Implementing net zero in commercial real estate

Summary

» Real estate is both a critical asset in investment portfolios, as well as a key contributor to global carbon emissions, making it an important asset class in the transition to net zero.

» We leverage a building model from Helios Exchange to explore steps a building owner or lender can take to assess the energy performance of a specific building or portfolio. In turn, we explore the impacts of a range of retrofit options on building or portfolio level emissions and costs. The analysis explores three retrofit pathways and finds significant emissions reductions are possible.

» We find that the energy efficiency benefits mostly outweigh the credit risks associated with two of the assessed retrofit options and that the credit risk associated with the third and most energy efficient option, electrification, is the highest. The credit risk differs by property type and associated term structure, showing that the best retrofit pathway will depend on many factors.

» Leveraging a building model to explore the impacts of energy efficiency options informs forward-looking risk management both at the asset and portfolio level, allowing building owners to preemptively stay ahead of shifting consumer preferences and emissions regulations. Yet it also highlights the opportunities for lenders and investors to support the transition to net zero while creating value-add solutions, such as new products that help finance energy efficiency retrofits.
Table of Contents

Summary 1

Commercial real estate is critical in the transition to net zero economies 3

Assessing Pathways to Net Zero in Commercial Real Estate 4
   Step 1 – Identify transition pathways and associated retrofit options 4
   Step 2 – Run the model to assess retrofit options 5
   Step 3 – Assess the Credit Risk of Retrofit Options 6

Implications for real estate lenders and investors 8
Commercial real estate is critical in the transition to net zero economies

As the world wakes up to the climate crisis, 97% of countries have ratified the Paris Agreement,¹ and many are committing to drastically reduce carbon emissions over the next thirty years. As nations begin moving more rapidly to implement relevant regulations across sectors, real estate will be one sector in the spotlight. Buildings are ubiquitous, underpinning economic activity and by some estimates the building sector is responsible for nearly 40% of all emissions as of 2020.² Commercial real estate (CRE) is also a key asset class for many institutional investors and is important in lending portfolios, with the total assets under management of 140 assessed real estate investment managers having grown by nearly 16% to reach around $3.8 trillion in June 2020.³

There are many ways in which transition risk can affect real estate, including the impact of policies such as carbon prices, shifting consumer preference for energy efficient and green buildings, and longer-term changes brought from shifts in our urban areas away from a car-centric design. One of the most imminent impacts of transition risks comes from emissions reductions regulation which can interact with these other risk drivers. For example, the EU is moving aggressively to implement regulations that require carbon emissions reductions in the building sector, with targets of 40% energy savings by 2030, 50% by 2040, and 60% by 2050. To meet that EU’s Paris Agreement commitment, the EU-27 can emit a maximum of 24 GtCO2e from 2019 until 2050 for a 2°C warming scenario. This ‘carbon budget’ would only last until 2039 at the current emissions rate. In a 1.5°C warming scenario, the EU’s carbon budget would be exhausted by 2036, or even sooner if the global budget continues to be surpassed.⁴ This demonstrates the need for the real estate sector to prepare for significant changes, as the EU and other jurisdictions strive to meet their Paris Agreement commitments.

Decarbonization Pathways for Real Estate

In light of increasing demand for a quantitative understanding of net zero pathways, researchers are projecting sector decarbonization pathways which estimate the level of decreased emissions that the sector must achieve over time to meet the targets of the Paris Agreement. For example, the International Energy Agency (IEA) calculates a pathway for residential and commercial buildings, expressed as carbon intensity (in kilograms of CO₂ per square meter), for two scenarios including the higher 2 Degree Scenario (2DS), and the lower Beyond 2 Degree Scenario (B2DS).⁵

The Carbon Risk Real Estate Monitor (CRREM) builds from the IEA pathways to model the decarbonization pathways that the building sector must follow in accordance with the EU carbon emissions commitments. In this context, “decarbonization pathways” means the annual carbon emissions intensity per square meter of building area for each year from the present to 2050. CRREM defines decarbonization targets and pathways, broken down by country and building use, which are consistent with the above low carbon pathways. These pathways and targets provide benchmarking roadmaps for individual properties, including the existing building stock.⁶ Using these pathways as guides, owners can estimate when their buildings will likely be above the benchmark, or have carbon intensity above the average building of their type, and may thus be at a disadvantage compared to more efficient building stock.

---

¹ The Paris Agreement is an international treaty adopted in 2015 with the goal to limit global temperature raise to below 2°C. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
⁵ While these scenarios were associated with warming outcomes of 2°C and 1.75°C degrees respectively on publication in 2017, increased carbon budgets in more recently published IPCC reports imply that the scenarios are actually consistent with temperature outcomes that are lower than these levels using the latest science.
Assessing pathways to net zero in commercial real estate

Real estate owners can expect pension funds and investment managers to start asking not only for analysis of portfolio carbon emissions but also plans to reduce emissions over time. In the case of real estate, lenders, investors and building owners need to analyze specific buildings and portfolios to determine what energy efficiency measures actually need to be implemented to meet the targets, identify retrofit strategies, and create robust underwriting and performance assessments to inform lending and investment decision-making.

In this paper, we analyze the steps that building owners can take to implement net zero in their portfolios, while addressing the transition risks associated with the policies discussed above. We leverage the Helios Exchange model, which is designed to analyze current building energy performance and assess building retrofit strategies to estimate cost savings, energy savings, carbon emissions reductions and other information. It creates a full digital twin of each building and runs scenarios for retrofitting using a library of over 40 energy efficiency measures. This informs quick identification of efficient retrofit options for individual properties and can also be applied across large portfolios to determine retrofit needs and costs at scale.

This analysis informs asset-level decision-making to guide net zero implementation and to improve reporting and transparency. In turn, it also highlights the credit risk implications, providing insights into the costs associated with this transition to net zero, to inform forward-looking risk management both at the asset and portfolio level. Lastly, the findings from building-level analysis of retrofit options shines light on the opportunities for lenders and investors to get ahead of transition risk and seize opportunities to create new products that help finance the transition to net zero.

Step 1 – Identify transition pathways and associated retrofit options

We assessed a portfolio of 89 sample properties which represent a wide range of property types and geographies as the charts below illustrate. Building age and size also vary widely across the sample dataset (see Figure 1).

Figure 1   Sample CRE portfolio composition

Source: Moody’s Analytics

To explore retrofit options, we looked at three levels of building renovation: Whole Building Retrofit (a significant energy upgrade), Deep Retrofit (includes additional efficiency measures) and Electrification (the most significant energy upgrade, focused on reducing use of fossil fuels). The platform allows users to define algorithms to create different energy retrofit scenarios with different goals, and to specify the particular energy efficiency measures to assess. Table 1 shows the parameters used to create the three scenarios in this study. These scenarios include retrofit measures ranging from heat recovery and daylight sensor systems to heat pumps and air leakage reduction, for electrification options.

---

7 Helios is a full-featured building energy model. See box 2 for more information, [https://helios-eex.com/](https://helios-eex.com/)
Table 1 Parameters for the selection of the three retrofit options

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>OPTION 1</th>
<th>OPTION 2</th>
<th>OPTION 3</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Whole Building Retrofit</td>
<td>Deep Retrofit</td>
<td>Electrification</td>
<td></td>
</tr>
<tr>
<td>Filter out Negative NPV Measures</td>
<td>true</td>
<td>true</td>
<td>false</td>
<td>By setting this parameter to “false” for the Electrification option, the model can select measures that have an actual cost, which is likely to be necessary to meet more stringent emissions targets</td>
</tr>
<tr>
<td>Measure Payback Limit (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Payback Limit (years)</td>
<td>6.0</td>
<td>15.0</td>
<td>200.0</td>
<td>The high number for Option 3 eliminates Payback as a parameter</td>
</tr>
<tr>
<td>Energy Reduction Target (%)</td>
<td>40.0</td>
<td>50.0</td>
<td></td>
<td>The targets for Option 1 and 2 are taken from the European Energy Performance of Buildings Directive currently in effect, which is focused on energy efficiency rather than carbon reduction</td>
</tr>
<tr>
<td>CO2 Reduction Target (%)</td>
<td></td>
<td></td>
<td>100.0</td>
<td>Option 3 focuses on carbon reduction rather than energy efficiency</td>
</tr>
<tr>
<td>Include Solar PV</td>
<td>false</td>
<td>false</td>
<td>false</td>
<td>Solar was not evaluated in this analysis</td>
</tr>
</tbody>
</table>

Source: Helios Exchange

Step 2 – Run the model to assess retrofit options

Running the three retrofit options through the model shows the estimated cost that an owner may incur to meet these different levels of carbon intensity, whether these are due to voluntary commitments or regulatory requirements, such as New York Local Law 97 which fines for non-compliance starting in 2024. Table 2 shows the estimated costs and carbon reductions of each of the three retrofit options at the portfolio level.

Table 2 Outcome of retrofit scenarios

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>ESTIMATED RETROFIT COST</th>
<th>CARBON EMISSIONS MtCO2e/yr</th>
<th>CARBON INTENSITY kgCO2e/sf</th>
<th>CARBON REDUCTION (%)</th>
<th>COST/PROP VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Portfolio Performance</td>
<td></td>
<td>109,300</td>
<td>9.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option 1: Whole Building Retrofit</td>
<td>$25,744,000</td>
<td>77,700</td>
<td>6.9</td>
<td>28.9%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Option 2: Deep Retrofit</td>
<td>$33,259,000</td>
<td>70,500</td>
<td>6.3</td>
<td>35.5%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Option 3: Electrification</td>
<td>$252,433,000</td>
<td>47,000</td>
<td>4.2</td>
<td>57.0%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>

Source: Helios Exchange

We mapped these results against the pathways for the 2DS and B2DS climate scenarios, based on the pathways developed by the CRREM discussed above. We find that the electrification option would reduce carbon emissions enough to meet the 2DS target in 2030, but would miss the lower B2DS target (Figure 2).

---

Step 3 – Assess the credit risk of retrofit options

After creating these scenarios and estimating their cost, we then investigated the possible effect from a lender’s perspective. To do so, we used Moody’s Analytics CMM™, which is an industry-leading credit risk solution for commercial mortgages.9 The CMM™ solution assesses the default risk and expected loss for CRE loan portfolios by combining property performance forecasts with commercial mortgage fundamentals. It enables wholesale lenders and investment professionals to perform robust analyses for equity and debt decisions in the CRE space.

The CMM™ model has a double-trigger framework with Debt Service Coverage Ratio (DSCR) and Loan-to-Value (LTV) ratio being the two major risk drivers. Both financial ratios would be affected by the various retrofit options assessed above. In particular, we assume the retrofit projects would be financed through an additional loan on top of the existing mortgage which would increase the outstanding loan balance and the debt service due in the remaining time to maturity. Meanwhile, we expect to see a boost in the property net operating income (NOI) and value after the completion of the retrofit project due to the resulting energy savings, as long as the in-place leases are not triple-net. Despite the increase in outstanding loan balance and associated retrofit cost, the analysis below demonstrates that the benefits of energy savings mostly balance out the increased credit risk. It is also important to note that the following analysis looks simply at the above variables, and doesn’t include the additional benefits of implementing energy efficiency retrofits, such as increased demand and associated premia for energy efficient buildings10 as well as the forward-looking preparation for tightening regulatory measures and the avoidance of associated fines.

Table 3 shows a few of the key outputs from the Helios assessment for a single property in this portfolio, namely First Stamford Place. It is a 33-floor office property located in Stamford, CT. The building was completed in 1986 and has a floor area of 810,471 square feet. Each of the retrofit options is expected to drastically reduce energy cost of the building which would lead to increases in property NOI and value, although the complete electrification option is much more costly than the whole building retrofit and deep retrofit options.

Table 3  Costs and benefits of retrofit options for a single property

<table>
<thead>
<tr>
<th>RETROFIT OPTION</th>
<th>PROJECT COST</th>
<th>ENERGY COST</th>
<th>PROPERTY NOI</th>
<th>PROPERTY VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>-</td>
<td>$2,974,744</td>
<td>$6,925,142</td>
<td>$104,347,826</td>
</tr>
<tr>
<td>Whole Building</td>
<td>$4,558,219</td>
<td>$2,861,154</td>
<td>$7,102,860</td>
<td>$107,025,676</td>
</tr>
<tr>
<td>Deep Retrofit</td>
<td>$5,055,125</td>
<td>$2,050,266</td>
<td>$7,110,038</td>
<td>$107,133,829</td>
</tr>
<tr>
<td>Electrification</td>
<td>$24,890,712</td>
<td>$1,762,686</td>
<td>$7,167,554</td>
<td>$108,000,478</td>
</tr>
</tbody>
</table>

Source: Moody’s Analytics and Helios Exchange

Based on these outputs, we then updated the outstanding loan balance, property NOI and value inputs which go into the calculation within the CMM™ model.

Figure 3 below illustrates the credit impact of the three retrofit options relative to Baseline under which no retrofit takes place. Importantly, the Baseline does not factor in impacts from shifting consumer demand and policies. We include three key credit metrics produced by CMM™, namely Expected Default Frequency (EDF), Loss Given Default (LGD), and Expected Loss (EL) over the remaining lifetime of all CRE loans in the portfolio.

The results suggest that the whole building retrofit and deep retrofit options will often be the most favorable retrofit options as the energy efficiency benefits mostly outweigh the costs, particularly when coupled with other factors such as avoidance of fines and increased premia discussed above. The complete electrification option is significantly more costly than the other two options yet also provides significant emissions reductions. While it may be less financially appealing under some circumstances, if regulators were to mandate a 40% reduction in carbon emissions by 2030 as seen with Local Law 97 in New York City, property owners might have to choose the complete electrification option. While this is the more costly option based on current economic conditions, it may become necessary with increasing net zero ambitious, underscoring the potential impacts of market shifts and the need for enabling mechanisms.

Findings such as this might also lead owners to re-run the model with additional parameters to explore retrofit options between the deep retrofit and electrification options that would best balance their risk and return. Below we briefly unpack some of the circumstances that may lead owners to pursue certain retrofit options.

**Figure 3  Credit impact of retrofit options on CRE portfolio**

**Aggregate Portfolio Results**

![Chart showing credit impact of retrofit options on CRE portfolio](chart.png)

*Source: Moody's Analytics*

We further break down the lifetime EL results by property type. Figure 4 illustrates that the whole building retrofit and deep retrofit options consistently lead to similar levels of credit risk compared to Baseline. On the other hand, the credit impact of complete electrification differs widely across property types. While it leads to an increase in credit risk for all property types, the hotel segment sees very limited increase in EL compared to the others. This is because we made the assumption that hotel owners derive the entire benefit from any energy savings as a result of the retrofit. By contrast, owners only derive partial benefits for other property types since commercial tenants are often responsible for paying part of the energy bill. In particular, we assume industrial property owners get no benefit at all from the retrofit while incurring the retrofit costs, which results in a substantial increase in EL for the industrial segment of the portfolio. This demonstrates that identifying retrofit strategy will depend on the lease structure, in addition to shifting market demand and regulations.
Figure 4  Credit impact of retrofit options by property types

Lifetime EL by Property Type

Implications for real estate lenders and investors

This analysis demonstrates that, to some extent, the credit impact of retrofitting commercial properties is mitigated by the resulting energy savings. Specifically, the whole building retrofit and deep retrofit options proposed by the Helios model lead to trivial increases in credit risk. However, as discussed above, there is a broad push to transition our economy to net zero, which has broad implications not covered by this model. This analysis demonstrates how lenders and building owners can leverage a detailed building energy model to inform their understanding of their options to achieve net zero and the credit implications. It is likely that landlords would explore options to spread these costs to their tenants under the premise that the benefits of energy efficiency will also be shared. This analysis does not include adjustments for replacing equipment at the end of its life cycle, which is the most cost-effective approach to retrofitting. This variable, as well as additional factors discussed above, such as higher premiums for energy efficient buildings, could be factored into further analysis using this model.

These different retrofit options for a sample CRE portfolio show the importance of understanding the implications of reducing energy emissions in real estate portfolios, as well as the opportunity to use this information to become part of the solution. For example, lenders can provide additional retrofit funding under existing loans, which will also improve the collateral, or they can build portfolios of retrofit financing, balancing risk and reward across many projects. Likewise, investors can create value-added strategies to retrofit properties, enabling them to sell at a premium giving the growing demands for low-carbon buildings. Understanding the costs of retrofitting buildings to reach different emissions pathways provides invaluable information to drive risk management, but also to inform opportunities to benefit from the transition to a low carbon economy.

About Helios Exchange

We’d like to thank Hewson Baltzell, President and COO of Helios Exchange (Helios) for his contribution to this report. Helios provides a Software-as-a-Service platform to analyze building energy performance by quickly creating a digital twin of each property, and then simulating energy efficiency and carbon reduction scenarios based on a library of energy efficiency measures. Outputs include total project cost, expected annual savings, savings over project lifetime, energy savings, carbon emissions reductions, peak demand savings, payback period, internal rate of return, net present value, estimated job creation from the project and other information.

Helios is a full-featured and detailed building energy model that uses building codes, weather station data, energy prices, and thermodynamics to model building performance. The model is derived from the US Department of Energy’s Energy Plus model, and uses over 750 reference building models including 16 building types, such as office, hotel, retail and others, three age vintages (newer than 2004, post-1980, and pre-1980); and 16 climate zones. It then calibrates these to specific energy use and other data for each building. Each energy efficiency measure in the library can then be assessed individually or in combination with other measures to determine its effects on the overall energy use and carbon emissions of the building.