Climatic risks and opportunities in real estate portfolio management

A LITERATURE REVIEW

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1 Introduction

Buildings have an enormous role to play in the global attempts to slash greenhouse gas emissions. According to the UNFCC, buildings represent 50% of the world assets value while being the source of some 20% of direct and indirect greenhouse gas emissions globally. Simultaneously a considerable and constantly increasing share of buildings are exposed to various climate-related risks.

Climate change is also becoming a central theme within the financial industry. The Financial Stability Board Task Force on Climate-related Financial Disclosures (TCFD), a market-driven initiative, was set up to develop a set of recommendations for voluntary and consistent climate-related financial risk disclosures. Given the prominence of the TCFD, and its potential to rapidly become the new normal of climate-related financial disclosure, we can expect further demands on the financial sector and climate-proof investment activities across asset classes – including the real estate assets.

While being at the nexus of both climate risk as well as solutions, for example incremental energy efficiency investments amounted to only USD 118 billion in 2015, which corresponds to less than 8.5% of construction and renovation of new and existing buildings globally[1]. Much more should be done to ensure that the investments in climate change mitigation and adaptation in the real estate sector match with the physical and transition risks entailed by climate change.

Not only are investments in energy efficiency and other mitigation methods needed to pave the way for a low-carbon resilient pathway in accordance with the Paris Agreement, but they are also justified from the financial point of view.

1.1 Summary

To comply with their fiduciary duty, institutional investors have a dual motive to take climate change mitigation and adaptation into account in their real estate investment decisions. Firstly, studies show that investments in greener buildings can result in higher rental and occupancy rates, lower operating expenses and higher asset values. Secondly, investments in climate change mitigation and adaptation can translate to lower risks related to stranded assets. To adopt a more sustainable investment policy, institutional investors should not only invest in more energy efficient buildings when planning new investments, but also review their existing

[1] http://climateaction.unfccc.int/media/1101/7-cop22_gca-buildings-report.pdf

real estate portfolio for improvement opportunities. Moreover, institutional investors can advance the development of climate-friendly solutions by focusing their investments in companies promoting products and services related to climate change mitigation and adaption.

1.2 Background

This literature review has been carried out with the financial contribution of the LIFE Programme of the European Union. The publication reflects only the EconomisE project's view, and the EASME/ Commission is not responsible for any use that may be made of the information it contains.

1.3 Definitions

A number of terms and abbreviations are used throughout this review. To support readability some of the key terms are presented and clarified in this section, in particular:

AEL	Annual Expected Loss
BIM	Building Information Modelling
BREEAM	Building Research Establishment's Environmental Assessment Method
CDP	Carbon Disclosure Project
DKRZ	Deutsches Klimarechenzentrum
ECBRD	European Bank for Reconstruction and Development
EEA	European Economic Area
EEFIG	Energy Efficiency Financial Institutions Group
GARI	Global Adaptation & Resilience Investment Working Group
GBP	Green Bond Principles
GCM	Global Climate Model
GHG	Greenhouse Gas
GRESB	Global Real Estate Sustainability Benchmarks
GRI	Global Reporting Initiative
HLEG	EU High Level Expert Group
IEA	International Energy Agency
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change

LEED	Leeadership in Energy and Environmental Design
NCEI	National Centers for Environmental Information
ND-GAIN	Notre Dame Global Adaptation Initiative
RCP	Representative Concentration Pathways
TCFD	Task Force on Climate-Related Financial Disclosures
WEF	World Economic Forum

1.4 Scenarios applied in this review

The impacts of climate change over the next few decades are to a large extent defined by the levels of greenhouse gases already in the atmosphere. The amount of mitigation action assumed in the scenarios has little impact in the near-term.

In the longer run, the trend of greenhouse gas emissions (which mainly depends on policy choices made by governments) has a major impact on climate change projected for the mid of the century and onwards. Although the results from the climate models vary, they all indicate that emissions at or above current rates would cause changes in all parts of the climate system and the global temperature.

The rise in global temperatures is causing changes in all geographical regions: the atmosphere and oceans are warming, the extent and volume of snow and ice are diminishing, sea levels are rising and weather patterns are changing causing extreme weather and heavy rainfalls.

For the Fifth Assessment Report of the IPCC, the scientific community has defined a set of four new scenarios, denoted Representative Concentration Pathways (RCP). They are identified by their approximate total radiative forcing in year 2100 relative to 1750:

- 2.6 W m-2 for RCP2.6,
- 4.5 W m-2 for RCP4.5,
- 6.0 W m-2 for RCP6.0
- 8.5 W m-2 for RCP8.5.

These four RCPs include one mitigation scenario leading to a very low forcing level (RCP2.6), two stabilization scenarios (RCP4.5 and RCP6), and one (business as usual) scenario with very high greenhouse gas emissions (RCP8.5).

RCP8.5 assumes a “business-as-usual” approach. By year 2100, atmospheric concentrations of CO2 are three to four times higher than pre-industrial levels. RCP2.6 assumes “aggressive” mitigation strategies that cause global greenhouse gas emissions to start decreasing after about a decade and to reach near zero levels around 50-60 years from now. RCP6.0 (medium-high) and RCP4.5 (medium-low) assume some action to control emissions.

The rise in global average surface temperature at the land and ocean surface by the end of the century (by year 2100) relative to the pre-industrial period is:

- likely to exceed 1.5°C for all RCP scenarios except RCP2.6.
- likely to exceed 2°C for RCP8.5 and RCP6.0
- more likely than not to exceed 2°C for RCP4.5.
- unlikely to exceed 2°C for RCP2.6.

Warming will continue beyond 2100 under all RCP scenarios except RCP2.6.

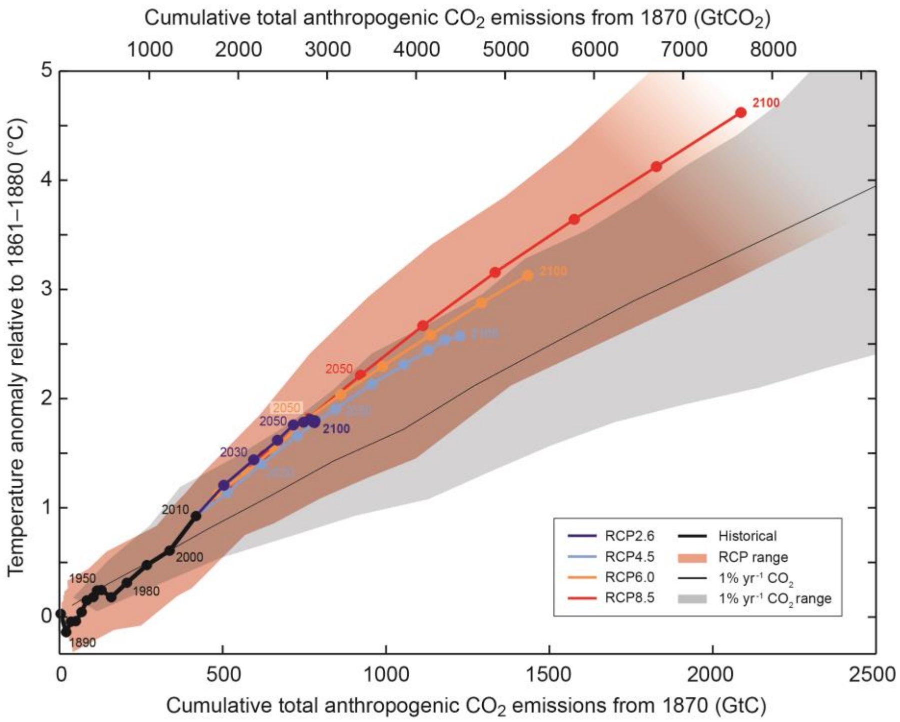

Figure 1 - RCPs and CO2 alt. Temperature. Source: IPCC, 2013: Summary for Policymakers. Source: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Impact on the Finnish climate

Ruosteenoja et al (2016) have estimated the impact of climate change for Finland by using global climate models (GCMs). If the RCP8.5 scenario would realize, mid-winter temperatures in Finland would increase by 2–7°C and precipitation by 3–36 % by the mid-21st century. This increase in temperature is estimated to correspond to the climate in Hungary of today.

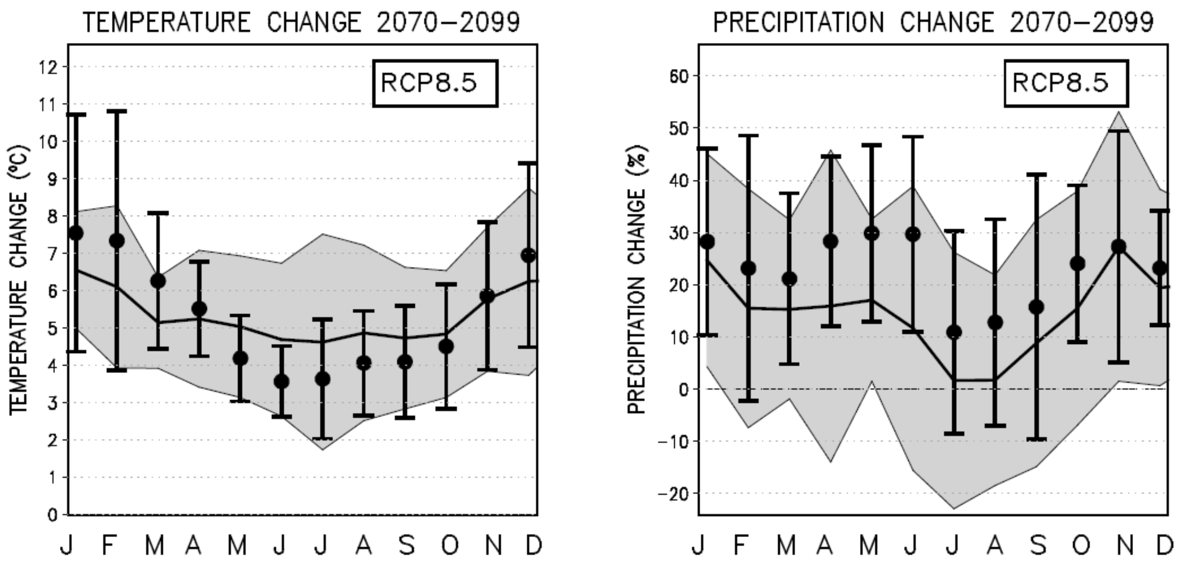

Figure 2 - Monthly-mean changes in temperature (in °C, left) and precipitation (in %, right) in Finland for the period 2070 - 2099. Source: Ruosteenoja et al. (2016)

The European Environmental Agency has provided information and maps on how the climate change will influence on the temperature in the northern regions like Finland[2]. **For Finland, the increase in temperature is estimated to be up to two times higher compared to the global average temperature increase in 2100.**

[2] see e.g. https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-4/assessment

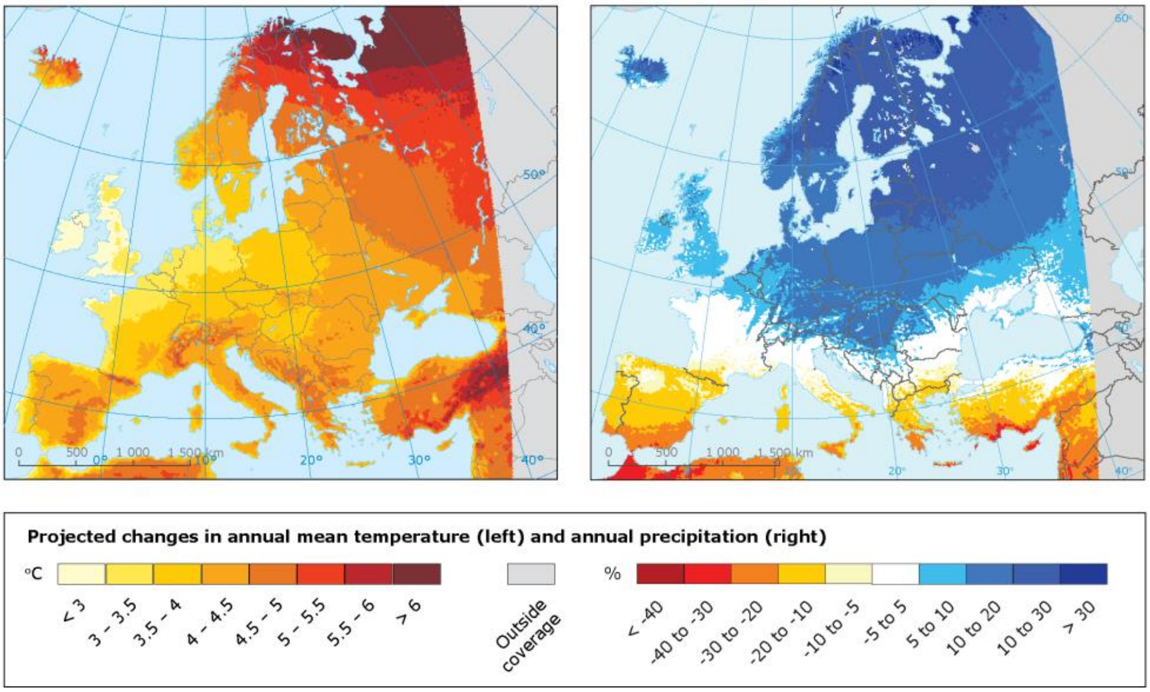

Figure 3 - Projected changes in annual mean temperature and annual precipitation for 2071-2100, compared to 1971-2000, based on the average of a multi-model ensemble forced with the RCP8.5 high emissions scenario. Source: EEA

Extreme weather such as cloudburst and heavy rainstorms are also real risks of flooding in city-areas where water drainage is dependent on well-functioning infrastructure like water sewers. Due to the built environment and pavements, the availability of natural rain water absorbent areas is limited. Over the last decade there have been heavy rainstorms in several Nordic city-areas that has been a challenge for the infrastructure and the cities have been forced to update the prepared adaption plans in order to cope with current and in particular forecasted extreme weather events.

Global sea level rise

With increased temperatures, water will expand and therefore cause the sea level to rise. Changes in air temperature cause a further change in the water cycle and ocean currents. Global sea level is projected to continue rising this century. Global mean sea level will continue to rise during the 21st century under all RCP scenarios but the sea level rise will not be uniform. Depending on the size of emission cuts, by the end of the 21st century the rise has a more than 66 % chance of being in the ranges 0.45–0.82 m (RCP8.5) and 0.26–0.55 m (RCP2.6). The collapse of some sections of the Antarctic ice sheet could cause global sea level to rise substantially above these ranges during the 21st century.

The rate of sea level rise has been simulated by the IPCC working groups and it is very likely that the sea level rise exceeds that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets.

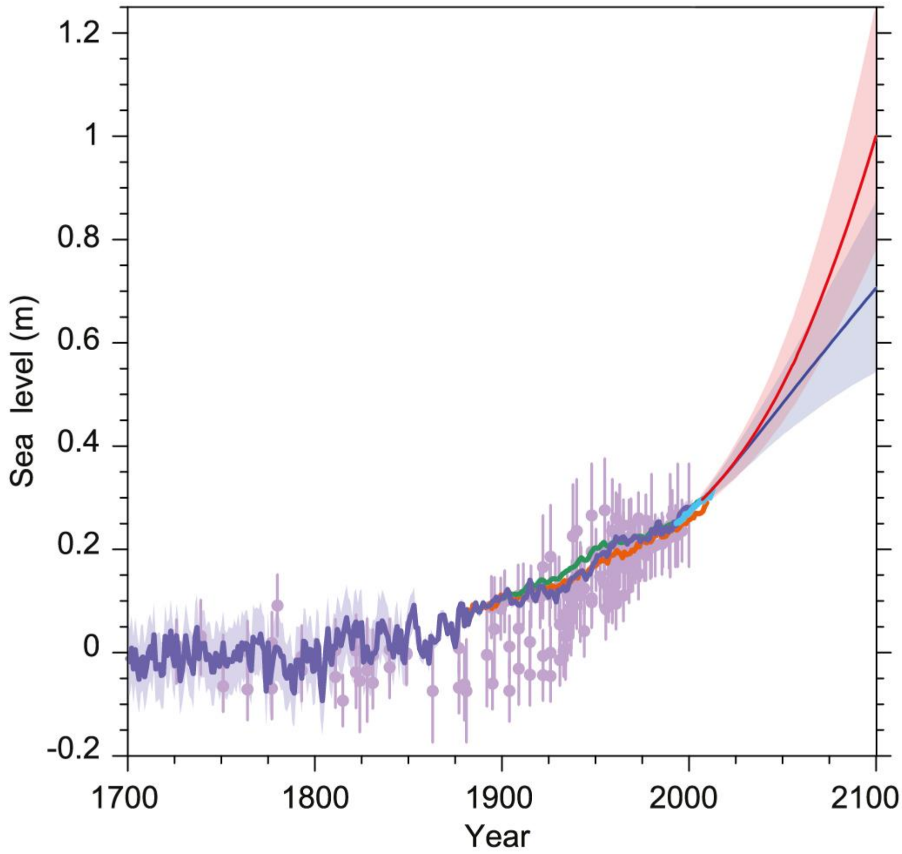

Figure 4 - Global mean sea level rise RCP2.6 (blue) and RCP8.5 (red) scenarios, all relative to pre-industrial values (Source: Sea Level Change (Chapter 13). Source: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the IPCC)

The German Climate Computing Centre (Deutsches Klimarechenzentrum, DKRZ[3]) has compiled information on the simulations covering scenarios on sea level rise for the different RCPs. In the RCP8.5 scenario the global mean sea level simulations show projections of sea level rises of over 1 meter.

DKRZ has also presented simulations on a very long period up to year 2300 showing that one can clearly assume that the sea level will rise over the next centuries, and, depending on the scenario, reach an average of between 0.3 and 1.6 meters by 2300 as compared to the pre-industrial situation.

Based on current understanding, the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the likely range during the 21st century. The researchers have indicated that there is a risk of a sea level rise of 1,3 meters in 2100 if the global carbon emissions continue on a business as usual level. In the Environmental Research Letters article *"Linking sea level rise and socioeconomic indicators under the shared socioeconomic pathways"* Alexander Nauels et al (2017) have incorporated

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[3] see https://www.dkrz.de/communication/climate-simulations/cmip5-ipcc-ar5/ergebnisse/meeresspiegel-en

the latest findings on Antarctic ice sheet dynamics into a new sea level rise modelling and they state the sea level rise could be 55 % more than projections of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change.

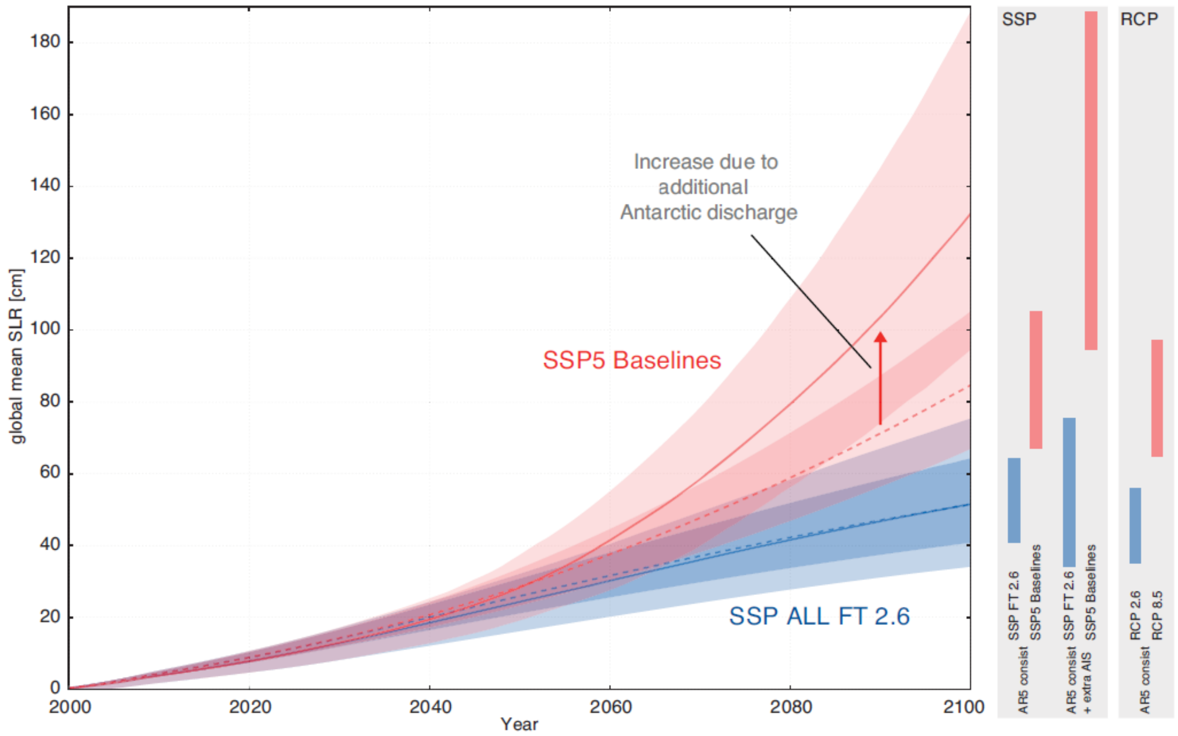

Figure 5 - Without any mitigation, sea levels could rise by an average of 132 cm in 2100 [likely range: 95 to 189 cm] relative to the 1986-2005 mean. (SLR = Sea Level Rise, SSP = Shared Socio-Economic Pathways, RCP = Representative Concentration Pathways) Source: Nauels et al. (2017).

Sea level rise in the Baltic Sea region

From a regional perspective the Baltic Sea region is of particular interest. The semi-enclosed nature and the irregularly shaped basin of the Baltic Sea create local differences in sea level rise around the whole Baltic Sea region. Both long-term and short-term variation can be seen in sea level changes. Long-term sea level changes are explained by changes in the Baltic Sea water volume, either through more water entering the Baltic Sea through the Danish Straits or through density changes originating from variation in seawater temperature and salinity, large-scale sea level rise in the world's oceans and land uplift.

Storm surges occur during long periods of heavy winds, as they change the water balance in the Baltic Sea by increasing the amount of water in the whole basin through increased flow via the Danish Straits. In addition to this, heavy winds create internal oscillation of the water in the Baltic Sea basin. This may cause sea floods of several metres, and the floods are most noticeable at the ends of long gulfs, such as the Gulf of Finland or in the northern part of the Bothnian Bay[4].

For instance, the average sea level in Helsinki has been of interest and the long-term sea level trend has been estimated by the Finnish Meteorological Institute, (see figure 6) showing a significant risk of sea level rise over the coming decades.

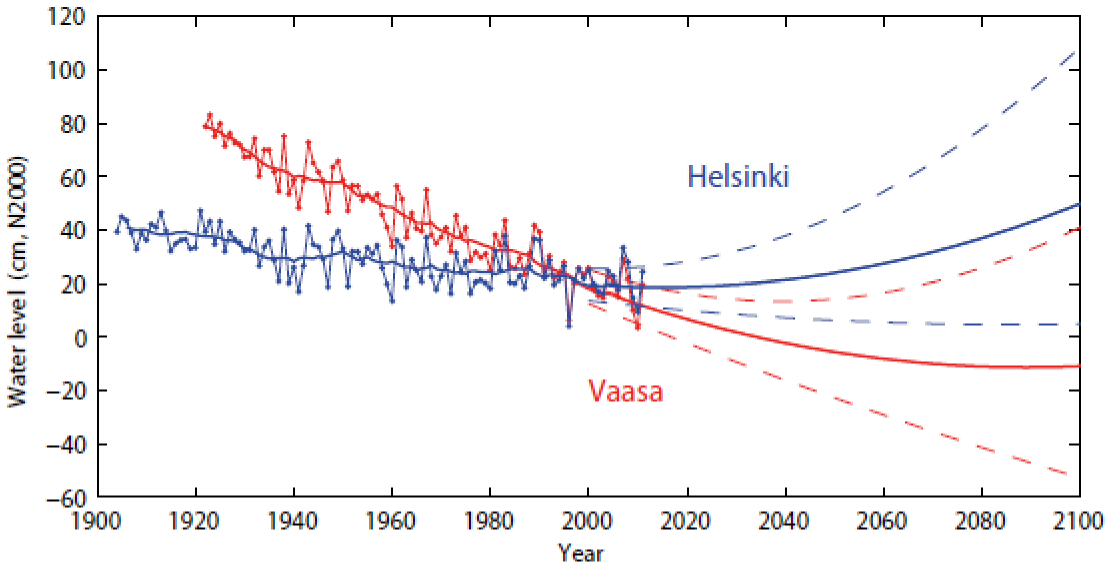

Figure 6 - Average sea level in Helsinki and Vaasa. The points indicate observed annual averages, the unbroken line is the long-term average based on observations until 1999 and on the estimated future average sea level from 2000[5].

Extreme weather scenarios covering changes in the sea level in Gulf of Finland and the Helsinki area has been an important topic since the flooding due to extreme weather in 2005. Table 1 (Särkkä et al. 2017) presents an assessment of the exceedance probabilities of sea levels at Helsinki, on the coast of the Gulf of Finland in the Baltic Sea, based on an 850-year numerical sea-level simulation. The sum of the maxima of the model components during a short 30-year verification period indicates that sea level 225 cm is possible at Helsinki if all the components simultaneously attain their maxima.

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4 Climate-Proof Living Environment – Methodologies, tools and practical recommenda-tions for climate change adaptation in the Kymenlaakso and Uusimaa regions and the Helsinki Metropolitan Area. http://tupa.gtk.fi/julkaisu/erikoisjulkaisu/ej_091.pdf

5 Dashed lines describe the degree of uncertainty of the estimates, due to uncertainty in the future behaviour of the ice sheets. Source: http://ilmatieteenlaitos.fi/merenpinnan-nousu-suomen-rannikolla

Exceedance frequency per year	Sea level estimate with Weibull extrapolation of daily maxima (cm, N2000)	Sea level best estimate with GEV extrapolation of annual maxima (cm, N2000)	Sea level 95% CLs with GEV extrapolation of annual maxima (cm, N2000)
1/10	155	141	139–143
1/20	163	152	150–155
1/50	173	166	162–169
1/100	180	175	171–179
10^{-3}	204	201	195–209
10^{-4}	227	223	214–234

Table 1 - Exceedance frequencies for the 850-year simulation of the combined sea level model at Helsinki. Source: Särkkä et al. (2017)

To date, the highest observed sea level at Helsinki was 170 cm on 9 January 2005. This corresponded to the exceedance frequency of once in 50–100 years given by the simulations. This means that the flood in the Gulf of Finland in 2005 was not entirely extraordinary, and a flood with equal height could happen again soon.

Finnish Meteorological Institute has presented estimates for rarely occurring flood heights and given new recommendations for minimum building elevations on the Finnish coast. The updated recommendations take into account the latest knowledge of the global sea level rise and its local impact on the sea level in the Baltic Sea. The postglacial land uplift, changes in wind conditions, and short-term variations in the sea level are also included in the estimates.

The new minimum recommended building elevations are based on the sea level that will be exceeded at most once during the lifetime of new buildings (ca. 200 years)[6]. However, there are large uncertainties in the global sea level rise scenarios, and at the moment it is not possible to make sufficiently reliable scenarios extending beyond the year 2100. For this reason, the recommendations are based on the sea level in 2100 with an exceedance frequency of one event per 250 years.

[6] Long-term flooding risks and recommendations for minimum building elevations on the Finnish coast https://helda.helsinki.fi/bitstream/handle/10138/135226/2014nro6.pdf?sequence=1

Recommended building elevations for some coastal cities in Finland	Elevation (cm), based on the sea level in 2100 with an exceedance frequency of one event per 250 years.
Kemi	260
Oulu	250
Vaasa	200
Rauma	210
Turku	240
Hanko	250
Helsinki	280
Hamina	320

Table 2 - Recommended building elevations for some coastal cities in Finland in the N2000 system. Source: Kahma et al. (2014)

2 *Climatic risks on real estate*

The Global Risk Landscape 2018 released by the World Economic Forum (WEF) lists extreme weather events, natural disasters and failure of climate-change mitigation and adaptation among the risks with the highest impact and likelihood – all far exceeding that of fiscal crises or asset bubbles in a major economy, as shown in figure 7 (WEF, 2018). These risks have been included in the WEF annual risk report for over a decade already.

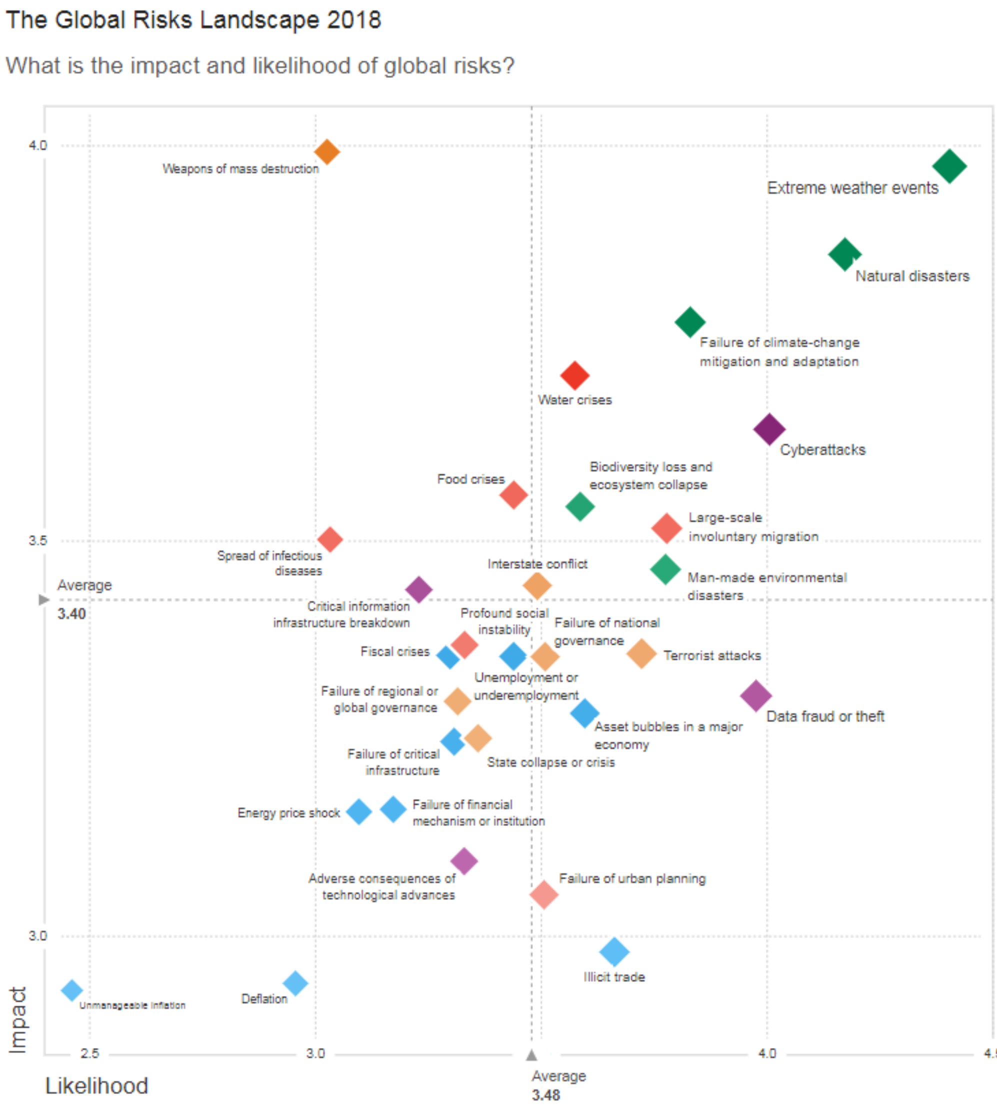

Figure 7 - The Global Risks Landscape 2018. Source: World Economic Forum, available at: *http://reports.weforum.org/global-risks-2018/global-risks-landscape-2018/#landscape*

Examples of extreme weather events and natural disasters and their effects on infrastructure, real estate and other property have been experienced around the world in the previous years. According to the National Centers For Environmental Information (NCEI), the cumulative cost of all weather and climate disasters resulted in the deaths of 362 people and exceeded $300 billion in damages in the US alone (NOAA, 2018). In the European context, the quantity and intensity of extreme meteorological events have increased by 250 percent in the past three decades, according to reinsurance companies. In Germany, the damages caused by extreme weather events between 1980 and 2011 were reported to be €2.2 billion annually (Hirsch et al. 2015.) In Copenhagen, a flood caused by 150 mm of torrential rain in 2011 caused around €1 billion in damages[7], making it the most expensive weather phenomenon of that year in Europe when measured in expenses paid[8]. Unexpected floods in Malmö in 2014 caused $35 million in damages. The Swedish weather service failed to issue warnings for the unexpected flooding event[9]. A summary of different risk categories is exhibited in table 3. Examples of risk drivers are presented in appendix 1.

Categories of risks	Description of potential risks
Physical Risks – Continuing changes and more frequent and severe extremes of climate	Increased business interruption and damage across operations and supply chains with consequences for input costs, revenues, asset values, and insurance claims Challenges of adaptation to permanent changes in local operation environment
Transition in Market and Technology Shifts – Strategies and investments to deliver a low carbon emissions economy	Reduced market demand for fossil intensive products/commodities Increased demand for energy-efficient, lower-carbon products and services New innovations in technologies that disrupt markets
Regulatory and Legal – More and complex requirements at both international and national level.	Increased input/operating costs for high carbon activities Threats of limitations on license to operate for high carbon activities Emerging concern about liabilities – people or businesses seeking compensation for losses due to physical or transition risks

7 https://www.forbes.com/sites/justingerdes/2012/10/31/what-copenhagen-can-teach-cities-about-adapting-to-climate-change
8 http://en.ilmatieteenlaitos.fi/news/464823048
9 https://www.thelocal.se/20140911/record-insurance-bill-after-mlmo-floods

Reputation – Growing expectations for responsible conduct from all stakeholders	Opportunity to improve reputation and brand value Risk of loss of trust and confidence in management

Table 3 - Risk Categories, source: TCFD (2017)

2.1 Physical risks

Physical risks include both chronic changes and more frequent and severe extremes of climate, such as temperature, flooding, sea level rise and wildfires (TCFD, 2017). The Global Adaptation & Resilience Investment Working Group (GARI) states that as equity holders, institutional investors need to understand the impact on investment's valuation and related implications on returns on equity and exit strategy (GARI, 2017).

Mercer's report (2015) analyses the risk and return impacts that different climate change scenarios can have for the real estate market. A 2°C scenario can have return benefits on real estate, whereas a 4°C scenario can negatively impact the real estate market globally. This should present a key motivation for investor action, as real estate is increasingly exposed to the risk of physical damage caused by climate change. This is especially true for investors with a long-term investment horizon, such as institutional investors.

As the Finnish institutional investors are invested in real estate assets especially in Helsinki and Espoo, the most acute physical risks include sea level rise, flooding and storms. According to a study by the City of Helsinki, recommended safe building heights could need to be redefined to +3.8 meters above sea level in Hernesaari in the year 2100 (up from +3.0 meters in 2020), +3.8 meters in Jätkäsaari (up from +3.0 meters in 2020), and +3.2 meters around City Hall, downtown Helsinki (up from +2.4 meters in 2020) (City of Helsinki, 2016)[10]. The analysis is based on estimated global sea level rise of 33 – 156 cm from the year 2000 to 2100 (5-95% confidence interval), which is derived from a weighted average of ten global sea level rise studies presented in Kahma et al. (2014). Consequently, investors with assets in coastal areas of Helsinki such as Hernesaari, Jätkäsaari, Sompasaari, Sörnäinen, Merihaka, Hakaniemi should assess their assets at risk of flooding. In addition to their real estate investments in Finland, the Finnish institutional investors have positions especially in Europe but also in e.g. the Asian real estate sector, mostly through real estate investment funds but also in some direct investments.

[10] The recommendations for lowest safe building heights have been defined from community planning point of view. They are based on p = 1/250 (0.4%) of exceeding the height during a given year.

Figure 8 - Possible significant flood risk areas in Finland. Source: http://www.environment.fi/floodmaps

GARI (2016) presents six examples of approaches to measure physical climate risk:

1. **Government indices and rankings**, such as Carbon Disclosure Project (CDP) cities data and Notre Dame Global Adaptation Initiative (ND-GAIN)
2. **Insurance risk ratings,** such as Willis Towers Watson Re and AIR Worldwide
3. **Corporate ESG data,** such as CERES water data and CDP water
4. **Risk screening tools,** such as European Bank for Reconstruction and Development (EBRD) and International Finance Corporation (IFC) tools
5. **Scorecards**, such as AECOM & IBM Disaster Resilience Scorecard
6. **Engineering due diligence & design analysis** to analyse e.g. flood vulnerability or windstorm resistance.

In addition, GARI participants identified eight criteria for a set of metrics to be successful and widely adopted. According to the criteria, the metrics have to be transparent and practical, in the sense that they provide clear scenarios and timeframes, and can be integrated to investment decisions. Moreover, the metrics need to be dynamic, financially relevant, and standardized to ensure comparability. Lastly, the metrics should aggregate multiple sector-specific factors, be supported by a stable and dependable identity, and be cost-efficient for the user (GARI, 2016.)

2.2 Transition risks

Transition risks can occur when transitioning towards a more climate-compatible economy. The transition can cause shifts in asset values or higher costs for operating in certain industries, e.g. due to required investments in low-carbon solutions (Bank of England, 2018).

The interplay between physical and transition risks (or 'stranded assets risks') is presented in the TCFD Technical Supplement (TCFD, 2017). In order to reduce the physical risks entailed by RCP scenarios 8.5 and 6.0, where global warming is likely to exceed 2°C, with corresponding temperate increase in a northern country like Finland almost the double, businesses need to employ radical mitigation efforts to cut emissions. Whereas businesses are in varying manner threatened by physical climate change impacts in the >2°C scenarios RCP 8.5 and RCP 6.0, in the RCP 4.5 ('more likely than not to exceed 2°C ') and the RCP 2.6 ('not likely to exceed 2°C) scenarios they are also impacted by policy changes, with climate relevant policies taking increasing space in that arena.

Policy change, aligned with the commitments made in the Paris Agreement, entails the introduction of new, transformation of existing as well as abolishment of counterproductive policy instruments, to align the enabling frameworks with climate compatible development overall. In some instances, this entails higher operation costs for businesses. Optimally it should gear investments in the development of low-carbon technologies ('technology shift'). In the Finnish context, stricter EU regulation related to e.g. energy efficiency can pose a transition risk for real estate investors ('regulatory and legal risks'). The transition to a more efficient, low-carbon economy can also entail reputation risks for companies and investors engaged in high-carbon activities, as well as liability risks – "people or businesses seeking compensation for losses they may have suffered from the physical or transition risks from climate change" (Bank of England, 2018).

A survey conducted by the Urban Land Institute (ULI) in 2014-2015 shows that senior executives in leading real estate investment and management firms, mainly based in Europe, recognize the following transition risks in particular:

- higher expectations on energy efficiency, resulting in increased investment on technology ('technology shift' risk)
- higher operational costs, possibly as a result of rising energy and water prices, as well as technologies,
- human mass migration affecting supply and demand in key real estate markets

Other identified transition risks include increasing regulation, higher construction costs due to adaptation, energy shortages, social conflicts as well as rising insurance premiums. The authors comment that respondents seem to underestimate certain impacts, for example sea level rise. (Bienert, 2016.) Generally speaking, the survey results show that transition risks have a higher influence in real estate investors' and managers' perceptions compared to actual physical risks.

Moreover, increased rainfall and windiness caused by climate change can cause strain on buildings' facades, which can lead to increased corrosion of buildings' envelope structures. A less discussed physical / transition risk in the literature is that caused by increased moisture load on building structures. Building moisture safety is a risk caused by improper thermal insulation methods. Thermal insulation is one way to improve the energy efficiency of a building. However, insulation without proper consideration to ventilation can cause increased moisture load on building structures, which can result in increased levels of mould (Vinha et al. 2013.) This should be taken into account when building resilience towards physical risks – improper resilience-building can lead to other types of physical risks on human health caused by unhealthy indoor air.

For institutional investors, transition risks can also provide opportunities. Investing in climate change mitigation efforts, e.g. companies providing low-carbon solutions in line with more stringent regulation and legislation, can result in higher returns in the future. Equally, investing in adaptation methods such as green roofs, which absorb rainwater during heavy storms and reduce the urban heat island effect, may also be financially viable in some cases.

2.3 Climatic risks' effects on valuation of real estate assets

Climate-related risks can affect real estate asset valuation either directly by means of physical risks or indirectly by means of transition risks. Floods and extreme storms can damage real estate assets and cause their value to be reduced or completely written off. On the other hand, in markets where transition risks drive real estate owners to build or refurbish real estate to mitigate climate risks, causing 'green buildings' to become more mainstream, there are indications of emerging 'brown discounts', where buildings that are not green may rent or sell for less (World Green Building Council, 2013).

Votsis and Perrels (2015) have studied the effects of flood map disclosure on housing prices in Finland. Their estimates indicate a significant price drop information disclosure for properties located in flood-prone areas as indicated by the maps. In the case of sea flooding information in Helsinki, the price effect is sensitive to the communicated probability of flooding. Consequently, flood risk disclosure through maps can be considered a policy instrument aimed at correcting information gaps and asymmetries related to the effects of flood risks on property values. The study does not discuss professional investors' reactions to disclosed flood map information. However, it can be argued that it is institutional investors' fiduciary duty to analyze their real estate portfolio for flood and other climatic risks.

The question how much at risk of losing value each property is depends on location-specific factors such as the probability and extent of extreme weather events it is subject to, as well as property-specific factors such as vulnerability and value (Hirsch et al. 2015). The authors have developed a tool called 'ImmoRisk'[11] for assessing the monetary annual expected loss (AEL) and the damage rate of storms, flooding and hailstorms for individual properties. Additionally, the output comprises information on the hazard of the input location with respect to forest fires, heat, heavy precipitation, lightning, as well as excess voltage. The tool is based on an IPCC scenario that entails rapid economic growth, global population that peaks mid-century and declines thereafter, and rapid introduction of new and more efficient technologies. The results are compared with the level of corresponding insurance policies for validation purposes. The authors emphasize that while these types of tools exist within (re)insurance networks, a risk information system should be publicly available to meet the needs of the housing and real estate industry. The reason is that in a setting where professional investors possess this type of information while ordinary homeowners and smaller communities do not, poses a situation with lacking market transparency. Naturally, it can't be expected that institutional investors pay and provide for this type of information system for the public, which is why it should be considered that, following the example of the German Federal Ministry for Transport, Building and Urban Development (BMVBS) and the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), a publicly-funded project would be launched to develop a similar tool in Finland. If a similar tool were to be developed, it should be considered to include other scenarios in addition to the applied IPCC scenario to support sensitivity analysis.

[11] http://132.199.122.199/ImmoRisk/startseite.php

3 Mitigation and adaptation to climatic impacts

There are clear emission targets for the real estate industry that need to be followed in order to mitigate the impacts of climate change to below 2°C. According to data from IEA's 2°C scenario, global emissions of houses and real estate need to decarbonize as follows:

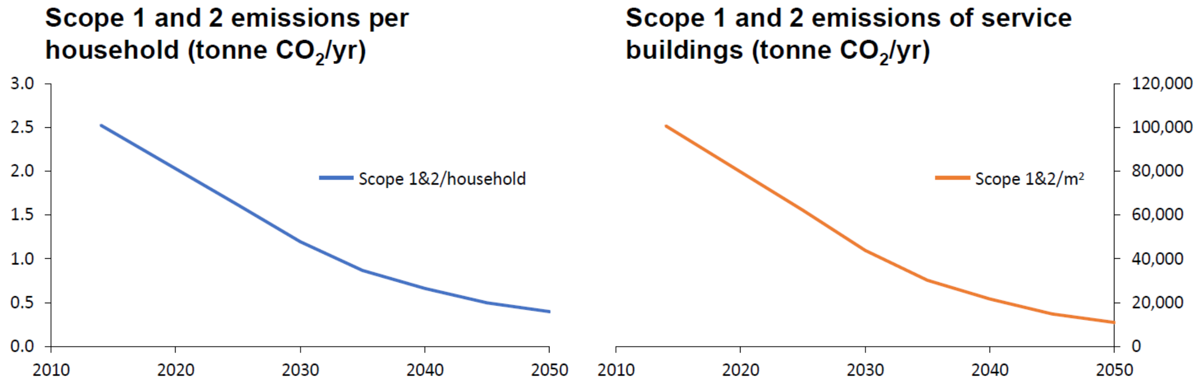

Figure 9 - Mortgages (left) and real estate (right) emission targets. Emissions per household vs Emissions per square meter. Source: Ecofys and 2 Degree Investing Initiative, Webinar Feb. 8 2018 "Development of Framework for Financial Institutions to Set

GARI stresses that institutional investors, "to implement capital preservation strategies in the interest of their beneficiaries, may also need to integrate climate risk management in investment practice and portfolio management. Failing to do so could result in a failure of fiduciary duties." They also note that physical climate risk and resilience can create investment opportunities. Investors can seek to "allocate their capital in favour of companies providing products and services that improve climate resilience and support adaptation planning." Such companies include e.g. weather analytics, or providers of solutions to physical climate risk like more efficient water processes, drought-resistant agriculture, and risk hedging and insurance (GARI, 2017).

3.1 Mitigation measures

Climate change mitigation measures aim to tackle the root problem of climate change. Mitigation measures either directly reduce or capture, or indirectly prevent the emission of greenhouse gases. Examples of mitigation measures include: switching from fossil energy sources to renewable ones, improving the energy efficiency of buildings, changing human behaviour to reduce pollution, as well as protecting or creating new natural carbon sinks, such as forests (Bienert, 2016).

Ambitious goals have been set in Finland for cutting energy consumption related to the built environment. The Smart Energy Transition, a project funded by the Academy of Finland, aims to cut buildings' energy consumption in Finland by 50% by 2030. Cleantech technologies related to the real estate market can either help save energy or produce cleaner energy for buildings. Energy savings can be achieved through better planning of new buildings by using e.g. Building Information Modelling (BIM) software, or by improving lifecycle energy efficiency by retrofitting old buildings to be more energy efficient, either through better insulation or building automation systems that optimize temperature and energy savings. Cleaner energy for buildings' needs can be produced by e.g. installing solar photovoltaic panels or by using geothermal heat pumps. Creative energy solutions have been piloted in Finland by e.g. Turku Energia in the Skanssi shopping mall area, where novel energy and heat production and storage solutions have been coupled with the possibility to buy and sell heating energy in a local grid. The EU provides resources to help investors de-risk energy efficiency investments. The De-Risking Energy Efficiency Platform (DEEP)[12] offers an open database to help assess the risks and benefits of energy efficiency investments. In addition, the Energy Efficiency Financial Institutions Group (EEFIG) has released an Underwriting[13] toolkit to help financial institutions scale up the deployment of capital into energy efficiency. Most recently, the European Investment Bank (EIB) has approved the creation of a new financial instrument, the Smart Finance for Smart Buildings initiative. The initiative aims to make investments in energy efficiency projects in residential buildings more attractive to private investors by unlocking €10 billion in public and private funds[14].

To tap on the opportunities and benefits provided by mitigation technologies and operating models, institutional investors can invest in mitigation-producing companies, as well as require their real estate asset managers to analyse which measures can be taken to improve the energy efficiency and the share of renewable energy in the energy mix in their portfolio.

Investors can follow green investment strategies when deciding between investment alternatives. The Climate Bonds Initiative has published the Low Carbon Buildings criteria, which sets out what property assets are eligible for certification under the Climate Bonds Standard. For commercial buildings, the criteria require properties to compare against local city baseline and performance target, or other building standards such as LEED or BREEAM in the absence of local standards, as is the case in the Finnish context[15]. The institutional investors can either improve their own assets' performance by funding the property upgrades with green bonds, or invest in green bonds to contribute to mitigation projects elsewhere. It has to be kept in mind, however, that although market initiatives such as the financial industry-led Green Bond Principles (GBP) exist, there is currently no actual certification for green bonds. The EU High Level Expert Group (HLEG) on Sustainable Finance has proposed in its recent report the following definition for an EU Green Bond (EU HLEG, 2018):

[12] https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency
[13] https://valueandrisk.eefig.eu/
[14] https://ec.europa.eu/info/news/smart-finance-smart-buildings-investing-energy-efficiency-buildings-2018-feb-07_en
[15] Criteria for commercial properties: https://www.climatebonds.net/standard/buildings/commercial

1) The proceeds will be exclusively used to finance or refinance in part or in full new and/or existing eligible green projects, in line with the future EU Sustainability Taxonomy; AND,

2) The issuance documentation of the bond shall confirm the intended alignment of the EU Green Bond with the EU Green Bond Standard; AND,

3) The alignment of the bond with the EU Green Bond Standard has been verified by an independent and accredited external reviewer.

Another issue that needs to be addressed is the true additionality of green bonds. This means that projects that could obtain finance on the mainstream market at a comparable cost of capital should not be labelled as green bonds.

3.2 Mitigation standards

Green building certificates can result in higher real estate value. A green building certification can result in higher rental and/or occupancy rates, as well as higher transaction prices. The actual influence of a green building certificate is difficult to measure, as there are always several factors influencing real estate price. Nonetheless, a literature review by the World Green Building Council (2013) shows that compared to non-certified buildings in the same sub-market, premiums for green certified buildings' sale prices vary between 0 – 30%, with evidence showing that higher levels of certification achieve higher sales premiums. However, one Australian study included in the review showed that while the higher level of performance (NABERS 5*) tended to achieve a sales premium of up to 21%, the lower levels of performance (NABERS 2-2.5*) were reporting discounts as low as 13% (World Green Building Council, 2013.)

Among the numerous green standards and certificates in the world, the most relevant and commonly used from the European real estate industry point of view are LEED, BREEAM, DGNB and HQE on building level (RICS, 2015) and GRESB on portfolio level. Table 4 provides an extended list of standards and certificates. The standards' applicability in the Finnish context is evaluated in the table as well. In general, all of the standards are rather generic and, in that sense, as applicable in Finland as in other developed markets. In Finland, LEED and BREEAM are the most popular certificates, with over 120 certified buildings combined[16].

[16] http://figbc.fi/tietopankki/ymparistoluokitukset/

Standard	Description	Applicability
LEED (Leadership in Energy and Environmental Design) supported by The U.S. Green Building Council (USGBC)	LEED is a green building certification program used worldwide and established by the US Green Building Council.	Nine categories in total, of which few key categories from the Finnish point of view include energy and atmosphere, indoor environmental quality, materials and resources as well as location and transportation. The new v4 published in 2017 includes e.g. higher credits for rainwater management and energy demand response.
BREEAM (Building Research Establishment's Environmental Assessment Method) published by the Building Research Establishment (BRE) UK	BREEAM is used across the world and is a leading environmental assessment method for buildings. BREEAM is an international scheme that provides independent third-party certification of the assessment of the sustainability performance of individual buildings, communities and infrastructure projects.	Key categories from the Finnish point of view include energy, transport, waste, as well as health and wellbeing. The BREEAM issue Wst 05 takes climate change adaptation into account by encouraging the consideration and implementation of measures to mitigate the impact of more extreme weather conditions arising from climate change over the lifespan of the building.
GRESB (Global Real Estate Sustainability Benchmarks)	GRESB assesses the sustainability performance of real estate and infrastructure portfolios and assets worldwide. The membership fee provides ESG data, scorecards, benchmark reports and portfolio analysis tools. GRESB collaborates with both LEED and BREEAM.	GRESB Real Estate has 60+ investor members, including e.g. Norges Bank and the Swedish AP fonds 1-4.

GRI CRESS (Global Reporting Initiative Construction and Real Estate Sector Supplement)	Covers sector-specific issues, including e.g. building energy intensity, GHG emissions relating to buildings in use, management and remediation of contaminated land etc.	GRI's sector disclosures for the construction and real estate sector. Covers mitigation but not adaptation. Disclosures include land degradation, contamination and remediation[17]
Science Based Targets Sectoral Decarbonization Approach (SDA) tools	Scientifically-informed method for companies to set GHG reduction targets necessary to stay within a 2°C temperature rise above pre-industrial levels. Consists of three different methods: sector-based, absolute-based and economic-based approach	The SDA CO_2 reduction potential for commercial buildings ('service buildings') is 26 per cent. Most reductions will be due to increased insulation, electrification of the offices, more energy efficient appliances, and an increase in the use of renewable energy. Tapping into this potential will be different for developed and developing countries (IEA 2012a). In developed countries, retrofitting existing building stock can significantly reduce CO_2 emissions.
Sustainable Energy Investment (SEI) Metrics, Benchmarks and Assessment Tools for the Financial Sector	The SEI Metrics research project aims to develop a climate performance framework and associated investment products that measure the exposure of financial portfolios to the new climate economy. Key include 2°C investing criteria and benchmarks for financial assets and portfolios.	The Climate Strategies and Metrics – Exploring Options for Institutional Investors report reviews the strategies and metrics available to investors seeking to measure and improve the climate-friendliness of their portfolios.

[17] For full list of disclosures, see https://www.globalreporting.org/resourcelibrary/GRI-G4-Construction-and-Real-Estate-Sector-Disclosures.pdf

Energy Efficiency Agreements 2017-2025	Finnish companies that join the Energy Efficiency Agreement commit to improving their energy usage. The energy savings goal for the real estate sector is 7.5 per cent from 2017 to 2025 with an interim goal of 4 per cent by 2020.	A total of 41 companies and 1173 buildings as members (in January 2018) in the commercial real estate sector. Ambition of targets lower to that compared to Science Based Targets.
RTS-ympäristöluokitus ja RT-ympäristötyökalu ('RTS environmental certification and the RT environmental tool')	A certification and a tool for investors ordering new construction projects who want to enforce environmentally friendly building.	The system is developed for Finnish environment by the The Building Information Foundation RTS in a wide collaboration with the real estate and construction sector.
Swan Ecolabel	The Swan is the official Nordic Ecolabel, introduced by the Nordic Council of Ministers.	Only a few Swan certified buildings exist in Finland by early 2018. New recommendations for buildings' energy efficiency do not apply to commercial real estate.
The Global Alliance for Buildings and Construction (GABC)	Initiative launched at COP21, as part of the Lima Paris Action Agenda. Aims to mobilise all stakeholders, including member states and non-state actors from the Buildings and Construction sector to scale up climate actions in the sector. Specifically, the GABC aims at supporting and accelerating the implementation of Nationally Determined Contributions (NDCs). It is committed to putting the buildings and construction sector on the below 2 °C path.	Members include mostly ministries, think tanks, private companies, research institutes and public agencies. The Ministry of the Environment is the sole Finnish member of the GABC.

HQE (Hauté Qualité Environnementale)	French certification awarded to building construction and management as well as urban planning projects. Promotes best practices, sustainable quality in building projects and offers expert guidance throughout the lifetime of the project.	Dominant in French-speaking Europe, there are no HQE-certified buildings in Northern Europe
DGNB: Gesellschaft für Nachhaltiges Bauen (German Sustainable Building Council)	German certification system for projects incorporating e.g. circular economy, innovation and the SDGs	Most projects are situated in the German-speaking Europe, however, some projects outside of the key territory, with over 20 projects in Denmark (in January 2018)
Energy Star	U.S EPA-run voluntary program that helps businesses and individuals save money and protect our climate through superior energy efficiency.	US-centered
BCA (Building and Construction Authority) Green Mark Scheme	Initiative by Singapore's Building and Construction Authority to drive the construction industry towards more environment-friendly buildings. Intended to promote sustainability in the built environment and raise environmental awareness among developers, designers and builders.	Singapore-specific

NABERS (National Australian Built Environment Rating System)	Measures the energy efficiency, water usage, waste management and indoor environment quality of a building or tenancy and its impact on the environment.	Australia-specific
ISO 14001	General environmental management standards	Applicable to real estate industry
ISO/NP 14097	Framework and principles for assessing and reporting investments and financing activities related to climate change, set to be published in 2019.	The standard will provide technical guidance to financial institutions on climate related metrics, in line with the recommendations of the TCFD, the provisions of Article 173 in France, and other climate-related disclosure requirements in preparation.

Table 4 – Real estate-related sustainability standards and certificates

3.3 Climate change related legislation and policies

Legislation

Finland is a member of the EU and so EU legislation also applies. For a detailed discussion on legislation in force see appendix 2.

National Energy and Climate Strategy for 2030

The National Energy and Climate Strategy[18] lays out concrete actions and objectives on how Finland is to achieve the energy and climate objective consistent with 2050 carbon neutrality target. It notably updates previous goals on renewable energy: 1) the share of renewable energy into final energy demand should rise to over 50 % in the 2020s while the use of oil products will be halved, 2) investment subsidies will be mainly targeted on commercialisation of new technologies, expanding biofuels in transport and promote the use of agricultural, societal and

[18] http://tem.fi/documents/1410877/2769658/Government+report+on+the+National+Energy+and+Climate+Strategy+for+2030/0bb2a7be-d3c2-4149-a4c2-78449ceb1976

industrial waste and side streams in transport, heat and electricity generation, and 3) promote the generation and use of biogas.

National Climate Change Adaptation Plan 2022

The aim of the National Climate Change Adaptation Plan 2022[19] is that the Finnish society has the capacity to manage the risks associated with climate change and adapt to changes in the climate. The objectives of the plan are:

- Adaptation has been integrated into the planning and activities of both the various sectors and their actors;
- The actors have access to the necessary climate change assessment and management methods, and
- Research and development work, communication and education and training have enhanced the adaptive capacity of society, developed innovative solutions and improved citizens' awareness on climate change adaptation.

To reach the aim, the National Climate Change Adaptation Plan specifies the key measures in support of adaptation to be implemented in the next few years. Adaptation is included in the Climate Act [609/2015]. According to this, the Government adopts a national adaptation plan at least once in every ten years and the State authorities must, to the extent possible, promote the implementation of the adaptation plan in their actions. The adaptation plan also implements the EU Strategy on Adaptation to Climate Change within Finland.

Adaptation has been included in the legislation and one of the key issues that has been developed regarding built environment and buildings is the prevention of flood risk due to rainwater and meltwater, i.e. runoff water. In 2014 the provisions on runoff water has been added into the legislation, e.g. in the Flood Risk Management Act (620/2010) flood risks in densely built-up areas are included[20].

The general target in adaptation is that importance of climate changes is widely understood and that the changes in the climate is included in the guidance, planning and decision-making. For instance, the Finnish Environment Institute provides flood risk maps the can be used in land use planning and as tools when adaptation on a building or a community level is planned.

3.4 Adaptation measures

Climate adaptation is strongly linked to climate resilience as a term. It focuses on adapting to the actual or expected impacts caused by climate change. Examples of building climate change

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[19] http://mmm.fi/en/national-climate-change-adaptation-plan
[20] https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/75594/YMra_25_2016_ilmasto-muutokseen.pdf?sequence=1

resilience through adaptation include elevating buildings, roads and other critical infrastructure to avoid river and sea-level flooding, as well as installing green roofs or cooling centres to address the urban heat island effect (Bienert, 2016.) As infrastructure plays a key role in climate change adaptation, the role of the public sector is often emphasized. Jarva et al. (2014) compiled best practices for climate change adaptation in the Baltic Sea area. As most widely used and applied adaptation measures, in particular related to storm surges they list:

- Regulations for building elevations in shore areas
- Raising land in relation to sea level rise scenarios before building activities
- Accepting the fact of flooding of the ground level of buildings and adjusting functions based on this fact
- Protecting buildings outside with different types and scales of technical solutions (floodgates, dykes, removable walls, sandbags)
- Choosing and preferring flood-proof building materials (waterproof basements/walls)

Climate change adaptation has raised significantly less attention among investors, compared to mitigation (GARI, 2016). This has often been explained by referring to various uncertainties related to climate adaptation, such as overall MRV (monitoring, reporting and verification - whereas mitigation is easily measurable by GHG emission ton reductions, adaptation is by nature more complex and more difficult to measure) challenges, or general uncertainties linked to what are the impacts and climate change threshold values that should be prepared for and when (hence working with probabilities and longer time perspectives). The uncertainty about how to evaluate or measure both existing and potential physical climate risk – and consequently the benefits of adaptation-related investments - make identifying successful investments and directing additional financial flows in this area very challenging (GARI, 2016).

On a general level, investors can either make *resilient investments*, e.g. invest in real estate assets where technical measures have been taken to protect the building from extreme weather events, or *invest in resilience,* i.e. invest in companies providing resilience-building products or services, such as rainfall storages or weather forecasting and modelling services (GARI, 2016).

In the real estate sector, adaptation methods include constructing more climate-resilient buildings or retrofitting existing buildings with adaptive structures or technologies. Cities also have a role in adaptation through planning: they can define where and how high buildings and their plinths need to be built. Cities can also assign areas where floodwaters can be directed and naturally retained in the case of floods.

The Global Adaptation & Resilience Investment Working Group lists investments that can help anticipate, absorb, accommodate or recover from the increased risk and impact of acute or chronic risks. The opportunities for these types of investments include (GARI, 2017):

- Products and services helping to identify, assess and manage climate risks. The guide mentions technologies that forecast the availability and improve efficiency in the use of natural resources, such as water, as an example

- Projects or practices that reduce physical climate risk, for example infrastructure and "hubs" for improved business continuity during and after extreme weather events
- Direct investments in companies that produce climate resilient products or services
- Climate resilient securities such as resilience bonds issued to raise capital for use in projects or activities with the specific purpose of building resilience to climate events investment vehicles focused on climate resilience companies or assets, such as CRAFT (Climate Resilience and Adaptation Finance & Technology Transfer Facility)[21]

A typical way for real estate owners to transfer extreme weather risks is through insurance. It has to be kept in mind, however, that insurance in Finland only applies to "exceptional floods". The definition of an exceptional flood varies between countries. Finance Finland, for example, has defined an exceptional flood as one whose occurrence is probable on average once every 50 years[22]. In Finland, the government no longer compensates damages caused by flood water. Since 2014, real estate owners have needed to obtain insurance from the private sector insurers.

In Canada, the private sector does not offer insurance for "overland" flooding. Storm surges or flooding from rivers and streams are an uninsurable risk to most property holders. Instead, the federal and provincial governments share the cost of flood recovery through Disaster Financial Assistance Arrangements (DFAA). In Germany, the private sector does offer insurance, except in high-risk areas near rivers. As the market penetration of natural hazard insurance is low, in some instances government steps in to help with flood recovery. In the United States, the federal government is responsible for the vast majority of flood insurance policies sold in the country through the National Flood Insurance Program (NFIP). The private sector sells insurance for other natural hazards, although in states with areas at high risk for hurricanes or earthquakes, various state-sponsored insurance arrangements exist. In the UK, the Association of British Insurers and the national government. The private sector sells flood insurance on all except high-risk properties, and in exchange the government is responsible for flood-risk mapping and funding mitigation measures designed to lower flood risks. The local governments also steer new building development toward low- and medium-flood risk areas. Only when no other land is available does the national government advise local governments to allow development in high-risk areas (ULI, 2014.)

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21 https://www.climatefinancelab.org/project/climate-resilience-adaptation-financetransfer-facility-craft/

22 http://www.finanssiala.fi/uutismajakka/Sivut/Ilmasto_muuttuu_Tulvariskeihin_varautuminen_etenee.aspx

Appendices

Appendix 1 – Examples of risks

Risk Category	Risk Driver	Description of risk
Transition	Building energy intensity	In the transition to a low-carbon economy, the energy efficiency of properties provides investors with an indication of the vulnerability of the portfolio to transition risk and thus earning capacity of real estate portfolios.
Transition	Building water intensity	In areas with scarcely water supply, water stress can result in increased cost of supply, factual inability to deliver water to real estate tenants, and/or legislation to regulate water withdrawal for consumption. The building water intensity informs the (transition) risk of significant costs or limitations to this service capacity.
Transition	Low-carbon economy	Investments in new technologies are needed to manage transition risk. The level of investment provides an indication of the level to which the future earning capacity of the core business might be affected.
Physical risks	Location & Flooding	Flooding risks can result in physical damage to properties, affecting their serviceability. Understanding the potential impacts of flooding risks and the related financial implications informs investors about potential changes to the earning capacity of real estate portfolios.
Physical risks Transition	Changes in physical environment	Heavy rain and windiness, higher outdoor temperature and humidity are climate challenges that the building sector is facing. Taking these factors together with the trend of increased thermal insulation (due requirements on energy efficiency), can cause increase moisture load on building structures and studies show that there are clear risks in relation to the moisture safety of buildings. This could cause a risk of systematic building defect and raise a concern on health issues, leading to potential stranded assets –issue in the real estate portfolio.

Regulatory	New regulatory environment and requirements	Regulatory measures such as carbon pricing as well as transition to low-carbon properties may affect the financial viability of existing properties. Understanding the percentage certified as sustainable (against relevant indices) provides investors with an indication about the potential impact of regulatory measures and demand changes on earning capacity of real estate portfolios.

Examples of risks, *sources: TCFD (2017), Vinha et al. (2015), Boverket (2010)*

Appendix 2 – Finnish legislation covering built environment, energy and climate change[23]

Climate Change Act (609/2015)

The Climate Change Act [24]intends to create a bottom up, long-term, consistent and cost-effective climate policy through enabling political decision making and its transparent implementation (Mitigation and Adaptation). To build a low carbon society, the act proposes to reduce Finland's emissions by 80% of the 1990 levels by 2050. The law exempts EU ETS from its remit. It aims to increase the efficiency of the public sector to improve smart "societal planning" while retaining the competitiveness of the economy in achieving the targets without imposing new obligations on businesses or others. The act includes a planning and monitoring system and measures to clarify the climate policy planning of state authorities.

Flood Risk Management Act (No. 620/2010) (2010)

As part of the implementation of the EU Directive (2007/60/EC) on the assessment and management of flood risks, flood risk maps have been produced for e.g. the Helsinki-Espoo coastal area and a flood risk management plan is under preparation. In the plan, significant risk areas are defined and flood protections measures are presented. This Act forms part of the adaptation strategy and concerns the organisation of flood risk management. The purpose of the Act is to reduce flood risks, prevent and mitigate the adverse consequences caused by floods and promote the preparedness for floods. The purpose of the Act is also to co-ordinate flood risk management and other management of river basins, with due account for the needs relating to sustainable use and protection of water resources. The principal administrative authority for purposes of this Act is the Ministry of Agriculture and Forestry. Executive tasks are assigned to the Centre for Economic Development, Transport and the Environment. The act is also accompanied by a Government Decree on Flood Risk Management to implement the provisions through preliminary flood risk assessment, preparation of flood hazard maps and flood risk maps, preparing flood risk management plans for river basins and coastal areas.

Other acts on environmental protection

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[23] see compiled information on http://www.lse.ac.uk/GranthamInstitute/country-profiles/finland/

[24] http://www.ym.fi/en-US/The_environment/Legislation_and_instructions/Climate_change_legislation

The Environmental Protection Act (527/2014) promotes the sustainable use of natural resources in general. In relation to geological resources, the Act unambiguously prohibits the contamination of soil or groundwater.

The Land Extraction Act (555/1981) ensures sustainable environmental development. It is applied to the extraction of rocks, gravel, sand, clay and topsoil (mull).

The Water Act (587/2011) promotes, organises and coordinates the use of water resources and the aquatic environment. Water services are ensured by the Water Services Act (119/2001). As part of the implementation of the EU Directive (2007/60/EC) on the assessment and management of flood risks, flood risk maps have been produced for the Helsinki-Espoo coastal area and a flood risk management plan is under preparation. In the plan, significant risk areas are defined and flood protections measures are presented.

The Water Services Act (119/2001) requires natural management methods as primary means in managing storm and rainwater in urban areas.

Land use and Building Act (132/1999) (1999)

Among its wide-ranging provisions, the act also aims to empower the authority of the municipal and regional councils to regulate buildings, developments and plans in their jurisdiction to be environment friendly and energy efficient along with other wide-ranging criteria.

The National Building Code of Finland [25]

The Land Use and Building Act (132/1999) specifies the general conditions concerning building, substantive technical requirements, building permit procedure and building supervision by the authorities. Further provisions and guidelines concerning building are issued in the National Building Code of Finland.

Traditionally the regulations in the Building Code have applied to new buildings only. In the case of renovation or alterations the regulations have been applicable only when required due to the type and extent of the measure or use of the building or part of it that may be changed (unless specifically regulated otherwise). The aim is to allow flexibility in the application of the building regulations, to the extent possible considering the characteristics and special features of the building. As the Building Code is being revised, each of the new decrees will specify whether it is applicable to new building or renovation or alteration of a building.

In Finland the requirement of energy efficiency in buildings has over the years been comparable strict. Table 5 presents a comparison of U-values in selected European countries.

[25] http://www.ym.fi/en-us/Land_use_and_building/Legislation_and_instructions/The_National_Building_Code_of_Finland

Comparison of energy requirements (insulation U-values) in some European countries				
U-Values (W/m2.K)	Walls	Floor	Roof	Windows
Finland Building elements of warm and cooled cold spaces	0.17	0.09	0.09	1
Sweden Electrically heated Non-Electrically heated	0.1 0.15	0.1 0.18	0.08 0.13	1.1 1.3
Germany	0.28	0.35	0.2	1.3
United Kingdom	0.3	0.25	0.2	2

Table 5 - Comparison of U-values in selected European countries. Source and more detailed information: http://www.iea.org/beep/

Energy performance of buildings undergoing renovation or alteration

Ministry of the Environment Decree (4/13) on improving the energy performance of buildings undergoing renovation or alteration. The decree provides minimum standards for improving energy performance of buildings in renovations and alterations. The decree specifies the requirements for specific building elements

For example, when the improvement in the energy performance of a building is planned and carried out by means of the building element, the following requirements must be observed:

a. External walls: The original U-value x 0.5, but not higher than 0.17 W/(m2 K).

b. Roofs: The original U-value x 0.5, but not higher than 0.09 W/(m2 K).

c. Floors: The energy performance is improved as far as possible.

d. The U-value of new windows and external doors must be 1.0 W/(m2 K) or better.

References

Bank of England, Climate change: what are the risks to financial stability? Accessible at: http://edu.bankofengland.co.uk/knowledgebank/climate-change-what-are-the-risks-to-financial-stability/

Bienert Sven (2016), Climate Change Implications for Real Estate Portfolio Allocation, Urban Land Institute (ULI) publications.

Boverket (2010). Klimatanpassning i byggande och planering – analys, åtgärder och exempel. Accessible at: https://www.boverket.se/globalassets/publikationer/dokument/2011/klimatanpassning-i-planering-och-byggande-webb.pdf

Climate Change: Action, Trends, and Implications for Business, Cambridge University Press, 2013. Accessible at: https://www.cisl.cam.ac.uk/business-action/low-carbon-transformation/ipcc-climate-science-business-briefings/climate-science

EU High Level Expert Group (HLEG) on Sustainability Finance (2018), Financing a Sustainable European Economy

GARI - The Global Adaptation & Resilience Investment Working Group (2016), Bridging the Adaptation Gap: Approaches to Measurement of Physical Climate Risk and Examples of Investment in Climate Adaptation and Resilience.

GARI - The Global Adaptation & Resilience Investment Working Group (2017), An Investor Guide to Physical Climate Risk & Resilience.

Hirsch Jens, Braun Thomas, Bienert Sven (2015). Assessment of climatic risks for real estate, Property Management Vol. 33 No. 5, 2015.

Intergovernmental Panel on Climate Change, Fifth Assessment Report (AR5), Accessible at: https://www.ipcc.ch/report/ar5/

Jarva Jaana, Nuottimäki Kristiina, Kankaanpää Susanna, Tarvainen Paula, Rautio Kaarina, Lampinen Hanna (2014), Climate Proof Living Environment – Methodologies, tools and practical recommendations for climate change adaptation in the Kymenlaakso and Uusimaa regions and the Helsinki Metropolitan Area. Recommendations for stakeholders and other interest groups on climate change adaptation; produced in the framework of the South-East Finland – Russia ENPI CBC 2007–2013 Programme project (2011-033-SE497) Climate Proof Living Environment (CliPLivE)

Kahma Kimmo, Pellikka Hilkka, Leinonen Katri, Leijala Ulpu, Johansson Milla (2014), Pitkän aikavälin tulvariskit ja alimmat suositeltavat rakentamiskorkeudet suomen rannikolla, Ilmatieteen laitoksen raportteja 2014:6.

Nauels Alexander, Rogelj Joeri, Schleussner Carl-Friedrich, Meinshausen Malte and Mengel Matthias (2017). Environmental Research Letters: Linking sea level rise and socioeconomic indicators under the Shared Socioeconomic Pathways

NOAA National Centers for Environmental Information (NCEI) (2018), U.S. Billion-Dollar Weather and Climate Disasters. Accessible at: https://www.ncdc.noaa.gov/billions/

Ministry of the Environment report nr 25 2016 on adaptation action plan (in Finnish: Ympäristöministeriön raportteja 25, 2016. Ympäristöhallinnon ilmastonmuutokseen sopeutumisen toimintaohjelma 2022. Accessible at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/75594/YMra_25_2016_ilmastomuutokseen.pdf?sequence=1

RICS - Royal Institution of Chartered Surveyors (2015), Going for Green - Sustainable Building Certification Statistics Europe 2015

Ruosteenoja Kimmo, Jylhä Kirsti, Kämäräinen Matti (2016. Climate Projections for Finland Under the RCP Forcing Scenarios. Geophysica (2016), 51(1), pp 17-50.

Särkki Jani, Kahma Kimmo K., Kämäräinen Matti, Johansson Milla M, Saku Seppo (2017). Simulated extreme sea levels at Helsinki Boreal environment research 22: 299–315

TCFD – Task Force on Climate-Related Financial Disclosures (2017), The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities.

The City of Helsinki, Finnish Meteorological Institute (2016), Turvalliset rakentamiskorkeudet Helsingin rannoilla 2020, 2050 ja 2100.

Vinha Juha, Laukkarinen Anssi, Mäkitalo Mikael, Nurmi Sakari, Huttunen Petteri, Pakkanen Tomi, Kero Paavo, Manelius Elina, Lahdensivu Jukka, Köliö Arto, Lähdesmäki Kimmo, Piiroinen Jarkko, Kuhno Vesa, Pirinen Matti, Aaltonen Anu, Suonketo Jommi, Jokisalo Juha, Teriö Olli, Koskenvesa Anssi & Palolahti Tuomas (2013). Effects of Climate Change and Increasing of Thermal Insulation on Moisture Performance of Envelope Assemblies and Energy Consumption of Buildings. Tampere University of Technology Research report 159.

ULI – Urban Land Institute (2014), What the Real Estate Industry Needs to Know about the Insurance Industry and Climate Change, Urban Resilience Program White Paper Series.

Votsis Athanasios & Perrels Adriaan (2015), Housing Prices and the Public Disclosure of Flood Risk: A Difference-in-Differences Analysis in Finland, J Real Estate Finan Econ (2016) 53:450–471.

World Green Building Council (2013), The Business Case for Green Building – A Review of the Costs and Benefits for Developers, Investors and Occupants.

World Economic Forum (2018), Global Risks Report 2018. Accessible at: http://reports.weforum.org/global-risks-2018/global-risks-landscape-2018/#landscape

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