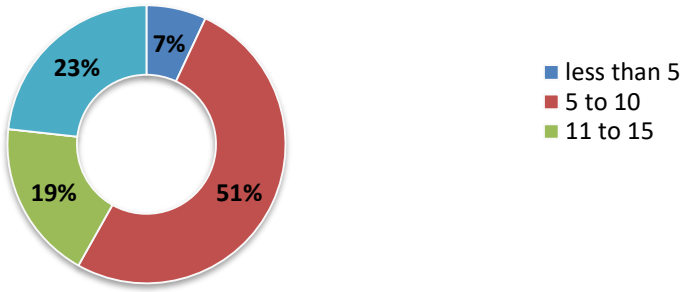


Source: *Prof. Sven Bienert MRICS REV*

5. Survey results

The next question was still rather general, but extremely important, given the background of dramatic climate change. Participants were asked about the intended holding period of their real estate investments. It seems natural that market participants with a shorter investment horizon might place less emphasis on climate risk assessment. More than half of the respondents stated that their average holding period ranges between less than one and ten years (58%). What is positive with respect to the time frame is that 23 % of the consulted people hold their properties more than 20 years.

Figure 10: Question 5 – How long is the average holding period for your direct real estate assets?



Source: *Prof. Sven Bienert MRICS REV*

Regarding the question as to which consequences of climate change have the greatest impact on investment-decisions and strategies today, respondents stated the following aspects – with top-results regarding a major influence (in red) vs. no relevance (in green):

Figure 11: Question 7 – Impact of climate change on investment and strategy TODAY.

	High influence	%	Medium influence	%	Low influence	%	No relevance	%
Gradually changing climate (e.g. temperature, precipitation)	1	2%	14	28%	19	38%	16	32%
Increasing extreme weather events (frequency and intensity)	5	10%	16	32%	20	40%	9	18%
Rising sea levels	1	2%	8	16%	16	32%	25	50%
Deterioration in air quality	1	2%	10	20%	20	40%	19	38%
Migration of people	16	32%	12	24%	15	30%	7	14%
Social conflicts	9	18%	14	28%	17	34%	10	20%
Food security	4	8%	8	16%	13	26%	25	50%
Rising fuel prices	5	10%	17	34%	18	36%	10	20%
Water shortages	2	4%	9	18%	21	42%	18	36%
Energy shortages	9	18%	15	30%	14	28%	12	24%
Other resource shortages	4	8%	9	18%	20	40%	17	34%
Increasing regulation (e.g. related laws regarding energy savings)	14	28%	22	44%	12	24%	2	4%
Changing technological requirements	15	30%	25	50%	7	14%	3	6%
Rising insurance premium	5	10%	14	28%	23	46%	8	16%
Higher construction costs (due to adaptation)	11	22%	22	44%	13	26%	4	8%
Higher operational costs	16	32%	24	48%	7	14%	3	6%
Other	1	2%	3	6%	5	10%	41	82%

Source: *Prof. Sven Bienert MRICS REV*

It appears that the ongoing regulation (in Europe, especially the recasting of the "Energy Performance Building Directive") of the sector goes hand in hand with technological progress

and therefore, also rising construction costs. In addition, the (running) operating expenses of properties increase constantly. The very substantial migration of people is not directly connected to the abovementioned aspects, but is of course a vital issue.

As expected, the aspects that were rated as not currently relevant were those that could become problematic for investment in the long term and could all is attributed to gradual climate change. However, neither rising sea levels, food security, and deterioration in air quality nor water shortages are issues (yet) for most of the participants with regard to their ongoing investment decisions. On the one hand, this attitude is problematic in the light of the generally long real estate holding periods and long-term problems in this segment projected by forecasts. The need for more intense observation becomes particularly clear if we realize and accept that the questions referred not only to the significance of individual investments, but to "investment strategy". Due to the European bias, the issue of air quality is less relevant than it would be if we were questioning those affected in, say, the Asian market.

Regulation, migration and technology top the list of today's topics.

In total, 80% of the survey participants believe that higher operational costs and changing technological requirements due to climate change have at least a moderate influence on their real estate investments today. Also, increasing regulation (e. g. related laws regarding energy savings) also have a significant influence on today's real estate investment decisions (72% of the participants expect at least a moderate influence). The migration of people and higher construction cost of buildings due to climate change adaptation also significantly affect the real estate investments of participants (the majority of the participants perceive at least medium influence).

Figure 12: Question 8 – Impact of climate change on investment in the FUTURE.

	No change	%	present-10 years	%	11-30 years	%	31-50 years	%	>50 years	%
Gradually changing climate (e.g. temperature, precipitation)	11	22%	13	27%	24	49%	1	2%	0	0%
Increasing extreme weather events (frequency and intensity)	7	14%	28	57%	13	27%	1	2%	0	0%
Rising sea levels	10	20%	7	14%	16	33%	11	22%	5	10%
Deterioration in air quality	17	35%	18	37%	10	20%	4	8%	0	0%
Migration of people	9	18%	30	61%	9	18%	1	2%	0	0%
Social conflicts	17	35%	20	41%	10	20%	2	4%	0	0%
Food security	23	47%	9	18%	9	18%	8	16%	0	0%
Rising fuel prices	8	16%	31	63%	9	18%	1	2%	0	0%
Water shortages	19	39%	9	18%	12	24%	8	16%	1	2%
Energy shortages	9	18%	27	55%	10	20%	3	6%	0	0%
Other resource shortages	22	45%	13	27%	10	20%	4	8%	0	0%
Increasing regulation (e.g. related laws regarding energy savings)	4	8%	43	88%	2	4%	0	0%	0	0%
Changing technological requirements	7	14%	40	82%	2	4%	0	0%	0	0%
Rising insurance premium	15	31%	25	51%	9	18%	0	0%	0	0%
Higher construction costs (due to adaptation)	13	27%	32	65%	4	8%	0	0%	0	0%
Higher operational costs	11	22%	33	67%	5	10%	0	0%	0	0%
Other	41	84%	5	10%	3	6%	0	0%	0	0%

Source: *Prof. Sven Bienert MRICS REV*

Over the next decade, investors expect the most negative implications for their real estate portfolios. Of 16 options, 11 and therefore 2/3 of all criteria were given as "very relevant". Especially further regulation and more technological progress are expected – whereas tech might lead to higher construction cost and a faster economic obsolescence of existing stock.

Further risk areas are extreme weather events, migration of people caused by climate change, rising energy prices and a further increase in construction and running cost.

Climate change, extreme weather and sea level: investors delay dealing with the topic.

High fuel prices might have impact with regard to the location quality of properties, with public transport gaining even more importance in the near future. Less important from the point of view of the survey participants are, in the coming decade, aspects like air quality, social conflicts, and energy shortages or rising insurance premiums.

Results for other sectors

* 51 % anticipated that their company's core business objectives will be affected by natural resource shortages in the next three to five years. 76 % state that water is most at risk.[53]

Over half of the respondents expect climate change to continue in the medium term (11 to 30 years), for example, in the form of a successive temperature rises. Equally, owing to the rise in sea levels and increasingly extreme weather, they predict challenges when it comes to investment. This evaluation overlaps with general climate projections, which forecast significant changes in the middle of this century.

Long-term expectations in line with climate projections.

Although various studies have pointed out that a rise in the sea level could have a considerable impact on the risk situation of properties in coastal regions, 80% of the respondents pay little or no attention to this in their investment decisions. Only 14% or so of respondents believe that this aspect has some medium-term impact on their investment decisions, and none of the investors attach particular importance to it. A potential explanation might by that respondents do not have properties close to the sea in their respective portfolios, so that it may not affect their investment decisions.

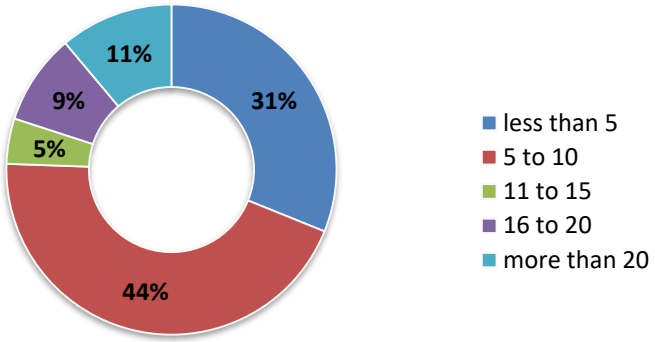
It is also interesting to note that investors forecast major changes due to climate change in the next 30 years. On the other hand, only a handful of individual respondents offered a prognosis for the two most remote periods of time, namely in 31-50 years and > 50 years. This presumably has to do partly with greater uncertainty about the reliability of projections and with the fact that investors lack the instruments or information to make any statements about periods so far ahead in the future.

The next question addressed the period which investors typically select for assessing their investments. 75 % of respondents chose an observation time frame of 10 years. This lends weight to our assumption that long-term potential risk is not being dealt with sufficiently or satisfactorily. Nonetheless, 11 % of the respondents did state that they chose over 20 years as a relevant period for their investment appraisal. If we set this alongside the average holding periods that were given, we can make some interesting deductions (see Question 5 above): 42 % of the respondents stated that they kept the properties longer than 10 years on average; however only 25% were in a position to carry out property assessments for a period longer

[53] EY, six growing trends in corporate sustainability, 2013, p.22f

than 10 years. This demonstrates that long-term risks are being structurally ignored, although they have a direct impact on holding periods and the intrinsic value of the assets.

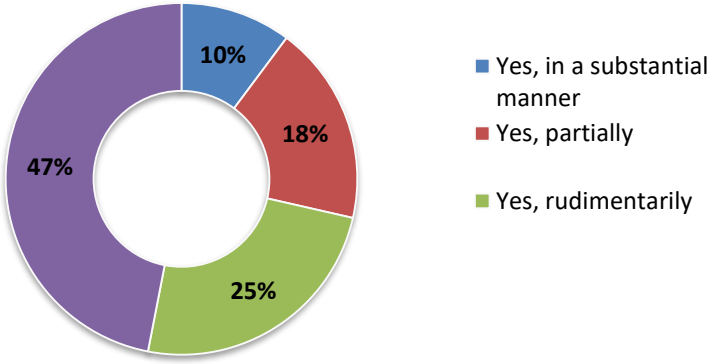
Figure 13: Question 9 – What is the timescale over which you appraise real estate investment opportunities?



Source: *Prof. Sven Bienert MRICS REV*

As mentioned, the impact of climate change is either not being assessed at all by the surveyed companies or only at a very rudimentary level. As the illustration below clearly shows, 72 % of the respondents conduct virtually no assessment of climate risks. Only 10% stated that their risk management took climate-change-related risks into proper consideration.

Figure 14: Question 10 – Do you perform climate change risk assessment for your portfolio?



Source: *Prof. Sven Bienert MRICS REV*

We cannot identify a clear correlation between the average holding period of real estate and the implementation of risk analysis with regard to climate change. In the case of both companies with an average holding period of less than five years, and companies with a holding period of over 20 years, between 50% and 60% carry out an analysis of climate-related risks. In the case of particularly long holding periods, the companies which assess climate-related risks were slightly in the majority.

On closer inspection, about 40% of the asset managers who participated in the survey carry out at least a rudimentary analysis of climate-related risks. When it comes to property companies, the figure is almost 60%.

Figure 15: Question 11 – How do you assess climate change risks?

	No	1-25% of portfolio covered	26-75% of portfolio covered	76-100% of portfolio covered
Scenario Analysis	58%	38%	0%	4%
Sensitivity Analysis	50%	42%	8%	0%
Sustainability Due Diligence for EXISTING buildings	19%	23%	38%	19%
Sustainability Due Diligence for NEW acquisitions	4%	8%	27%	62%
Measurement of KPI	15%	31%	35%	19%
Other	92%	0%	4%	4%

Source: *Prof. Sven Bienert MRICS REV*

At nearly 90%, the most widespread type of climate risk analysis is a sustainability due-diligence assessment in the case of new real estate acquisitions – as expected, this has already become more or less "standard procedure" for institutional investment. This procedure is employed to a lesser extent in connection with portfolio properties. Many investors state that they analyze these types of real estate, although the analysis is often limited to individual portfolio properties. Also there is clear evidence that that climate risk analysis is performed mainly for specific investments rather than at the portfolio level.

The compilation of so-called Key Performance Indicators (KPIs) is also relatively common. Only 15 % of the respondents do not carry out any kind of measurement of sustainability to date. Over 50 % of the investors apply these KPIs to over 1/4 of their total portfolio. Benchmarking initiatives such as Greenprint, Gresbee, GRA or MSCI are boosting this development in the market. At present, we are seeing a great deal of positive activity in this particular segment, and such performance figure systems are becoming increasingly widespread.

Only 15 % of market participants do not carry out any sustainability related measurements to date.

Whenever potential risks are very high, but perhaps cannot be clearly/easily quantified, it makes sense to depict the probable future at least in the form of scenarios, which might provide a more qualitative depiction of the future development of portfolios. It is puzzling, then, that the institutional market players largely ignore the basic available systems for such observations. Instruments such as scenario and sensitivity analysis are seldom employed to assess the impact of climate change. Considering the uncertainties associated with the development of climate change with respect to property values in the future, it would be a good idea to use these instruments. For example, using these analytical methods, parallel changes of several parameters can be analyzed and a certain range of effects defined. This

would allow proactive and timely strategic adjustments to investment activity as a whole or specific individual divestment. The identified lack of use of systems to assess climate risks is supported by the fact that 92% of the respondents state that they have no further instruments for assessment at their disposal (here, effective methods such as Monte-Carlo-simulation would, for example, be helpful).

Our findings are in line with GRESB´s 2015 results. 54 % of the participants had environmental policies in place to address climate change, but only 35 % addressed resilience. GRESB states that climate change risk assessments for investments have progressed.[54] However, our detailed questions regarding coverage and methods reveal that there is still a long way to go in order to make portfolios "future proof".

Currently, only the insurance industry routinely tests its investments against annual losses associated with climate change. The development and adoption of standards for risk evaluation that perform effectively for portfolios and assets a 1-in-100 year stress test and integrate these standards into financial decision making, are therefore a core task.[55]

Results for other sectors

* 79% of respondents state that sustainability risks are incorporated into their enterprise risk management framework. However, only 30 % of the companies said they apply scenario analysis. In essence, risk awareness has not been yet translated into real preparedness.[56]

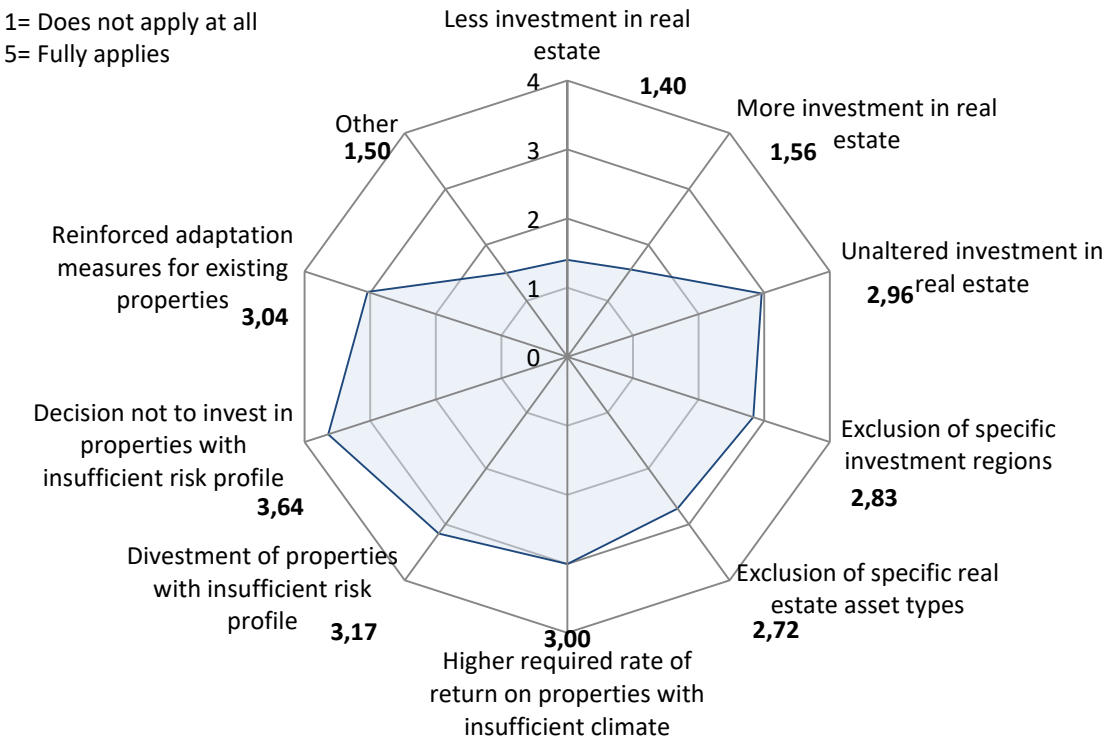
* "Almost all asset owners and asset managers identify climate change as a material risk, but (only) half use a risk assessment framework across the portfolio to interpret it, and only about a quarter have changed an investment process or decision-making process as a result of their analysis."[57]

Also IPCC states that due to the high level of uncertainty, scenario analysis for strategic planning is a suitable tool. [58]

When asking participants which conclusions they draw from climate risk analysis, they stated the following:

[54] Gresbe, 2015, p.13, p.18
[55] Climate Summit, The 1-in-100 Initiative, 2014, p.4
[56] EY, six growing trends in corporate sustainability, 2013, p.26
[57] Global Investor Survey, 2013, p.7, p.15
[58] IPCC, 2014, p. 11: "Future risks related to climate change vary substantially across plausible alternative development pathways, and the relative importance of development and climate change varies by sector, region, and time period (high confidence). *Scenarios are useful tools* for characterizing possible future socioeconomic pathways, climate change and its risks, and policy implications."

Figure 16: Question 12 – What conclusions have you drawn from your climate change risk assessments? (1/2)



Source: *Prof. Sven Bienert MRICS REV*

The graph is easier to interpret when focusing on areas that require a strong need for adaptation. Investors with a multi-asset-portfolio generally do not question the role of real estate per-se. Also, they do not intend to exclude whole regions from their investment universe on this basis. However, a strong tendency can be noticed to exit specific assets identified as no longer matching the defined internal "sustainability-standards" or not to invest any more in properties that fail to reach a certain standard of sustainability-due-diligence when it comes to new acquisitions. Furthermore, risk premiums for inferior properties are likely to increase.

Stronger focus on resilience is on the radar of most investors.

Equally, we can identify the first signs of a closer link between planned refurbishment activities for properties, and sustainability aspects and general climate resilience. All these aspects highlight the fact that "certification" in connection with climate change is also well established in the real estate industry. Increasingly, we will see not only "green premiums" for particularly sustainable properties, but also more "grey discounts" in cases of insufficient sustainability or adaptability of buildings.

Figure 17: Question 12 – What conclusions have you drawn from your climate change risk assessments? (2/2)

Response Choice	Score
Less investment in real estate	1,40
More investment in real estate	1,56
Unaltered investment in real estate	2,96

Exclusion of specific investment regions	2,83
Exclusion of specific real estate asset types	2,72
Higher required rate of return on properties with insufficient climate resilience	**3,00**
Divestment of properties with insufficient risk profile*	**3,17**
Decision not to invest in properties with insufficient risk profile	**3,64**
Reinforced adaptation measures for existing properties	**3,04**

Source: *Prof. Sven Bienert MRICS REV* (*low return in relation to high risks)

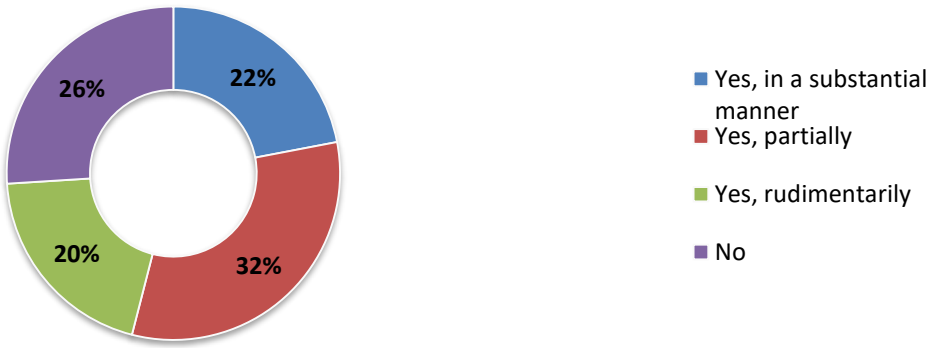
It would seem logical to conclude that real estate with an inadequate climate risk profile should not be considered for investment. This is a relatively simple way of guaranteeing that portfolios have a very low climate risk potential. When investments are made in property with inadequate resilience to the impact of climate change, investors nonetheless expect a correspondingly higher yield by way of compensation.

Compared to the results of *Mercer*, where in scenarios with climate breakdown, real estate as a climate–sensitive asset class has a significantly reduced portfolio weight,[59] investors in our survey did not seem to have any intention to withdraw or reduce real estate allocation in general.

However, for 46 % of the respondents, this issue is not touched on in any depth or is not at all relevant in their management board meetings. At the same time, just over 50% of the market players are apparently already quite active when it comes to the issue. Ultimately, the industry is ambivalent and a large, possibly too large section, does not approach the issue of climate change as a strategically important area.

In general, it should be stressed that effective management, leadership and a governance structure that ensures superior sustainability performance is the foundation for outperforming peers, also in respect of financial figures. To ensure that sustainability and climate change received sufficient board attention, a formal board responsibility for this subject is essential.

Figure 18: Question 13 – Is climate change and / or sustainability a topic of board level discussion?

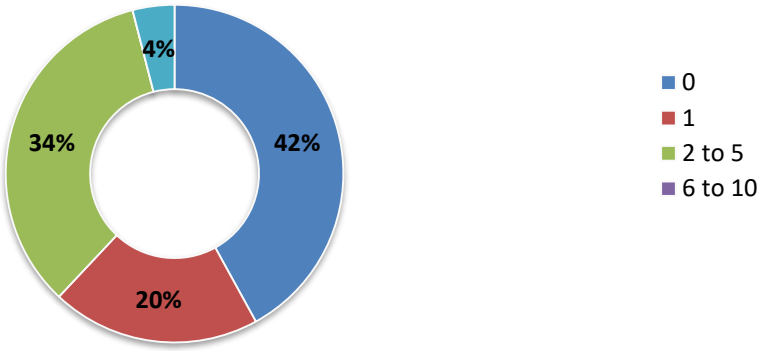


Source: *Prof. Sven Bienert MRICS REV*

[59] Guyatt, 2011, p.12; p.2, 24, 32.

The fact that this issue is underestimated is underlined by the findings of the survey with respect to full-time equivalent staff (FTEs) dealing broadly with the area of sustainability. 42 % of the companies ultimately have no full-time position and another 20% employ only one person. Thus, with a volume of over €400 billion AUM, a total of about 150 people at most deal with the issue of sustainability.

Figure 19: Question 14 – How many members of your company's staff are exclusively employed with respect to the topic of sustainability? (full-time equivalent)



Source: *Prof. Sven Bienert MRICS REV*

It has already been established that in many companies, more staff and greater management board attention need to be dedicated to handling strategic issues relating to climate change. Nevertheless, 58 % of the surveyed market players plan to maintain the status quo in the coming years or to carry out just minor changes. Nonetheless, there are clear differences in the way the investors assess this situation: 42% of the companies are planning to increase measures partially or substantially.

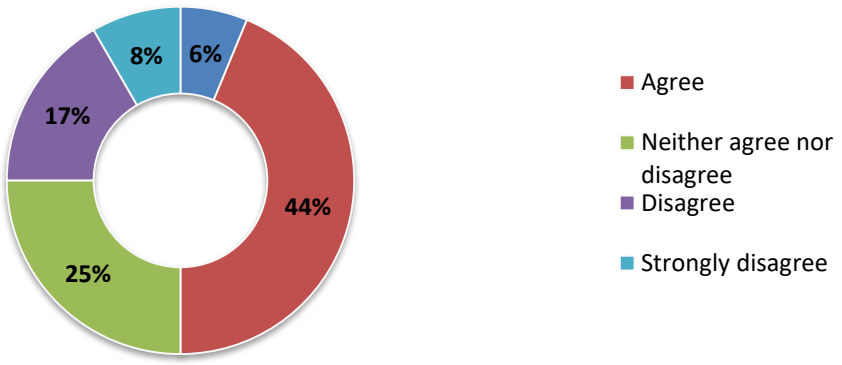
Figure 20: Question 15 – Will you start / increase climate change risk assessment activities in the next two years?

Source: *Prof. Sven Bienert MRICS REV*

Uncertainty in the treatment of resilience issues can also be observed in the way in which green building certificates are generally interpreted. Although most certificates are based on scoring systems, where negative aspects can at least partially be compensated for by positive characteristics, 44% of the respondents equate a certificate with low vulnerability and high

resilience. Objectively, this is an erroneous conclusion and can lead to strategically poor decisions. Only 14% of the respondents rightly reacted critically to the statement. This clearly shows that there is still a lot of work to do in educating companies about basic facts (or in this specific case the way a certificate is interpreted). Only informed investors who interpret available information correctly will be able to make strategically sound decisions.

Figure 21: Question 16 – "Green building certificates are an appropriate indicator of the climate resilience of properties."



Source: *Prof. Sven Bienert MRICS REV*

Next, we asked what kind of adaptation measures the participants intend to undertake.

Retrofitting Measures – Action taken for adaptation

The focus is still on on-site building improvements. These cover a wide variety of activities, but the key focus is still on energy efficiency, and then waste and water management. Half the respondents are currently carrying out such measures for over 25% of their portfolio. A quarter of portfolio holders are even active in this respect for as much as 75% of their real estate portfolio. Only two investors state that they do not carry out any such type of real estate modernization.

It is questionable, however, whether investment by the respondents in improving the energy efficiency of buildings is only intrinsically motivated. Depending on where the investment is located, an increasing number of regulatory measures are being introduced, aimed at increasing the energy efficiency of buildings. In addition to increasing energy efficiency, more than two thirds of the investors are striving to improve waste management in buildings. Nearly one fifth of the respondents state that they are performing such measures for over 75% of their portfolio. This relatively high number might be explained by the fact that, compared to other modernization measures, the improvement of waste systems in buildings generally involves relatively low costs, which, as already mentioned, allows the savings made through sustainable technology to be distributed between landlords and tenants.

Figure 22: Question 17 – Do you carry out the following (retrofitting) measures for existing properties in your portfolio?

Response Choice	No	1-25% of portfolio covered	26-75% of portfolio covered	76-100% of portfolio covered
Energy-efficiency improvement	6%	47%	24%	22%
Water-efficiency improvement	29%	47%	14%	10%
Air-tightness improvement	47%	33%	18%	2%
Waste-management improvement	29%	35%	18%	18%
Improvement of resilience regarding extreme weather events	55%	35%	8%	2%
Energy generation on site	20%	59%	16%	4%
Green procurement	31%	43%	22%	4%
Green building certification	22%	45%	29%	4%
Green leases / Memorandum of understanding	37%	45%	12%	6%
Use of renewables	14%	55%	22%	8%
Other	96%	4%	0%	0%

Source: *Prof. Sven Bienert MRICS REV*

Interpreting the results, one could summarize that generally, the quick gains (like energetic retrofitting) which affect cash flows even in the short run are on the radar of most investors. Only 6 % state they “do not” carry out any energy efficiency improvements. However looking at the portfolio coverage, it is also clear that there is still a long way to go. Most investors (47 %) state they have worked on their respective assets, specifically one quarter of their entire holdings. Only just above 20 % state this is a companywide endeavor. Looking at the policy goals with regard to national refurbishments rates, it seems urgent to speed up activities, since they pay off in the short run. For instance, in Germany, the aim is to have an annual refurbishment rate for existing buildings of around 2 % - the current rate is still just above 1 %. Since these rates are directly linked to the INDCs (Intended Nationally Determined Contributions), it become clear that the industry must work harder speed up the process, so as to meet GHG reduction targets on a global scale.

Besides quick gains, the retrofitting agenda to create a truly sustainable building out of the existing stock is lagging behind since refurbishment rates are in most states currently to low to achieve INDC goals. Again, there seems to be a barrier between investors that are early adopters – and therefore ahead of the market - and a huge group that is still waiting passively and inactively for the inevitable (and obvious) to come. For example, more than 1/3 of the participants stated that they are currently not addressing the issues of indoor air quality, resilience against extreme weather events, green procurement or green leases. 96 % state there are “no other” aspects than those suggested, that they could think of being currently implemented in their companies in order to increase the sustainability of their stock.

GRESB states in its 2015 report that most participants have integrated sustainability into their business strategy, (93 %) inform senior management in a structured way, as well as integrate

sustainability requirements for procurement (76%).[60] Our results indicate that this, however, does not refer in detail to the integration of climate risk considerations into external manager procurement and monitoring – which is lagging behind by far. Also, it seems as if the integration regarding procurement has not yet been rolled out for the entire portfolio. Studies for other sectors confirm this view.[61]

GRESB states in its 2015 report that water conservation measures appear to be growing more slowly than energy-related practices, which is in line with our detailed findings above.[62]

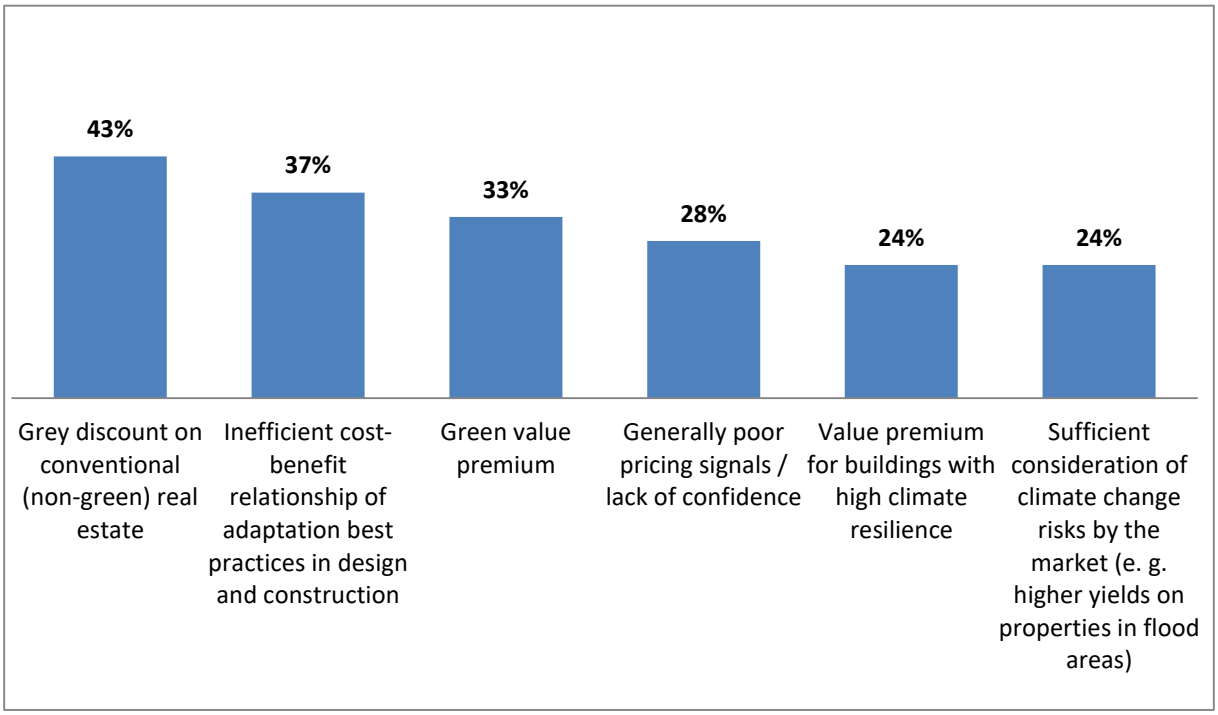
Of course, positive developments can also be noted. Regarding the coverage of at least up to 25 % of their portfolio, just about all of the mentioned 10 areas of potential improvement for retrofitting were taken into account by investors and asset managers. More than 1/3 stated that they are working on these aspects. As expected, certification is again at the forefront of measures. Even though we already concluded that certification is not necessarily equivalent to the "maximum sustainability level" or "highly resilient" –a lot of the abovementioned retrofitting aspects might still be subsumed under the "ongoing maintenance measures", meaning that the CEO might not even know that the detailed aspects have already been carried out, since he is only aware of the resulting certificate.

The results are in line with GRESB 2015 findings, in which green building certificates for construction were obtained by 51%.[63]

Clearly the message is as follows: increase awareness, reveal pay-offs to decision makers and speed up investments. Only if all of the three mentioned triggers work together, will the amount of refurbishments increase and management approaches shift hand in hand. But one has to be careful: the problem is not only the missing information or a lag in awareness. Industry leaders need to be better informed about the insecurity associated with the potential outcome of events that might influence any pay-off regarding the investment they are undertaking at present. A sensible start is to obtain a clear picture about the market impact of climate changes that can already be observed.

[60] Gresbe, 2015, p.12ff
[61] Global Investor Survey, 2013, p.8: 83% consider the extent to which managers integrate climate change into their investment process and ownership activities, 63% monitored their existing asset managers on climate change integration. However, only 23% have set clear expectations of their existing managers on climate change in their IMAs.
[62] Gresbe, 2015, p.13
[63] Gresbe, 2015, S.17

Figure 23: Question 18 – Which of the following / current market impacts of climate change do you observe?



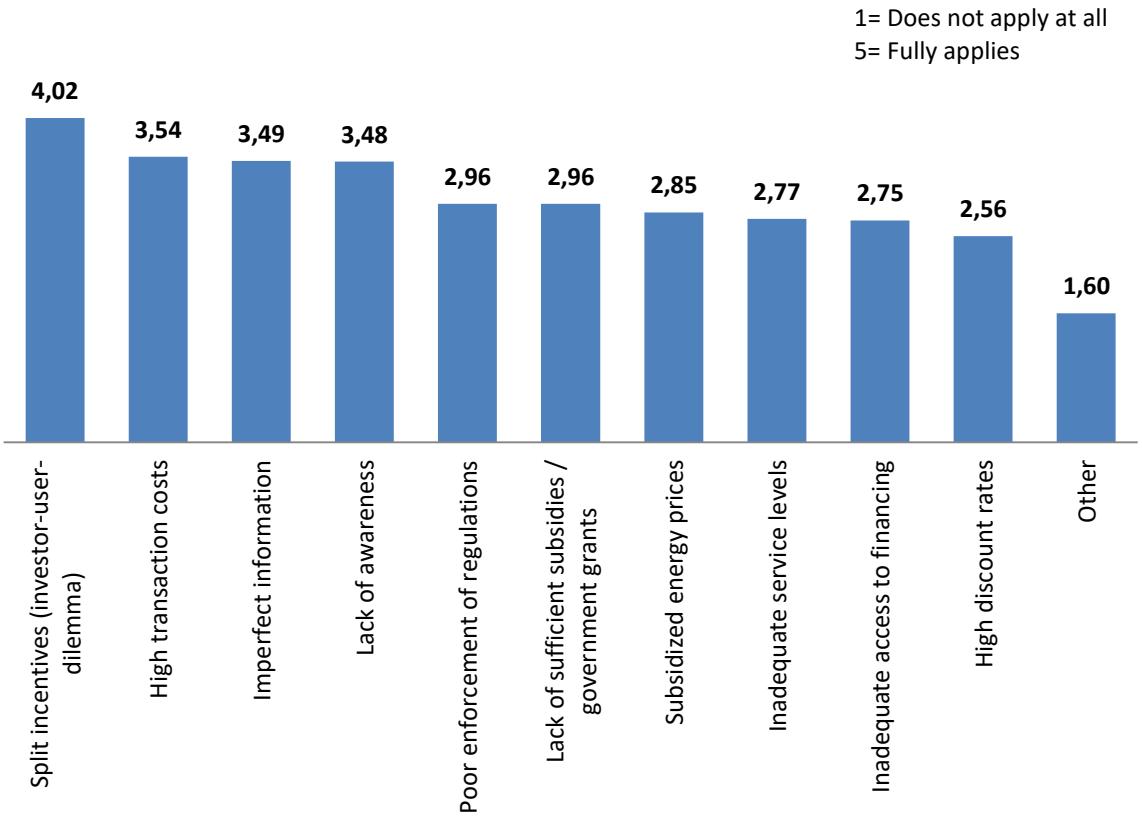
Source: *Prof. Sven Bienert MRICS REV*

Interestingly, most investors stated they already observe grey discounts for less "sustainable" buildings. This is surprising, since all research studies state that after a period of green premiums for "very" sustainable buildings that are ahead of market standards, the situation is likely to evolve and the more common green buildings become, the more likely grey discounts become. It seems that this situation is already starting to become reality in some of the analyzed market segments and regions. Another statement of the industry is also loud and clear: we need quantitatively more, and more precise pricing signals. 37 % of the respondents stated that the "cost-benefit-relationship" is insufficient and 28 % complained about generally "poor pricing signals". This is a clear call for politicians and the regulatory framework. In a market environment, investors will allocate their funds to the highest yielding opportunity – without a reasonable relationship between cost-benefit, this might not be retrofitting. Grants, subsidies, tax incentives and a good regulatory framework can influence this outcome positively.

The answer of up to 1/3 of the market participants, who stated that there are positive pricing signals like green premiums or a yield spread between highly resilient and highly vulnerable properties, is promising and encouraging.

Besides the stated market impact, it is interesting what investors and asset managers believe are the main reasons for poor or insufficient pay-offs. Therefore, we asked the participants to state their impressions regarding the main barriers for a faster uptake of green retrofit technologies in the industry.

Figure 24: Question 19 – What are the main market barriers to a faster uptake of green retrofit technology for real estate?



Source: *Prof. Sven Bienert MRICS REV*

Above all, the investor-user dilemma scored highest (4,02). According to these aspects, investors question the pay-pack of their sustainable investments. This aspect is further stressed by the fact that respondents stated that transactions cost for sustainability-related investments and technologies are still too high in a lot of cases (3,54). A solution – at least to some extent – might be a further implementation of "green leases", which, as already mentioned, enables the cost savings made through sustainable technology to be distributed fairly between landlords and tenants. A number of EU countries have already amended their regulations for this purpose. For example, in Germany, the so-called "*Mietrechtsänderungsgesetzes*" (Tenancy Law Amendment Act) in the housing sector allows parts of renovation costs to be apportioned (up to a certain limit), to a lease agreement, in effect without previous contractual agreement. Also, aspects related to the underlying information that forms the basis for potential investment is somehow in sufficient. "imperfect information" and a "lack of awareness" therefore also score high among survey participants.

The subsidization of energy costs could theoretically have an impact on the demand for sustainable technologies in two respects. Firstly, a greater extraction of fossil fuels could serve to push the use of sustainable technologies into the background. Secondly, the subsidies which are intended for innovation in sustainable technology, might be too low. Particularly

the fact that energy prices are currently low poses an additional challenge for the feasibility of energetic retrofits.

Approx. 1/3 do not yet include adaptation measure in Capex-budgeting.

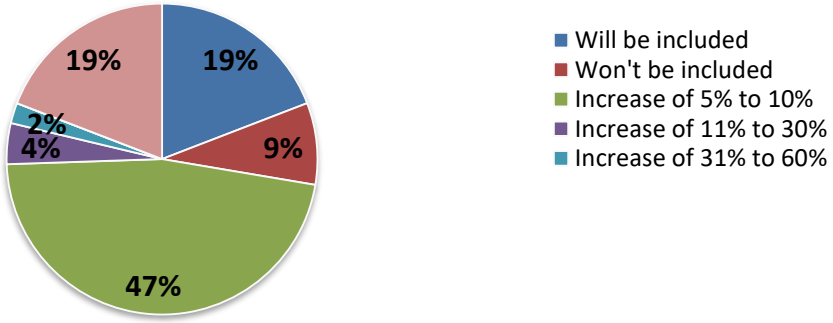
We then asked if adaptation measures for the existing property stock are currently included in the regular CAPEX-budget. 73 % stated that this is the case. However, 27 % of market participants *do not* yet include these aspects in their regular budget. This is again a clear indication that a large portion of the market is within their day-to-day business and that they are passive regarding future climate change and potential effects that might harm their existing portfolio.

Figure 25: Question 20.1 – Are adaptation measures for properties currently included in your capital expenditures budget?

Source: *Prof. Sven Bienert MRICS REV*

Regarding the outlook with regard to adaptation measures, most investors anticipate an increase in the CAPEX-budget of up to 10 % and also expect the adaptation measures to be included in future budgets.

Figure 26: Question 20.2 – How will these capital expenditures develop in the next five years?



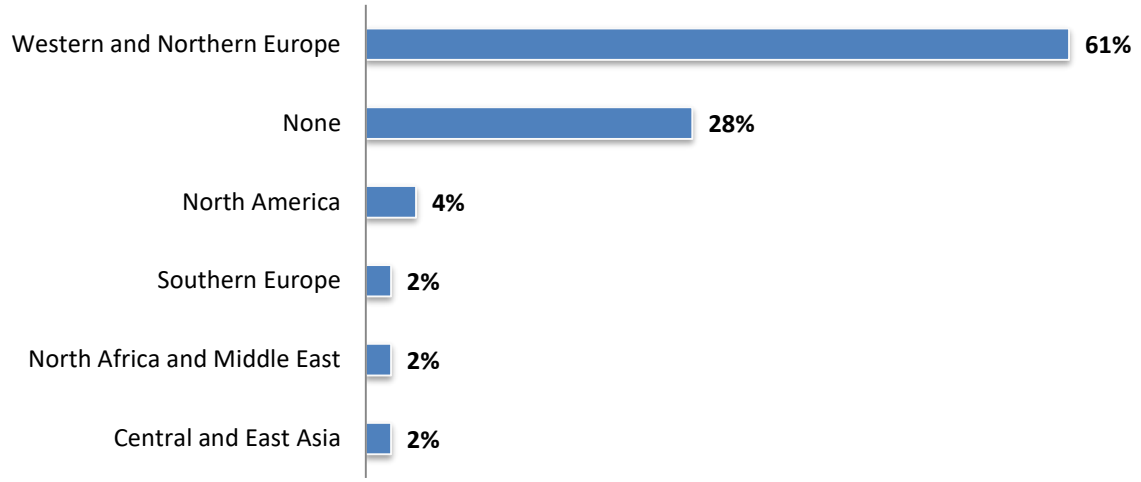
Source: *Prof. Sven Bienert MRICS REV*

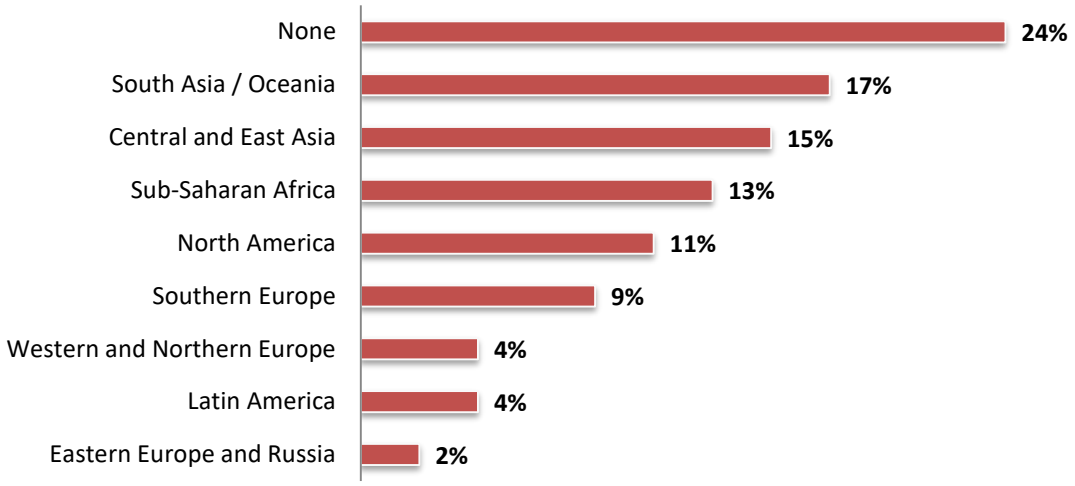
We then moved on to a very hypothetical or perhaps more correctly (given the insecurity and imponderability's associated with climate change) philosophical question. We raised the question of whether the market participants could make a spontaneous guess regarding a region that might evolve as a "climate change winner" with regard to real estate business and a "Climate change looser". The precise wording was "Please name an investment location (region) which has, from your point of view, the biggest upside (or the biggest downside) potential, due to climate change in the next 20 years." As expected, the participants could not draw a clear picture – which is clearly related to the lack of information and insecurity, see above).

Europe: a "climate change winner"?

One might interpret the above as implying that more developed regions like Europe are more likely to be a continent on the winning curve than less developed regions. This statement would be in line with general research on this subject that points to a sophisticated and predictable regulatory framework, as well as sufficient financial resources (of the state) are essential for coping with climate change. However, this part of the survey is of course highly affected by personal perceptions – as, for instance, the extreme weather events in the Philippines, which might have influenced perceptions of Asia as a region at that time.

Figure 27: Question 21 – Climate change "winner regions" and "loser regions"





Source: *Prof. Sven Bienert MRICS REV*

The overwhelming majority of investors consider Northern and Western Europe to be definite climate winners (62%). 26% of the respondents, however, believe that no region will really benefit from climate change.

The response to the question as to which region will suffer the greatest impact from development of climate change was less clear. 24% of the surveyed investors stated that they do not expect this for any region in particular. 21% of the respondents, however, stated that they saw the regions of South Asia and Oceania as climate losers. 15% of the companies believe that North America, Central and East Asia will be most affected by climate change. A smaller number of respondents feel, however, that Southern Europe (9%) or Northern and Western Europe (6%) should be seen as climate losers.

Figure 28: Question 22 – Which climate change impacts do you expect in the following regions?

Response Choice	Rising temperature	More precipitation	More drought	More storms	Rising Sea level	Unsure
North America	62%	60%	49%	78%	40%	24%
Latin America	45%	40%	40%	50%	40%	36%
Western and Northern Europe	67%	64%	29%	38%	42%	13%
Southern Europe	67%	40%	56%	31%	40%	18%
Eastern Europe and Russia	57%	34%	39%	23%	27%	32%
Sub-Saharan Africa	61%	25%	57%	23%	30%	36%
North Africa and Middle East	58%	23%	51%	16%	28%	35%
Central and East Asia	56%	49%	42%	51%	44%	36%
South Asia / Oceania	58%	42%	36%	56%	67%	31%

Source: *Prof. Sven Bienert MRICS REV*

Looking at the results in more detail, investors expected the following threats to be more relevant for the regions in the future. Comparing the results with IPCC and other forecasts, the respondent's did not too badly. Primary differences and similarities between respondent perceptions and scientific predictions are summarized below:

- **Africa:**[64] Respondents diverge from the IPCC in relation to storms. According to the IPCC, more frequent storms are expected as a result of higher temperatures. Storms are relevant to the real estate industry as they may cause damage to real estate. Only two respondents have assets in that region. One respondent correctly identified that storms will to have an impact, but diverging from the IPCC's view by stating that that precipitation will increase. With regard to heat and droughts the respondents were in line with climate experts.
- **Asia**:[65] Respondents' expectations diverge to some extend from predictions set out in the 4th IPCC report in relation to precipitation and storms. Precipitation is difficult to predict as most areas of the Asian region lack sufficient observational records. Storms are expected to be more severe but not necessarily more frequent. This is a key difference as 90% of population in Asia is exposed to tropical cyclones, which are expected to be worsened by sea level rise, even if there is no increase in frequency in storms.
- **Australasia**:[66] Respondents' perceptions regarding rising temperature and more droughts were not as severe as IPCC's predictions. This is significant because fires during hot, dry and windy summers can cause substantial property damage. Fire management is identified by the IPCC as increasingly challenging, as there is the potential for it to exacerbate existing conflicts between biodiversity conservation versus protection of property. The IPCC also noted effects on property prices as a barrier to adaptation options to address river and local flooding, and coastal erosion and inundation.
- **Central and South America**:[67] Only 45 per cent of respondents correctly identified temperature increases as a risk for Latin America, despite the IPCC predicting that temperatures in South America could increase by as much as 6.7 degrees Celsius by 2100. This increasing temperature is likely to exacerbate problems of water stress and intense precipitation events, both of which may result in property damage.

[64] Niang, I. et al. (2014) Africa. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1199-1265.

[65] Hijoka, Y. et al. (2014) Asia. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1327-1370.

[66] Kitching, A. R. L. et al. (2014) Australasia. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1371-1438.

[67] Magrin, G. O. et al. (2014) Central and South America. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1499-1566.

- **Europe**:[68] Respondents understood with the greatest degree of accuracy the implications of climate change in the European region. For Europe, the IPCC identified risks resulting from flooding in river and coastal regions as a result of sea level rise and more intense and frequent precipitation.
  At present, we are talking about a moderate key risk that could increase in the long term, depending on the development of climate change. Respondents also expect these events. However, only 31% of the investors assume that there will be effects in Northern and Western Europe caused by a rise in the sea level (Southern Europe 38%, Eastern Europe and Russia 22%). Thus, here we see a lack of awareness on the part of the companies that were surveyed. In southern Europe, the IPCC also expects more frequent drought periods and heat. Both temperature rises and an increased number of drought periods in Southern Europe are risks that are mentioned relatively often by the surveyed investors (63%; 53%). Almost half of respondents do expect an increase in storm incidence in Western and Northern Europe due to climate change, which is an impact not explicitly forecast by the IPCC for the European continent.
- **North America**:[69] For the North American region, the report by the IPCC describes - among other things - damage to real estate caused by forest fires as a moderate key risk at present. In the long term, this type of risk will increase, depending on the development of climate change. Important drivers of this development are, above all, temperature rises and an increasing number of drought periods. Furthermore, the experts on the IPCC assume there will be greater risks of flooding in urban areas near rivers or coastal areas, caused primarily by greater precipitation, an increase in storm incidence and a rise in the sea level. This all poses a medium threat, which, however, will increase in the relatively short term (2030-2040) and in the long term, could pose a high potential risk. Thus, for this region, we can identify an overlap between the impact of climate change, as forecast by investors and the estimates of the climate experts of the IPCC. However, particularly when it comes to the key risks "rise in sea level" and "increasing number and intensity of drought periods", there seems to be a lack of awareness on the part of investors. This also applies partly to the other identified effects of climate change described in the IPCC report.

It is generally accepted that climate change will produce regional winners and losers.[70] The winner-loser perceptions of respondents presented in figure 28 align to a certain extent with expectations of the scientific community. For example, in a study published in the widely respected journal *Nature*, Burke et al examined expected percentage change in GDP per capita to identify winners and losers. [71] The authors identify Russia, Mongolia and Canada as those countries that stand to gain most. Overall, Europe is expected to benefit, North America to do slightly better, and Central and East Asia only slightly worse. The vast majority of Oceania, Latin America, Middle East and North Africa, Southeast Asia, Sub-Saharan Africa

[68] Kovats, R. S. et al. (2014) Europe. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1267-1326.

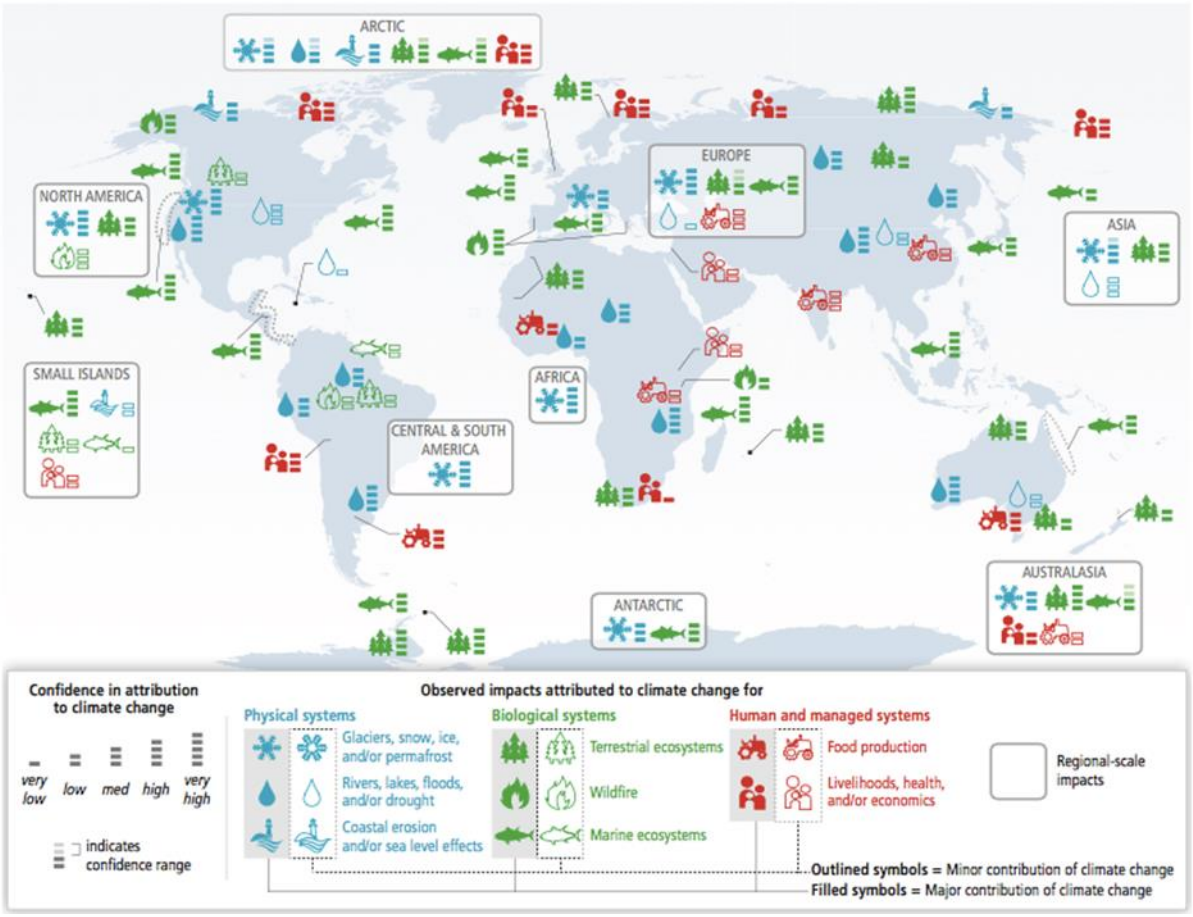
[69] Romero-Lankao, P. (2014) North America. In: Barros, V. R. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom, Cambridge University Press, pp. 1439-1498.

[70] O'Brien, K. L., & Leichenko, R. M. (2003) Winners and Losers in the Context of Global Change. *Annals of the Association of America Geographers.* 93(1), 89-103.

[71] Burke, M., Hsiang, S. M., & Miguel, E. (2015) Global Non-Linear Effect of Temperature on Economic Production. *Nature*. 527(7577), 235-239.

and South Asia are expected to do worse (in that order of increasingly worse).[72] The main differences between the work of Burke et al and the views of survey respondents are that respondents identified North America overall losers, while Burke et al found that they will be winners. Inconsistent views of this region may be explained by the large geographic area it covers, and the wide variety of climate change impacts. For example, agriculture in the USA is generally expected to benefit from climate change, but in southern US it is likely to be adversely affected.[73] Also Burke focuses on overall impacts while investors participating in this study only refer to real estate.

Figure 29: Widespread impacts attributed to climate change based on the available scientific literature since the 4th IPCC report



Source: *IPCC. (2014) Summary for Policymakers.pp. 1-32.*

[72] Burke, M., Hsiang, S. M., & Miguel, E. (2015) Global Non-Linear Effect of Temperature on Economic Production. *Nature*. 527(7577), 235-239.

[73] O'Brien and Leichenko (2003) Winners and Losers in the Context of Global Change. *Annals of the Association of America Geographers.* 93(1), 89-103. See also: Adams, R., Hurd, B., & Reilly, J. (1999) *Agriculture and Global Climate Change: A Review of Impacts to U.S. Agricultural Resources.* Washington D.C., Pew Center on Global Climate Change; Fischer, G. M. et al. (2001) *Global Agro-ecological Assessment for Agriculture in the 21st Century.* Vienna, International Institute for Applied Systems Analysis.

6. Conclusion

Climate change is likely to reshape not only the global economy by severely reducing worldwide economic output; it will also impact on climate-sensitive assets like real estate to a great extent. Especially investors with a long-term fiduciary duty to safeguard the capital invested must build resilient portfolios, focusing on resilient locations and assets.

The state of organizational preparation among real estate investors in the light of climate change is clearly not sufficient:

* Upcoming changes regarding allocation are treated bottom-up rather than by means of a structured analysis of implications for strategic asset allocation;
* Best-practice portfolio preparation measures exist, but are applied only by a few market participants;
* Winning and losing regions can be identified, but do not yet affect asset allocation;
* Timing implications: long-term investment does not yet correspond with long-term evaluation;
* Organizational structures are lagging behind.

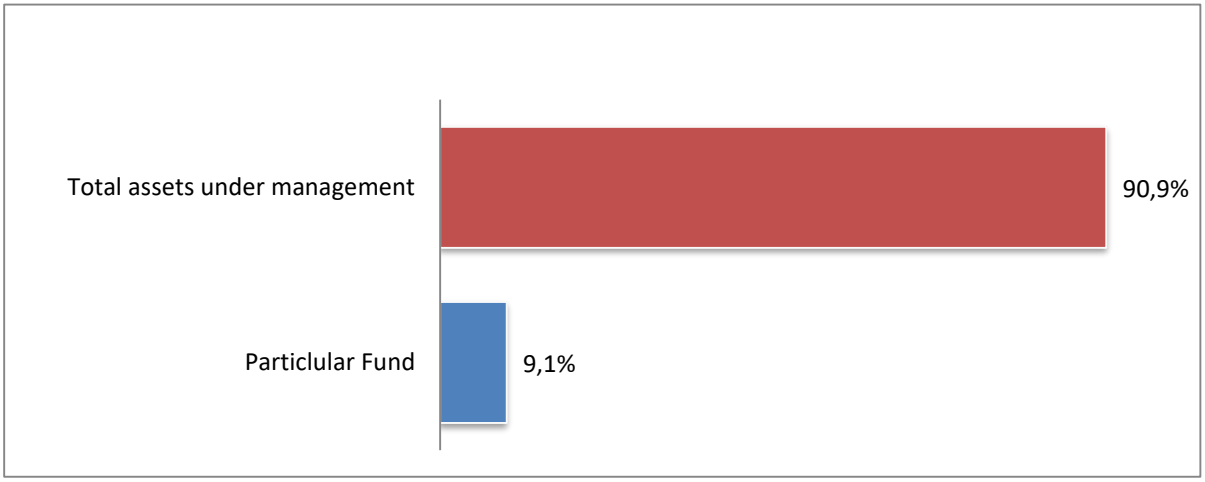
Appendix: Additional Research results

Figure 1: Question 1 - Please specify your main business activity.

Response Choice	Participants	%
Insurance Company	2	4,0%
Pension Fund	2	4,0%
Sovereign Wealth Fund	1	2,0%
Property Fund	9	18,0%
Asset Management Company	15	30,0%
Property Company	7	14,0%
Bank	3	6,0%
REIT	1	2,0%
Family Office	1	2,0%
Advisory Services	6	12,0%
Other	3	6,0%
	50	**100,0%**

Source: *Prof. Sven Bienert MRICS REV*

Figure 2: Question 2 - Are you referring to a particular fund or your total assets under management?



Source: *Prof. Sven Bienert MRICS REV*

Figure 3: Question 3 - What is the gross asset value (GAV) of your direct real estate portfolio?

	Average portfolio of participant	Total volume of assets under management
GAV (in million EUR)	< 10.000	428.930

Source: *Prof. Sven Bienert MRICS REV*

Figure 4: Question 4 - What is the asset allocation of your direct real estate portfolio?

Asset Class	0% of GAV		1 - 25% of GAV		26 - 50% of GAV		51 - 75% of GAV		76 - 99% of GAV		100% of GAV	
Retail	5	11%	21	48%	6	14%	6	14%	4	9%	2	5%
Office	5	11%	9	20%	18	41%	9	20%	3	7%	0	NV
Industrial / Logistic	18	41%	25	57%	1	2%	0	NV	0	NV	0	NV
Residential	16	36%	18	41%	6	14%	3	7%	0	NV	1	2%
Hotel	27	61%	17	39%	0	NV	0	NV	0	NV	0	NV
Other	32	73%	10	23%	0	NV	1	2%	1	2%	0	NV

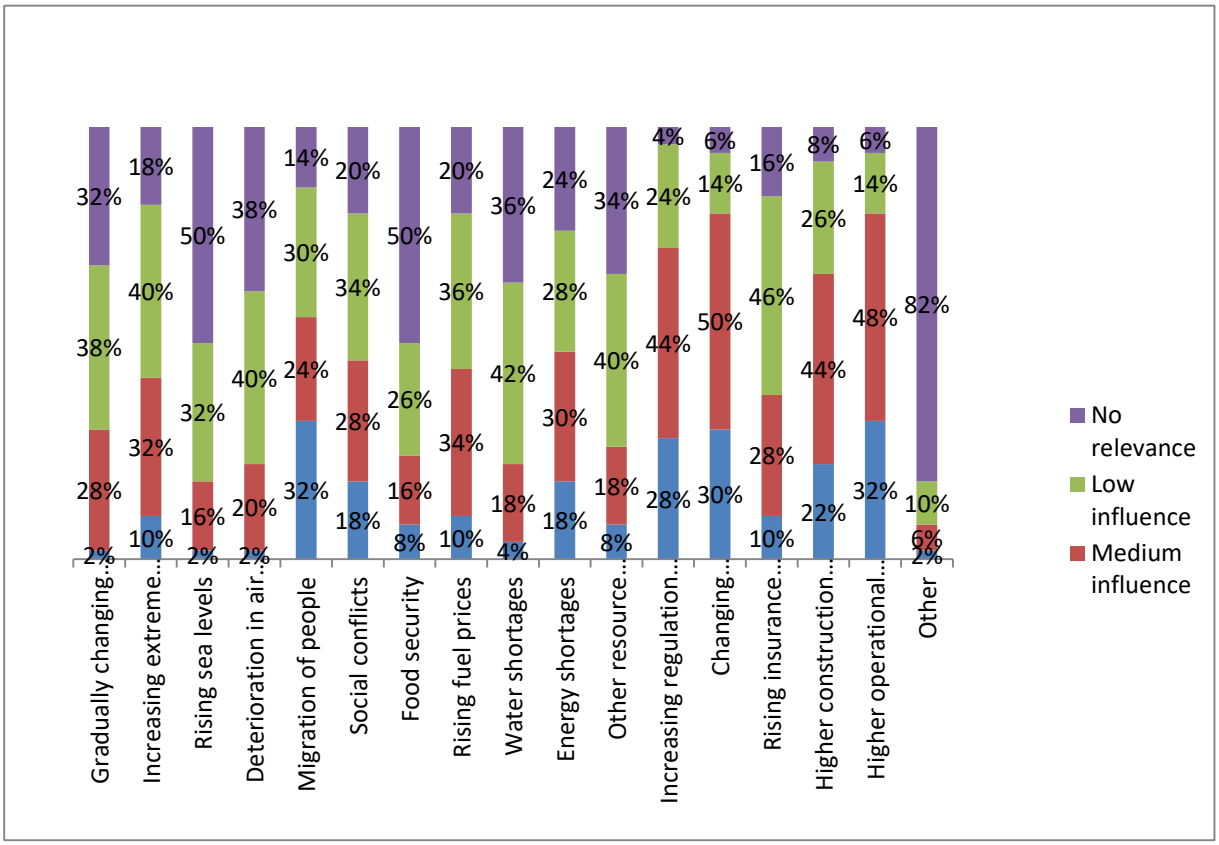
Source: *Prof. Sven Bienert MRICS REV*

Figure 5: Question 6 - Which regions are included in your direct portfolio?

Region	0% of GAV		1-25% of GAV		26-50% of GAV		51-75% of GAV		76-100% of GAV	
North America	28	65%	11	26%	2	5%	1	2%	1	2%
Latin America	39	91%	4	9%	0	0%	0	0%	0	0%
Western, Northern, Southern Europe	5	12%	5	12%	8	19%	10	23%	15	35%
Eastern Europe and Russia	19	44%	12	28%	5	12%	3	7%	4	9%
Africa and Middle East	41	95%	2	5%	0	0%	0	0%	0	0%
Central and East Asia	30	70%	11	26%	1	2%	0	0%	1	2%
South Asia / Oceania	35	81%	8	19%	0	0%	0	0%	0	0%

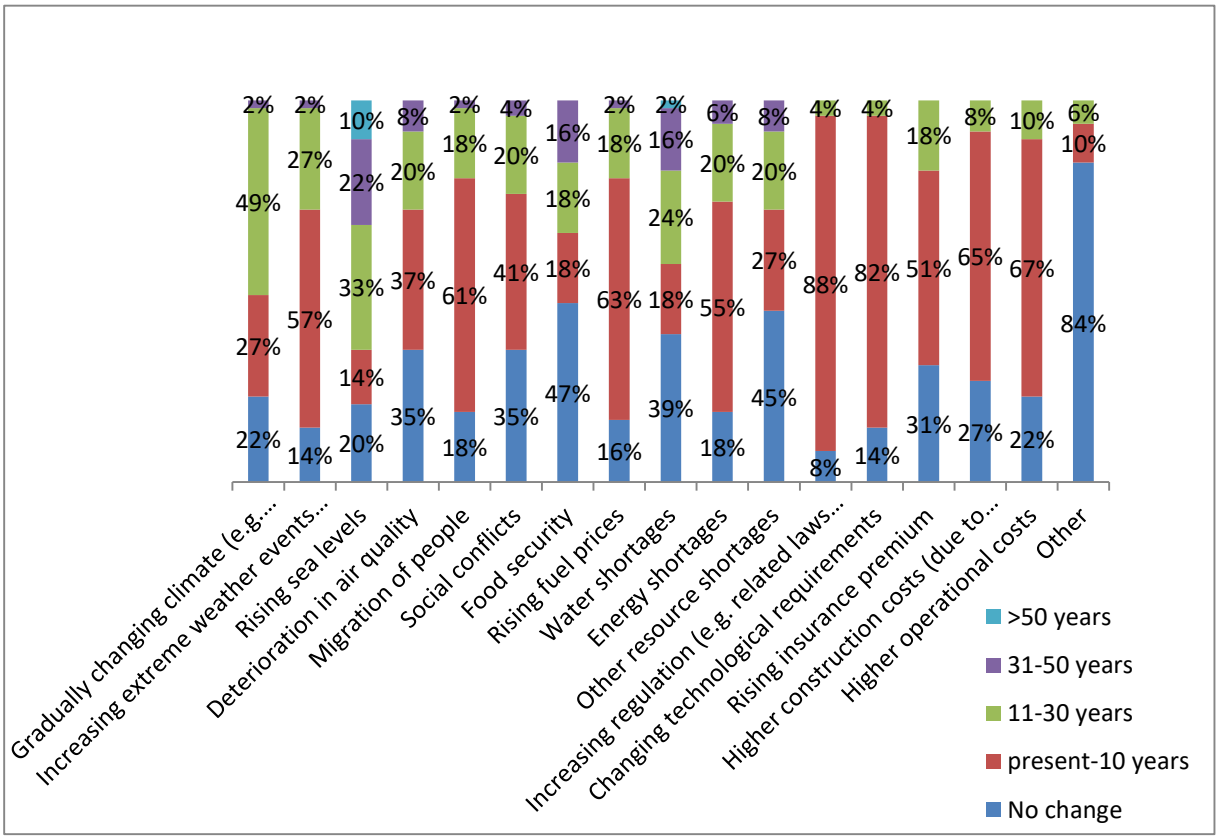
Source: *Prof. Sven Bienert MRICS REV*

Figure 6: Question 7 - Please indicate the impact of the following issues on your real estate investments and investment strategy TODAY.



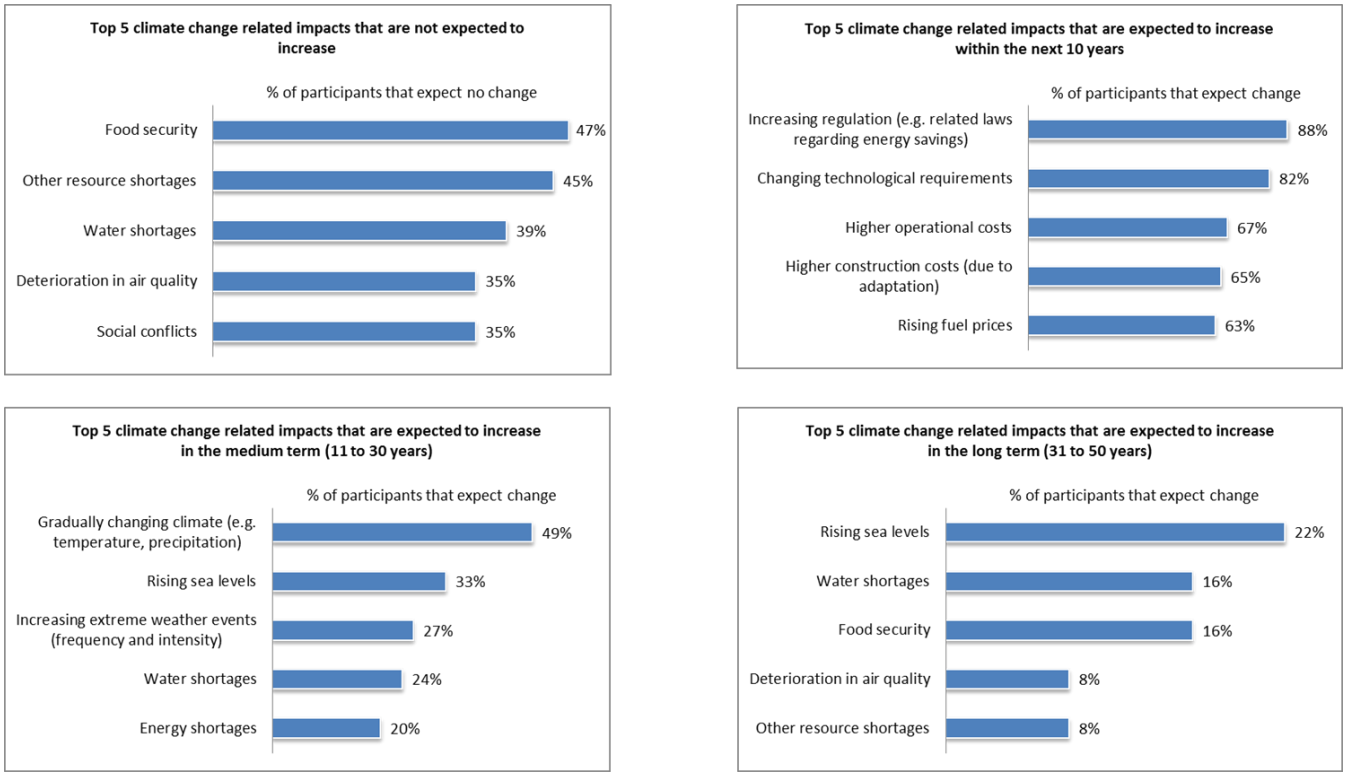
Source: *Prof. Sven Bienert MRICS REV*

Figure 7: Question 8 - Do you expect SIGNIFICANT increases regarding that impact IN THE FUTURE and if so, when?



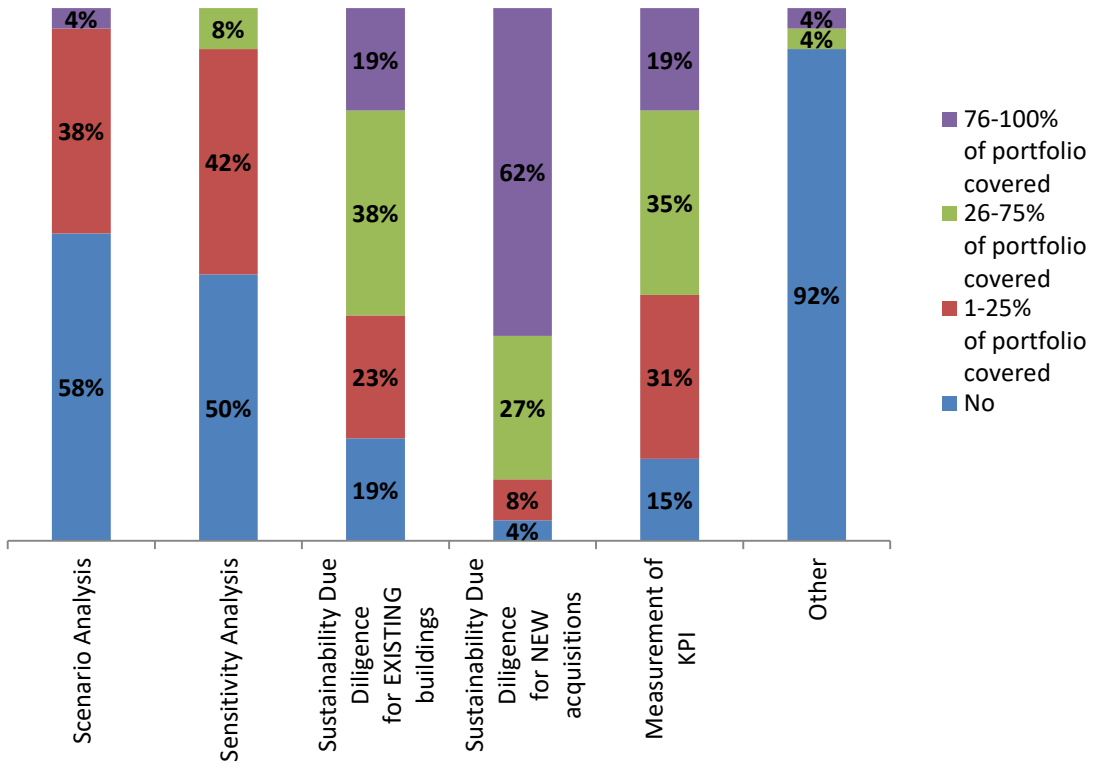
Source: *Prof. Sven Bienert MRICS REV*

Figure 8: Question 8 - Impact of climate change on investment in the FUTURE.



Source: *Prof. Sven Bienert MRICS REV*

Figure 9: Question 11 - How do you assess climate change risks?



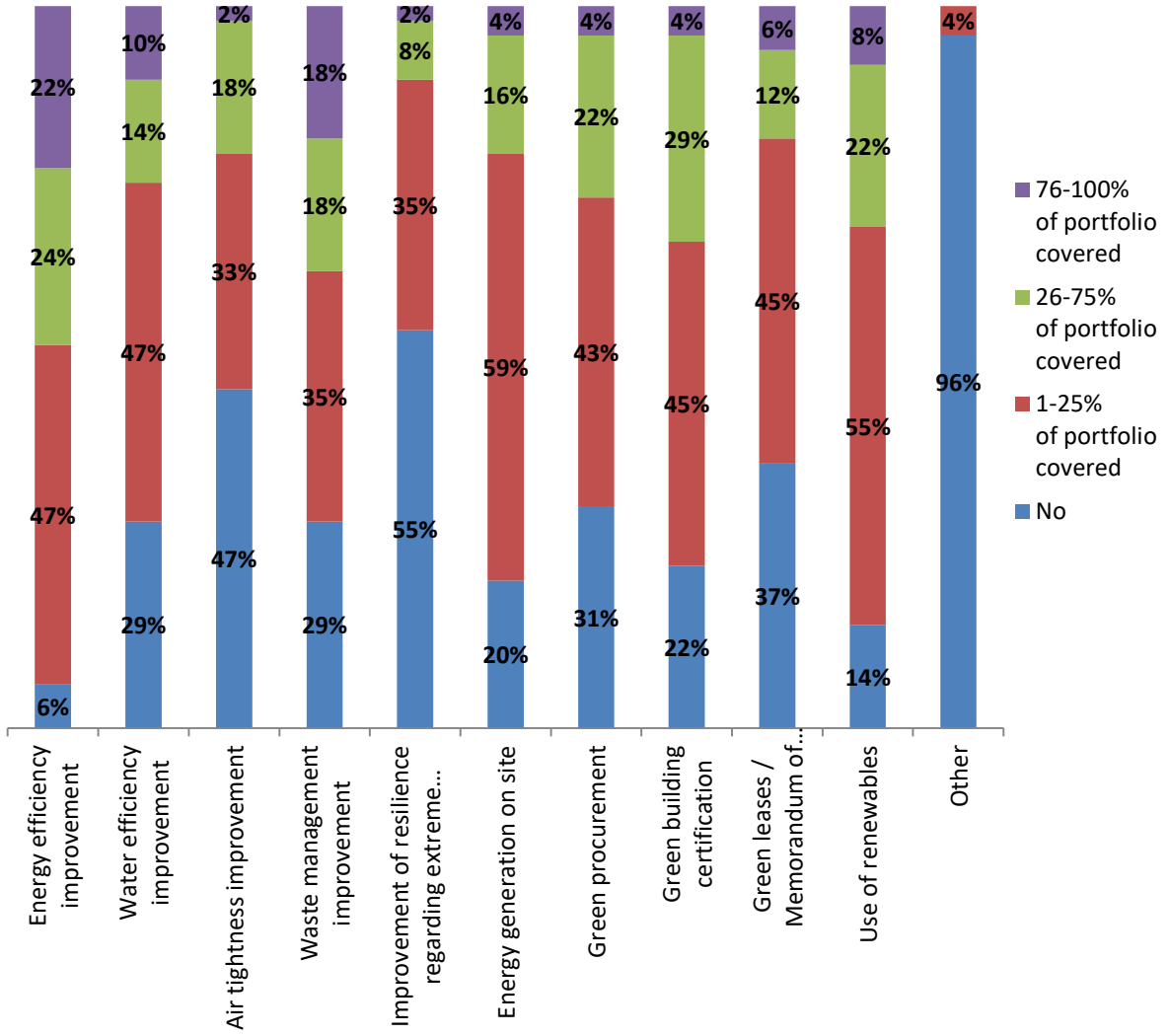
Source: *Prof. Sven Bienert MRICS REV*

Figure 10: Question 12 - What conclusions have you drawn from your climate change risk assessments?

Response Choice	Fully applies	%	Largely applies	%	Partially applies	%	Does rather not apply	%	Does not apply at all	%
Less investment in real estate	0	0%	0	0%	3	12%	4	16%	18	72%
More investment in real estate	0	0%	0	0%	5	20%	4	16%	16	64%
Unaltered investment in real estate	8	32%	2	8%	4	16%	3	12%	8	32%
Exclusion of specific investment regions	1	4%	9	38%	5	21%	3	13%	6	25%
Exclusion of specific real estate asset types	2	8%	3	12%	11	44%	4	16%	5	20%
Higher required rate of return on properties with insufficient climate resilience	1	4%	7	30%	8	35%	5	22%	2	9%
Divestment of properties with insufficient risk profile	2	8%	4	17%	15	63%	2	8%	1	4%
Decision not to invest in properties with insufficient risk profile	4	16%	10	40%	9	36%	2	8%	0	0%
Reinforced adaptation measures for existing properties	1	4%	6	24%	13	52%	3	12%	2	8%
Other	0	0%	0	0%	1	25%	0	0%	3	75%

Source: *Prof. Sven Bienert MRICS REV*

Figure 11: Question 17 - Do you carry out the following (retrofitting) measures for existing properties in your portfolio?



Source: *Prof. Sven Bienert MRICS REV*

Figure 12: Question 19 - What are the main market barriers for a faster uptake of green retrofit technology for real estate?

Response choice	Fully applies	Largely applies	Partially applies	Does rather not apply	Does not apply at all	Total	Score
Split incentives (investor-user-dilemma)	16	20	9	3	0	48	**4,02**
High transaction costs	8	18	15	6	1	48	**3,54**
Imperfect information	11	13	15	4	4	47	**3,49**
Lack of awareness	8	18	14	5	3	48	**3,48**
Poor enforcement of regulations	4	12	15	12	5	48	**2,96**
Lack of sufficient subsidies / government grants	3	11	18	13	3	48	**2,96**
Subsidized energy prices	1	13	14	16	3	47	**2,85**
Inadequate service levels	1	9	20	14	4	48	**2,77**
Inadequate access to financing	3	6	19	16	4	48	**2,75**
High discount rates	1	6	17	14	7	45	**2,56**
Other	1	0	1	0	8	10	**1,60**

Source: *Prof. Sven Bienert MRICS REV*

Figure 13: Question 21 – Climate change winner and looser region

Response Choice	Climate Winner	%	Climate Loser	%
Western and Northern Europe	28	**61%**	2	4%
None	13	28%	11	24%
North America	2	4%	5	11%
Southern Europe	1	2%	4	9%
North Africa and Middle East	1	2%	0	0%
Central and East Asia	1	2%	7	15%
Latin America	0	0%	2	4%
Eastern Europe and Russia	0	0%	1	2%
Sub-Saharan Africa	0	0%	6	13%
South Asia / Oceania	0	0%	8	**17%**

Source: *Prof. Sven Bienert MRICS REV*

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