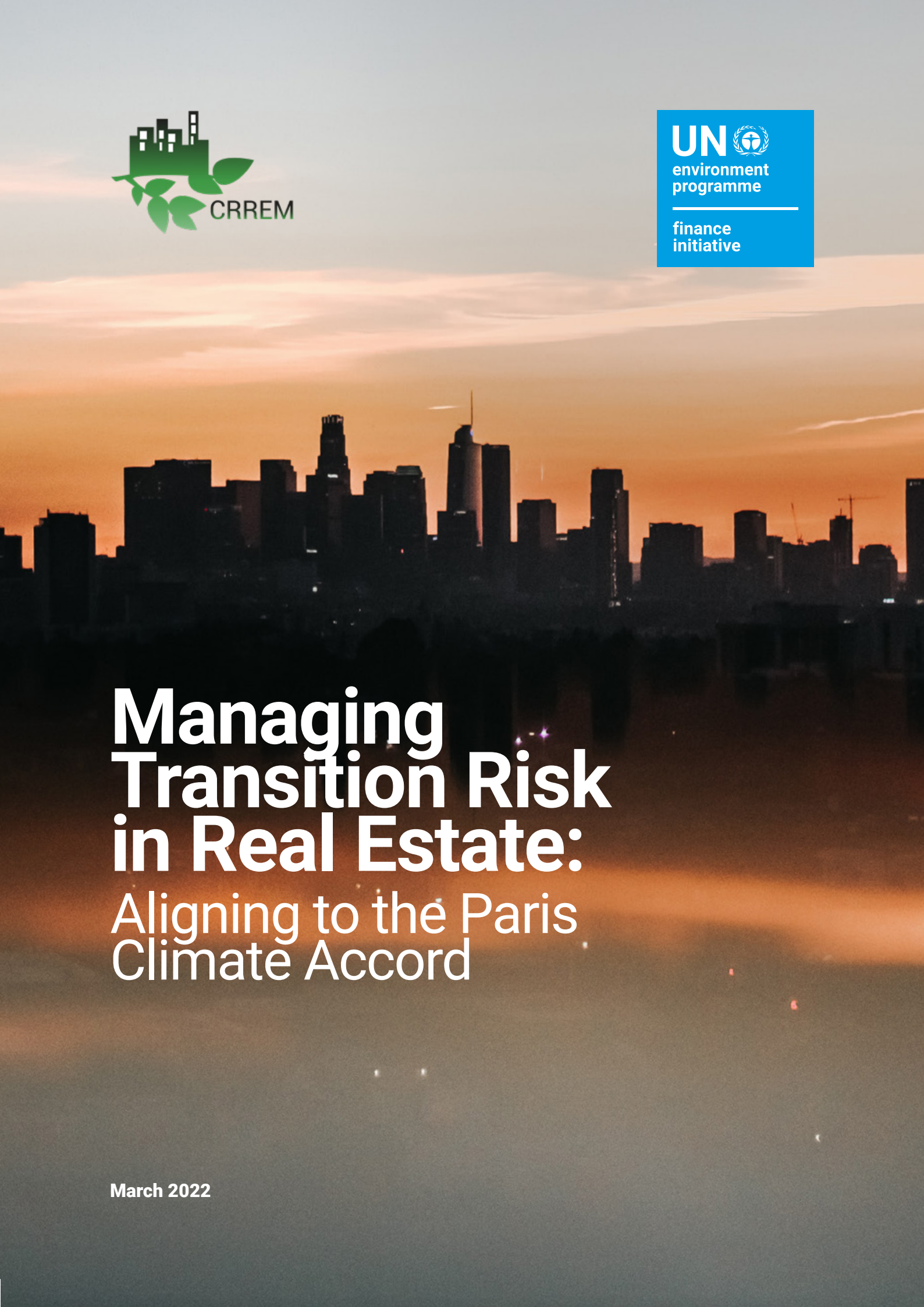

Managing Transition Risk in Real Estate:

Aligning to the Paris Climate Accord

March 2022

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Acronyms and abbreviations

AIM	American Innovation and Manufacturing Act
ANZ	Advancing Net Zero
APAC	Asia-Pacific
AuM	Assets under Management
BBP	Better Building Partnership
Bn	Billion
°C	Degrees Celsius
CAPEX	Capital Expenditures
CCl_3F	Trichlorofluoromethane
CDP	Carbon Disclosure Project
CO_2	Carbon dioxide
$CO_2e(q)$	Carbon dioxide equivalent
CRREM	Carbon Risk Real Estate Monitor
Carbon VaR	Carbon Value-at-Risk
CRE	Commecial Real Estate
ESG	Environmental, Social and Governance
EPA	Environmental Protection Agency
EPBD	Energy Performance Building Directive
EPRA sBPR	European Public Real Estate Association Sustainability Best Practices Recommendations
EU TEG	European Union Technical Expert Group on Sustainable Finance
ETS	Emissions Trading System
F-Gas	Fluorinated Gas
FSB	Financial Stability Board
GDP	Gross Domestic Product
GHG	Greenhouse gas
GRESB	Global Real Estate Sustainability Benchmark
GRI	Global Reporting Initiative
GWP	Global warming potential
HDD/CDD	Heating degree days/Cooling degree days
IIGCC	Institutional Investors Group on Climate Change
INREV	European Investors in Non-Listed Real Estate
IPCC	Intergovernmental Panel on Climate Change
IPMS2	International Property Measurement Standards
IEA	International Energy Agency
KPI	Key Performance Indicator
kWh	Kilowatt hour
LCA	Life cycle assessment
LP	Limited partner
m^2	Square meters
NABERS	National Australian Built Environment Rating System
NED	Net energy demand
NZCBC	Net-zero carbon building commitment
PCAF	Partnership for Carbon Accounting Financials
PRI	Principles for Responsible Investment
REIT	Real Estate Investment Trust
SBTi	Science Based Targets initiative
SDA	Sectoral decarbonization approach
TCFD	Task Force on Climate-related Financial Disclosures
UNEP FI	United Nations Environment Programme Finance Initiative
WGBC	World Green Building Council

Foreword

The global financial system has a critical role to play in helping business and society achieve a net-zero future. UNEP FI has worked closely with financial institutions to empower them to take the lead on climate-related challenges. Since its inception in 2017, UNEP FI's TCFD programmes have engaged over 100 banks, investors and insurers, developing a range of tools, frameworks and guides to support them in identifying, assessing, managing, and disclosing climate risks.

With the property sector accounting for nearly 40% of global CO2 emissions, real estate decarbonization is key to achieving global climate goals. In recent years, there has been a growing awareness that the real estate faces significant transition risks as economies decarbonize. To mitigate the impact of potential transition risks, financial institutions must be proactive.

To further advance the understanding of transition risks in the real estate sector, UNEP FI partnered with the CRREM initiative, whose CRREM tool helps firms understand the magnitude and nature of their potential risks. Through this collaboration, UNEP FI and CRREM have produced this report, building on work done by UNEP FI's Property Working Group. Now convened by the Principles for Responsible Investment (PRI), the Property Working Group has been a hub for innovation, developing the tools property investors and professionals need to consider ESG in investment and lending decisions. The report provides further clarity on the state of real estate assets and the challenges remaining in aligning to net zero, highlighting:

- The current high energy consumption of residential and commercial assets globally;
- The need to prioritize retrofitting and refurbishment of existing property stocks;
- The potential for increasing capacity for on-site renewable energy production; and
- The need to improve energy intensity, along with electrification.

The findings in this report offer both opportunities and warnings for financial institutions. The firms that capitalise on the low-carbon transition will find themselves in a position to thrive in the years ahead. However, firms that avoid the imperative of change will find themselves increasingly at risk and potentially holding stranded assets. Beyond the actions of any one firm, the decarbonization of the real estate sector is a must for our climate and our planet.

Eric Usher
Head, UNEP FI

The right tool for the job: the experience of participants

'The real estate sector would benefit from a streamlined carbon accounting methodology to guide organizations towards a Paris-aligned net-zero transition. CRREM is the first solid step that allows EU asset owners and managers to integrate carbon risk into their real estate decision-making.

Link is pleased to be an early APAC evaluator of the CRREM tool—where we value its transparency, credibility and synergy with like-minded organizations such as GRESB. We encourage our APAC peers and investors to trial and disclose their experience with this tool in order to further refine its compatibility and application across various geographies in the future.'

Dr. Calvin Lee KWAN, Head of Sustainability & Risk Governance, Link Asset Management Limited

Under our 1.5°C target, the huge challenge in the real estate industry is to improve climate efficiency in existing buildings. This is more important than building new zero-emission buildings, since it is expected that 80% of the building stock in 2050 has already been built.

We welcome CRREM as a tool for analyzing risks and opportunities in the context of science-based reduction targets, supporting strategic decision-making and optimizing measures at the asset and portfolio level.'

Unn Hofstad, Sustainability Manager, Storebrand Real Estate

'CRREM is a very useful tool to move forward with our climate change countermeasures. Although we had assessed our portfolio based on a TCFD scenario analysis to understand the financial implication based on 2°C and 4°C scenarios, we had no detailed milestones regarding transition risks towards net-zero carbon emissions by 2050. As we are focused on enhancing stakeholder value over the medium-to-long term through maintaining our initiatives towards ESG, we feel it is essential for us to test and utilize new technology such as this CRREM tool.'

Miki Mitsuoka, Director in Charge of Risk Management and Compliance Department, Head of ESG, ORIX Asset Management Corporation

Executive summary

The effects of climate change are increasingly being felt around the world, and social and economic pressure for a low-carbon transition is building. Climate risks have become a growing part of public discussions, media reports, and government policies. While decarbonization is critical to mitigate these climate risks, the large-scale economic changes required by a low-carbon transition will introduce significant 'transition' risks. For the real estate sector, much attention has been paid to extreme weather events and other climate-driven consequences (physical risks), but transition risks must also be considered. Potential transition risks include rising costs due to the pricing-in of carbon emissions (through carbon taxes and pricing schemes), market effects, technological disruptions, legal liabilities, energy efficiency and other regulations and reputational risks, all of which can impact property values.

Proactive management of real estate transition risks is essential in the face of rising regulatory expectations around emissions and energy efficiency and growing concerns about climate change from real estate market participants. Proactivity demands suitable methods to identify, assess and ultimately manage these transition challenges. The CRREM initiative supports the need for information and analysis by providing the Carbon Risk Real Estate Monitor (CRREM) tool, which uses a downscaling approach to break down decarbonization targets to regional and sectoral levels (resulting in country and use-type decarbonization pathways).

The tool allows building owners to compare the protected carbon emissions from individual property assets or portfolios with the reductions of emissions that will be needed, over time, to meet the goals of the Paris Agreement, and therefore their alignment with global decarbonization pathways. In doing so, the tool enables the analysis and management of transition risks for a wide range of properties.

This report summarizes the experiences of a group of real estate investors and banks who piloted the use of CRREM as part of UNEP FI's TCFD programme. Over 70 participants from across the financial sector participated in webinars on real estate transition risks, with more than a dozen piloting the latest CRREM tool and resources. This report documents the learning and experience of participating financial institutions and illustrates how the latest iteration of the CRREM tool can be deployed to effectively measure and manage real estate transition risks. The report also includes insights on other climate challenges confronting the real estate sector and recommendations for addressing them.

The overview below provides a summary of the major insights contained within the report.

Section A: UNEP FI-TCFD pilot

Overall messages

- Transition risk is a topic of strategic relevance for real estate investors. Energy efficiency regulations and carbon pricing schemes are gaining prominence around the world. As the low-carbon transition accelerates, there is a growing risk of stranded assets and write-downs from properties that fail to meet market expectations and regulatory requirements.
- To limit the global temperature rise to 1.5˚C, the world must reach net-zero GHG emissions by 2050. Real estate investors must support this global climate goal by setting net-zero targets. For these targets to be effective, data transparency, appropriate metrics and management support are critical.
- For real estate, a special focus must be placed on operational GHG emissions, since most buildings that will exist in 2050 have already been built. Aggressive retrofitting and refurbishment within the existing property stock is a strategic priority.
- On-site renewable energy production offers untapped potential for further improvement of the GHG profile of assets.
- Much of the world is moving to decarbonize the production of electricity, a development that supports decarbonization in the real estate sector. However, this effect does not mean market participants can avoid taking action; energy intensity must be continually improved within assets to stay competitive.

Pilot findings

- As part of the UNEP FI programme, the CRREM risk assessment tool was extended with country-specific data to the Asia-Pacific, North America and Scandinavia.
- CRREM analysed 340 residential and commercial assets across various geographic regions globally and found average energy consumption of around 300 kWh/m²/year. These results demonstrate the significant challenge in reaching net zero by 2050 for residential and commercial buildings, since even among the best performing assets, only a few were aligned to net zero.
- Among the pilot project participants, the best performers also had the best data and data transparency. However, challenges regarding access to reliable and granular data on property-related GHG emissions and related metrics still remain. Some focus areas include improved tenant data and information on F-gases.

Section B: Industry challenges: What to tackle next

- Surveys of market participants show that regulation, reporting requirements and potential property write-downs are the main drivers of their increased focus on climate risks. A major obstacle to assessing and managing transition risk involves limitations in asset-level data. The majority of respondents expressed an intention to enhance their climate risk assessment capabilities and data.
- To overcome industry challenges, asset owners and managers need to prioritize (i) improving data collection and management and (ii) strategic and tactical responses to the energy efficiency and carbon reductions of their assets.
- **Data enhancement**
  - Recommendations for addressing asset-level data gaps begin with reducing asset-level assumptions, increasing access to user-specific inputs, and focusing on energy usage.
  - Another recommendation concerns refrigerants or fluorinated gases (F-gases). F-gas exit programmes must be implemented consistently by tenants and investors. Capex budgets must be allocated for this purpose and assessments should be linked to the normal refurbishment cycles.
  - Access to improved tenant data also means collaborating with tenants to capture consumption information within tenant spaces.
  - When data is missing, investors and asset managers should clearly state where gaps exist and what assumptions have been made to enable comparisons.
- **Efficiency measures**
  - Retrofitting existing building stock will require investment. Investors should ensure that these investments are not only viable from a financial perspective, but also have net efficiency and emissions benefits.
  - More focus should be placed on ‘refurbish and reuse’ instead of ‘demolish and rebuild’.
  - Market participants should consider more renewable energy procurement and increases in on-site renewable energy production (e.g., use of solar, wind power and heat pumps).

Section C: Conclusion and Recommendations

The conclusion of this report focuses on the actions and considerations that are essential to improve the carbon footprint of real estate portfolios.

- **Avoid stranded assets:** Climate-related risks must be integrated into real estate investors' risk management practices. Understanding the fundamental drivers of climate-related risks and developing appropriate mitigation strategies is key. Properties offering short-term returns can quickly become stranded due to changing climatic, regulatory or market conditions. Investors should consider multiple time horizons and scenarios in their risk assessments.
- **Consider the whole building:** Good practice in the industry involves taking a 'whole building' perspective. This means considering all of a property's energy consumption and emissions.
- **Carbon intensity is a key metric:** Alongside absolute emissions metrics, investors should also consider the emissions intensity of an asset's energy consumption and any other emissions it produces, by applying commonly used intensity metrics.
- **Take a sectoral approach to target-setting:** Benchmarks have been developed for the real estate sector that provide a pathway to net-zero emissions by 2050. Regional considerations, climatic conditions, and developments in the local energy system are important factors when setting a target.
- **Baseline data quality is important:** Beyond the decarbonization target and pathway, attention must also be paid to the adjustment of occupancy rates, usage times and the basis for space definitions, etc. to ensure reliable and valid like-for-like comparisons and appropriate benchmarking.
- **Take action on existing assets:** Most of 2050's building stock already exists today—and new construction alone (even if net-zero aligned) will not be able to offset the emissions from existing buildings. Persistently low retrofit rates may reflect the fact that retrofits are still primarily pursued based on short-term cost-benefit analyses for most investors, rather than longer-term sustainability-related motivations. Long-term thinking is needed to overcome this challenge.

Introduction

Climate change poses a fundamental threat to economic growth, quality of life and political stability around the world. To avoid the negative consequences of future climate change, a sharp reduction in GHG emissions is needed.

Large-scale decarbonization of the global economy introduces 'transition' risk, which encompasses not only the risk of rising costs due to the pricing-in of carbon emissions on national and international scales, but also market effects, technological disruptions, legal liabilities and reputational risks. In the case of the real estate sector, transition risks from carbon pricing, energy efficiency regulations and increasing energy prices loom large.

UNEP FI is supporting institutions with the theoretical and informational foundations to carry out climate risk analysis, implement mitigation strategies, and set decarbonization targets aligned with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). For the real estate sector, a targeted effort has been made to inform market participants (owners/investors and lenders) on sector transition risk issues and the data and assessment needs for managing these risks. This included trialling the Carbon Risk Real Estate Monitor (CRREM) tool with a group of institutions against a small portfolio of assets to improve internal risk management capacity and reveal potential asset stranding risks.

The CRREM initiative provides a solution to the challenges faced by the real estate sector in aligning with the Paris Agreement targets and mitigating transition risk. The initiative focuses on operational carbon emissions during the use-phase and offers a methodically rigorous, industry-supported and globally leading framework for the real estate sector to set science-based targets, benchmark specific real assets, and analyse portfolio performance. Core resources include the CRREM decarbonization pathways, which are available for most global real estate markets and use-types, and which can be applied as a benchmark against current and projected future property performance. The purpose of these pathways is to translate the goals of the Paris Agreement into regionally and property type-specific trajectories, which in turn define the ambition level for science-based real estate targets. The CRREM initiative also offers a 'translation' of energy reduction trajectories (energy intensity). The timespan covers 2020 to 2050, to enable interim goal-setting and ongoing control.

The pathways are also integrated in the CRREM tool, which enables market participants to ensure strategic planning, benchmarking, ongoing management and reporting in line with the TCFD and other initiatives. Using the software, investors and lenders can: analyse real estate portfolios in a number of different ways (including their alignment with Paris goals); identify assets in danger of stranding due to non-compliance with carbon intensity and energy efficiency requirements; and draw up potential retrofit strategies to

comply with future decarbonization requirements. With major global investors, industry bodies and academics recommending the use of CRREM for the real estate sector, the tool is now the standard for the real estate market's net-zero ambitions. (For more information on CRREM, see Appendix B.)

This report focuses on transition risk within the real estate sector by highlighting the results of CRREM analysis conducted as part of the UNEP FI TCFD programme. The analysis focuses on Asian and American financial institutions who are early adopters in the real estate sector. As part of the UNEP FI TCFD programme, sample portfolios were analysed with the CRREM software and the degree of alignment with the CRREM decarbonization pathways was identified. The project helped firms build capacity to address transition risk and implement decarbonization strategies. Through the programme, a pre-filled CRREM tool using Asia and American default data was also produced. Financial institutions also took part in a global survey on various investment philosophies, objectives and experiences. As a result, the report extracts lessons learned on how to best leverage CRREM in specific use cases, and it provides a way forward for how CRREM could best serve the real estate sector's ongoing decarbonization.

Section A:
UNEP FI TCFD PILOT

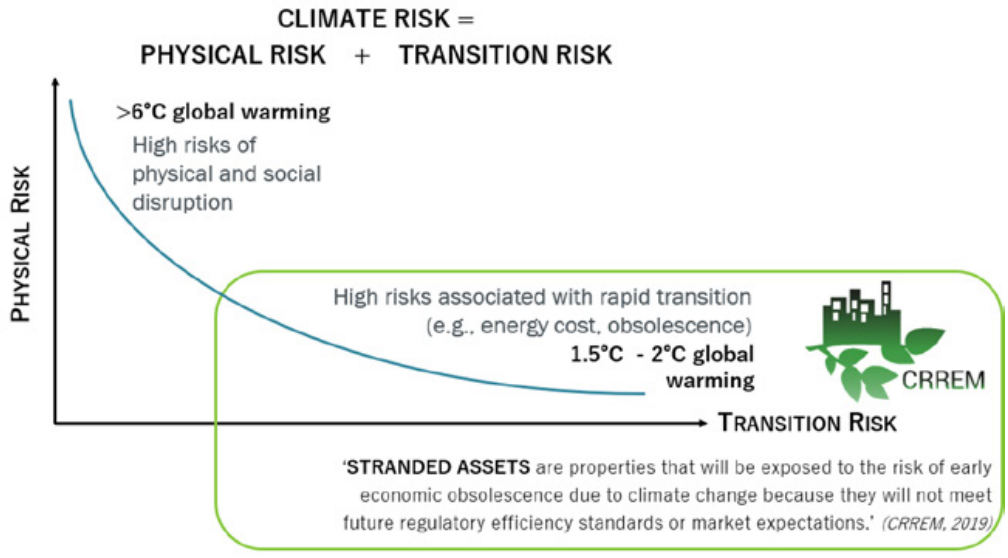
A. Definition and key drivers for transition risk

Without sufficient action, climate change has the potential to cause enormous disruption. The planet has already warmed more than 1˚C since pre-industrial times and a further 3 to 4°C rise in temperature by the end of the century cannot be ruled out on current emissions trajectories (IPCC 2021). The civilization-threatening risks of climate change have prompted the World Economic Forum to put climate change at the top of its annual *Global Risk Report* (World Economic Forum 2020).

Transition risk in the real estate sector

As real estate (directly and indirectly) contributes nearly 40% of all GHG emissions globally, it is vital to understand potential climate change-related risks for the sector (UNEP FI 2020). Climate change risks include both direct **physical risks** and indirect **transition risks**. With rapidly rising temperatures and uncontrolled GHG emissions, more physical risks (natural disasters and extreme weather events) will result. Mitigating these physical risks demands a shift to a low-carbon society, which poses transition risks (Figure 1).

Figure 1: **Transition risk vs physical risk**



Source: CRREM 2022.

Transition risk for the real estate sector can result from rising costs due to the pricing-in of carbon emissions and other factors such as high energy costs, stringent building codes, shifts in market expectations (public attention, decreasing demand for assets with high energy consumption and poor GHG performance, etc.) (UNEP FI 2020). In addition, other risks, such as competition, reputational and legal risks, may also arise for firms.

To limit climate-related risks, all sectors, including real estate, need to decarbonize. Buildings no longer compliant with the 1.5°C Paris-aligned decarbonization requirements will be increasingly exposed to transition risks and may even become 'stranded assets'. The term 'stranding risk' implies potential write-downs due to direct climate change impacts and devaluations related to the transition to a low-carbon economy. Table 1 below provides examples of transition risks and their potential impacts on the real estate sector.

Table 1: Examples of transition risk and impacts on real estate

Transition Risk	Impact on Real Estate
Declining market attractiveness Declining attractiveness of submarkets due to increased vulnerability and exposure to higher costs	▪ Lower demand (investor and tenants) ▪ Lower competitive advantage by increasing energy costs for properties with high-energy intensities] ▪ Reduced asset values may lead to a depressed market environment ▪ Decreasing market values
Increasing regulation Legislation focused on climate change—e.g., disclosure of climate risks, stricter building standards, CO_2 pricing, carbon credits, etc.	▪ Tax increases, e.g. CO_2 tax ▪ Decrease in subsidies for certain technologies ▪ Additional costs from reporting requirements ▪ Additional investment costs to bring the real estate portfolio in line with national laws ▪ Enforced rules that properties can only be rented if they meet a certain energy standard
Risks to reputation and market positioning Stakeholder demand for real estate companies where climate risks are included in the investment calculation	▪ Loss of reputation if action is too late or if no action is taken ▪ Reputational risks for companies, that do not sufficiently consider ESG topics in their strategy

Source: CRREM 2022.

As key market stakeholders become increasing aware of potential climate risks, an inactive and passive approach to climate change is neither informed nor rational. Such risks are among the key reasons for the growing importance of climate risk disclosure. Well-informed decision-making requires transparency, available data, the right analytical tools and timely processing of information.

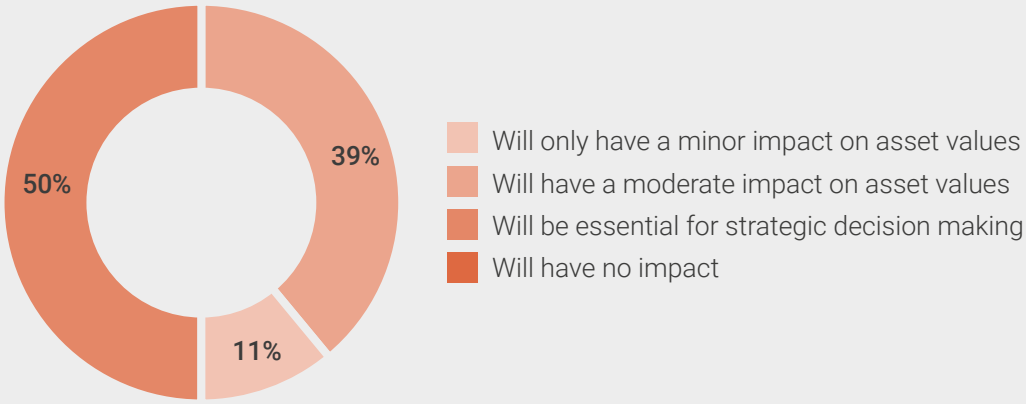
Growing action on climate change

GHG emissions regulations, CO_2 taxes and other related regulatory requirements are increasing globally. Currently, 65 countries have implemented carbon pricing initiatives, covering 21.5% of global GHG emissions. In the EU, CO_2 prices have reached an all-time

high of approximately EUR 75 (US$85), due to the EU Green Deal and initiatives such as the EU Sustainable Finance Action Plan (Trading Economics, as per 2 December 2021). Large carbon emitters like the United States and China are yet to announce comprehensive carbon pricing initiatives, although China has recently launched a national ETS in its power sector (The World Bank 2021). Half of the world's 500 largest companies have internal CO_2 'shadow' prices to manage investments. Current forecasts by the International Energy Agency's 'World Energy Outlook' estimate a carbon price of up to US$250/t$CO_2$e in its net-zero emissions by 2050 scenario (IEA 2021; Energy Brain Pool 2021, CDP 2021).

A survey of financial institutions by UNEP FI and CRREM showed that 50% of participants felt that carbon prices will have a moderate impact on asset values and 39% of participants felt they will be essential for strategic decision-making. Only 11% of respondents felt that carbon prices will only have a minor impact on asset values.

Figure 2: Do you think carbon pricing and/or taxation for real estate in the upcoming years?



Furthermore, a growing number of governments and the private sector are announcing net-zero targets (The World Bank 2021; UNFCCC 2021). In real estate, the concepts of net- or nearly-zero energy are frequently used. The World Green Building Council (WGBC) defines net zero as:

'When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net-zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset'

WGBC 2019

B. Transitioning to a low-carbon portfolio

To achieve the Paris Agreement (United Nations Framework Convention on Climate Change and limit global warming to 1.5°C (EC EU 2020; UNFCCC 2016, pp. 22, 2008), extensive decarbonization of all economic sectors is needed by 2050. The building and construction sectors account for around 36% of global energy consumption and generate around 29% of total GHG emissions (INREV, EPRA 2018), meaning that effective decarbonization of real estate is critical to global climate goals.

From 'nice to have' to 'must have'—tightening of the legal framework

Currently, real estate is not included in the EU's Emissions Trading System (ETS), although the scheme may be extended to include real estate in the near future (European Commission 2021). Other countries are also increasing the regulator focus on energy consumption within their real estate sectors. China, the US, Canada and the UK are all understood to be closely watching the EU's plans regarding its ETS with a view to possibly replicating similar measures. For example, China is using market mechanisms to help bring its carbon emissions to a peak before 2030 and reach net zero by 2060; its ETS is the world's largest carbon market by volume (Reuters 2021). E.g.: In the US, New York implemented mandatory building performance standards in 2018 for all commercial and multifamily buildings above 25,000 square feet (New York City 2019).

In order to decarbonize the real estate sector, clear goals and sector-specific trajectories are needed—a high-rise office building in Hong Kong does not have the same consumption level and relative intensities as an apartment building in Stockholm. It is important to take into consideration the fundamental differences between different property types. It is also important that real estate market participants do their homework first, which means:

1. Achieve transparency about one's own status quo regarding essential KPIs.
2. Define a clear strategy as to how targets can be met.
3. Set a clear financial budget to implement necessary energy retrofits across the portfolio.
4. Clearly commit to decarbonization and broader ESG goals and ensure employees are given the skills to deliver the commitments.

Energetic retrofit of existing proporty stock

As countries commit to net-zero goals, additional pressure will fall on existing real estate assets to reduce their carbon footprints. These properties are likely to require adaptation to avoid becoming stranded assets. Therefore, executives and asset managers need to identify gaps and where retrofitting is required. Firms will need to establish timetables and budgets and ensure cost-effectiveness by linking measures to normal refurbishment cycles whenever possible.

Questions which need to be asked by financial institutions in this context include:

- Are our properties currently above or below the country average regarding energy intensity?
- Do we have sufficient energy consumption data and general property information to make strategic decisions?
- What is the carbon footprint of our energy consumption within our real estate holdings?
- Are our properties already 1.5°C ready?
- What future payments related to high consumption do our properties face if carbon pricing is introduced or intensified?
- What are the most relevant voluntary and regulatory requirements for decarbonization today and in the future?
- Against what benchmark might we could compare our own consumption?
- How might climate change and decarbonization of energy grids affect our CO_2 balance over time?
- Do we have particularly 'good' or 'bad' properties in our portfolio in terms of energy consumption?
- Do we need to consider—besides energetic retrofits—divestment of properties with above-average carbon intensities?
- Which properties should be our priority for energetic retrofits and are we clear what the right timing is for interventions?
- Can we visualize and communicate our carbon footprint for sustainability and risk reporting?
- Are we clear on the budget needed and how that will be financed?
- Can we decarbonize the property by reducing only energy consumption, or are other measures such as procurement of green energy, production of on-site renewable energy, carbon credit sourcing etc. potentially also relevant?
- Do we have enough information on potential changes in user and investor behaviour over time?
- What are our peers and competitors doing to address these challenges?

Although there are more aspects that need to be considered by financial institutions for a sound basis for strategic decision making, the questions above illustrate the need for a well-defined roadmap for measures to manage climate-related risks and enable ongoing control.

C. Overview of UNEP FI's TCFD programme

i. Project overview

The Task Force on Climate-related Financial Disclosures (TCFD) was established by the G20's Financial Stability Board to provide guidance to companies on how to clearly, consistently and reliably disclose climate-related risks, opportunities and their financial impacts (TCFD 2021). After the release of the TCFD's recommendations in 2017, UNEP FI created a set of pilot programmes for international banks and investors to implement the TCFD framework and issue climate-risk disclosures (UNEP FI 2020). Over 100 financial institutions have participated in these programmes to create tools, frameworks and

guides to help the financial industry build capacity in identifying, assessing, managing and disclosing climate risks.

Phase I of UNEP FI's TCFD programme was a year-long programme involving 16 international banks. Participants collaborated to develop approaches to assess physical and transition risks and opportunities for banks across geographies. Phase II convened 39 banks to enhance climate risk toolkits and improve climate-related disclosures. In 2021, Phase III of the TCFD Programme expanded to include nearly 50 global banks and investors. The diverse range of perspectives from these financial institutions has enabled the programme to develop good practices for climate risk assessment and disclosure.

In Phase III of the programme, as part of a targeted module on assessing climate risks for the real estate sector, UNEP FI partnered with CRREM to provide participating financial institutions guidance on best-practice approaches for TCFD aligned metrics, targets and tools to assess and manage transition risk within the real estate sector. The output parameters derived by the CRREM tool and pathways are intended to assist with disclosing climate risks in line with the TCFD´s recommendations. Though the work conducted was global in nature, it focused on Asia and North America, as this was the first project carried out to assess Paris alignment of real estate portfolios in those regions. Analysis using the CRREM tool was also used to develop an approach to increase transparency and define measures to speed up decarbonization on an aggregated level, and to establish what data is needed to monitor and track progress.

The scope of the project included:

- A deep-dive into CRREM resources, including the tool, its pathways and methodology
- Explanation of the data submission process
- Training sessions to pilot the CRREM tool
- Analysis of asset and portfolio transition risk and asset stranding
- An exploration of opportunities for and limitations to the use of CRREM by lenders for credit risk assessment and loan book reviews in different regions
- Analysis outputs and feedback workshops

This report aims to synthesize lessons from the CRREM tool analysis and workshops to help users of the tool assess transition risks within the real estate sector and address the challenges of decarbonizing the sector.

Getting on the same page: main project targets

Two introductory webinars were hosted by CRREM for participating financial institutions. They explained the CRREM tool, its pathways and underlying methodology, requirements regarding real estate loan books and investments, CRREM alignment with PCAF and the TCFD, and CRREM reporting templates for data gathering.

Data gathering and data refinement

The next step included a deep-dive into the CRREM Risk Assessment Tool and an explanation of mandatory data required by financial institutions. In a workshop led by CRREM, participants were provided with an overview of the main outputs generated from

the analysis. The CRREM team further assisted participants in the process to derive high-quality outputs for the assets analysed.

Training on data quality assurance, processing and results presentation

Throughout the module, in-depth individual training sessions were conducted to provide data-quality assurance and assistance in dealing with data gaps. Individual feedback was given to all participants who submitted data based on the results of the CRREM analysis. Investors and banks were also trained to run the CRREM-based transition risk analysis themselves.

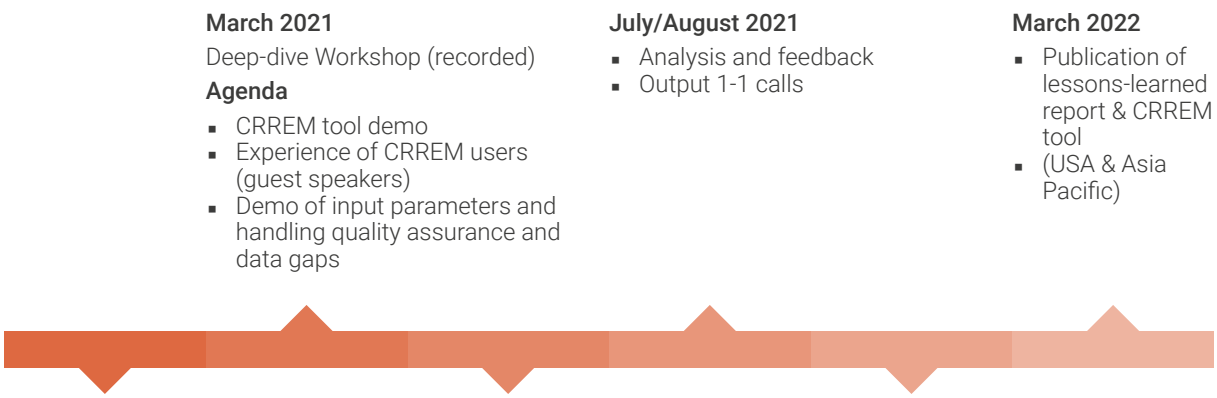
CRREM survey on transition risk

In addition to the asset-level analysis of module participants, a survey was conducted on transition risk for the real estate sector. The questionnaire allowed financial institutions to provide insights, feedback and their current viewpoints regarding transition and carbon risks.

Disseminating feedback and best practice cases

A final webinar was held on the results of the pilot with lessons learned and with feedback from participants in the module focusing on different needs in North America and the Asia-Pacific.[1]

Figure 3: Timeline of the UNEP FI Real Estate Module



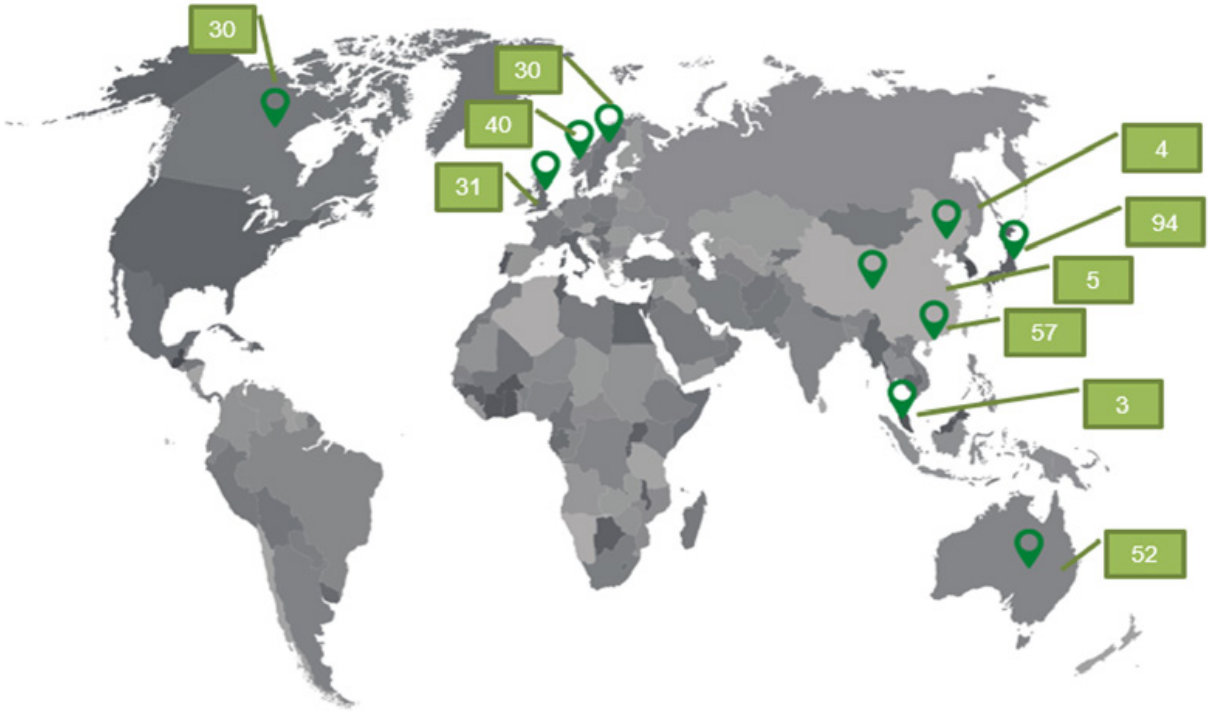
Source: CRREM 2022.

1 As part pf the UNEP FI programme, the CRREM risk assessment tool, with all pre-filled settings and default values, was extended with country-specific data for the Asia-Pacific, North America and Scandinavia. The versions of the tool customized with regional context can be downloaded via CRREM.org and CRREM.eu.

ii. Property sample details

As part of UNEP FI's TCFD Programme, the CRREM initiative analysed assets located in Mainland China, Hong Kong, Japan, Singapore, South Korea, Canada, UK, Australia, Norway and Sweden (See Figure 4). The asset classes included offices, retail shopping centres, retail high street, retail warehouse, industrial distribution warehouse, residential, hotel, logistics and healthcare (Figure 5). Over 340 assets globally were processed in the project via the CRREM tool and using the CRREM pathways.[2] This represents over 10.6 million square metres of floor space, with nearly 3.3 billion kWh of energy consumption reported in the baseline year. Most of the assets in the sample can be considered trophy and prime institutional real estate—this is particularly relevant as many market participants intuitively think that there should be little need to adjust for climate risks in these often quite new and certified buildings.

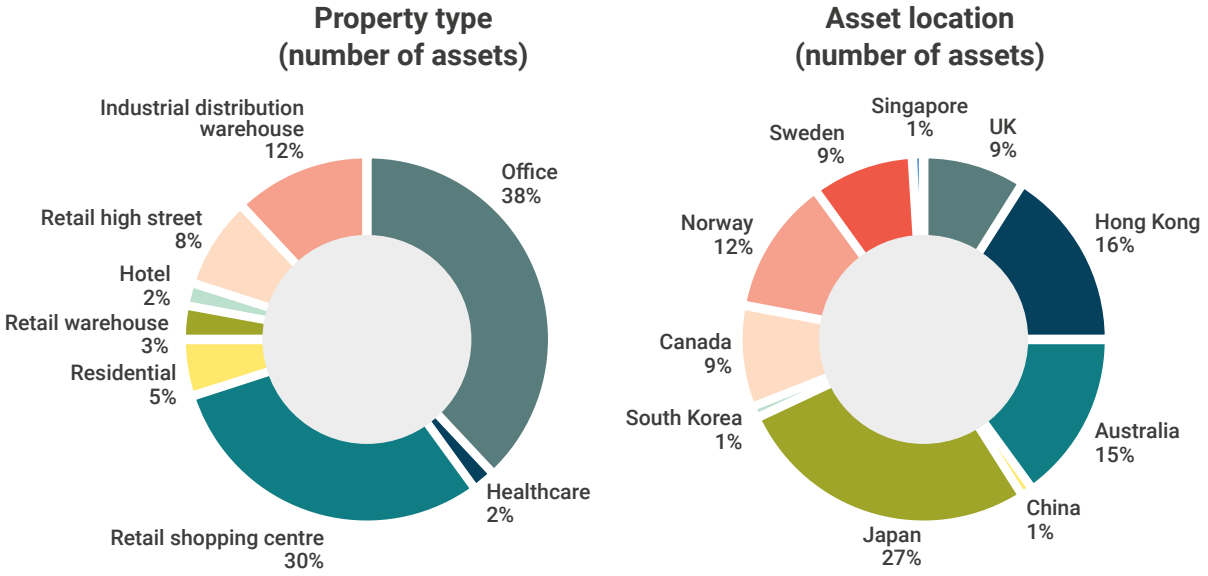
Figure 4: Number of assets in each country analysed via CRREM



Source: CRREM 2022.

2 Note: the total number of properties analysed via CRREM to date can be found in Appendix B.

Figure 5: Asset analysis of the participants—asset location and property type



Source: CRREM 2022.

Table 2: Portfolio summary of UNEP FI participants

Location:	China, Hong Kong, Japan, Singapore, South Korea, Canada, UK, Australia, Norway and Sweden
Total number of assets:	346
Asset class:	Office, Retail SC, Retail HS, Retail WS, Industrial Distribution Warehouse, Residential, Hotel, Logistics, Healthcare
Total gross floor area:	10,632,218 m^2
Total energy procured:	3,275,146,642 kWh/yr
Renewable energy produced on-site (consumed and exported):	1,333,294 kWh/yr (<2% of overall energy consumption)
Purchased renewable energy:	43,694,295 kWh/yr (approx. 1.5% of total energy consumption)
Fugitive emissions:	5.845 kg/yr

Source: CRREM 2022.

iii. Summary of results and lessons learned

In the baseline year, the properties had a combined energy consumption of approximately 3.3 billion kWh (or around 300 kWh/m²/year), resulting in GHG emissions of 1.24 million tCO_2e (or 117 $kgCO_2e/m^2$/year) in the reporting year (2020). The weighted emission factor of all properties and all energy sources is therefore approximately 0.38. This demonstrates the massive challenge faced to reach full decarbonization, or net-zero emissions, by 2050. There is a clear need for energy sources to fully decarbonize and/or energy consumption to be reduced accordingly.

According to the participating financial institutions, their average asset holding period is relatively long, with 44% of assets being held over 10–20 years, and 31% of assets being held for more than 20 years. These long holding periods show why it is important that investors and asset owners conduct transition risk analyses on their assets.

Key takeaways on asset-level data required

Most module participants had data that was better than average in terms of its quality; however, asset-level data availability and quality showed room for improvement. The majority of mandatory data required for the CRREM analysis was available to financial institutions. Participants were able to collect data on on-site renewable energy production, procured (renewable) energy, individual emission factors for the procured energy sources (enabling them to apply market-based emission-factor approaches), data coverage and vacancy rates. However, collecting fugitive emissions and tenant-related data for residential properties posed a major challenge for many participants. Optional data was, however, often not collected by firms for the latest reporting years. Collecting optional data for the CRREM tool can increase the accuracy of outputs, leading to a more specific analysis against the CRREM pathways, as well as within portfolios. Table 3 illustrates the data gaps and challenges for financial institutions when collecting asset-level data. Given data gaps, firms need to improve transparency to collect sufficient data and make assumptions where data is not available.

Table 3: The greatest challenges when collecting asset-level data.

	Data coverage	Data on fugitive emissions	Data of occupancy	Full tenant data	Data for all energy types	Data for all energy types	Data on renewable energy	User-defined informtion (e.g. on energy prices emission factors)	General data quality	General data availability/ accurcy
Institution	A	X	X	X	X	X	X	X	X	X
Institution	B	X	X	X	X	X	X	X	X	X
Institution	C	X	X	X	X	X	X	X	X	X
Institution	D	X	X	X	X	X	X	X	X	X
Institution	E	X	X	X	X	X	X	X	X	X
Institution	F	X	X	X	X	X	X	X	X	X
Institution	G	X	X	X	X	X	X	X	X	X
Institution	H	X	X	X	X	X	X	X	X	X

X	Well above/excellent averge data quality
X	Above average/good data quality
X	Average data quality
X	Below average/poor data quality

Source: CRREM 2022.

A survey of financial institutions by UNEP FI and CRREM showed that a plurality of respondents (41%) only had some of the asset-level information needed to carry out transition risk analysis. Less than a third (29%) said they did not have enough information available to carry out transition risk analysis. A quarter (24%) of institutions indicated that most information was available, but only 6% reported that all asset-level information was fully available and accessible to them.

Participating financial institutions were able to achieve good data quality, by:

- Correctly entering general asset information
- Correctly tracking and displaying vacancy information
- Accurately entering data coverage for energy; default figures from the CRREM tool can be replaced with 'user-defined' information, which is more property specific compared with sector or regional averages;
- Specifying information regarding company-specific assumptions on carbon prices, energy pricing and emission factors which makes the results more valuable than those using CRREM's default numbers.

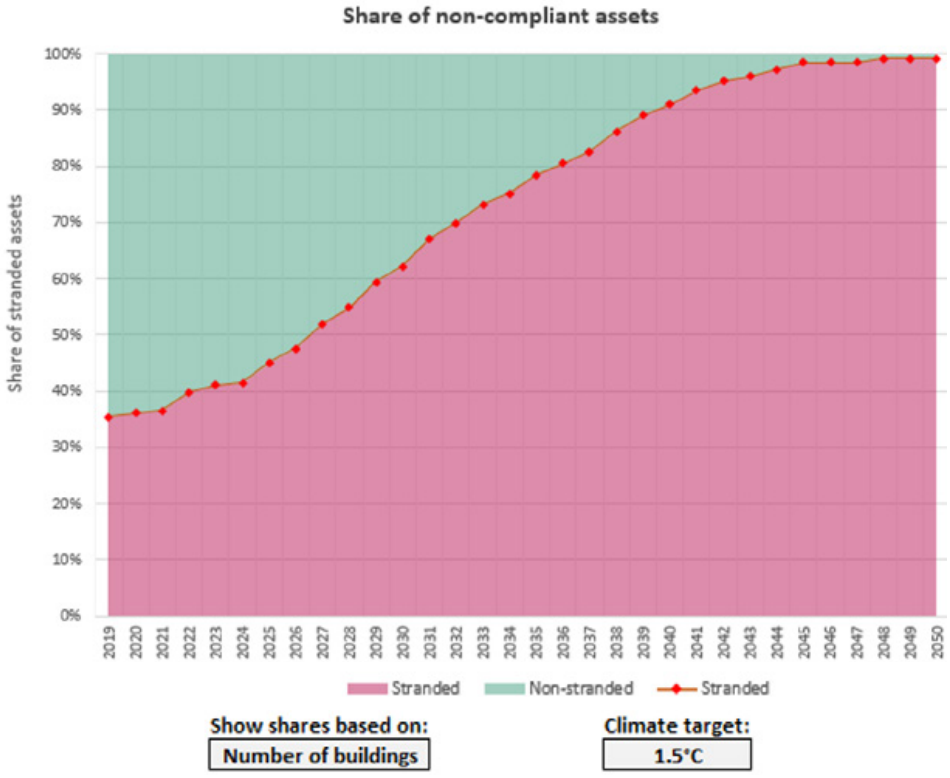
Key results

The results showed differences in overall performance due to differing geographical profiles and property types. Significant variance between the participants was also observed.

Asia-pacific sub-portfolio analysis

In the baseline year, the majority (65%) of the assets in the Asia-Pacific sub-portfolio complied with the threshold for the 1.5°C Paris-compliant target in terms of their GHG intensity.[3] However, by 2050, only around 1% of all assets included in the Asia-Pacific sub-sample will be Paris-compliant (Figure 6).

Figure 6: Evolution of stranding within the portfolio (Asia-Pacific)



Source: CRREM tool output 2021.

3 Energy intensity is also important and should not be neglected. The CRREM tool offers analysis of both the GHG- and energy-intensity at the asset- and portfolio-level.

The results show a clear need for measures and strategies to be implemented to ensure ongoing decarbonization, to avoid transition risks increasing over time. Relying solely on the energy system to decarbonize will not be sufficient for most real estate assets to reach net zero by 2050. As a majority of properties in the sample portfolio were top-certified 'trophy' assets, properties achieving a 'gold' sustainability label today will still have to undergo massive energetic retrofits and other measures to decarbonize to net zero by 2050.

Energy intensity of the asia-pacific sub-portfolio

On average, the energy intensity for the Asia-Pacific sample portfolio was around 375 kWh/m²/year in 2020. The average GHG intensity of all properties included in the Asia-Pacific portfolio amounted to 135 $kgCO_2e/m^2$/year in 2020 and 104 $kgCO_2e/m^2$/year in 2050.[4] To be Paris-compliant in 2050, the average GHG intensity needs to be close to zero (or at least around 11 $kgCO_2e/m^2$/year for the 2°C target in the Asia-Pacific region and just 2.5 $kgCO_2e/m^2$/year for the 1.5°C trajectory). The energy intensity in the Asia-Pacific in this sample showed high outcomes of approximately 375 kWh/m^2/year (compared with the average starting point in that region according to the CRREM pathway of 260 kWh/m^2/year in 2020).

Better performing sub-portfolios in the sample included Japan and Australia, while other assets located in South Korea, China, Singapore and Hong Kong require more attention to avoid stranding. For example, Japanese assets had a GHG intensity of around 30 $kgCO_2e/m^2$/year on average and an energy intensity of 93 kWh/m²/year in the baseline year, while assets in Hong Kong were already stranded in the baseline year. There was also variance in performance by property type, with office, residential and medical properties showing above-average performance compared with the overall market. Attention should particularly be paid to retail high street properties and some shopping centres, as these showed the worst performance in both GHG and energy intensity.

North america sub-portfolio analysis

Analysis of the North America sub-portfolio showed that a majority of the assets in the sample were already stranded in the baseline year. Higher excess emissions can lead to higher energy and carbon costs if carbon pricing is introduced. There is also potential for properties to be exposed to reduced tenant interest if energy efficiency is below market expectations, with resulting above-market operating expenses and energy costs. Therefore, stranded assets face higher retrofitting costs to put them back on track for decarbonization.

Solutions for lowering real estate emissions

Properties relying mainly on electricity as their energy source in countries with highly decarbonized electric grids will benefit from lower energy emissions intensity. However, as shown in the analyses above, while this benefits asset performance, it is often insufficient to reach net-zero goals.

4 The figure for 2050 is lower since projected grid decarbonization in the region is taken into account, as are changes to demand for heating and cooling, measured by heating and cooling degree days (HDDs and CDDs).

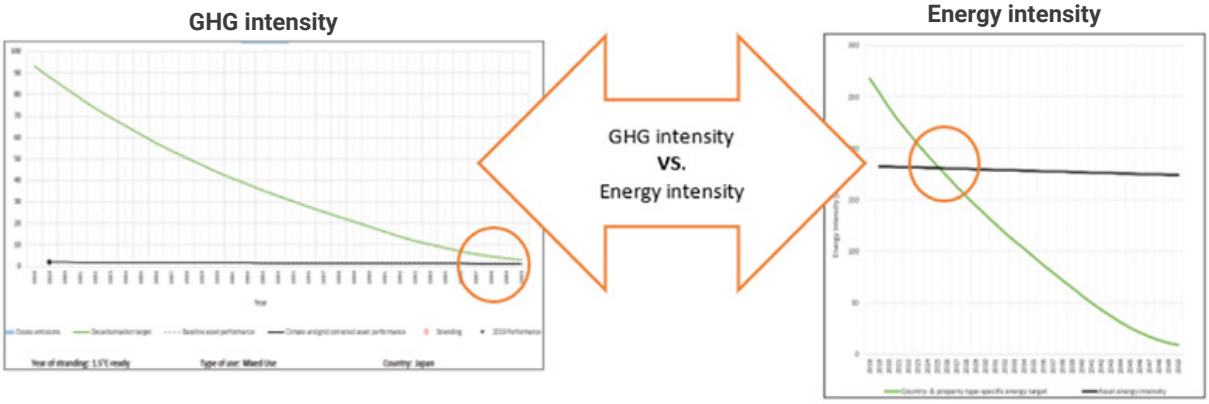
The baseline performance of an asset projected by CRREM out to 2050 is mainly affected by two factors. First, global warming may increase demand from tenants for cooling.[5] Secondly, grid decarbonization can also affect the baseline asset performance. For example, outputs from the Asia-Pacific region show an average emissions factor for electricity of 0.573 in 2020, which will need to drop to near zero by 2050. The procured electricity for UNEP FI participants in the Asia-Pacific was above 1.8 billion kWh in the baseline year, meaning that reducing the emissions factor by about 30% would lead to to an equivalent reduction in GHG emissions without any further measures.

Sample analysis results highlight the need for investors to take significant action. Simply relying on further grid decarbonization will be insufficient to avoid stranded assets by 2050. Along with switching energy sources to decarbonized electricity, properties should be energy efficient. The financial sector also needs to actively promote reductions in both the GHG and energy intensity of their real assets to reduce the exposure to non-compliant assets by 2050.

GHG intensity vs energy intensity

Figure 7 illustrates that, despite some early adopters having assets which are currently Paris compliant and '1.5°C-ready' regarding their GHG-intensity, firms will still have to work harder on their building's energy efficiency. High energy intensities result in an early stranding against the CRREM energy intensity pathways. It is therefore vital to address the energy-intensity of these properties. A number of countries, including the UK and Netherlands, have already implemented minimum energy efficiency standards for rental properties (MEES 2018).

Figure 7: GHG intensity versus the energy intensity of an exemplary asset in Japan

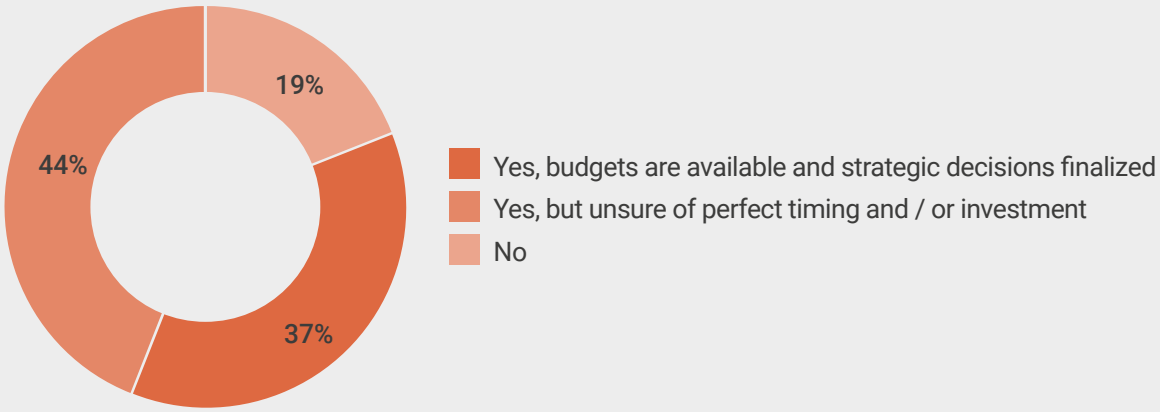


Source: CRREM 2022. Own illustration based on CRREM 2022.

5 Depending on the climate scenario used, the number of HDDs and CDDs change over time. This effect is integrated in the CRREM tool. For more details, please refer to our reference guide on www.CRREM.eu.

Survey results from UNEP FI and CRREM showed that 37% of respondents have set and finalized budgets for energetic property retrofits.

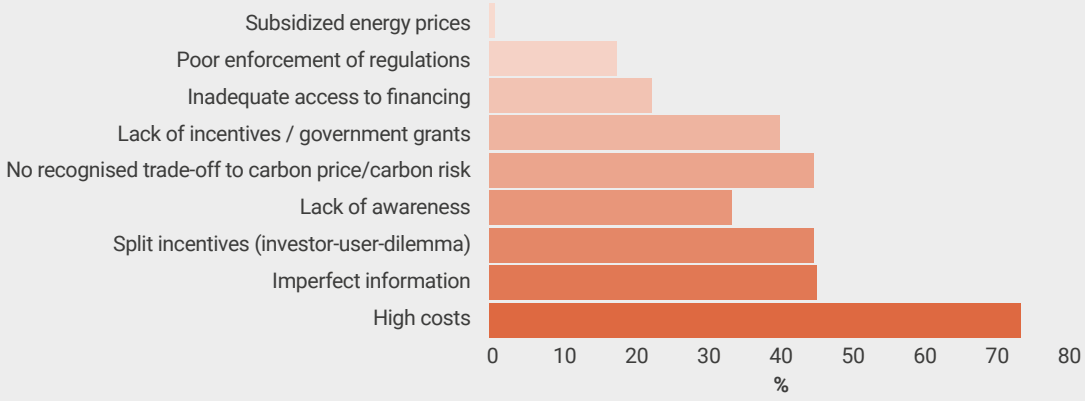
Figure 8: Survey: Do you already have refurbishment budgets and capex for energetic retrofits of your properties?



Source: CRREM, UNEP FI—CRREM Survey 2021.

It is likely that market demand for resources needed for energetic retrofitting will further increase in the coming years. Due to current supply shortages, it is important to focus more on purchasing costs and procurement security in addition to a specific retrofit strategy.

Figure 9: Survey: Barriers for a faster uptake of green retrofit technology for real estate



Source: CRREM, UNEP FI—CRREM Survey 2021.

For some institutions, the CRREM outputs suggest an earlier starting point in the process toward real estate decarbonization than others in the industry. A large proportion of respondents (35%) said that the results of the analysis were as expected, showing a mix of well- and medium-performing assets. However, almost a quarter of institutions were surprised to learn that they were exposed to substantial transition risk and will need to take action. Only 6% of respondents were happy with the positioning of their assets and their degree of Paris-alignment. Forty-one per cent of respondents felt that

the CRREM outputs helped to improve their transparency and strategic decision-making in regards to real estate. The same percentage of participants intend to use the CRREM tool in future.

On-site renewables production

Analysis of the UNEP FI portfolio sample showed that, as of 2020, less than 2% of total energy consumed was supplied from renewables (whether produced on-site or procured from renewable energy providers). There is very limited potential for high-rise office towers, in high-density urban areas and erected on fairly small plots, to produce a significant amount of renewable energy on-site. However, other properties from the sample portfolio, such as shopping centres and logistics facilities, have rooftops and large land areas which may enable their owners to generate renewable energy on-site. Financial institutions will benefit from analysing their portfolio to identify possibilities to produce green energy within building boundaries.

F-Gas transparency

Although a large number of properties in the sample were located in warmer regions or represented use-types which typically need cooling and air conditioning, an insignificant amount of fugitive emissions of fluorinated gases (F-gases) were reported by pilot participants.[6] As F-gases are amongst the most harmful GHG emissions and can contribute up to 20% to the overall volume of such emissions, there is a need for improvement regarding data transparency in this respect.

Best practices

UNEP FI programme participants include some of the most advanced players in the real estate industry and their approaches, as revealed through the programme, offer examples of best practice. The most advanced institutions already have:

- Sufficient data coverage regarding their assets and asset-level data transparency
- Precise data on average vacancies in properties analysed
- Clarity on tenant data regarding consumed energy
- Improved data accuracy by isolating outliers and comparing similar buildings
- Information on energy sources and an ability to convert all consumption figures to kWh
- Information on fugitive emissions
- Their own assumptions for asset-level data to deal with missing information and data gaps
- Procured green electricity where possible and entered market-based emission factors where applicable
- Clarity on renewable energy produced on-site (whether sold or consumed on-site)

Firms can benefit from these insights, as well as the strategic decisions and measures implemented by early adopters participating in the UNEP FI pilot.

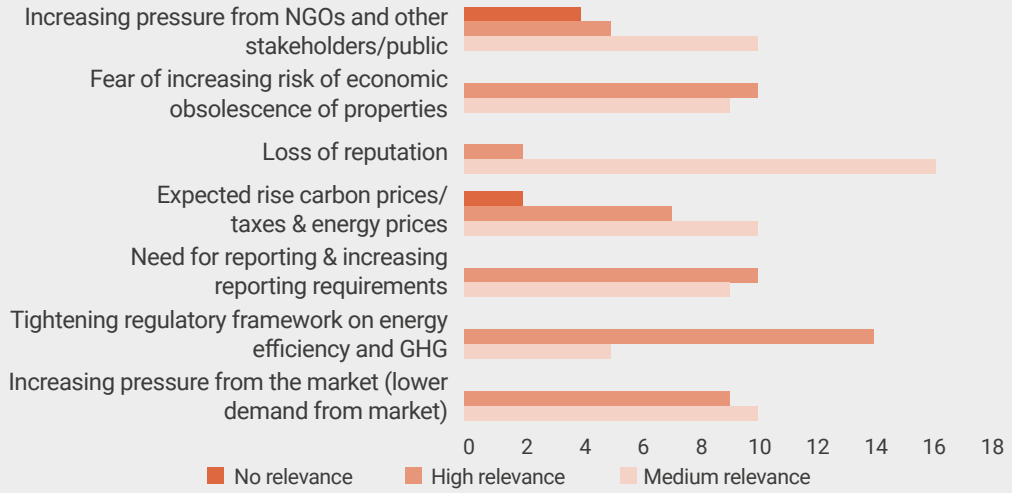
6 CRREM asks users to report upon the type of refrigerant losses associated with fugitive emissions (leakages in terms of kg) due to air conditioning, refrigeration or industrial processes.

Section B: Industry challenges: What we need to address next

This section highlights areas where further action is needed. Challenges remain, especially in regard to stemming refrigerant leaks, collecting tenant data (particularly for residential properties), closing data gaps and reducing the need to make assumptions at the asset level. Further challenges also include defining uniform units of measurement and building areas.

> According to the results of surveys of pilot participants and wider stakeholders, transition risk is increasingly viewed as a strategic concern. A majority (68%) of financial institutions surveyed by UNEP FI and CRREM expect climate risks to become substantially more important in coming years when making strategic decisions regarding real estate holdings. They cited key drivers such as tightening regulatory frameworks regarding energy efficiency and GHG emissions, the increasing risk of economic obsolescence of properties, expected increases in carbon and energy prices and increasing reporting requirements. The survey showed that respondents feel that carbon prices will have a particular impact on asset values, with 39% of institutions stating that carbon prices will be central to strategic decision making. With its increasing importance, climate change is increasingly being included in board-level discussions. Almost all (95%) of responding institutions said they had included climate change and/or sustainability in board-level discussions in a substantial manner.

Figure 10: Survey: What are the key drivers for increasing focus on transition risk?



Source: CRREM, UNEP FI—CRREM Survey 2021.

A. F-Gases: An underestimated source of GHGs

Fluorinated gases (F-gases) are powerful greenhouse gases. They are used in buildings within foam insulation and refrigeration and air conditioning systems. These systems can suffer from leaks, releasing harmful gases into the environment. A certain leakage rate is common with these systems, so the refrigerants must be constantly refilled.

F-Gases have significant climate impacts

To measure their impact on climate change—their global warming potential (GWP)—GHGs are converted into CO_2 equivalent, abbreviated 'CO_2e'. The GWP of other GHGs can be significantly higher than that of CO_2 (which has a GWP of 1). F-gases are a particularly powerful set of GHGs with warming potential hundreds to thousands of times higher than CO_2. While F-gases have caused only about 2% of GHG-induced warming to date, they are also the fastest growing type of GHG in emerging economies (De Graaf et. al 2021; Velders et al. 2012). F-gases are particularly relevant to the real estate sector, as buildings are responsible for the emissions of between one-eighth and one-third of all F-gases globally (IPCC 2014). As a result of stricter regulations, the use of F-gases has significantly dropped in many developed nations and they are increasingly being targeted by those concerned with their climate impact (German Environment Agency 2021; Department for Business, Energy & Industrial Strategy 2021; European Union 2014; UNIDO 2017).

As the real estate sector pursues operational efficiencies to decarbonize properties, market participants tend to focus predominantly on energy efficiency and often ignore the F-gas emissions from property cooling systems. The effect of fugitive emissions from refrigerant losses is considerably underestimated (WBCSD 2018; World Green Building Council, 2018; De Graaf et al. 2021). For some retail and office buildings, 20% or more of their overall impact on warming comes from F-gases (see example below). Including those gases in analysis and tracking and optimizing their use can therefore be important to meet real estate climate targets.[7]

For precise sustainability reporting F-gases must be tracked

Using CRREM, the type of gas and average annual volume of leakage/refill (in kg) can be inserted in the asset-level input sheet for a given baseline year. The average annual refrigerant loss tracked will be automatically converted to carbon equivalent emissions using official emission factors. For example, the GWP of trichlorofluoromethane (CCl_3F) is over 4,500, whereas nitrous oxide (N_20) has a GWP of only 265. This, different fugitive emissions can be analysed and added to the overall carbon (equivalent) intensity of an asset.

Figure 11: F-Gases: An underestimated source of GHGs—Example calculation

Example Asset: Area: 16.576 m^2
Electricity: 2.68.380 kWh (EF 2019: 0,517)
Gas: 676.945 kWh (EF 2019: 0,184)
F-Gases: R-404A: 363 (GWP 3.922)

1. GHG-Intensity (Electricity + Gas): 90 $kgCO_2e/m^2$
2. Fugitive Emissions: 363 * 3.922 = 1,423,686 / 16,576
   = 86 $kgCO_2e/m^2$

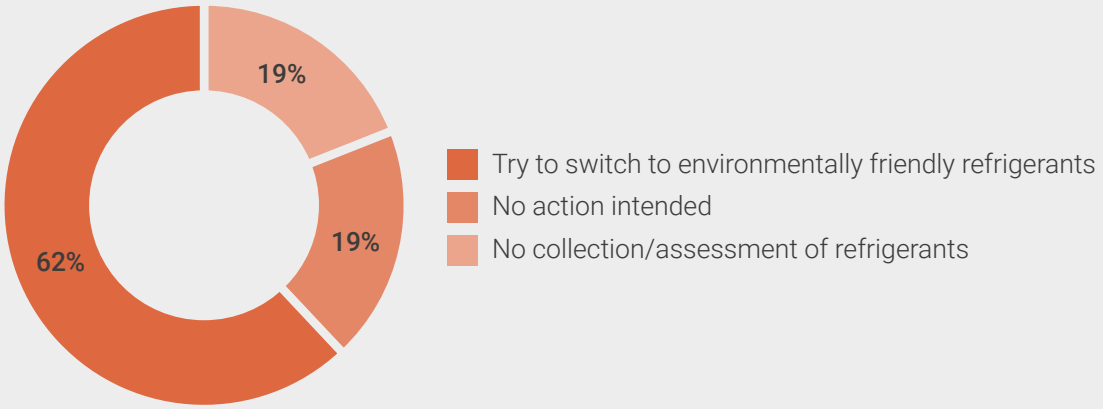
Without "Fugitive Emissions" **90** $kgCO_2e/m^2$
With "Fugitive Emissions" 176 kg
Fugitive emissions account for 48% of the total emissions.

It is essential to not only measure the impact of fugitive emissions but also to switch to environmentally friendly refrigerants (German Environment Agency 2021; De Graaf et al. 2021). This will require new equipment and the replacement of old refrigeration solutions. For new buildings, market participants are increasingly relying directly on alternative coolants or limiting the need for active cooling through additional shading or insulation. In contrast, replacing refrigerants in retrofits can be challenging due to the age of the infrastructure and the costs involved.

7 Accounting and reporting CO_2e emissions according to the GHG Protocol and the Global Reporting Initiative requires proper tracking of F-gases (World Resource Institute, WBCSD 2018). Likewise, an accurate assessment of transition risk in line with TCFD recommendations would require an appropriate assessment of refrigerants. This information must be gathered for corporate sustainability reporting as well as transition risk analysis, as all GHG emissions, including CO_2 equivalents, must be reported and disclosed (GHG Protocol 2004; GRI 2016).

Feedback from UNEP FI survey participants shows that even though most institutions are already trying to switch to environmentally friendly refrigerants, nearly half state that they do not currently assess the impact of refrigerant emissions nor plan to in future.

Figure 12: Survey: How do you deal with fugitive emissions?



Source: CRREM; UNEP FI—CRREM Survey 2021.

F-Gases: Lessons learned

Refrigerant losses can be an important source of harmful GHG emissions from buildings, especially for retail assets and offices. The measurement of these fugitive emissions and the switch to environmentally friendly technology is therefore essential. Also, a clear comparison and differentiation between the wording 'CO_2' and 'CO_2e' for controlling and reporting is important, especially for commercial properties.

Key take-aways:

- Data is often missing but needs to be tracked because fugitive emissions can have a large impact on the total GHG intensity of a building.
- F-gas exit programmes must be implemented consistently by tenants and investors. Capex budgets must be allocated accordingly and remedial measures linked to normal refurbishment cycles.
- It is increasingly necessary to switch to alternative refrigerants, such as ammonia or CO_2.
- Strict and clear guidelines for tenants on what they are allowed to install are essential.
- Popular refrigerants with a GWP greater than 2,500 must be phased out in many countries due to stricter regulation.
- Proper reporting and disclosure of F-Gases are also required by the GHG protocol and the TCFD.
- CRREM software enables the tracking of F-Gases and their conversion to CO_2 equivalents.

B. Collecting tenant data: A collaborative approach is needed

Stranding risk and its potential impact on an asset's value is a function of all the emissions of the property (the so-called 'whole building approach'). However, in the case of investment properties, these emissions might be partly controlled by tenants (tenant space) and only to an extent by the owners or landlord (common areas and shared services). Investors and asset managers will need to work with their tenants and other service providers (e.g., energy suppliers) to avoid data gaps.

A whole property view is essential to avoid investment risks

The tenant-landlord dilemma is omnipresent in the real estate industry, but it is a particularly issue with retail and residential properties. It is ultimately the asset manager that is responsible for the overall optimization of the entire property. This starts with green procurement manuals and ends with the use of green leases to intensify data exchange. The ultimate goal to decarbonize properties can be achieved if all stakeholders ensure a holistic, whole building analysis, using like-for-like benchmarking and optimization.

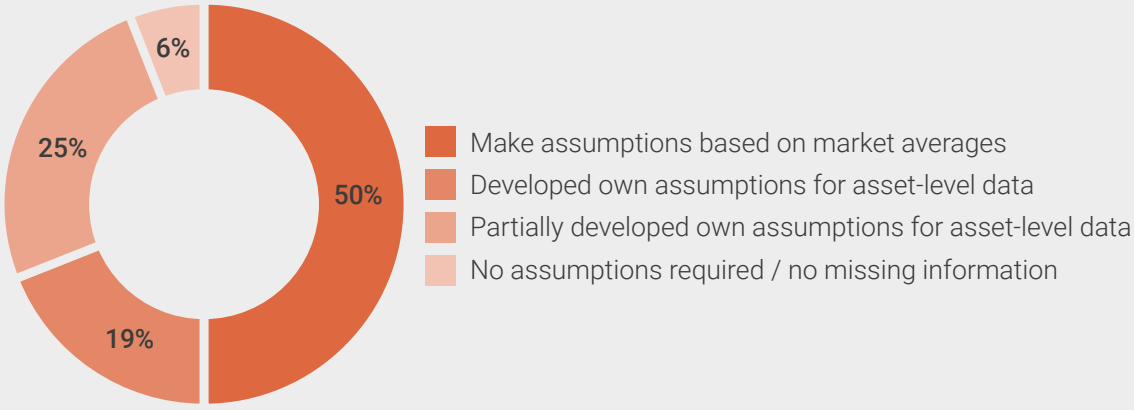
Despite the importance of tenant data, periodic data gaps can emerge with a new acquisition, a lack of information on energy consumed and paid for by tenants, a lack of information on unregulated carbon emissions (such as those from cooking and catering), or inaccurate reporting if occupation/vacancies of buildings are incorrectly reported.

Data gaps can give a misleading impression of the 'greenness' of an asset. Only a whole-asset perspective can ensure the climate footprint of the asset is appropriately captured.

Using assumptions to fill data gap leads to more risks in the future

Participants stated that the greatest challenge when collecting asset-level data was the requirement to make assumptions based on market averages. Survey responses showed that a quarter of respondents at least partially used their own assumptions for asset-level data, while only 6% did not need to make any assumptions given the completeness of data supplied.

Figure 13: Greatest challenge when collecting asset-level data



Source: CRREM, UNEP FI—CRREM Survey 2021.

Collecting tenant data: Lessons learned

The market finds it especially difficult to track and collect tenant data, especially for residential property in some regions. This underlines the importance of increasing transparency and communication between landlords and tenants. Measures such as green leases and smart metering can help overcome this issue.

Key take-aways:

- Collaborate with tenants to capture all consumption data within tenant spaces. Introduce green leases, etc.
- A 'whole-building' approach must be applied to ensure a like-for-like comparison and benchmarking.
- Missing critical data, if not properly reported, can mean that inefficient buildings are not identified as such. Investors and asset managers must clearly state what data is missing to enable normalization.
- If possible, assumptions should be developed based on an institution's own asset-level data. If this is not possible, then assumptions should be based on market averages.
- Collaboration with tenants and the use of technology such as smart metering can help overcome data challenges.
- Addressing transition risk and corporate-level sustainability reporting both require tenant consumption data.

C. Data quality and user-specific inputs

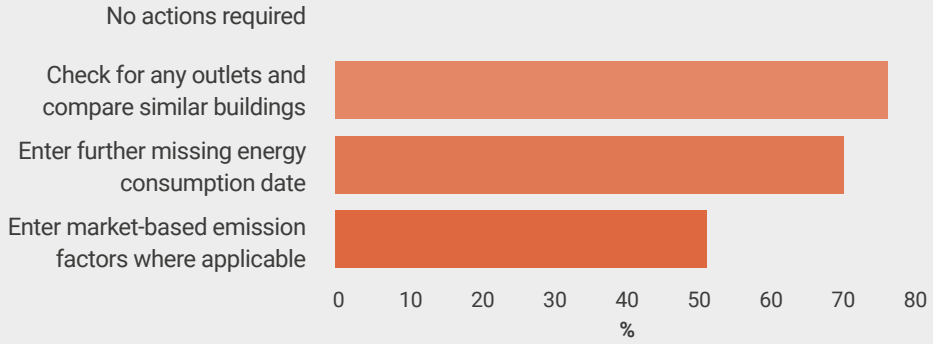
The data required by users to derive a transition-risk analysis via the CRREM tool are building-related KPIs that are typically standard information collected within the sector (CRREM 2020c).[8] The required information ranges from description of the assets, including space details, average occupancy rates and consumption data. Despite the clear specifications and supposedly simple input data, challenges frequently arise.

It is important to ensure that the data inputted by users into the CRREM tool is of sufficient quality and that the investor is aware of any data gaps or missing information. This is especially important as under-reporting of, for instance, energy consumption data can lead to an underestimate of a portfolio's carbon risk. To avoid such underreporting, CRREM encourages users to perform rigorous internal data quality checks and conduct third-party verification on energy consumption data. We encourage market participants to use data that is certified by third parties.

Furthermore, the CRREM tool extrapolates and/or normalizes data for the Reporting Period, Occupancy and Data Coverage. However, these must have been correctly stated. For example, the extrapolation of reported data to 12 months is not linear, due to the varying need for cooling and heating over different months of the year.

The majority of banks and investors say they need to do more work to close data gaps at the asset level. Three-quarters of survey respondents said that data outliers and anomalies indicated inconsistent data collection across different assets. Outliers can be identified by comparing the asset-level results (i.e., year of stranding) with similar properties (e.g., that have a similar year of construction, same building use-type, size, location, etc.).

Figure 14: Mesures to be taken to check outputs and improve future data accuracy



Sources: CRREM; UNEP FI—CRREM Survey 2021.

Floor area is the key denominator to calculate carbon and energy intensity metrics in real estate, making it an important determinant for assessing carbon risk. Even a slight difference in the methodology for calculating floor area will change the intensity value, in turn impacting the carbon assessment. To ensure a like-for-like comparison, users should report the gross internal area of the asset, aligned with the International Property Measurement Standards (IPMS2) (RICS 2018).

8 More details in the 'Reference guide' of CRREM.

Furthermore, the vacant floor area is a key parameter to calculate carbon and energy intensity metrics for a property. Vacant assets generally consume significantly less energy than fully occupied real estate. To ensure correct normalization to full occupancy, it is therefore essential to state correct occupancy figures.

Data quality and user-specific inputs: Lessons learned

The CRREM tool has been specifically designed to enable risk assessment calculations with limited information. For example, if a company is unable to collect the energy consumption data from certain tenants, the user must report the missing information as 'data coverage area' versus 'maximum potential coverage area' to ensure a robust output. In cases where the asset is not fully let, the tool extrapolates the information and normalizes to full occupancy (this can be changed in the settings sheet). Nevertheless, where information is missing, the input and limitations of the data used must be clearly stated by the investor to ensure correct normalization and reliable output.

Key take-aways:

- The CRREM-tool extrapolates and/or normalizes data for 'Reporting Period', 'Occupancy' and 'Data coverage'—however, these must have been correctly stated.
- The average annual occupancy, data coverage and floor space must be entered correctly to ensure a like-for-like comparison. A clear definition of space according to IPMS is required.
- In the case of mixed-use properties, the percentage of floor space per sub-use must be entered correctly. The tool can only combine the sector specific pathways correctly if that information is correctly input.
- Outliers should be analysed and data quality checked. Appropriate controlling instruments and software should be in place to enable regular data provision. Outliers can be identified by comparing asset-level results (i.e., year of stranding) with similar properties (e.g., with a similar year of construction, the same building use-type, size, location, etc.).
- Access should be provided to all energy data, including energy sources, and proxy data should be avoided to increase the output accuracy (e.g., estimations of the split of energy usage between electricity and natural gas have often been entered since no clear differentiation between energy sources was available).
- Further user-defined data can be entered, such as energy prices and individual emission factors for the procured energy to further improve accuracy and property specific output. If, for example, district heating is procured, investors can ask their energy provider for the specific emission factor instead of using the country average default figures.

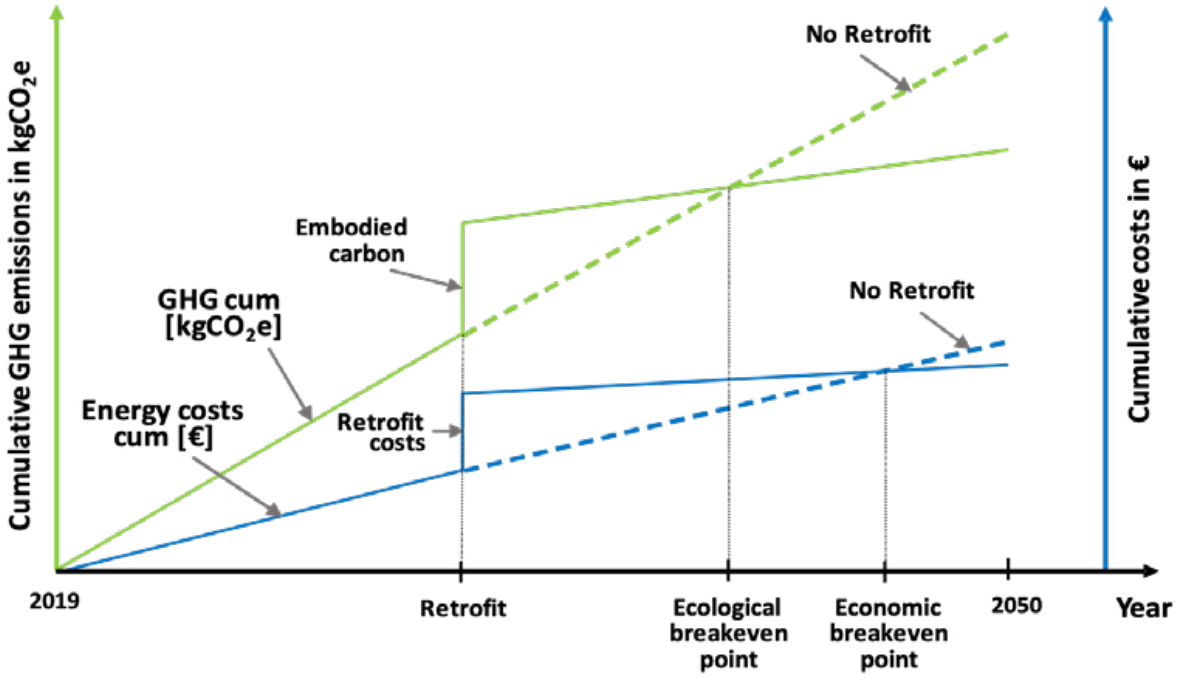
D. Embodied carbon of retrofits: the ecological pay-off is important

CRREM focuses on the emissions resulting from the ongoing use of the property (operational carbon). The pathways do not include emissions from the construction or refurbishment of the property (embodied carbon).

Ensuring that energetic retrofits have a positive impact on climate

The CRREM tool does, however, support users to ensure that energetic retrofit measures are not only viable from a financial point of view, but also from a climate perspective. For existing building stock, it is essential to evaluate if the cumulated operational carbon savings after a decarbonization intervention are greater than the one-off (embodied) GHG emissions from the retrofit itself, therefore ensuring a net positive environmental benefit. For example, if a building is close to the end of its economic life, it likely makes no financial or environmental sense to apply full thermal insulation to the facade. For each retrofit measure, the CRREM tool calculates potential energy and GHG savings, retrofit costs and the volume of embodied carbon related to the sourcing and installation of new materials as well as the disposal of waste material. It provides standardized values for CO_2e emissions per invested euro per country and type of use. The user can use these default datasets or directly enter their own assumptions and detailed calculations for the planned energy retrofit.

Figure 15: Cumulative GHG emissions and costs



Source: CRREM 2018.

The construction of a new commercial property generates approximately 1,000 $kgCO_2e/m^2$ of embodied emissions (LETI 2020). This means that a new office building or shopping centre with even the best energy certificate starts its lifecycle with a huge carbon footprint. This fact shows that simply constructing highly efficient or even 'zero-energy' buildings cannot deliver decarbonization. In the future, it will be much more important to

emit as little CO_2 as possible during construction and, even better, to be able to continue to use existing buildings through conversion or revitalization—in other words, to extend the economic life of property and reduce its carbon footprint during operation.

Reuse and refurbish instead of demolish and rebuild

If, rather than demolishing and rebuilding an existing building, say 60–80% of its structure can continue to be used, this avoids the emissions associated with 25–35 years of use (LETI 2020). This illustrates the trade-off between sustainable refurbishment in terms of extending the lifecycle versus new construction.

For this purpose, the lifecycle assessment (LCA) method (EC 2020) is widely used. The methodology is standardized in ISO 14040/14044 and includes the emissions created by a process or product, from cradle to cradle.

In general, the use of less GHG-intense, and ideally climate-neutral, building components is also necessary in modernization. This implies less steel, less cement, more wood, and technical solutions with on-site renewable energy production, etc. (Ramboll 2020). Also, in an urban context, it is often possible to connect to a public district heating network which is decarbonized, or will become so over time.

Embodied carbon: Lessons learned

For each retrofit measure, the CRREM tool calculates potential energy and GHG savings, necessary retrofit costs and the volume of embodied carbon related to the provision and installation of new materials as well as the disposal of waste material.

Key take-aways:

- Embodied carbon from the retrofit itself must be considerably less than the resulting operational carbon savings. Retrofitting existing building stock generates embodied carbon emissions from the construction works and materials used. Investors should ensure that retrofits are not only viable from a financial point of view, but they also make sense in climate terms.
- Simply constructing efficient or even zero-energy buildings cannot deliver decarbonization.
- More focus should be placed on refurbish and reuse instead of demolish and rebuild.
- To evaluate the full climate impact, the whole life cycle needs to be considered. For this purpose, the lifecycle assessment method is widely used. The methodology for building construction is standardized in ISO 14040/14044 and includes emissions from cradle to cradle.
- The use of less GHG-intense, and ideally climate-neutral building components is necessary in modernisation.

E. Energetic retrofits: the need for a pro-active strategy

Assuming an economic lifetime of 50 years and approximately 50 $kgCO_2e/m^2$/year, the majority of a building's overall lifetime GHG emissions, perhaps 80%, are attributable to the use phase—known as operational emissions.

Comittment itself is not sufficient

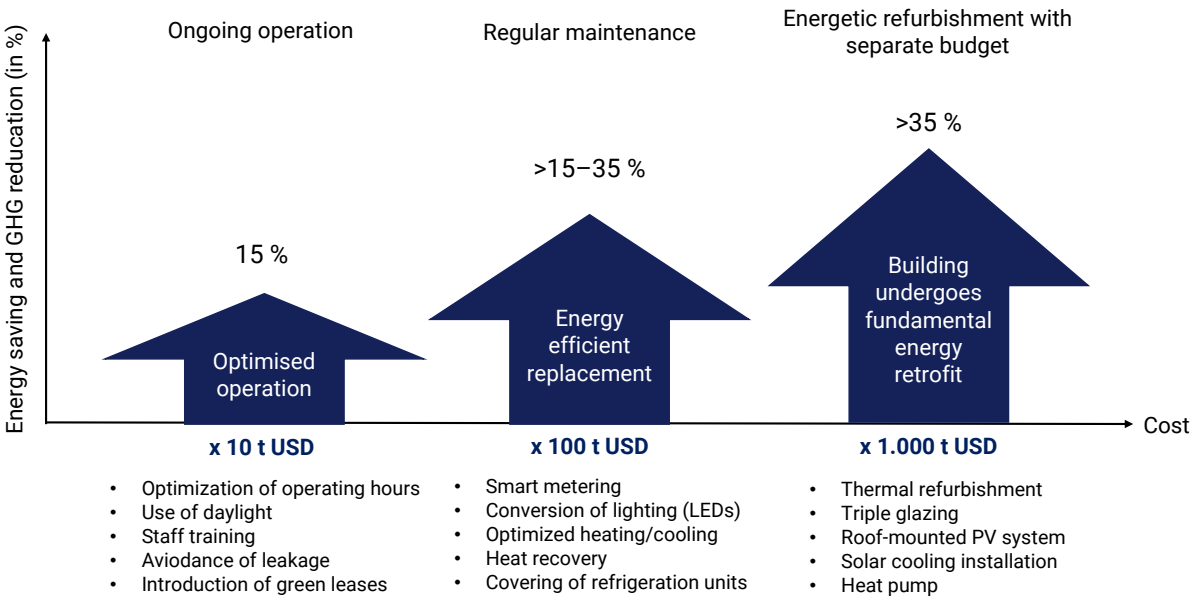
To reduce operational carbon emissions, investors must develop a well-defined roadmap consisting of measures, priorities, timing, milestones, budgets and corresponding GHG savings. Nevertheless, in our many discussions with investors, we continue to see a large discrepancy between commitments and clear roadmaps to fulfil these commitments. Plans often contain the following drawbacks or omissions:

- Energy refurbishments are often budgeted as 'extra' to full refurbishment costs, although ongoing maintenance measures would have occurred to maintain the usability of the buildings. This understates the economic benefits of energy efficiency measures.
- Often, energy-related and GHG-reducing investment decisions are made solely on the basis of internal company-level return requirements. Other important strategic considerations (avoidance of transition risk, avoidance of future CO_2 taxes, better ESG ratings, corporate reputation, employer perception, security of energy supply, insulation from energy price fluctuations, etc.) are not sufficiently taken into account.
- There is frequently no holistic analysis based on energy concepts across the entire portfolio. Uncoordinated individual measures on selected properties often have only a marginal effect.
- Management often underestimates fundamental changes that are already underway with regard to the climatic conditions and the constantly tightening regulatory framework and their implications for the business model.
- Management does not want to be the 'first-mover' and waits to see what competitor companies do.
- There is insufficient knowledge about potential funding instruments, technical solutions/innovations, specialized consultancies and other aspects necessary for successful implementation.
- There is a lack of qualified in-house specialists or external consultants who can support decision-making. Consequently, the appropriate controls and underlying data are often missing.

Climate risk affects the core business of any real estate company and therefore has to be embedded in general controls and risk management. Survey results reveal varying approaches to energy efficiency and carbon reductions. For example, over a quarter of respondents (26%) said energetic retrofit is their main strategic approach to improving efficiency, while 11% of respondents said that buying renewable energy is their main strategy. Over half of respondents (53%) said they are increasing their emphasis on both approaches. Only 5% of firms plan to increase their emphasis on green energy, offsetting and improved energy management as their strategies for building efficiency.

It is important to understand the fundamental drivers of the changes in framework conditions underway as a consequence of climate change, and to formulate appropriate strategic approaches. To avoid stranded assets, it is of high importance to implement a proactive asset management strategy. A wait-and-see approach could result in unexpected one-off write-downs, increasing vacancies, inferior ESG ratings, lagging investor interest, increasing CO_2-related payments and other negative implications.

Figure 16: Reduction of GHG emissions and corresponding investment budgets



Source: CRREM; Redevco 2020.

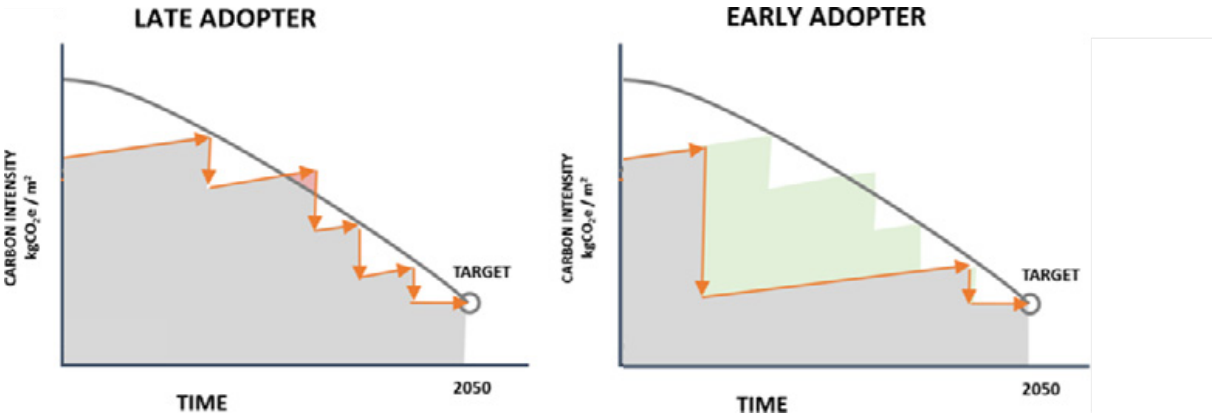
Getting the timing right

However, a proactive approach to decarbonization does not necessarily mean that all measures to reduce GHG emissions must be implemented immediately. Ultimately, it is the management's assessment as to when and to what extent individual measures should be implemented. This decision is influenced by many factors. To decide whether to act or wait, clear answers are needed to the following questions:

- Will policy intervention become even more ambitious in the future?
- Will retrofit measures become cheaper or more expensive?
- How will commodity prices and other costs of decarbonization measures change?
- Will the goals of the Paris agreement be met?
- What difference will higher or lower energy costs than our peers make to our potential tenants?
- Will strong ESG credentials become even more relevant for investment analysts?
- Can we incorporate our retrofit plan within our usual end-of-life replacement and maintenance cycles? If so, when?
- Do we believe that carbon taxes for the real estate sector will be cut or increased?
- Is security of energy supply important to us?
- What is the financial capacity of the company?
- What is our expectation on the availability of new technologies in the future?

The following figure below illustrates two different corporate strategies related to the timing of energetic retrofits and decarbonization.

Figure 17: Different ambitions regarding stranding risk



Source: CRREM 2022.

The figure shows that there is no single answer to determine which approach is the most suitable to tackle carbon risk—but doing nothing is not a sensible option in the current market environment. Heterogeneous portfolios require different approaches, depending on the exposure of each property and use-type to carbon risk, its location and age, the costs of retrofit, etc. Many participants in the UNEP FI pilot had already introduced a clear roadmap to decarbonize their portfolios, with 37% of survey respondents having set and finalized budgets for energetic retrofits. This will help reduce transition risk and is line with the TCFD recommendations. However, financial institutions face possible barriers in reducing the exposure of real estate portfolios to transition risks, including high costs associated with the uptake of on-site renewable energy and improvements in green retrofit technologies. Furthermore, a lack of information, split incentives between investors and users, lack of awareness and failure to recognize the trade-offs between carbon prices and carbon risks are all potential barriers financial firms face.

Energetic retrofits: Lessons learned

Proactive management does not necessarily imply that all measures must be taken now. It rather requires that information is made available and a decision to decarbonize now or later (or not at all) can be taken on a well-informed basis.

Key take-aways:

- Whenever possible, increase the use of energy sources with low future emission factors (e.g. electricity, district heating).
- Consider renewable energy procurement and an increase in on-site renewable energy production (e.g. use of solar-power, wind or heat-pumps).
- Reduce buildings' energy demand (e.g. with automatic lighting, automatic reduction of ventilation, heating according to the number amount of people in the building, greater use of natural light) and carry out deep-energetic retrofits (replacement of old technical equipment, new insulation etc.).
- Use energy-management systems such as smart metering to control and monitor whole-building energy consumption.
- Explore 'green leases' to identify incentives for reducing consumption together with tenants and to improve transparency for exchanging data. Work on tenant behaviour by providing tenant manuals and training sessions.
- Develop and design concepts that extend the lifecycle of the building.

F. Market-based measures vs. location-based emission factors: efficiency first

A net-zero strategy should not be achieved exclusively through the purchasing of green power. Instead, firms should implement all options for reducing a building's energy consumption. Remaining energy demand should be met through renewable energy sources, which are preferably generated on-site rather than purchased from the grid. Undertaking thermal refurbishment (e.g., installation of enhanced thermal insulation) alone will be insufficient to meet climate goals. 'Buying one's way out' through compensation or offsetting with certificates should be the last resort after all other strategic options have been exploited.

Efficiency first!

The emissions factors of electricity grids vary depending on the mix of generation sources involved. Companies may source the energy from the grid (the location-based method) or choose for their properties energy providers which only supply green energy (the market-based method) (GHG Protocol 2015):

1. The emission factor for power sourced via the location-based method provides a figure for Scope 2 GHG emissions (those from purchased electricity) derived from the average emissions intensity of the electricity grids within which the energy consumption occurs. These emission factors are often defined using geographic locations. These can be based on local or subnational boundaries but are most often based on national ones.

2. The market-based method quantifies Scope 2 GHG emissions based on the emission factor reported by the generators from which the entity purchases electricity.

Typically, industry bodies specify that the location-based method is a minimum reporting requirement. Emission figures based on the market-based method can, however, be reported optionally (EPRA 2017). CRREM applies, as default, a location-based emissions factor.[9] However, users may choose their own emission factor based on the energy procured from their energy provider. Since the market-based method raises issues around verification, errors and validity, the GHG Protocol has introduced eight market-based Scope 2 minimum quality criteria relating to the integrity of contractual instruments (GHG Protocol 2015). Given some of these potential issues, we recommend that building owners buy green electricity that meets high standards of environmental integrity.

Results from the UNEP FI TCFD real estate module have shown that only a minority of participants have selected and entered user-defined emission factors via the market-based-option. In future, it will be important for building owners to be well-informed regarding the emission factors of energy from current suppliers as well as those of energy from alternative suppliers that might offer lower emissions.

Market- vs location-based emission factors: Lessons learned

Location-based emission factors are derived from the average emission intensity of power generators supplying an electricity grid, while the market-based approach reflects the emissions factors of the specific energy provider selected for the respective property. Market- or location-based data can be selected in the input sheet of the CRREM tool for renewable energy or entered in the settings sheet.

Key take-aways:

- Purchasing 'green' electricity will not improve the energy intensity or efficiency of the property. Therefore, off-site renewables do not significantly reduce the carbon risk of individual buildings.
- It is clear that offsetting with carbon credits and procuring green energy should be the last alternatives after all other strategic options have been exploited.
- UNEP FI TCFD real estate module has shown that only a minority of participants have selected and entered the user-defined emission factors and therefore the market-based-option.

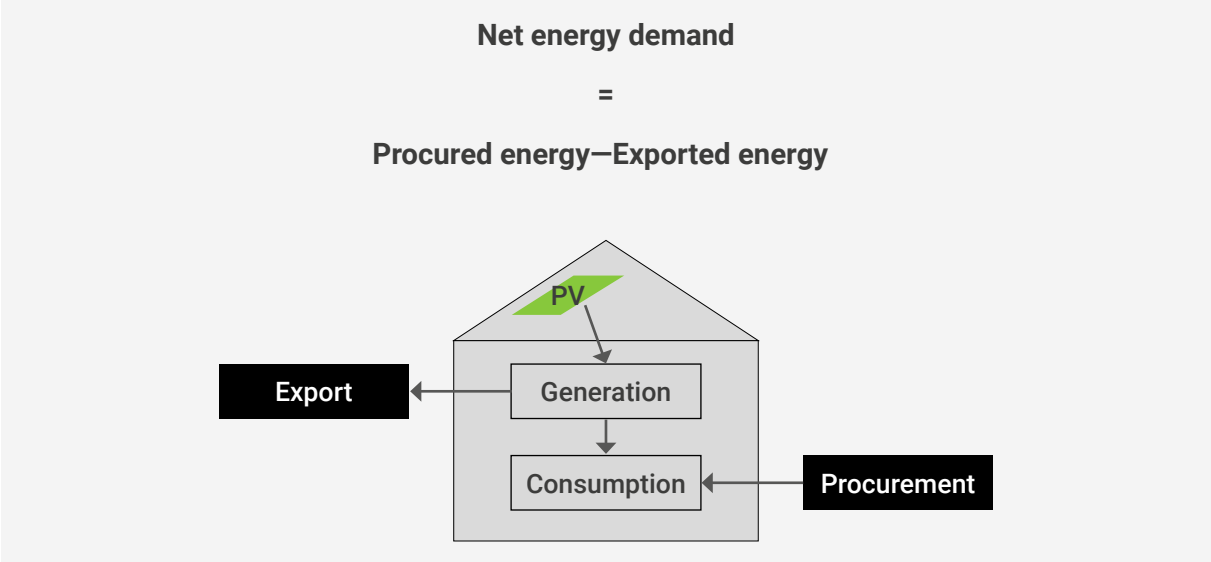
9 Market- or location-based data can be selected in the input sheet for renewable energy or entered in the settings tab

G. Renewable energy: A need for more on-site production

The CRREM analysis is based on the whole-building approach. This means that the energy consumption of both common and tenant-controlled areas contribute to the building's overall GHG emissions and therefore climate transition risk.

In this context, it is important to understand that net energy demand (NED) is the relevant figure for calculating a building's energy intensity, rather than consumption itself. The NED figure reflects the balance of energy imports and exports, and is not identical to a building's energy consumption. Therefore, renewable energy produced on site supports decarbonization in two ways: first, renewable energy produced and consumed on site will not add any GHG emissions to the overall balance; and second, surplus energy produced that could not be stored or consumed directly can be sold to the public grid, thus reducing the building's NED. Both aspects are relevant for the interpretation of the results, since only the NED is benchmarked against the country- and asset type-specific 1.5°C or 2°C Paris-aligned target pathway.

Figure 18: Schematic overview of net energy demand, energy procurement, export, consumption and generation



Source: CRREM 2022.

However, results within this UNEP FI module showed that less than 2% of total energy reported by participants was from renewables (either renewables generated and consumed on site or renewables generated on site and exported). Nevertheless, while many participants plan to expand on-site renewables, however, many often still fail to measure and track data accurately (with the "renewables" section of the CRREM input sheet remaining empty). In future, increasing renewable energy production on-site will have a significant positive impact on emissions and GHG intensity.

Renewable energy: Lessons learned

The CRREM methodology refers to the net energy demand of a building, reflecting both imports and exports. Renewable energy production on site can therefore reduce transition risk.

Key take-aways:

- Increased use of renewable energy is recommended (e.g. use of solar-power, wind or heat-pumps).
- Renewable energy production on site will reduce net energy demand and GHG intensity of properties.
- Own energy consumption can be (partially) met with renewables generated on site. Likewise, surplus renewables produced can be sold to the grid. Exporting on-site produced energy reduces the asset's net energy demand.
- Besides lowering the GHG intensity of the property, other benefits include higher security of supply.
- Producing energy on site will also reduce exposure to further increases in energy prices from the grid and therefore has a positive impact on the asset's risk profile.

Section C: Conclusion & recommendations

In this UNEP FI TCFD real estate module, participants could identify whether their real estate holdings were already compliant with a 1.5°C or 2°C Paris-aligned decarbonization pathway. In doing so, they were able to put a price tag on their transition risk. Following the recommendations of the TCFD, they were able to produce the relevant output figures (such as carbon intensities, excess emissions, carbon costs etc.) to ensure they met climate-related disclosure requirements. The exercise, enabled by the CRREM tool, allowed this transparent assessment of more than 340 properties, across various residential and commercial property types. It provided a transition- and carbon-risk analysis for banks and investors with a particular focus on North America and the Asia-Pacific. Furthermore, supported by UNEP FI, the CRREM tool was extended with default data for North America and the Asia-Pacific, which is now included in the system's backend, making its application to these regions much easier. The new free-ware versions are available on the CRREM website.

The exercise showed that the decarbonization roadmaps should proceed along the following steps:

1. **Beliefs:** The roadmap should begin with a clear ESG policy and net-zero commitment. The company should set and enforce clear goals and targets regarding decarbonization (aligned with the SBTi and CRREM).
2. **Assess carbon exposure:** The portfolio should be analysed using CRREM and other tools. Companies should know the *status quo ante* in relation to the overall market and where gaps exist in relation to the company's short-, medium- and long-term targets.
3. **Implementation of carbon risk mitigation measures:** A carbon reduction plan or roadmap should be established, including a timeline, budgets and well-defined measures to ensure that targets are achieved. These plans should be linked to operational asset management and the company's climate goals should be linked to incentives for those employees involved in implementation.
4. **Transparency:** Maximum transparency should be ensured regarding the assessed data and the carbon status quo of the asset/portfolio. Also, it is necessary to monitor the status and changes to the goals articulated in relation to the real estate portfolio (e.g., through a regular update of CRREM pathways).

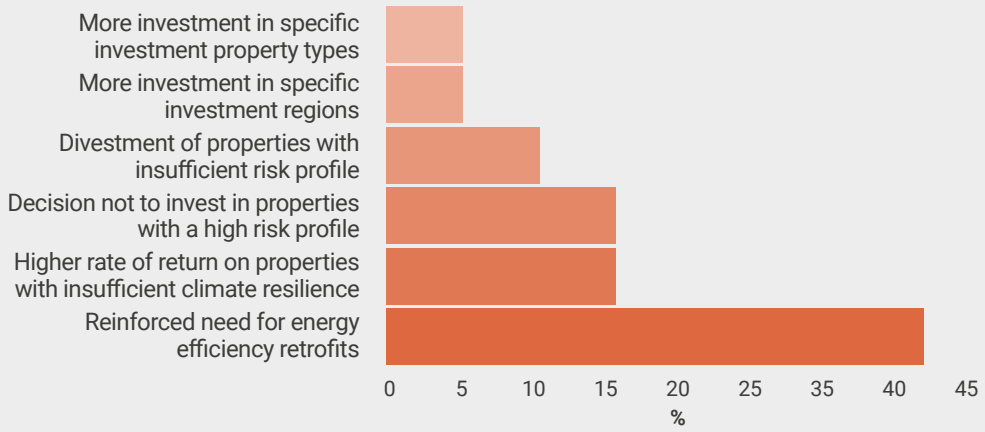
5. **Monitoring, review and disclosure:** Carbon risk mitigation plans should incorporate a regular review and controlling process to analyse the success of the corporate strategy as well as the impact of each implemented carbon risk reduction measure. Responsibilities within the organization should be clearly defined and understood by staff. Final results should be disclosed on an annual basis.

Participants that piloted CRREM as part of the UNEP FI programme learned how to:

- Account for and calculate carbon and overall GHG emissions for sample portfolios
- Develop strategies regarding GHG mitigation
- Identify alignment of real estate portfolios against Paris-compliant decarbonization pathways (including 1.5 and 2°C scenarios)
- Track GHG mitigation over time and evaluate the progress of investors' carbon performance
- Quantify risks at the property and portfolio levels
- Improve transparency and communication regarding climate-related financial risk reporting for real estate assets
- Analyse the impacts of retrofits on total carbon performance (comparing embodied carbon with operational savings)
- Visualize the energy performance of individual properties, portfolios and companies
- Apply default data (on emissions factors, carbon pricing, energy mix development, HDDs and CDDs etc.) and develop their own assumptions
- Understand the value of (smart) control and enhanced measurement infrastructure, to support standardisation and reduce reliance on purely modelled data
- Ensure alignment with good practice developed by other standards and initiatives (such as GRESB, INREV, PCAF, etc.)

Participants developed a strategic vision for reaching their climate goals, as evidenced by their feedback (see Figure 19 below). Specifically, that vision requires an increased focus on energy efficiency retrofits as a top priority. Further actions include rebalancing portfolios to increase the share of low-carbon property-types and move away from those facing significant transition risks. For those continuing to hold high-risk properties, a higher rate of return may be required to compensate.

Figure 19: What conclusions have you drawn from the CRREM risk assessment?



Source: CRREM; UNEP FI—CRREM Survey 2021.

Survey results showed that 82% of respondents were currently using or intend to use the CRREM tool to support increased transparency and strategic decision-making regarding the real estate sector.

Within this UNEP FI TCFD real estate module, it also become clear that there is still room for improvement in certain areas related to decarbonization in line with the TCFD recommendations. Key challenges include:

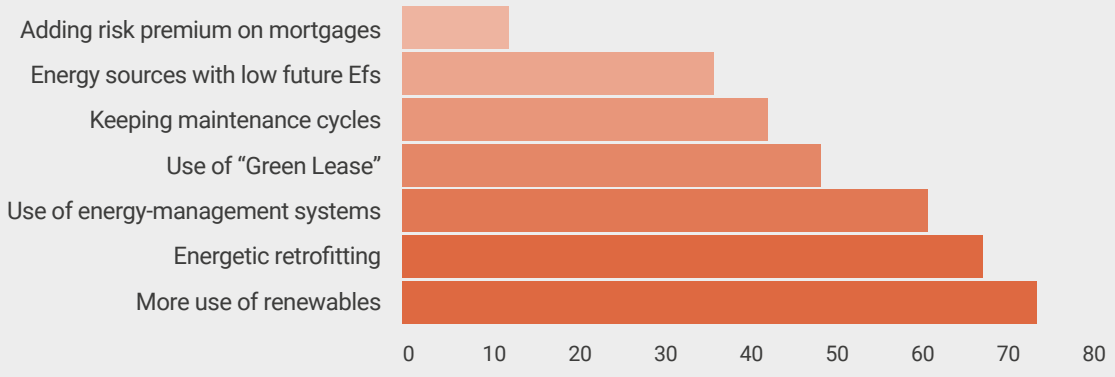
- F-gases are not yet sufficiently on the agenda of institutional investors: Actions should include the increased tracking and assessment of refrigerant losses. Where possible, building owners should also switch to more environmentally friendly alternatives.
- There is insufficient focus on intensified energetic retrofit measures and the allocation of the respective capex budgets.
- While several participants purchase renewable energy, there was a lack of differentiation between market- and location-based emission factors in the majority of cases. Also, priorities (such as improving energy efficiency first rather than simply procuring green electricity) must be further adjusted. Buying green energy is positive, but it should be the last option to be considered to decarbonize a property.
- Increased use of air conditioning will result in decreased asset performance: Given increasing CDDs due to climate change, cooling loads and energy consumption will increase. In refurbishments, natural ventilation systems should be used as much as possible.
- The ecological trade-off between the embodied carbon emitted by retrofitting measures and operational savings is not yet reflected by market participants.
- The differentiation of total capex expenses into costs for real energy efficiency measures vs. other expenditures that would have occurred anyhow is often neglected—leading to overly negative return on investment calculations for energetic retrofits.

- Transparency and data quality must be further improved.
- Further improvements in data coverage and tracking energy consumption within tenant areas is needed.
- Participants showed that there is considerable opportunity to increase renewable energy production on site, which in turn would reduce transition risk.

Many firms participating in this UNEP FI module have already implemented sustainability strategies and made changes to their portfolios, providing examples of 'best-practice' approaches. Paris Agreement-alignment may already be achievable by some firms over the short-term (e.g. until 2025) with relatively low-cost measures, such as better energy management for example. However, there is still a large discrepancy between the status quo of most properties, which imply significant GHG emissions, and the goal of reaching nearly-zero emissions by 2050. Therefore, long-term measures with a more significant impact, alongside sufficient capex budgets, need to be defined to ensure long-term Paris-compliance.

It remains an open question as to which measures investors should consider to gradually bring their portfolios in line with Paris Agreement trajectories. It is clear that refurbishment roadmaps and other strategic considerations must be made very quickly to limit transition risks and possibly build up competitive advantage. It is certain that, for example, thermal refurbishment (application of full thermal insulation) is not enough, and that carbon offsetting is also ultimately not a long-term solution either. On the contrary, the avoidance of an organization's own emissions must be the priority to achieve global climate goals. Various steps can be taken to meet Paris-aligned targets in the future, including a mix of direct and indirect measures. Direct measures include, for example, the use of more renewables and energetic retrofits, while indirect measures can be taken which act as incentives to drive the market towards a greener portfolio.

Figure 20: Steps to meet Paris-Aligned targets in future



Source: CRREM; UNEP FI—CRREM Survey 2021

Appendix

Appedix A: Case studies

Module feedback has been structured and provided in the form of case studies provided by pilot participants. Below, global players ORIX Asset Management, LINK REIT, NAB and Storebrand set out their objectives for using CRREM and describe their experiences to date, highlighting key take-away points as well as explaining how CRREM helps with reporting and disclosure requirements. Strategic feedback and CREEM best practice are presented in the following section.

Case Study: Orix Asset Management

Objectives

ORIX JREIT Inc. is one of a few Japan-based real-estate investment trusts (REIT) that has disclosed its TCFD scenario analysis, via a financial briefing in April 2021, receiving positive responses from stakeholders. We are committed to reduce greenhouse gases and aim for carbon neutrality by 2050. However, as we hadn't set specific interim milestones to achieve the said target and manage transition risks, we decided to join the CRREM collaboration with UNEP FI. We also sought to exchange ideas with other participants on how to reduce transition risks.

Experience

We recommend that all users study the CRREM Reference guide user manual before starting to apply the tool. As well as pure energy consumption data, a lot of other aspects and data has to be considered to ensure valid and property-specific outputs, and it initially took us some time to understand each required data input and how to feed in the appropriate data. As the collection of data can vary from country to country, we suggest that country-specific manuals be produced in future.

In addition, it is challenging to accurately assess whole-property energy intensity. In some of our properties, we can only obtain partial energy intensity data (i.e. from common areas). Although we have an obligation to make our best efforts in gathering data from tenants under the Japanese Energy Saving Act, it is not mandatory (especially regarding exclusive tenant areas in an entire building). This meant we could not use the extrapolation function integrated in the CRREM tool. Taking a holistic, whole-building view is important to ensure a robust decarbonization approach, and we will make greater efforts to work with our tenants to gather more data from tenant exclusive areas.

Take-aways and lessons learned

It was recommended that we install solar panels or other renewables on a larger scale on our assets as a result of the CRREM assessments. However, J-REITs such as ORIX JREIT Inc. have to consider regulations and related laws.

On-site power generation is permitted, but we face many regulatory challenges in exporting surplus electricity for sale. (E.g., J-REITs are prohibited from selling electricity externally as a business). We understand that other countries (such as Germany) also face comparable challenges and, ultimately, regulation must change to ensure that property owners can properly benefit from the production of on-site renewable energy. Due to the insights gained while applying the CRREM tool to a limited number of our assets, we have decided to expand our use of the tool to analyse our entire portfolio.

Reporting and disclosure

Results from CRREM assessments will also be used to make decisions about when energetic refurbishments should be done (in terms of budget, timing and extent of the refurbishment) to help avoid stranded assets.

Case Study: LINK REIT

Objectives

Awareness is relatively high among investors in the EU regarding the CRREM tool and its usefulness in providing a common language to measure the carbon footprint and transition risk exposure of real estate portfolios. That awareness is lower in the Asia-Pacific. This pilot provided a valuable process of trial and error—one which will only become more valuable as more industry players provide feedback to further improve the tool and ensure it is utilized effectively. As an ardent supporter of the work of UNEP FI, Link is always keen to articulate our own experiences and challenges. Hong Kong and mainland China have pledged to reach net-zero carbon emissions by 2050 and 2060 respectively. Earlier this year, we at Link REIT announced our own accelerated efforts to achieve net zero across our portfolio by 2035. As we embark on our net-zero journey, we have been actively assessing different interim target-setting approaches that would enhance the measurability and accountability of our asset-level energy-use intensity and carbon-intensity performance.

Experience

The CRREM tool works well at a macro level by aligning data reporting requirements and identifying decarbonization opportunities across a portfolio, providing asset owners with comparable data to make informed decisions. Application at the micro level, however, requires greater flexibility and customization to take into account local nuances. For example, in Hong Kong, tenants are billed directly by local utility providers and landlords do not have direct access to their consumption data. Furthermore, common or shared services such as air conditioning in retail shopping centres are rarely sub-metered. Therefore, the results of data analysis can be misleading, particularly if results are compared to portfolios where tenant energy consumption data is segregated. Data extrapolation, however, may also lead to distortions that falsely conclude an asset will become stranded; conversely, an asset identified as 'better-performing' may simply have benefited from its asset positioning within the portfolio. For instance, a shopping centre primarily serving the surrounding community's daily living necessities could be quite different—in terms of energy and emissions profile as well as services offered—to a higher-end retail property, despite being in the same asset category of retail shopping centres.

With the recent launch of China's national Emissions Trading Scheme, development of carbon pricing would impact our upcoming renewable energy strategy. CRREM's user-defined inputs (i.e. market-based emission factors, electricity and carbon costs under 1.5°C or 2°C scenarios) enable continuous and effective forecasting for portfolio decision-making. However, we also notice that markets in the Asia-Pacific region provide less transparency and clarity on the prospective trajectories, thus creating challenges for us to predict at this stage.

Take-aways and lessons learned

The CRREM tool has the potential to be a powerful tool for asset owners to examine the long-term climate risks a portfolio may experience. It provides the manager with key insights into the vulnerability and prioritization of assets, potentially facilitating more effective responses.

Reporting and disclosure

The CRREM tool and reduction pathways have laid the groundwork for real estate industry players to quantify transition risk exposure, develop target setting, and streamline their TCFD reporting. CRREM's whole-building approach remains novel within Asia-Pacific markets, but we anticipate that disclosures using this tool will increase as more regional players participate, pilot the methodology and contribute feedback for its further improvement.

Case Study: National Australia Bank Ltd

Unep fi phase 3—Evaluating real estate transition risks

National Australia Bank requires access to industry-specific tools that are science-based, regionally relevant and user-friendly to enable us to monitor the decarbonization of the Group's commercial real estate (CRE) portfolio towards its goal of net-zero emissions by 2050. In partnership with the CRREM project, the Group piloted the use of the CRREM tool, which models and evaluates transition risks and alignment with the goals of the Paris agreement for specific real estate assets and portfolios. We selected 38 office properties from our CRE customers' portfolios where GHG emissions data was publicly available through the National Australian Built Environment Rating System (NABERS). Properties were selected from five states to provide geographic diversity in the data set.

The tool outputs provided a view of the degree to which the overall CRE sample portfolio, and each building within the portfolio, had energy and GHG emissions performance aligned to a 1.5-degree decarbonization pathway to 2050. It also models the impacts of potential building retrofits that might be undertaken by customers to improve the performance of each asset. The Group tested the use of the tool to help deliver on our Collective Commitment to Climate Action (CCCA) requirements. The tool also provides a range of resources to help align portfolio reporting and target setting for commercial real estate portfolios aligned to the TCFD requirements.

The pilot highlighted a key challenge of data capture across the CRE portfolio—both in terms of quality and coverage. Additional data granularity for each building would also improve the accuracy of future modelling. This additional data includes a breakdown of energy consumption by energy type, emissions from additional sources such as refrigerant leakage, and information on percentage building occupancy.

Case Study: Storebrand real estate

Objectives

Storebrand has committed to net-zero GHG emissions from our investment portfolios by 2050 at the latest. In 2019, Storebrand was one of the founding members of the UN-convened Net-Zero Asset Owner Alliance. The members of the Alliance commit to transitioning their investment portfolios consistent with a maximum temperature rise of 1.5°C above pre-industrial temperatures. Storebrand has set a target of a 32% reduction by 2025 (vs 2018) across our listed equity, publicly traded corporate debt and real estate portfolios. Storebrand Group Management oversees the implementation of our Climate Policy, in line with the TCFD recommendations on governance structure. Storebrand Real Estate (SRE) committed in 2016 to contributing to the Paris Agreement. In 2020, an assessment by the Science Based Targets initiative, based on the first SBTi guideline for the financial sector and the 1.5°C target, resulted in an average portfolio target of a 70% emissions reduction by 2030 (location based). This would mean on average a 50% reduction in energy use. In exploring the CRREM tool, we had two objectives: understanding its function and reduction targets with reference to those from previous SBTi calculations; and understanding its potential role in further assessing transition risks and opportunities, as a basis for the optimization of strategy at both asset and portfolio levels.

Experience

While the SBTi calculations were based on more general sectoral decarbonization pathways, CRREM provides specific pathways for countries and for different commercial building types. It also provides a direct calculation of corresponding energy reductions. Using the location-based method on Scope 1 and 2 emissions, including metered tenant energy consumption, the resulting CRREM targets generally seem to confirm previous SBTi calculations of 70% emissions and 50% energy reductions by 2030. Assessing opportunities for reaching the targets must be based on asset-level simulations. Physical assessments of the energy savings and conversion opportunities of each asset result in CRREM input figures on investments and energy reductions for given years. The results will be used for optimizing strategy and asset development plans towards 2030 and beyond.

The tool further allows for including embodied carbon and other development project emissions. This is important to optimize total operational and project emissions over the asset lifespan. Embodied carbon and other development emissions are significant and short term, and must be optimized in relation to long-term operational energy and climate efficiency in order to get the highest net carbon reductions. This is a major challenge to strategic planning and implementation at the asset level. The 'Emission budget depletion and ecological payback of retrofit measures' may support the optimization process. The concept of stranding risk and the consequences for investment decisions need to be further explored, along with the value at risk, which seems to comprise more than carbon costs. The CRREM tool will support the further development of our climate risk assessment process.

Take-aways and lessons learned

The combined asset- and portfolio-level tool makes a great contribution to the assessment of risk, targets, opportunities and consequences of measures and strategies. Being newly expanded to cover Norway, a non-EU member, the tool may need further assurance on the basic assumptions around pathway starting points, emissions levels etc. A further look at the possible harmonization of pathways, e.g. between Nordic countries, seems relevant from the point of view of a Nordic real estate actor. Comparing our Norwegian and Swedish portfolios' stranding risk was not immediately easy. The tool comprises complex technical and statistical assumptions, as well as output graphs for different purposes. Utilizing the tool adequately demands skilled professionals and time to comprehend the system and context properly. There is more work to be done to ensure that data assumptions and outputs are representative of our beliefs, and to convert the results into risk assessment and management. For investors, the use of the CRREM reporting data for comparison between portfolios or managers will be affected by the reporter's choice of assumption, e.g. perceived emission factors. This appears to be a complicating issue.

Reporting and disclosure

The CRREM results will be used to support our risk review and TCFD reporting, as well as reporting progress on emissions reductions against targets.

Appendix B: Managing transition risk with CRREM

A. About the Carbon Risk Real Estate Monitor (CRREM) Initiative

The Paris Agreement commits governments to reach net-zero emissions by the second half of this century, meaning that reliable, granular and science-based decarbonization pathways are needed for countries and economic sectors—including real estate—to provide clear guidance to market participants. The CRREM initiative's main objective is to help align investors and building owners with such a decarbonization pathway. It aims to reduce investor uncertainty and offer a viable basis for investment decision-making regarding stranding risks and strategic retrofit planning in order to meet forthcoming climate regulations and decarbonization requirements.

The initiative's main objectives are to:

- Increase transparency regarding specific country and use-type decarbonization requirements in accordance with the Paris Agreement and the latest scientific evidence for real estate.
- Support real estate investors and asset managers in measuring and reducing their operational carbon footprint at the property and portfolio levels with software tools, new methods and scientific recommendations.
- Support the global harmonization of decarbonization initiatives within the real estate sector.
- Create higher awareness of transition risk within the real estate industry.

CRREM resources are aligned with and accepted by the leading international organizations and initiatives (e.g. TCFD, SBTi, PCAF, IIGCC, NZAOA, E-CORE, INREV, ULI Greenprint, etc.). Major investors managing more than EUR 500 billion of assets are already using CRREM on a regular basis to avoid stranding risk, manage transition exposures and comply with Paris-aligned decarbonization efforts. The tool has been used to analyse over 4,500 properties, representing more than 50 million m² of property globally, as of the end of 2021.

The not-for-profit-initiative is supported by the EU Commission and the Laudes Foundation, as well as the GRESB Foundation, APG, PGGM, Norges Bank Investment Management, GPIF and Ivanhoé Cambridge. To ensure appropriate governance, two committees

of leading experts and scientists were established to advise the initiative and support its work. The Global Scientific Committee consists of academic experts with backgrounds in real estate and environmental sustainability across Europe, North America and Asia. The Global Investors Committee comprises representatives of leading industry bodies and major investors, asset managers and IT companies; most of its members also have strong backgrounds in sustainability as well as in real estate. The methodological processes and functional specifications of CRREM resources, tools and metrics are regularly scrutinized by the committee members.

The CRREM tool's benefits and outputs

The tool was designed to help investors and other financial institutions with, for example, buy-hold-sell decisions, decisions on capex, planning retrofit measures, and to produce indicators for risk management reporting and disclosure. The CRREM risk assessment tool helps investors and banks better understand outputs and how those outputs can be selectively applied in support of credit risk decisions and loan book analysis.

CRREM enables users to:

- Identify the stranding point at which a property is no longer compliant with a Paris-aligned target
- Deal with gaps in data using extrapolation
- Display results at the asset and portfolio levels
- Identify 'good' and 'bad' assets in a portfolio
- Visualize carbon and kWh intensities
- Derive a monetary value of transition risks from operational carbon emissions
- Identify Paris-alignment at the property level and set targets for 1.5 and 2°C scenarios
- Benchmark property energy consumption
- Conduct retrofit scenario analysis
- Use default data or own assumptions, and apply country-average default values (if asset-specific data is not available)
- Undertake a transparent analysis of carbon risks, calculation of abatement costs and evaluation of the correct timing of future retrofit measures
- Initiate dialogue between investors and fund managers about the carbon performance of their assets and possible ways to reduce carbon footprints
- Assess carbon-related transition risks at both the asset and portfolio level, as well as planning retrofit actions that would be required to mitigate risks.
- Focus on net energy demand, and account for on-site green energy generation and grid exports
- Leverage vast amounts of background data for different metrics (emissions factors, carbon prices, HDDs and CDDs, energy mix evolution etc.).
- Align outputs with related initiatives (such as GRESB, SBTi, INREV, PCAF, etc.)

Download the CRREM tool and pathways

B. Paris compliance with the CRREM Global Decarbonization Pathways

How CRREM paris-aligned pathways are derived

A real estate company's climate strategy and risk management must ensure that individual efforts to mitigate CO_2e within its portfolio are sufficient to meet the 1.5°C Paris-aligned sectoral targets—otherwise, market participants could face a situation where properties do not meet future market expectations and/or regulatory requirements and therefore will be exposed to transition risks.

The CRREM decarbonization trajectories are based on the remaining carbon budget for the real estate sector that can be emitted to limit warming to either 1.5°C or 2°C. The trajectories are broken down by country and use-type. It covers the main real estate investment hubs globally (44 countries in total) and the most common 11 use-types. For these segments, decarbonization pathways from 2018 onwards until 2050, with corresponding annual interim targets, were derived. This includes additional GHGs as well as carbon dioxide.[10]

Since the real estate industry not only focuses directly on GHGs but also on energy intensity, this was included as an additional KPI. Energy intensity was also scaled down and the respective trajectories provided. This results in real estate sector pathways for both GHGs and energy intensity from 2018 to 2050, available free of charge in XLS form on the CRREM website, expressed in the following ways:

- Carbon intensity: $kgCO_2e/m^2$/year (kilograms of carbon dioxide equivalent per square metre per year)
- Energy intensity: kWh/m^2/year (kilowatt hours per square metre per year)

These pathways can be regarded as maximum emission allowances for equity investors or as a benchmark for financed emissions for banks and other financial institutions.

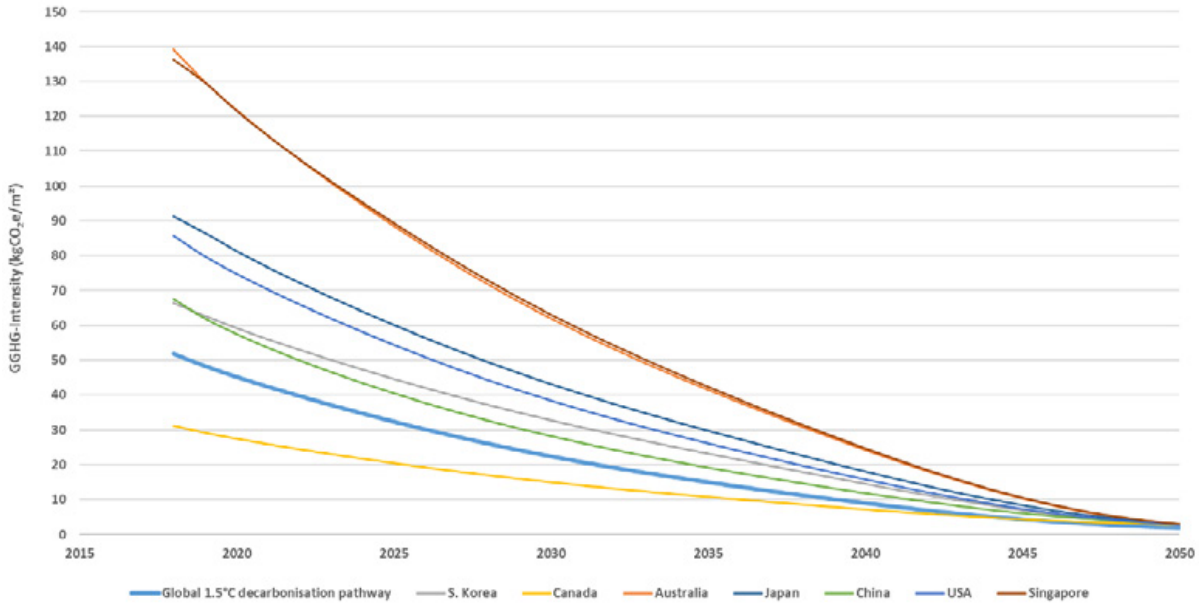
Pathways can be used to analyse individual assets or financed emissions

Based on continuously evolving scientific evidence and market data, these targets are updated on a regular basis. The CRREM pathways begin with the current (national or global) market average, showing that current and projected emissions are too high to meet Paris targets, and hence must fall if the sector is not to exceed its carbon budget (CRREM 2020b).[11]

10 The reported emissions exclude biogenic CO_2. GHG data displayed here in units of carbon dioxide equivalent (CO_2e) reflect the global warming potential (GWP) values.

11 For more details regarding the downscaling process, please refer to the CRREM methodology document.

Figure 21: Convergence of carbon-intensity pathways in different countries (2021 version)



Source: CRREM 2020a.

To derive country- and use-type-specific pathways, the global budget must be further broken down. CRREM uses each country's baseline energy intensity per use-type and converts those figures, applying the national energy mix per use-type and the granular emission factors of different energy sources, to calculate the current carbon intensity average. Based on this, converging carbon intensities to 2050 to the 1.5°C and 2°C targets were applied. CRREM uses the Sectoral Decarbonization Approach (SDA) (CDP 2015) and a downscaling methodology also used by the Science-Based Targets Initiative.

Downscaling follows scientific requirements

The pathways are available in a separate file within the software tool. They can be used by investors, asset managers and banks for the analysis of real estate financing. The PCAF, for example, has recommended the use of the CRREM tool by banks to measure their "financed carbon emissions" in the real estate sector (PCAF 2021). As per the recommendations of the TCFD, these pathways and metrics can be used for target setting.

A more detailed description of the CRREM downscaling documentation and assessment methodology and the pathways are available at CRREM.org/pathways.

C. Addressing transition risk with the CRREM Risk Assessment Tool

The pathways mentioned above are also integrated in the freely available CRREM Risk Assessment Tool, which supports market participants in strategic planning, benchmarking and ongoing management, and which facilitates reporting and disclosure requirements according to the TCFD and other initiatives.

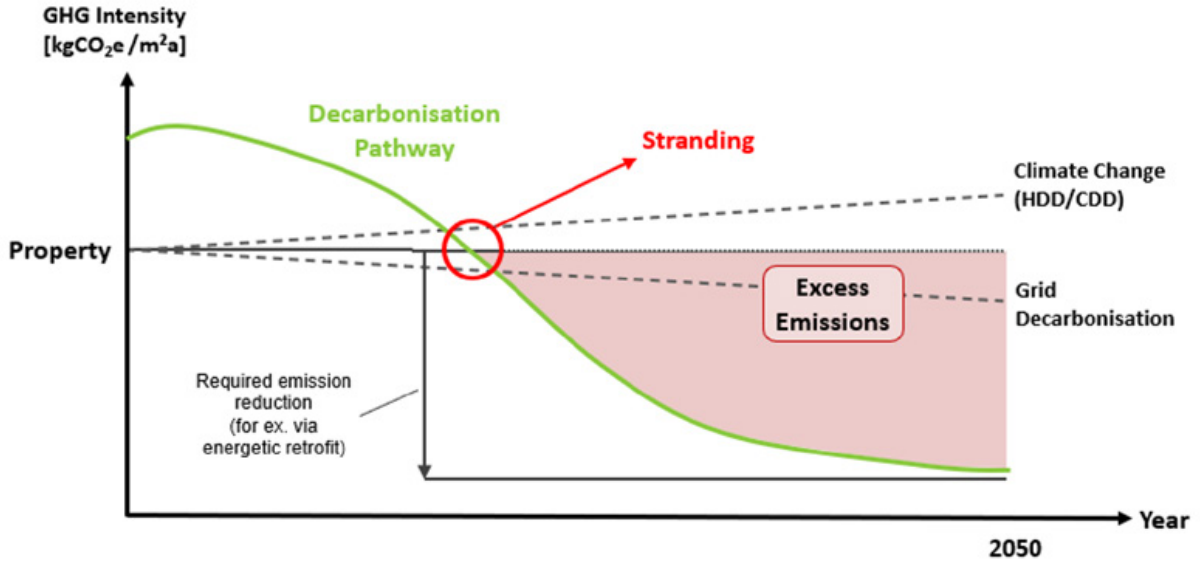
The CRREM tool enables transition risk analysis

After inputting specific information about the energy consumption of a particular asset in the Excel-based-software, investors and lenders can immediately analyse their real estate portfolio, from alignment with Paris goals to identification of assets at risk of becoming stranded as a result of non-compliance with carbon intensity or energy efficiency requirements, and regarding potential retrofit strategies to comply with future decarbonization goals.

Asset-level analysis

One of the main outputs regarding asset-level analysis is the stranding diagram. It shows the point in time at which an asset is no longer compliant with the Paris target trajectory. The asset-level analytics in the CRREM tool allow the user to map how a particular asset performs against a specific decarbonization and/or energy reduction pathway. The baseline performance of an asset is projected, and the estimated date of stranding is identified (see Figure 22).

Figure 22: Stranding of real estate assets



Source: CRREM 2022.

- The black line represents a building's baseline and future carbon performance in terms of its GHG intensity, which is calculated as the volume of GHG emissions per square meter per year. Emission figures include those directly generated by the on-site combustion of fossil fuels for heating and indirect emissions from, for example, district heating or purchased electricity.
- The green curve represents the decarbonization pathway for the specific building use-type that aligns with a certain climate target (1.5°C/2°C). If the emission intensity is above the target value, 'stranding' occurs. To be clear, this does not mean an instant or full write-down of an investment's value, but it implies higher transition risk.
- The red area above the decarbonization pathway describes the property's excess emissions, i.e., GHG emissions above the defined Paris-compliant budget targets. If these are assigned a carbon price (e.g., within the framework of CO_2 taxes or a CO_2 trading system), excess emissions can be directly converted into costs. A present value analysis of these emissions could, in turn, inform a budget for energy efficiency refurbishments to bring the building back on to a Paris-compliant pathway.

In the figure above, the building is Paris aligned only at the very beginning of the period, and risks stranding far before 2050. Appropriate energetic retrofit measures could reduce its GHG emissions and would ensure that it meets future targets.

The asset's performance projection takes into account how much more (or, in some cases, less) energy an asset will use in the future given changes in temperature patterns (and resulting changes in HDDs and CDDs). It also incorporates the projected evolution of the electricity grid for the region in which the asset is located. Should the local grid become much cleaner over time, the grid-corrected asset performance will correspondingly improve, reducing the asset's GHG intensity.

This benchmarking exercise allows asset managers, institutional investors, banks and other stakeholders to estimate not only when a particular asset might be stranded as a result of non-compliance with defined carbon intensity and energy efficiency goals, but also, upon aggregation, what this means at the portfolio level.

Portfolio-level analysis

The CRREM tool works from the bottom up, but it also aggregates data at the portfolio level to derive meaningful insights for strategic planning. The asset analytics described above are automatically aggregated into portfolio-level analyses.

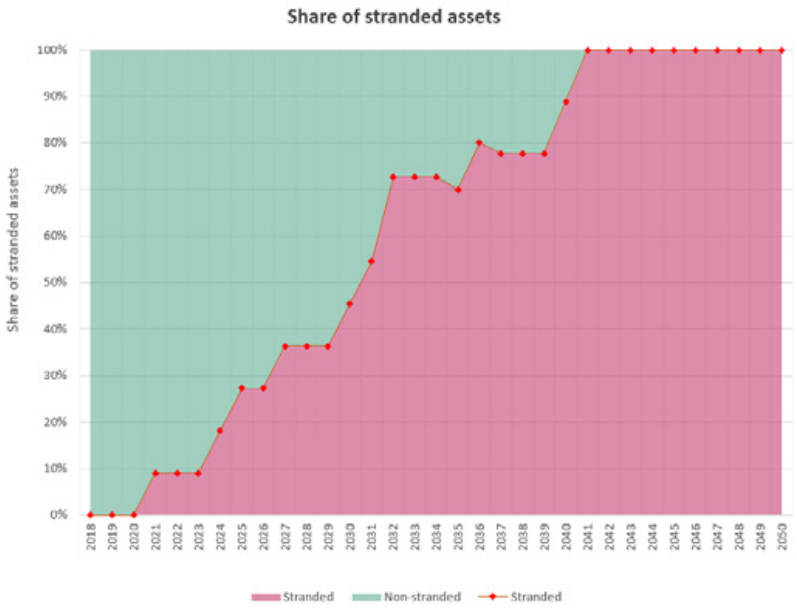
One of the primary functions is the ability to project the evolution of stranding within a portfolio over time. The example below illustrates a portfolio in which the share of assets exposed to stranding risk increases from 0% in 2020 to 100% over the course of the next 20 years.

Figure 23: Share of stranded assets

EVOLUTION OF STRANDING WITHIN PORTFOLIO

Diagrams on the right display the evolution of stranding within your portfolio. Upper graph: Relative share of stranded assets. Lower graph: Absolute figures. Choose whether to display data based on the number of buildings, gross floor area (GFA) or gross asset value (GAV). Choose whether to exclude individual assets or exclude them from a certain year on.

Asset ID	Include	Sell in year
1	Yes	Don't sell
2	Yes	Don't sell
3	Yes	Don't sell
4	Yes	Don't sell
5	Yes	Don't sell
6	Yes	Don't sell
7	Yes	2035
8	Yes	Don't sell
9	Yes	Don't sell
10	Yes	2037
11	Yes	Don't sell



Source: CRREM 2022.

A more detailed description of the vast number of additional functionalities of the software can be found in the Reference Guide. This user manual, as well as the CRREM risk assessment tool, is available at CRREM.eu.

The following table shows a summary of the CRREM tool's alignment with the TCFD recommendations for disclosure on metrics and targets which can be used to assess and manage transition risk within the real estate sector. Outputs derived from the CRREM tool can be directly extracted and used for further risk analysis and reporting requirements as suggested by the TCFD.

Table 4: CRREM alignment with TCFD-recommended disclosures

TCFD recommendation	TCFD Recommended disclosure	CRREM element
Strategy: Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy and financial planning, where such information is material.	a. Describe the climate-related risks and opportunities the organization has identified over the short, medium and long term.	The CRREM tool identifies stranding risk/transition risk due to non-compliance with regional energy efficiency and GHG-intensity pathways aligned with the Paris Agreement, from 2020 until 2050.
	b. Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy and financial planning.	Carbon value-at-risk and excess emissions, as well as other financial figures, are estimated at the asset and portfolio level, to put a price-tag on carbon-risk.
	c. Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.	The CRREM tool applies two scenarios: 2°C (based on the IEA's 2DS scenario) and 1.5°C (based on the Friends of the Earth scenario). The organization can also calculate a retrofit budget needed to upgrade properties and relate that to internal budgets and available cash flow. Downscaling follows scientific guidelines.
Risk management: Disclose how the organization identifies, assesses and manages climate-related risks.	a. Describe the organization's processes for identifying and assessing climate-related risks.	Asset-level performance projections and benchmarking of energy and GHG intensities against science-based pathways. The whole CRREM methodology and process and how to apply the pathways and tool are described in detail in various documents, including a reference guide.
	b. Describe the organization's processes for managing climate-related risks.	The retrofit functionalities in the asset sheet allow for planning of actions to mitigate stranding risk. Scenario analysis with greater renewable energy production on site, more procured green energy or even disinvestment of non-compliant properties are options that can be simulated with the tool.

TCFD recommendation	TCFD Recommended disclosure	CRREM element
Metrics and targets: Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities, where such information is material.	a. Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management processes.	GHG emissions intensity ($kgCO_2e/m^2$); Energy intensity (kWh/m^2); Costs of excess emissions; CRREM clearly states the KPIs needed to assess and manage transition risk. Also, the data quality and how inputs needs to be prepared are clearly described.
	b. Disclose Scope 1, Scope 2 and, if appropriate, Scope 3 GHG emissions, and the related risks.	CRREM applies the so-called whole building approach. The analysis includes tenant and landlord-controlled spaces. Disclosure of Scope 1 and 2 (and Scope 3 if tenant space is reported here) is therefore a key focus area.
	c. Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.	The decarbonization pathways developed by the CRREM initiative serve as science-based, widely recognized, easily understandable and actionable targets. They are 1.5°C or 2°C and Paris-aligned.

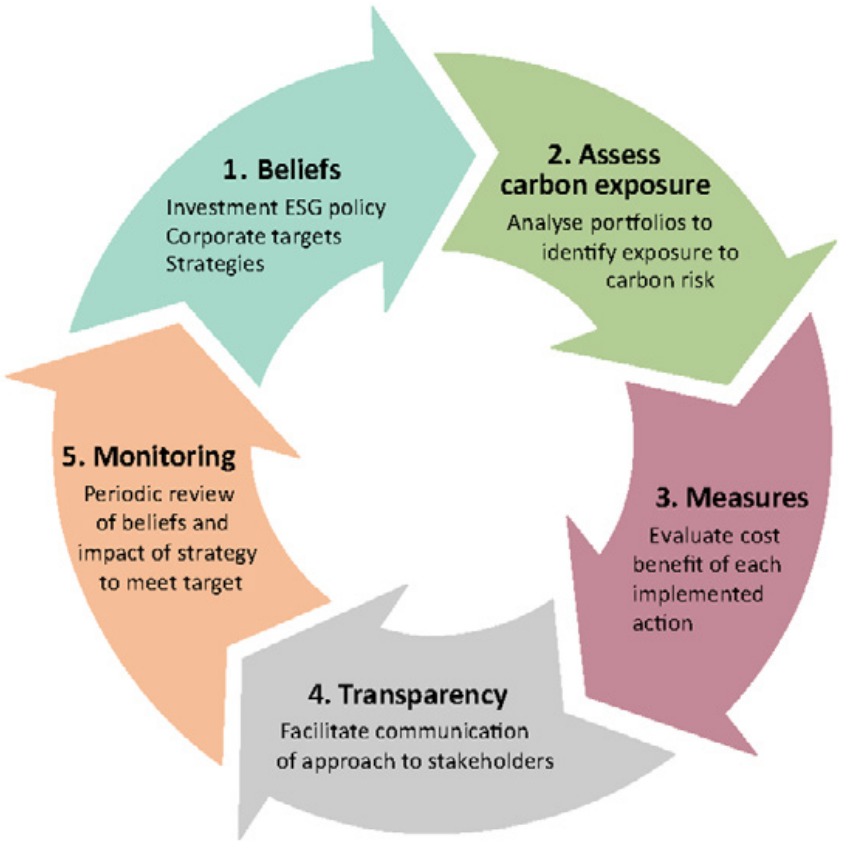
D. Enabling strategic decision making

Investors and asset managers need well-defined and clear strategies to assess, quantify and mitigate the stranding risk faced by their portfolios. To achieve a net-zero target that is compliant with the Paris Agreement, carbon risk mitigation strategies need to be aligned with corporate ESG principles, and risk mitigation actions and cost-benefit trade-offs need to be monitored and reported. This will require owners to undertake a bottom-up assessment of each asset and then make strategic decisions regarding whether to sell, buy, hold, upgrade or retrofit, ensuring the appropriate timing.

Decarbonization must be integrated in ESG roadmaps

A strategic approach would start with sound ESG targets and net-zero commitments at the company level, including policies and corporate strategies for measures to ensure appropriate transparency. This should include periodic review and ongoing monitoring, as the figure below illustrates:

Figure 24: Roadmap for carbon risk management

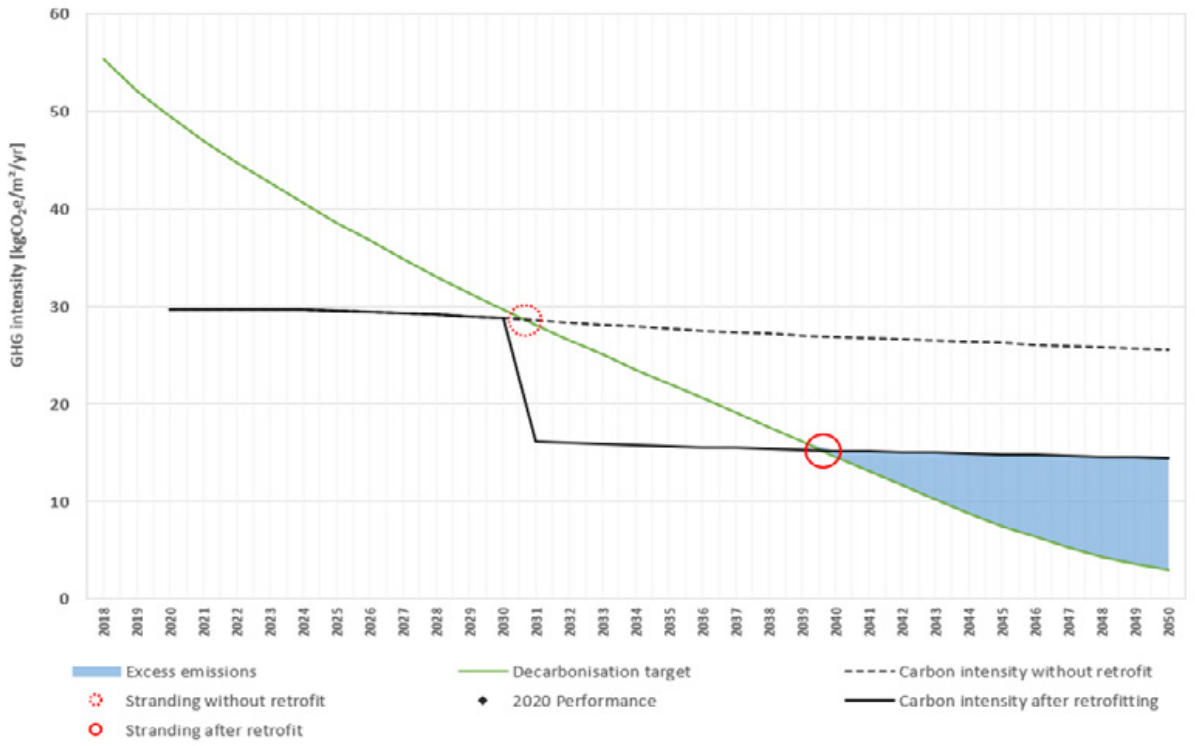


Source: CRREM, based on Towers Watson 2015.

Using CRREM resources, investors and banks alike can analyse their commercial and residential real estate holdings in a number of different ways, supporting a forward-looking and proactive approach to addressing transition risk and answering the strategic questions summarized in Section A. Putting a price tag on transition risk, for example by deriving a present value of the excess emissions above the decarbonization pathway, helps users take strategic decisions on managing that risk.

The asset-level analytics of the tool go beyond benchmarking against various pathways. They also allow users to test out various (energetic) retrofitting options so that the best cost-benefit measures can be selected to put a property back on a Paris-aligned track.

Figure 25: Asset stranding analysis with planned retrofits



Source: CRREM tool 2022.

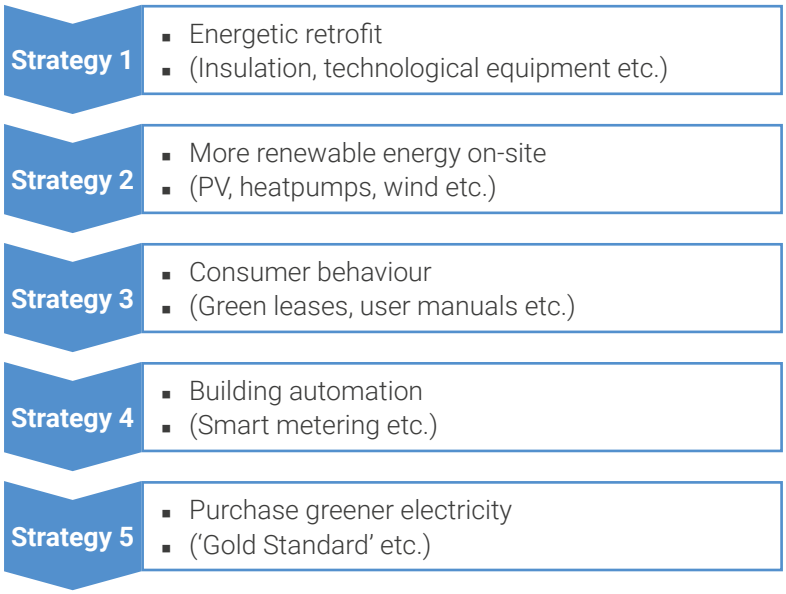
The diagram above illustrates how an energetic retrofit investment undertaken in 2022 keeps an asset in compliance with the decarbonization pathway until 2032; without the measure, the asset would have become stranded in 2023 (note that in this illustration, the property will be stranded even with the retrofitting intervention and is therefore not fully compliant with the decarbonization pathway).

Energetic retrofits are the cornerstone for decarbonization

Of course, energetic retrofitting and smart building technology are only one option to reduce the operational carbon footprint of a given property. Besides cutting energy demand and hence carbon emissions, the electrification of assets is an essential step towards net-zero emission goals (Urban Land Institute 2021).

Further possibilities include: greater use of energy sources with low future emission factors (for example district heating as well as green electricity); increasing on-site renewable energy production; developing design concepts that extend the lifecycle of the building; and the use of green leases to implement incentives to reduce tenants' energy consumption.[12]

Figure 26: Strategies and measure to improve the portfolio:



Getting to net zero

12 More information on strategies and options for measures to reduce the carbon footprint of properties can be found on the CRREM website, in particular Report No. 1: Stranding Risk & Carbon and Report No. 3 Retrofit Harmonisation Roadmap. See CRREM.eu/publications/reports.

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United Nations Environment Programme Finance Initiative (UNEP FI) is a partnership between UNEP and the global financial sector to mobilise private sector finance for sustainable development. UNEP FI works with more than 450 members—banks, insurers, and investors—and over 100 supporting institutions—to help create a financial sector that serves people and planet while delivering positive impacts. We aim to inspire, inform and enable financial institutions to improve people's quality of life without compromising that of future generations. By leveraging the UN's role, UNEP FI accelerates sustainable finance.

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