

Sustainable investing

The financial risk of carbon footprint in the real estate sector





White paper For professional investors December 2021

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## Introduction

This document will focus on decarbonization in the real estate sector, a major contributor to global greenhouse gas (GHG) emissions.

> Research undertaken by the International Energy Agency (IEA) shows that the built environment accounts for 36% of the world's energy use and for more than 39% of global carbon dioxide (CO<sub>2</sub>) emissions. Therefore, the adoption of effective decarbonization strategies in the real estate sector will have to become top priority in the coming years.

Guidelines and strategies to reduce climate impact are provided by the European Union (EU) and the Intergovernmental Panel on Climate Change (IPCC) report.<sup>2</sup> The European Green Deal, for example, provides strategies to achieve the targets set by 2030 and 2050 by the 2015 Paris Agreement. The aim is to push companies to reduce GHG emissions by 55% by 2030 (compared to levels in the 1990s) and net-zero emissions by 2050. Recently, the European Commission published legislative proposals<sup>3</sup> to include buildings in the Emissions Trading System, while highlighting that "strong regulatory measures on energy efficiency, renewables, eco-design, energy performance of buildings [...] will also drive the shift towards greener [...] buildings."

How much would inaction cost the real estate sector? And in what ways could the sector reduce its emissions? Achieving the carbon reduction targets under the Paris Agreement globally could require at least USD 50 trillion<sup>4</sup> of investments dedicated to decarbonization technologies for all industries combined. According to Robeco estimates, the real estate sector's fair share of this could potentially reach a staggering 19% of the value of global real estate.

In this paper, we quantify the potential financial impact the sector faces, if it does not reduce CO₂ emissions under different carbon tax scenarios. We examine strategies and solutions to reduce carbon emissions, looking at approaches that should be adopted to reduce operational and embodied carbon emissions. We also compare the listed real estate sector with the total real estate sector. Moreover, we construct the decarbonization pathway for the listed real estate sector, using the targets released in the sustainability reports of listed real estate companies. Finally, we estimate the financial impact of decarbonization on different segments within the listed real estate sector, highlighting the degree in which the segments will be challenged.

<sup>1</sup> Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector.

<sup>&</sup>lt;sup>2</sup> IPCC, 2018: Summary for Policymakers, In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above preindustrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)

<sup>&</sup>lt;sup>3</sup> Questions and Answers - Emissions Trading - Putting a Price on carbon, July 2021, https://ec.europa.eu/commission/presscorner/detail/en/qanda\_21\_3542.

<sup>&</sup>lt;sup>4</sup> UBS Global Research (2021): Energy transition and the capital goods sector; A US\$75-90tn tailwind for the sector? — Morgan Stanley BluePaper (2019): Decarbonization: The Race to Net Zero – BofA Global Research (2021): "Transwarming" World: Net Zero Primer.

# Incorporating decarbonization in real estate values: what's at stake?

Over the past 20 years, CO<sub>2</sub> emissions by the built environment<sup>5</sup> have increased significantly.

These emissions currently account for the largest share of global energy-related  $CO_2$  emissions, representing around 13.4 billion metric tons<sup>6</sup> of  $CO_2$ . For this research, we will focus only on the emissions deriving from energy-related  $CO_2$  emissions as a result of fossil fuel and industrial processes, which also represent the largest share (65%) of total GHG emissions (see Box 1 for more information).

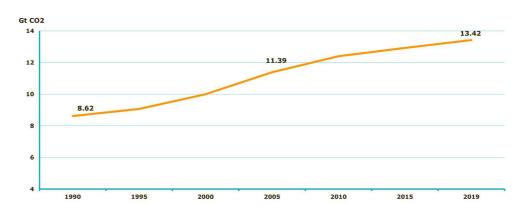


Figure 1 | Total energy-related emissions CO<sub>2</sub> from the built environment, 1990-2019

Source: IEA (2020) - https://www.iea.org/reports/tracking-buildings-2020, Robeco.

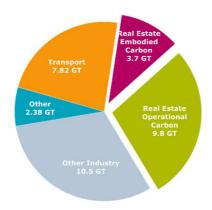
According to the International Energy Agency (IEA) and UN Environment Programme, building operations including heating & cooling and lighting are responsible for 28% of total global emissions (around 9.8 billion metric tons of  $CO_2$ ) annually. Building materials and construction, typically referred to as embodied carbon, are responsible for an additional 11% (around 3.7 billion metric tons of  $CO_2$ ).

<sup>&</sup>lt;sup>5</sup> In urban planning, architecture and civil engineering, the term built environment refers to the human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighborhoods and cities that can often include their surrounding infrastructure. (See ScienceDirect: Definition "Built Environment").

<sup>&</sup>lt;sup>6</sup> "Ton" is an Imperial measurement (still widely used in the USA) while a "Tonne" is a Metric measurement.

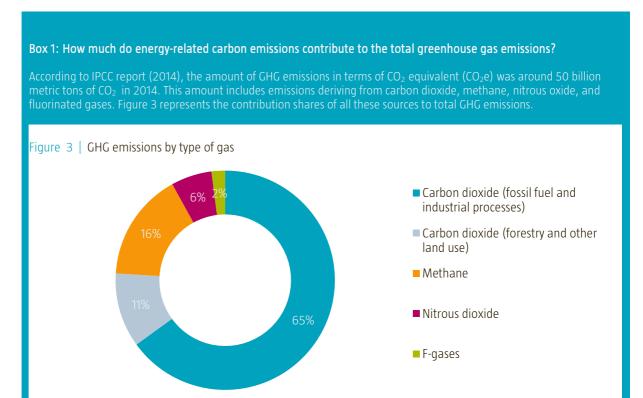
<sup>&</sup>lt;sup>7</sup> IEA provides the quantity of energy-related emissions deriving from operational activities in buildings (around 10 billion tonnes of CO<sub>2</sub> in 2020). In Figure 1, we have also estimated the amount of embodied carbon emissions, using their percentage contribution rate (according to IEA and UN Environment Programme, around 11% of global energy-related emissions).

Figure 2 | Global energy-related CO<sub>2</sub> emissions and real estate contribution



Source: Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector, Robeco.

With CO<sub>2</sub> emissions playing an important role in global warming (see Box 1), decarbonization has become a top priority. Demand from tenants and investors, as well as pressure from regulators, mean that the real estate sector must decarbonize or pay a big price not to do so. This includes carbon taxes, fines, and potentially stranded assets. How much is at stake? The next paragraphs will define and quantify these costs, outlining the main assumptions that lie behind them.



Source: IPCC, 2014: Climate Change 2014: Mitigation of Climate Change, US Environmental Protection Agency.

For this research, we will focus only on the emissions deriving from the CO<sub>2</sub> released from fossil fuel and industrial

## Estimating the decarbonization costs: not an easy task

Due to the large number of variables involved, and the constant change in events (e.g., weather conditions, energy and CO<sub>2</sub> price, material prices, etc.), accurately estimating the overall cost of decarbonization depends on many assumptions.

Two approaches to estimating the impact on the sector are:

- 1. Estimating the costs of retrofitting the buildings to make them 'Paris-aligned'.8
- 2. Putting a price on the carbon emissions of buildings that are not 'Paris-aligned'.

Figure 4 represents these two ways of estimating the costs of decarbonizing in a stylized fashion, using a chart from the Carbon Risk Assessment Tool for European Commercial real estate Industry 9 (CRREM) report. The black line represents a building's baseline GHG intensity and its future carbon emissions, in case the owner will not decarbonize the building's footprint. Meanwhile, the green curve represents the target decarbonization pathway of the building aligned with the target of containing global warming below 1.5°C. The retrofit dotted line represents the costs needed for decreasing the GHG emissions to what is ultimately needed to meet the targets of the Paris Agreement. The second approach is to look at the cost in terms of potential carbon taxes. Whenever a building's GHG emissions are above the decarbonization pathway, costs may arise from carbon taxes, where the government would set a price that emitters must pay for each metric ton of GHG emissions released. The red surface in Figure 4 represents the amount of carbon taxes that a company will have pay in case it exceeds the threshold of the emissions allowed to meet carbon neutrality by 2050.

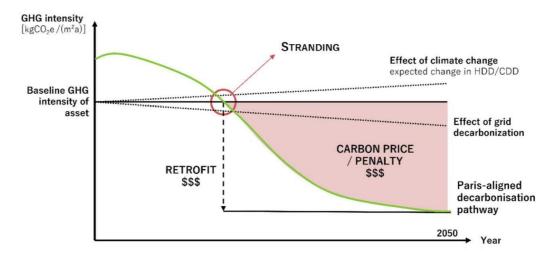


Figure 4 | Two ways of representing decarbonization costs

Source: CRREM Report (2020): Completion of Pilot Testing Phase.

## How much could retrofitting cost?

According to research by Morgan Stanley, 10 reducing global carbon energy-related emissions will require USD 50 trillion by 2050. This provides a way of estimating the total costs that the built environment will face in the coming years. We assume that the costs necessary for the built environment to achieve net-zero emissions will be proportional to its share

<sup>&</sup>lt;sup>8</sup> The term "Paris-aligned" is used when the company respects the Paris Agreement. Specifically, the Paris Agreement offers a way forward to address climate change that supports Sustainable Development Goal (SDG) 13 on climate action and the broader 2030 Agenda for Sustainable Development (UN.2015).

<sup>9</sup> Many organizations are seeking to develop tools that would simulate scenarios based on the multitude of variables that contribute to the final costs needed to reduce emissions. One of them is the Carbon Risk Assessment Tool for European Commercial Real Estate Industry (CRREM) which provide investors with a roadmap for individual properties on how much it will cost to reduce its carbon footprint over the next decades.

of current CO<sub>2</sub> emissions. According to the IEA, the built environment contributes 38% to total energy-related emissions. As Figure 5 shows, the real estate sector will therefore need to invest an estimated USD 20 trillion to achieve net-zero emissions by 2050.

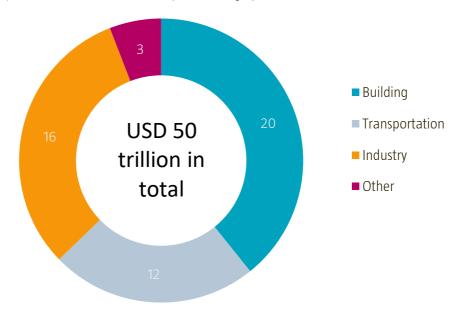


Figure 5 | Overall decarbonization costs by broad category (USD trillion)

Source: Morgan Stanley BluePaper (2019): Decarbonization: The Race to Net Zero, Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector, Robeco. Note: figures have been rounded and may not add to 50.

## Paying the price in carbon taxes

There are currently two main mechanisms to set carbon prices, namely emission trading systems (ETS) and carbon taxes. Both methods set a price on the emissions, which should discourage activities requiring high levels of carbon emissions and encourage the advancement of technologies that enable lower levels.

Today, the EU's ETS is the world's leading CO<sub>2</sub> market, covering the greatest share of global emissions compared to any other carbon pricing initiative. The EU's ETS sets a desired maximum level of emissions and allows the market to find the carbon price necessary to achieve this level. Figure 6 shows the level of the EU's ETS carbon price between 2011 and 2021. During this decade, the price of emitting one metric ton of CO<sub>2</sub> on the EU's ETS has increased sixfold. More stringent regulations and more aggressive climate policies, at global level, are expected to lead to materially higher carbon prices.

On the other hand, carbon taxes follow the opposite approach by setting the carbon price beforehand, and using this price to achieve the desired maximum level of emissions.

€ per t/CO2 50 40 30 20 10

12/10/2017

12/10/2019

12/10/2

Figure 6 | The EU's ETS carbon price history

Source: Bloomberg (10-12-2021).

12/10/2011

It is clear that the level of  $CO_2$  pricing, which is determined by a carbon tax or an ETS, is crucial for a decarbonization pathway. Indeed, the set price must be high enough to change companies' behavior. Firms can be expected to invest in reducing their emissions when these investments result in lower carbon tax costs. Therefore, the goal of net-zero emissions implies that the carbon price needs to be high enough to incentivize the reduction of most, if not all, emissions in the sector covered by carbon pricing.<sup>11</sup>

12/10/2015

Figure 7 shows how much the actual energy-related carbon emissions released by the built environment would cost annually. The chart considers different carbon tax levels, keeping constant the amount of emissions released per year (13.4 billion metric tons of  $CO_2$ ).

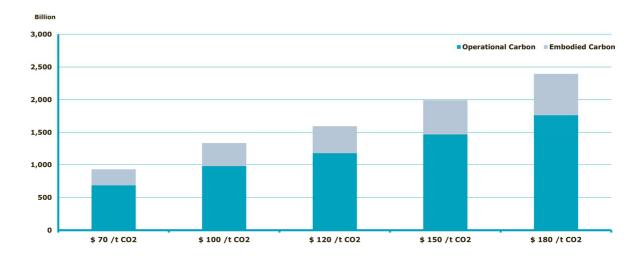


Figure 7 | Total annual costs with carbon taxes

12/10/2013

Source: IEA, Robeco

<sup>&</sup>lt;sup>11</sup> OIES report (2021):The Challenges and Prospects for Carbon Pricing in Europe, Alex Barnes.

In line with the IEA and its Sustainable Development Scenario, 12 the carbon price is expected to range between USD 63/t CO<sub>2</sub> and USD 140/t CO<sub>2</sub>, for developed economies, and between USD 43/t CO<sub>2</sub> and USD 125/t CO<sub>2</sub> for developing economies, over the 2025-2040 period. However, according to UBS<sup>13</sup>, full decarbonization could require higher carbon prices than generally assumed. These could range between USD 200/t CO<sub>2</sub> and USD 500/t CO<sub>2</sub>. For our simulations, we use a price between USD 70/t CO<sub>2</sub> and USD 180/t CO<sub>2</sub>.

Using these numbers as an internal price of carbon, companies will be better able to weigh climate-related risks and opportunities. Assuming that the real estate sector does not decarbonize in the future, the discounted value<sup>14</sup> of their cumulative costs will range between USD 19 and USD 48 trillion, using a constant carbon price of USD 70 and USD 180 per metric ton of CO<sub>2</sub> respectively. Considering the total value of real estate globally (around USD 250 trillion<sup>15</sup>), the cumulative costs will represent between 7% and 19% of the global real estate market value.

### Box 2: What about carbon credits?

Currently, firms are able to offset their emissions by purchasing carbon credits from emission reduction projects. Their CO<sub>2</sub> for such credits.

carbon neutral company using carbon credits are expected to increase in the future. Moreover, even though more and more organizations offset their emissions through this mechanism, its use draws criticism and skepticism. Its current low

<sup>12</sup> The Sustainable Development Scenario describes the broad evolution of the energy sector that would be required to reach the key energy-related goals of the United Nations, including the climate goal of the Paris Agreement (SDG 13), universal access to modern energy by 2030 (SDG 7), and a dramatic reduction in energy-related air pollution and the associated impacts on public health (SDG 3.9). See: IEA (2020), Clean Energy Innovation, IEA, Paris - https://www.iea.org/reports/clean-energy-innovation.

<sup>&</sup>lt;sup>13</sup> UBS Global Research (2021): Energy transition and the capital goods sector: A US\$75-90th tailwind for the sector?

<sup>&</sup>lt;sup>14</sup> A discount rate of 5% has been used in the calculation

<sup>&</sup>lt;sup>15</sup> Savills World Research (2021): The total value of global real estate.

<sup>16</sup> UCL—Trove Research report (2021): "Future Demand, Supply and Prices for Voluntary Carbon Credits — Keeping the balance".

## Pathway to net-zero emissions

The real estate sector has taken up the challenge to decarbonize, and progress has heen made.

> However, to remain Paris-aligned and achieve carbon neutrality, decarbonization efforts have to accelerate. In 2019, the amount of global energy-related emissions of CO<sub>2</sub> was 34 billion metric tons, according to the IEA. Of this total amount, the built environment emitted 13.4 billion metric tons of CO<sub>2</sub>. These numbers allow us to project the trajectory needed to achieve a 1.5° Celsius transition scenario, and to evaluate how close the sector is to its 2030 and 2050 targets.

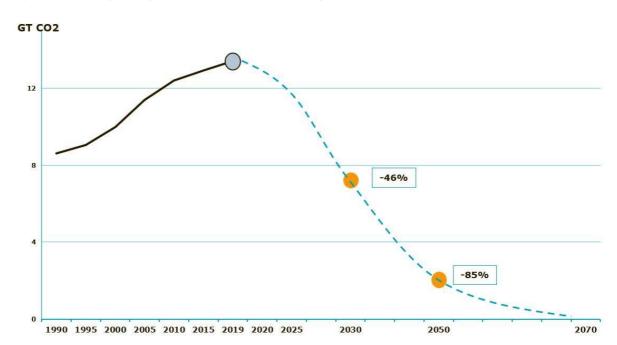


Figure 8 | Buildings' energy-related CO<sub>2</sub> emissions according to the 'Sustainable Development Scenario 2019 -2020'

Source: IEA (2020), Tracking Buildings 2020, IEA, Paris https://www.iea.org/reports/tracking-buildings-2020, Robeco.

The IEA estimates in their Sustainable Development Scenario that the built environment will see the fastest CO2 reduction, falling by an average of 6% per year to one-eighth of current levels by 2050. To achieve the results needed for the 1.5 ° Celsius scenario, the real estate sector has to decrease its emissions by 46% between 2020 and 2030, lowering the current quantity of energy-related emissions from 13.4 to 7 billion metric tons of CO<sub>2</sub>. Subsequently, the real estate sector will have to reduce its emissions by 85% by 2050 compared to 2019 levels.

The progress made so far to decarbonize the industry is still a long way from the goal of limiting global warming to well below 1.5° Celsius. While the industry has already made progress in improving energy efficiency and carbon intensity. the growth in global floor area outpaced these improvements. Indeed, looking at the last two decades, the industry's emissions actually rose from 8.6 billion metric tons of CO<sub>2</sub>, to around 13.4 billion metric tons of CO<sub>2</sub> in 2019.

To conclude, a 6% reduction per year will be necessary. This would mean that the sector's carbon intensity would have to decrease even more, due to the expected growth in built floor area.

The next section expands on how the real estate sector could reduce its carbon footprint, by looking at the various aspects related to the life cycle assessment of buildings.

## Life cycle assessment of a building's CO<sub>2</sub> emissions

Before we describe what an optimal strategy to achieve net-zero entails, it is important to distinguish different phases in the life cycle of a building, because each phase needs a different decarbonization pathway.

All carbon emissions related to the construction and maintenance of a building are referred to as 'embodied carbon', while all carbon emissions during the operational lifetime of a building are called 'operational carbon'. Figure 9 represents the different characteristics of these two types of CO<sub>2</sub> emissions. Embodied carbon creation is concentrated in a few phases of the life cycle of a building, primarily its construction. The emissions generated in those few periods are, however, large. Operational CO<sub>2</sub> generation shows a different pattern, namely smaller annual amounts, but for many more years. This already suggests that a different approach will be needed to reduce both types of emissions.

 End of life Maintenance Operational carbon Onsite activities Gate to site Cradle to gate 

Figure 9 | Carbon emissions over the lifespan of a typical office building

Source: UK GBC, Embodied Carbon Task Force, Guy Battle (Chair) 2014.

As Figure 9 and Figure 10 show, operational CO<sub>2</sub> emissions typically remain the main contributor to total emissions on an annual basis, accounting for 28% of the total global energy-related emissions. Meanwhile, embodied carbon is represented in Figure 10 by the colored segment for the building construction industry. It is estimated to contribute 11% of annual global energy-related CO<sub>2</sub> emissions.

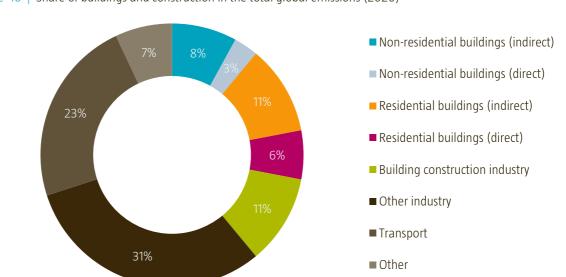


Figure 10 | Share of buildings and construction in the total global emissions (2020)

Source: Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector.

### Box 3: What is the main difference between operational and embodied carbon emissions?

propane, and wood.

Regarding embodied carbon emissions, these represent the quantity of Co<sub>2</sub> emitted during the construction of buildings. As Figure 11 shows, they include raw materials extraction, manufacturing of products, transportation, construction activities,

Figure 11 | Building life cycle stages and associated types of carbon emissions Operate / Manufacture Use & Maintain Decommission Embodied Embodied **Embodied Embodied Embodied Embodied Embodied** Embodied Embodied 000 Tim Haul away Extract Manufacture Construct **USE** and Demolish Landfill Transport Transport to factory raw products to site mantain the waste (or recycle) the building building materials materials the bulding

Source: FII (2017), Net Zero Carbon Construction (2019).

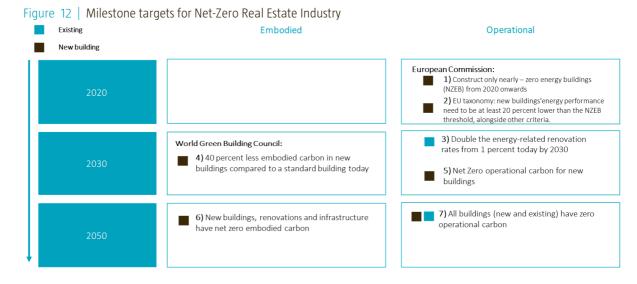
### How to address these emissions

Since the timelines to remove these emissions are different, decarbonization targets should differentiate between embodied and operational carbon emissions, for both new and existing buildings. For instance, retrofitting all the existing buildings is likely to take more time than to build new properties that already are net-zero emissions (NZE) compliant, <sup>17</sup> resulting in different decarbonization timelines. Moreover, the decarbonization of the embodied carbon requires a different approach compared to the operational carbon. To make these changes as effective as possible, a good strategy should follow the following steps:

- 1. Decrease energy use in buildings through renovation and better-performing designs.
- 2. Optimize and introduce renewable sources of energy.
- 3. Minimize embodied carbon emissions using different materials, components, and processes to construct new buildings.

Figure 12 summarizes all these points, creating a combination of targets and objectives set by the EU and the World Green Building Council, that real estate companies should strive to achieve.

<sup>17 &</sup>quot;Net Zero Emissions" refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere. In particular, all man-made greenhouse gas emissions must be removed from the atmosphere through reduction measures, thus reducing the Earth's net climate balance to zero. See: IPCC Special report (2018) - Climate Council (2020): What does net zero emissions mean?



Source: ShareAction report (2021): Decarbonising Real Estate, Robeco.

1. Reduce operational emissions deriving from energy use. More than 70% of the annual carbon footprint of buildings is derived from operational carbon emissions. This amount comes mainly from the use of energy for heating & cooling or for lighting, as Figure 13 shows. Solutions to reduce these emissions are already available. Various alternatives can replace old and outdated systems, improve energy efficiency, and reduce building costs and emissions. Moreover, within the real estate sector, each subsector and geographic region needs its own action plan to reduce emissions, in line with their specific energy use characteristics.

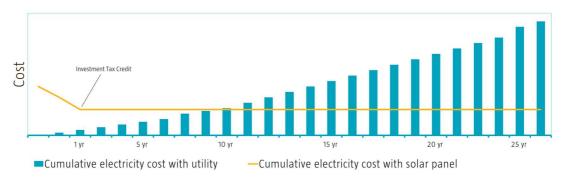
Mixed-use (office - hotel) Office Heating Heating Cooling Cooling Lighting Lighting ■ Hot water ■ Hot water ■ Small power ■Small power ■Fans and pumps ■ Fans and pumps Large distribution warehouse Supermarket Heating Heating Cooling Cooling Lighting Lighting ■ Hot water ■ Hot water ■Small power ■ Small power ■ Fans and pumps ■ Fans and pumps

Figure 13 | Operational carbon – Energy use segmentation for select types of buildings

Source: SteelConstruction.info.

2. Invest in renewable energy. Today, switching to renewable energy can be one way to achieve net-zero operational emissions. Fittings, such as solar panels, can contribute toward decarbonization and lower energy costs. The cost savings they can generate are one of the main reasons why landlords invest in these technologies. For example, Figure 14 shows the cumulative costs a typical building faces with and without solar panels. Furthermore, schemes such as REGO<sup>18</sup> should be expanded to encourage landlords to adopt renewable energy.

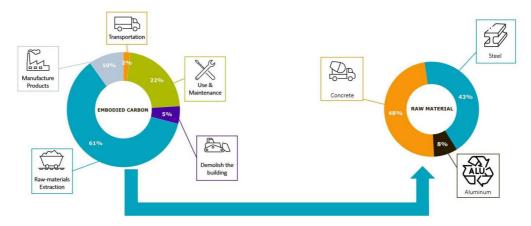
Figure 14 | Cumulative electricity costs with/without solar panels



Source: Energysage, Robeco.

3. Reduce construction impact (embodied carbon). The initial design has a decisive influence on the total quantity of carbon emissions that the building will release during its lifetime. During the design phase, the company will make choices on different factors determining the building's carbon impact, such as the type of building materials used (since cement and steel are responsible for 91%19 of the total emissions deriving from the raw material stage), the insulation features, the quality of components, and the energy systems installed (see Figure 15). Subsequently, the construction phase will cause further emissions from installation processes and transportation. The company should be committed to lowering its embodied carbon emissions through construction methods consistent with the 2030 and 2050 targets. There are various monitoring tools available (e.g., EC3,<sup>20</sup> eToolLCD<sup>21</sup> & One Clic LCA<sup>22</sup>) that allow for a calculation of the emissions released during construction activities.

Figure 15 | Embodied carbon emissions – segmentation by stages



Source: International Energy Agency and the United Nations Environment Programme (2018): 2018 Global Status Report: t owards a zero-emission, efficient and resilient buildings and construction sector, Architecture 2030, Robeco.

<sup>18</sup> A renewable energy guarantees of origin (REGO) scheme provides transparency to consumers about the proportion of electricity that suppliers source from renewable generation. All EU member states are required to have such a scheme.

<sup>&</sup>lt;sup>19</sup>International Energy Agency and the United Nations Environment Programme (2018): 2018 Global Status Report: towards a zeroemission, efficient and resilient buildings and construction sector. Architecture 2030 – BuildingGreen – Robeco

<sup>&</sup>lt;sup>20</sup> The EC3 tool takes data from Environmental Product Declaration (EPDs) to align, assess, and present the embodied carbon impacts. It has been conceived by Skanska and Microsoft, and nowadays have more than 50 partners which collaborate for updating the tool with information about the embodied carbon impact of buildings.

<sup>&</sup>lt;sup>21</sup> Web-based life cycle assessment tool developed by engineers and best suited for international schemes, including BREEAM and Green Star.

<sup>&</sup>lt;sup>22</sup> Service with options for multiple design stages, incl. broader design guidance more specific EPD-based calculations of the final building design.

### **Box 4: Land Securities Group Case**

16 shows the steps defined by the company in their decarbonization approach, which is very much in line with the approach



- Reduce operational carbon emissions. The current target of Land Securities Group is to reduce their absolute carbon emissions by 70% by 2030, from a 2013/2014 baseline. This target includes scope 1 and 2 carbon emissions, and the portion of operational emissions accounted for by the tenants' use. One of their key approaches to reduce carbon is to
- projects through power purchase agreements (PPAs). Moreover, it aims to increase the amount of renewable electricity
- 4. Reduce construction impacts. Across their development pipeline, Land Securities Group is continuing to reduce with their construction activity is crucial. However, they still have shortcomings in disclosing these emissions.
- Offset remaining carbon. To be truly net-zero carbon in construction, they will need to offset emissions once they have minimized all those on site. Land Securities Group aims to do this by funding projects that remove carbon from the atmosphere through the procurement of carbon credits.

## Embodied or operational: what is the priority?

Over the last few years, the focus on embodied carbon has grown significantly. Meanwhile, operational carbon emissions are still by far the largest component of annual CO<sub>2</sub> emissions and are not decreasing at a sufficient rate to reach net-zero targets. But which of the two types of carbon emissions should have priority?

According to Architecture 2030, numerous life cycle assessments have concluded that an average existing building still shows a carbon profile – over a typical 60-year life cycle – in which the cumulative emissions from operating activities are significantly higher than those from construction. This is shown in Figure 17.

CO Cumulative Carbon **Emissions Operating Carbon Embodied Carbon** Year 1: Construction Time Year 60+: Demolition

Figure 17 | Whole-life carbon for a typical building

Source: Architecture 2030, Robeco.

However, with current technologies rapidly improving energy efficiency and reducing operational carbon emissions in buildings, the situation may change soon. Indeed, as Figure 18 shows, high-performance buildings or NZEs have a very different whole-life carbon footprint from the typical existing building. Here, the embodied carbon would account for around 50% of total emissions.

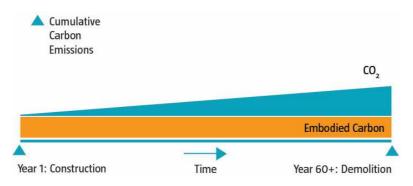


Figure 18 | Whole-life carbon for a high-performance or NZE building

Source: Architecture 2030, Robeco.

To conclude, operational carbon emissions remain the priority for the real estate sector for now, both because they represent a large share of total emissions and because they are relatively easier to tackle. The industry remains at a much earlier stage when it comes to addressing embodied carbon. While tools are available to better quantify the embodied carbon, they still need be developed further. Progress is being made and the World Green Building Council is targeting a 40% reduction in embodied carbon for newly constructed buildings in 2030, but it will still require a lot of effort for the industry to become net-zero.

## Decarbonization implications for the listed real estate sector

Decarbonizing the real estate industry could potentially cost a staggering 19% of the value of global real estate.

> For this research, 200 of the largest listed real estate companies, accounting for 84% of the market value of the S&P Global Developed Property Index, have been analyzed. We used information from their CSR/Sustainability reports, regarding historic environmental performance and reported targets.

> The 200 companies analyzed in general have good and improving disclosure on operational carbon (scope 1 and 2),23 which are the emissions considered in this chapter. However, it needs to be highlighted that reported scope 1 & 2 emissions do not always account for all operational carbon. For example, emissions generated by tenants when they use buildings tend to be allocated in different ways, and sometimes not considered at all.<sup>24</sup>

The table below summarizes how many companies report on and set targets for scope 1 & 2 emissions, as well as scope 3 emissions, and what percentage of the total market capitalization they represent. Also, it shows the total amount of emissions reported. Finally, based on published targets, the table shows the estimated targeted level of emissions in 2030.

Table 1 | Disclosure of environmental performance and targets of the 200 analyzed companies

	Scope 1 & 2 reporting	Scope 1 & 2 targets	Scope 3 reporting
# Companies	156	139	72
% Market Cap	70%	63%	35%
Million metric tons of CO <sub>2</sub> emissions	20.104	17.473	40.007

Source: Company reports, Robeco.

Based on these companies' environmental performance, and their respective goals for reducing GHG emissions, we project the decarbonization pathway of the benchmark for the coming years. The method employed to aggregate the emissions from the companies uses the benchmark weights of the 200 names to calculate a weighted carbon intensity, or EVIC intensity, as illustrated by the formula below:

$$\sum_{i}^{n} \left( \text{Investment Weight }_{i} * \frac{\text{Emissions Scope 1 and Scope 2 }_{i}}{\text{EVIC market }_{i}} \right)$$

i = companies in the S&P Developed Property Index

Investment weight = individual stock weight in the S&P Developed Property Index

EVIC = enterprise value including cash

Scope 1 & 2 emissions = carbon emissions in metric tons, as reported by each individual company.

<sup>&</sup>lt;sup>23</sup> Scope 3 emissions, including embodied carbon, is only starting to be addressed, both in terms of reported environmental performance as well as targets. Therefore, these emissions will not be considered in our research, even though they represent an important part of total footprint. <sup>24</sup> The emissions from tenants are frequently accounted under scope 3. For example, Land Securities Group shows in its sustainability report that these emissions account for around 40% of the total emissions released by the company, which represents three times the total amount of scope 18 2 emissions (See: Land Securities Group report (2020): Sustainability Performance and data report 2020).

The weighted carbon intensity of the companies representing the remaining 16% of the benchmark was assumed to be in line with the rest of the sample. 25 The resulting projected pathway is shown in Figure 19.

Σ Weighted Carbon EVIC Intensity (Log) 8 6.48 43% decrease by 2030 5.79 5.17 4 4.3 2 2020 2021 2022 2023 2024 2025 2026 2030 2027 2028 2029

Figure 19 | Projected decarbonization pathway for the S&P Developed Property Index

Source: Robeco.

The listed real estate sector is expected to decrease its emissions by 43% by 2030, if all companies meet the targets set in their sustainability reports. Yet this estimate may turn out to be overly optimistic. Indeed, our calculations assume that the companies we did not analyze decarbonize in line with the rest of the sample. This group includes smaller companies in the listed real estate sector, which are typically those with less ambitious decarbonization goals. Conversely, the projected pathway could also turn out to be excessively cautious, as many companies have not yet disclosed decarbonization targets in their sustainability reports. In fact, only 139 out of 200 analyzed companies have set targets (see Table 1). Regulatory and investor pressure to do so is building up quickly, and we expect many of these companies to start disclosing targets soon.

Altogether, assuming a comparable starting point, the targeted decarbonization is broadly in line with the IEA's 'Sustainable Development Scenario' (see Figure 8), although an acceleration will probably be needed after 2030.

## How much is at stake for the listed real estate sector?

The quantity of operational (scope 1 & 2) emissions reported by these companies was around 20 million metric tons of CO<sub>2</sub>. Using various price levels of carbon emissions, it is possible to derive the discounted cumulative carbon tax that the listed real estate sector might face each year.<sup>26</sup>

<sup>&</sup>lt;sup>25</sup> As a result, the average intensity of the 84% was used, even though the companies within this 16% are worse in terms of target setting.

<sup>&</sup>lt;sup>26</sup> As for Figure 7, a discount rate of 5% has been used to calculate the discounted cumulative carbon tax.

Billion 100 90 70 60 40 30 10

120 /t CO2

Figure 20 | Total cumulative carbon tax for the listed real estate sector

Source: Robeco.

70 /t CO2

Assuming that the listed real estate sector does not decarbonize in the future, the discounted value of the cumulative costs would range between USD 34 and USD 87 billion, using a carbon price range of USD 70 - USD 180 /t CO2. Considering the total market capitalization of the companies in this sample (around USD 2.2 trillion), the discounted cumulative carbon tax will range from 1.5% to 4% of their total market capitalization. These percentages are relatively lower than those obtained for the entire building industry (7% and 19%), although they are still significant, as in the latter all scope 1,2 and 3 emissions are taken into account.

150 /t CO2

180 /t CO2

Assuming a scenario in which the carbon price starts at USD 70 /t CO<sub>2</sub> and will reach USD 180 /tCO<sub>2</sub> by 2030, Figure 21 shows the comparison of the cumulative costs in terms of carbon taxes with and without incorporating the companies' decarbonization targets.

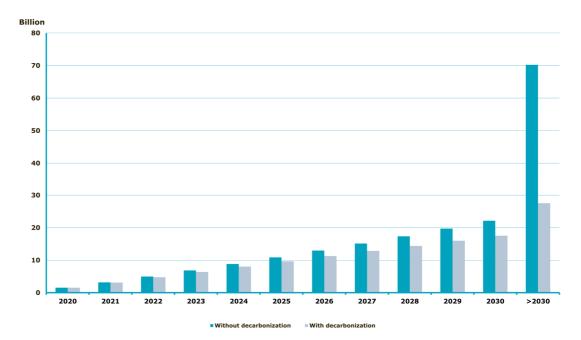


Figure 21 | Cumulative carbon tax with & without decarbonization

100 /t CO2

Source: Robeco.

The cumulative carbon tax without decarbonization is expected to reach over USD 70 billion by 2030, as Figure 21 depicts. However, if the companies achieve the decarbonization targets they have set, the potential financial impact deriving from the carbon tax will be reduced from USD 70 to USD 27 billion, accounting for 3% and 1% of their total market capitalization respectively.

To conclude, the companies in the listed real estate sector face a threat from an expected increase of carbon taxes. Failure to decarbonize could potentially have a very high financial impact, in terms of carbon taxes, relative to their market capitalization. However, these costs are not equally distributed across the sample. Some segments of the sector, regions and sub-industries will face greater risks, due to their higher volumes of emissions and overall, less ambitious decarbonization targets.

The next paragraphs delve into how the different segments of the listed real estate sector are positioned with regards to the net-zero transition.

## How are different segments of the listed real estate sector positioned for the net-zero transition?

There are large discrepancies between companies when it comes to the potential impact of carbon. Dividing the sample into five quintiles ranked by EVIC carbon intensity and calculating the carbon tax impact as a percentage of the market capitalization for each quintile shows that the first 20% of the companies, the ones with the highest EVIC carbon intensity, will obviously be most exposed to a carbon tax. Meanwhile, the bottom 20% will be less exposed, as Figure 22 shows. While the direction is obvious, the difference between the top and bottom quintiles is large.

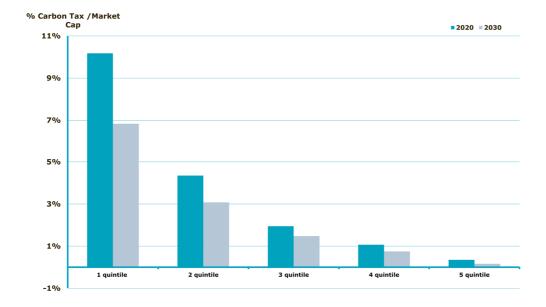


Figure 22 | Top-bottom 20% of companies in terms of EVIC carbon intensity - cumulative carbon tax impact

Source: Robeco.

The financial impact of a carbon tax could reach 10% of the market capitalization for companies with the highest carbon intensities, decreasing to less than 1% for those with the lowest intensities. This means significant risks for those investing in the first quintile, and considerably less risks for investments made in the fifth quintile.

Looking at the 2030 targets for these intensity-ranked quintiles, high EVIC carbon intensity companies do not have particularly ambitious decarbonization targets either, at least for now. In fact, the most ambitious targets are presented by the companies within the fifth quintile, that is those with the lowest EVIC carbon intensity. The companies in this quintile, based on current emissions, already present the lowest financial impact in 2020. Their targets imply a further decrease of the carbon tax impact by more than 50%.

Further conclusions can also be drawn by ranking all companies in quintiles by market capitalization (from the top 20% with the highest market capitalization to the bottom 20%). As Figure 23 shows, the expected impact of a carbon tax is different for each quintile with no clear trend. More specifically, the highest impact is seen in the fourth quintile which, despite presenting relatively ambitious decarbonization targets for 2030, still fails to reach the levels of the other quintiles.

On the other hand, the bottom quintile doesn't present any or at least no ambitious targets by 2030, showing the same percentage impact from a potential carbon tax both in 2020 and 2030. The companies in this fifth quintile, the smallest among the 200 analyzed, are not prepared for increasingly stringent regulations and are therefore most at risk.

% Carbon Tax /Market 2020 = 2030 9% 7% 3% 1% 1 quintile 2 quintile 3 quintile 4 quintile 5 quintile

Figure 23 | Top-bottom 20% of companies in terms of market cap – cumulative carbon tax impact

Source: Robeco

While the smallest companies among the 200 analyzed are most at risk from a carbon tax perspective, from a sector view the impact is small, as these companies only account for 5% of the sector's total emissions in 2020. From an absolute footprint perspective, the 20% largest companies account for 51% of the sector's total emissions. The potential financial impact for the largest companies is smaller due to their larger market capitalization, but to achieve the net-zero goal for the sector, investors still need to monitor their progress.

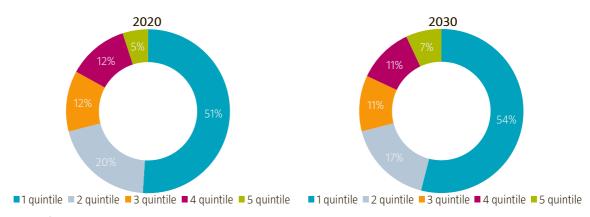


Figure 24 | Top – Bottom 20% of companies in terms of market capitalization - total carbon emissions

Source: Robeco

As seen so far, cumulative carbon tax impacts are not homogeneously spread across the whole sector. This is also the case from the perspective of regions and sub-industries.

## How are the different subindustries of the listed real estate sector positioned for the net-zero transition?

The net-zero challenge has been taken up by many real estate companies through important and ambitious targets set for the coming years. However, not all sub-industries are addressing this challenge with the same intensity. Some of the sub-industries are more at risk than others in the transition towards net-zero.

Figure 25 shows the financial impact that each sub-industry will face in relation to their own market capitalization. The hotel & resort REITs sector appears to be most at risk, showing the highest expected impact, and also the lowest decarbonization rate by 2030. Diversified real estate activity also appears to run a higher risk. However, unlike hotel & resort REITs, this sub-industry aims to decrease its emissions by over 40% by 2030, which should limit the risks for investors.

At the other end of the spectrum, retail REITs and residential REITs are the sectors least at risk, while the targets presented by retail companies are more ambitious than residential ones.

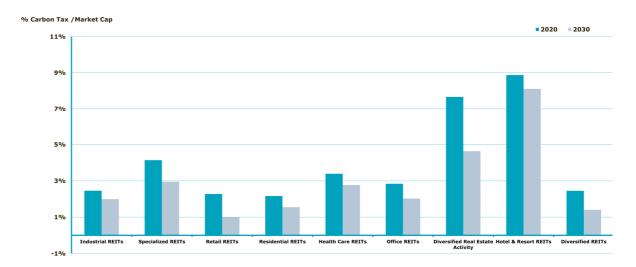
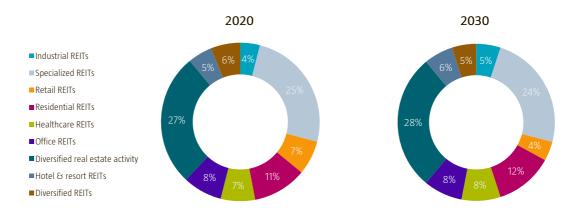


Figure 25 | Impact of cumulative carbon tax — sub-industries

Source: Robeco.

From the perspective of the sector's absolute amount of carbon emissions, the hotel & resort REITs sub-industry is less relevant. As Figure 26 shows, the share of emissions deriving from hotel & resort REITs is just 5% and 6% in 2020 and 2030 respectively. On the other hand, diversified real estate activity and specialized REITs are the sub-industries which release the most emissions, accounting for 27% and 25% respectively in 2020. Considering the large quantity of emissions of these sub-industries, and the risk that their decarbonization targets may not be achieved, their carbon footprints still present risks, and progress will have to be monitored.

Figure 26 | Total absolute carbon emissions – sub-industries

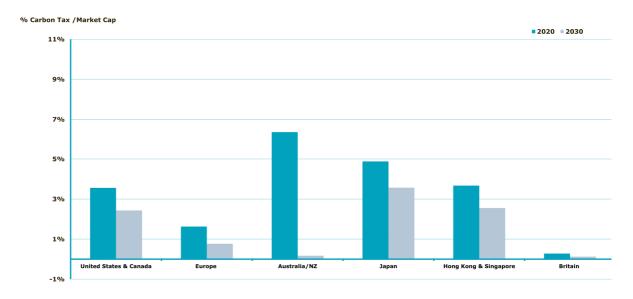


Source: Robeco.

## How are the different regions of the listed real estate sector positioned for the net-zero transition?

The results obtained so far have shown large discrepancies among segments and sub-industries. Figure 27 shows the financial impact that each region faces in relation to its market capitalization.

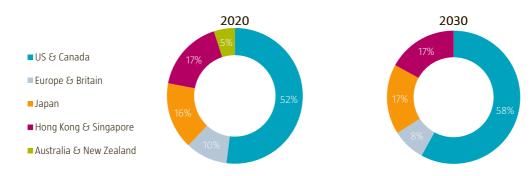
Figure 27 | Impact of cumulative carbon tax - regions



Source: Robeco.

Figure 28 shows the share of total emissions deriving from the six different regions considered in the sample in 2020 and 2030.

Figure 28 | Total absolute carbon emissions – regions



Source: Robeco.

With some regions, such as Australia and New Zealand, represented by very few companies, conclusions from a regional perspective are limited. However, some observations can be made.

Both Europe ex-UK and the UK appear to be ahead of other regions in both their current carbon intensities as well as their target setting. Australia and New Zealand is only represented by 9 companies. These companies still have high carbon intensities, but are advanced in detailed target setting. Japan faces relatively high financial impact from current carbon emissions, and also lags in target setting. However, we believe Japanese companies are quickly catching up regarding best practices, and we expect them to improve materially in the coming years.

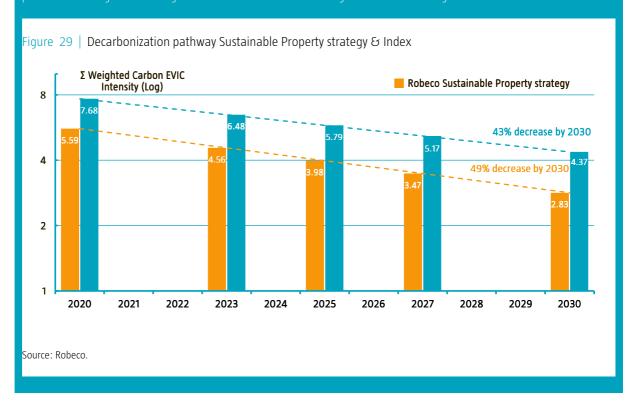
The US and Canada is the region with the largest absolute footprint, and has lagged so far in target setting. Its contribution to the total carbon footprint of the sector potentially is expected to increase from 52% in 2020 to 58% in 2030.

This chapter has highlighted important differences regarding the financial impact of decarbonization strategies within the listed real estate sector. The listed real estate sector needs to decarbonize and must intensify its efforts to achieve the targets set in the Paris Accord on climate change. Moreover, we have shown that failure to decarbonize may lead to significant financial impact from carbon taxes. These risks are not equally distributed amongst companies. Investors in the listed real estate sector should already incorporate decarbonization strategies and risks into their valuation framework, and engage with companies to monitor their progress.

## Box 5: Decarbonization pathway, Robeco Sustainable Property strategy and S&P Global Developed Property Index

To mitigate the risks from climate change, one of the objectives of the Robeco Sustainable Property investment strategy is monitored. On an aggregate level, the decarbonization pathways are also compared to the broader sector. This

Figure 29 shows the outcome of this analysis, comparing the estimated energy intensity levels of the portfolio's holdings to the average levels of 200 of the largest companies in the S&P Global Developed Property Index. The gap between carbon



## Conclusion

The UN Climate Change Conference (COP26) has highlighted once more the need to drastically reduce GHG emissions.

> In order to maintain the global temperature increase well below 2.0° Celsius, emissions have to be reduced by 55% by 2030. As many industries pledge to do their part in the climate transition, the built environment will need to make significant efforts to reach the targets set by the Paris Agreement. The GHG reduction efforts undertaken so far are not enough. The real estate sector remains one of the largest contributors to global GHG emissions.

> Decarbonization targets and strategies to reduce buildings' related emissions have become a key priority for many real estate companies. Besides increasing social responsibility awareness, this is also driven by increasingly stricter regulations and imposed carbon taxes, that are expected to increase materially in the coming years. Nevertheless, the slow decarbonization progress and the risks stemming from not meeting net-zero targets leads to the question of what the financial consequences could be for the real estate sector, and in what ways the sector could reduce its carbon emissions.

> According to the IEA, the built environment accounts for 38% (13.4 billion metric tons of CO<sub>2</sub>) of total energy-related emissions. In order to reach the set targets and become Paris-aligned, the real estate sector should decrease emissions with a decarbonization rate of 6% annually (85% by 2050). This challenge requires large investments in retrofitting programs; potentially more than USD 20 trillion. This represents the only alternative to incurring even higher costs in the form of potential carbon taxes, or the risk of stranded assets. By not reaching the required decarbonization targets, the real estate sector faces a potentially significant financial impact, ranging between 7% and 19% of the value of all real estate assets globally, or almost USD 50 trillion.

> Ever since humans began to build with concrete and steel, the embodied carbon emissions from construction activities have started to be a significant contributor to the total emissions of the built environment. However, operational carbon emissions still represent the main source of emissions during the typical lifespan of a building. Technologies to retrofit buildings to reduce the carbon footprint are already available in the market. Renewable energy and efficient designs can offset the operational carbon of a building. While progress is being made to quantify and reduce embodied carbon, operational carbon emissions remain a priority for the real estate sector, for now.

Based on publicly available disclosures from 200 companies of the listed real estate sector and their decarbonization strategies, this research paper shows that the sector is expected to cut its carbon emissions intensity by 43% by 2030. Although this reduction falls below the required levels under COP21, this pathway would considerably reduce the financial impact from potential carbon taxes. At the current levels of carbon emissions, the cost of tax on operational carbon alone could easily be equal to 4% of the market capitalization of the listed real estate sector.

Furthermore, the research has highlighted that these potential costs are not equally distributed across the sector, and range from insignificant, for some segments, to more than 10% of market capitalization for the worst performing segments. This leads to the conclusion that some segments are clearly more at risk than others. Therefore, investors in the listed real estate sector should already incorporate decarbonization strategies into their valuation framework and investment decisions.

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Additional information for investors with residence of seat in malaysia Generally, no offer or sale of the Shares is permitted in Malaysia unless where a Recognition Exemption or the Prospectus Exemption applies: NO ACTION HAS BEEN, OR WILL BE, TAKEN TO COMPLY WITH MALAYSIAN LAWS FOR MAKING AVAILABLE, OFFERING FOR SUBSCRIPTION OR PURCHASE, OR ISSUING ANY INVITATION TO SUBSCRIBE FOR OR PURCHASE OR SALE OF THE SHARES IN MALAYSIA OR TO PERSONS IN MALAYSIA AS THE SHARES ARE NOT INTENDED BY THE ISSUER TO BE MADE AVAILABLE, OR MADE THE SUBJECT OF ANY OFFER OR INVITATION TO SUBSCRIBE OR PURCHASE, IN MALAYSIA. NEITHER THIS DOCUMENT NOR ANY DOCUMENT OR OTHER MATERIAL IN CONNECTION WITH THE SHARES SHOULD BE DISTRIBUTED, CAUSED TO BE DISTRIBUTED OR CIRCULATED IN MALAYSIA. NO PERSON SHOULD MAKE AVAILABLE OR MAKE ANY INVITATION OR OFFER OR INVITATION TO SELL OR PURCHASE THE SHARES IN MALAYSIA UNLESS SUCH PERSON TAKES THE NECESSARY ACTION TO COMPLY WITH MALAYSIAN LAWS.

Additional Information for investors with residence or seat in Mexico
The funds have not been and will not be registered with the National Registry of Securities, maintained by the Mexican National Banking and Securities Commission and, as a result, may not be offered or sold publicly in Mexico. Robeco and any underwriter or purchaser may offer and sell the funds in Mexico on a private placement basis to Institutional and Accredited Investors, pursuant to Article 8 of the Mexican Securities Market Law.

and any underwriter or purchaser may offer and sell the funds in Mexico on a private placement basis to Institutional and Accredited Investors, pursuant to Article 8 of the Mexican Securities Market Law.

Additional Information for investors with residence or seat in Peru
The Fund has not been registered with the Superintendencia del Mercado de Valores (SMV) and is being placed by means of a private offer. SMV has not reviewed the information provided to the investor. This document is only for the exclusive use of institutional investors in Peru and is not for public distribution.

Additional Information for investors with residence or seat in Shanghai
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liabilities imposed to the shareholders or affiliates of Robeco Shanghai. Additional Information for investors with residence or seat in Singapore ("MAS"). Accordingly, this document may not be circulated or distributed directly or indirectly to persons in Singapore other than (i) to an institutional investor under Section 304 of the SFA, (ii) to a relevant person pursuant to Section 305(1), or any person pursuant to Section 305(2), and in accordance with the conditions specified in Section 305, of the SFA, or (iii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA. The contents of this document have not been reviewed by the MAS. Any decision to participate in the Fund should be made only after reviewing the sections regarding investment considerations, conflicts of interest, risk factors and the relevant Singapore selling restrictions (as described in the section entitled "Important Information for Singapore Investors") contained in the prospectus. Investors should consult your professional adviser if you are in doubt about the stringent restrictions applicable to the use of this document, regulatory status of the Fund, applicable regulatory protection, associated risks and suitability of the Fund to your objectives. Investors should note that only the Sub-Funds listed in the appendix to the section entitled "Important Information for Singapore Investors" of the prospectus ("Sub-Funds") are available to Singapore investors. The Sub-Funds are notified as restricted foreign schemes under the Securities and Futures Act, Chapter 289 of Singapore ("SFA") and invoke the exemptions grow compliance with prospectus registration requirements pursuant to the exemptions under Section 304 and Section 305 of the SFA. The Sub-Funds are not authorized or recognized by the MAS and shares in the Sub-Funds are not allowed to be offered to the retail public in Singapore. The prospectus of the Fund is not a prospectus as defined in the SFA. Accordingly, statutory liability u

Robeco Institutional Asset Management B.V., Sucursal en España with identification number W0032687F and having its registered office in Madrid at Calle Serrano 47-14%, is registered with the Spanish Commercial Registry in Madrid, in volume 19.957, page 190, section 8, sheet M-351927 and with the National Securities Market Commission (CNMV) in the Official Register of branches of European investment services companies, under number 24. The investment funds or SICAV mentioned in this document are regulated by the corresponding authorities of their country of origin and are registered in the Special Registry of the CNMV of Foreign Collective Investment Institutions marketed in Spain. Additional Information for investors with residence or seat in South Africa

Robeco Institutional Asset Management B.V. is registered and regulated by the Financial Sector Conduct Authority in South Africa.

Additional Information for investors with residence or seat in Switzerland

The Fund(s) are domiciled in Luxembourg. This document is exclusively distributed by Robeco Switzerland to qualified investors as defined in the Swiss Collective Investment Schemes Act (CISA). This material is distributed by Robeco Switzerland tild, postal address: Josefstrasse 218, 8005 Zurich. ACOLIN Fund Services AG, postal address: Affolternstrasse 56, 8050 Zurich, acts as the Swiss representative of the Fund(s). URS Switzerland AG, Bahnhofstrasse 45, 8001 Zurich, postal address: Europastrasse 2, P.O. Box, CH-8152 Opfikon, acts as the Swiss paying agent. The prospectus, the Key Investor Information Documents (KIIDs), the articles of association, the annual and semi-annual reports of the Fund(s), as well as the list of the purchases and sales which the Fund(s) has undertaken during the financial year, may be obtained, on simple request and free of charge, at the office of the Swiss representative ACOLIN Fund Services AG. The

went as the list of the purchases and sales which the reliably has undertaken during the financial year, may be obtained, on simple request and nee of charge, at the onice of the swiss representative Account rulid services Ac. The prospectuses are also available via the website.

Additional Information relating to RobecoSAM-branded funds/services
Robeco Switzerland ttd, postal address Josefstrasse 218, 8005 Zurich, Switzerland has a license as asset manager of collective assets from the Swiss Financial Market Supervisory Authority FINMA. RobecoSAM-branded financial instruments and investment strategies referring to such financial instruments are generally managed by Robeco Switzerland ttd. The RobecoSAM brand is a registered trademark of Robeco Holding B.V. The brand RobecoSAM is used to market services and products which entail Robeco's expertise on Sustainable Investing (SI). The brand RobecoSAM is not to be considered as a separate legal entity.

Additional Information for investors with residence or seat in Thailand

The Prospectus has not been approved by the Securities and Exchange Commission which takes no responsibility for its contents. No offer to the public to purchase the Shares will be made in Thailand and the Prospectus is intended to be read by the addressee only and must not be passed to, issued to, or shown to the public generally.

Additional Information for investors with residence or seat in the United Arab Emirates

Some Funds referred to in this marketing material have been registered with the UAE Securities and Commodities Authority (the Authority). Details of all Registered Funds can be found on the Authority's website. The Authority assumes no liability for the accuracy of the information set out in this material/document, nor for the failure of any persons engaged in the investment Fund in performing their duties and responsibilities.

Additional Information for investors with residence or seat in the United Kingdom Robeco is subject to limited regulation in the UK by the Financial Conduct Authority. Details about the extent of our regulation by the Financial Conduct Authority are available from us on request.

Additional Information for investors with residence or seat in Uruguay

The sale of the Fund qualifies as a private placement pursuant to section 2 of Uruguayan law 18,627. The Fund must not be offered or sold to the public in Uruguay, except under circumstances which do not constitute a public offering or distribution under Uruguayan laws and regulations. The Fund is not and will not be registered with the Financial Services Superintendency of the Central Bank of Uruguaya. The Fund corresponds to investment funds that are not investment funds regulated by Uruguayan law 16,774 dated September 27, 1996, as amended.

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