Implementing a Net Zero Carbon Strategy in the Real Estate Industry

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Executive Summary

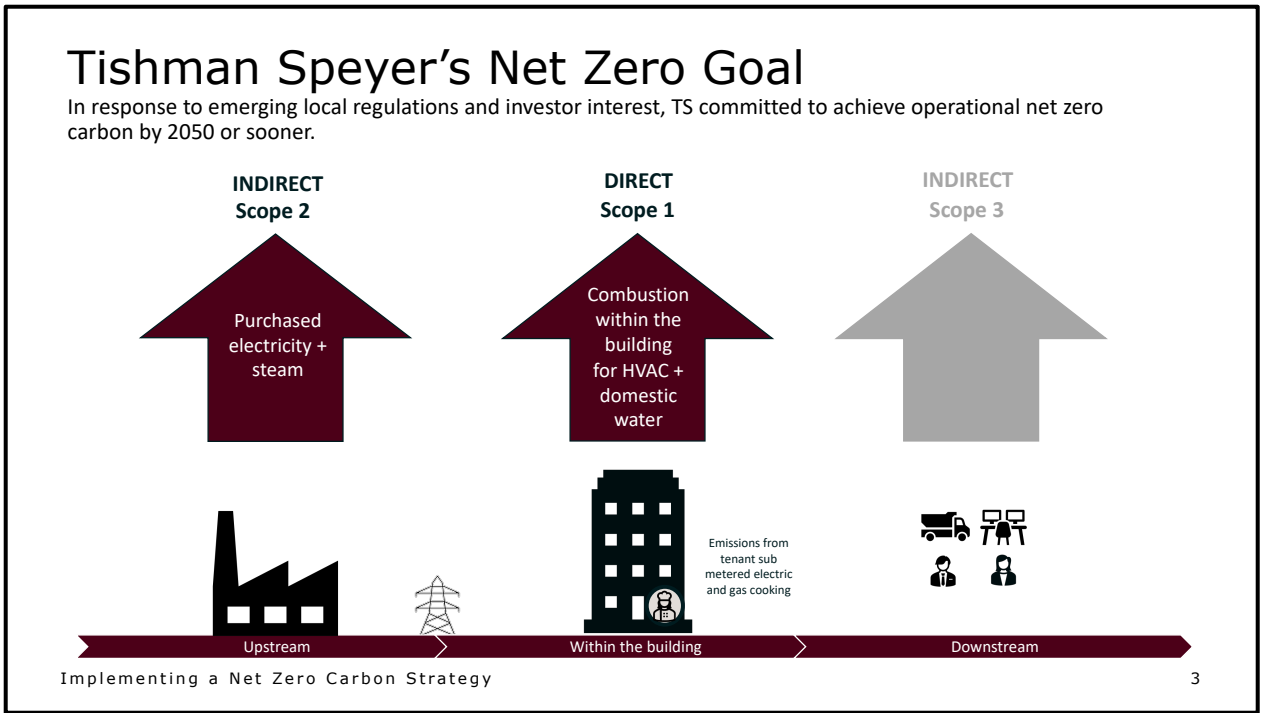
Tishman Speyer is a real estate developer that owns an international portfolio of office properties in major cities globally. The firm has a goal to reach net zero carbon emissions across global operations by 2050. As an intern with Tishman Speyer last summer, I delivered a tool that provides pathways for each US asset to reach operational net zero. I worked with internal stakeholders such as asset managers, portfolio managers, engineers, and members of the sustainability team to inform the tool's design. The deliverable provides financial models that project NPV and IRR associated with individual energy efficiency, retrofit, electrification, and on-site renewable projects by evaluating future energy costs, fines from regulators, and future REC/offset costs. The tool also estimates emissions reductions associated with energy projects, recommends project prioritization, and estimates future building emissions under multiple decarbonization scenarios.

For my MP Project, I expanded the scope of this tool and helped deploy it. I worked throughout the year to add features that provide scenario-level financial models, incorporate scenario operating expenses and capital expenditure changes into property Profit and Loss Statements, and give users the option to design customized decarbonization scenarios. I helped Tishman Speyer use this tool to generate net zero pathway reports for its US assets. Reports will be sent to employees and investors, ensuring that all stakeholders across the organization understand what is needed for Tishman Speyer to reach net zero.

Objectives

In 2021, real estate developer, owner, and property manager Tishman Speyer (TS) was facing pressure from European investors to set a net zero GHG emissions goal. Furthermore, many of the markets in which TS owned properties were in the process of passing local laws that tax commercial buildings based on their energy and emissions performance. An increasing number of TS' corporate tenants were asking for information about the environmental performance of Tishman Speyer's properties. In response to these growing pressures, Tishman Speyer set a firm-level goal to be net zero across global operations by 2050.

Exhibit 1. Tishman Speyer Net Zero Goal



Tishman Speyer's net zero goal includes all Scope 1 emissions, Scope 2 emissions, as well as Scope 3 emissions coming from tenant sub-metered energy use. Tishman's scope 1 emissions are from on-site combustion of natural gas, diesel, and fuel oil for space heating and domestic water heating within buildings. Scope 2 emissions include both the emissions associated with purchased electricity as well as the emissions associated with district steam production. Many properties located in older cities such as New York, Boston, and San Francisco rely on district steam systems for space heating and domestic water heating rather than using on-site natural

gas combustion. The TS net zero goal also includes tenant sub-metered electricity and natural gas, which is commonly used within retail environments for cooking.

Tishman Speyer plans to achieve its net zero goal through a 5-step process of implementing building-level *interventions*, following industry-established best practices*. Interventions* are defined simply as building energy projects that deliver a reduction in greenhouse gas emissions. Tishman Speyer's 5-step intervention strategy is as follows:

1. **Invest in Energy Efficiency:** Improve the building envelope, upgrade appliances and HVAC systems, conduct retro commissioning, and retrofit existing systems to improve building performance.
2. **Purchase Renewable Electricity:** In deregulated power markets, procure renewable electricity at the wholesale level where feasible.
3. **Install Onsite Renewables:** Deploy rooftop solar across the portfolio for properties with favorable regulatory, climatic, and financial conditions.
4. **Electrify Away from Scope 1:** Eliminate on-site combustion by replacing natural gas, diesel, and fuel oil systems with fully electric systems.
5. **Purchase RECs and/or Offsets:** Offset any remaining operational emissions through the purchase of Renewable Energy Certificates (REC's) or industry-accepted offsets by 2050 or earlier to reach net zero.

While many real estate firms have set analogous net zero goals and followed similar decarbonization strategies, most industry players lack the planning tools necessary to systematically make decarbonization decisions across their organizations. I worked with Tishman Speyer over the past year to develop an excel tool that would allow their Asset Managers to make data-informed decisions around building decarbonization.

The objective of my Master's Project was to develop a tool to help Tishman Speyer Asset Managers to make decarbonization decisions. The desired tool should deliver the following features:

- Evaluate both individual interventions and decarbonization scenarios based on two criteria:
    - **Resulting Emissions Reduction**, both immediate and projected in the future.
    - **Impact of Decarbonization on Financial Performance of Asset**, capturing the savings associated with energy spend, reduced penalties from local carbon laws, and reduced spend on RECs/offsets.
- Allow asset managers to prepare net zero plans and experiment with different decarbonization scenarios.
- Generate asset-level reports that can be delivered to employees, investors, and property managers.

The tool that I produced through my MP is titled the *Tishman Speyer Net Zero Carbon Model*. However, the expectation is that Tishman Speyer will continue to improve my tool in future years and regularly deploy it across their portfolio.

Methodology

The first step in designing the product was simply to understand the Tishman Speyer Net Zero goa;. I began by examining the major sources of emissions and discussing the challenges of planning for net zero with Engineers, Asset Managers, and the Sustainability team.

Next, I went through the process of identifying data sources that would be relevant to the project. Identified key inputs included:

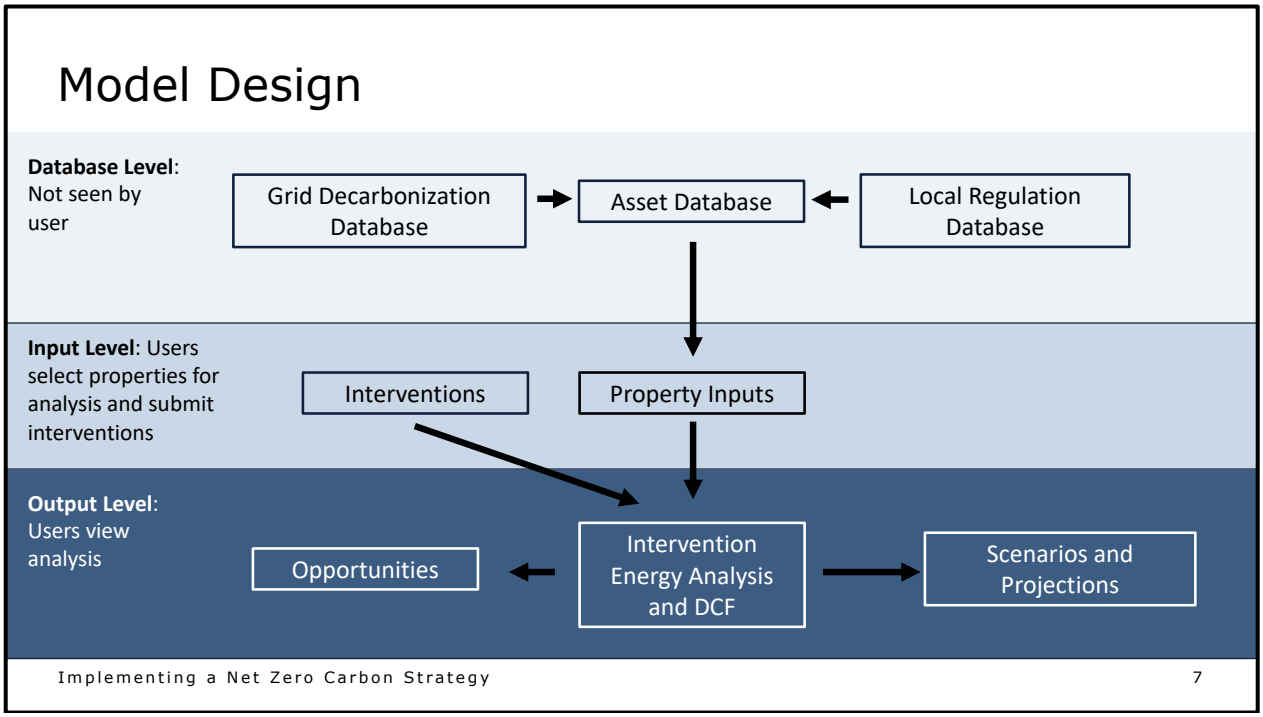
- Asset-level energy data (Sourced from *EnergyStar Portfolio Manager*, *Measurabl*, and Property Managers)
- Asset-level financial performance data, including *pro formas*, opex, capex, discount rates (Sourced from Portfolio Management team)
- Location-based emissions factors for electricity, steam, natural gas, diesel, and fuel oil (Sourced from *EPA EGRID*, city-level energy reports, and *EPA GHG Emission Factors Hub*)
- Building interventions provided by chief engineers for each property, verified by external consultants.

Model design required me to make several major assumptions that would impact the projected emissions and financial impact on the building. Assumptions included:

- **Future energy prices:** To determine the energy spend savings associated with interventions, we needed to predict the future cost of energy products such as electricity, steam, natural gas. We relied on the futures market to predict 5-year prices and then assumed no change in prices following this 5-year period due high levels of uncertainty. However, we conducted a sensitivity analysis on NPV/IRR metrics based on energy price assumptions.
- **Future cost of REC's/Offsets:** We used 2022 prices for in-state RECs for the current price. We assumed that the 2050 cost of REC's for a building would match the price of carbon under the local law, as price will increase with demand for REC's until the price of REC's matches the price of the fine. In markets without carbon emissions regulation, we assumed a 2% increase in the cost of REC's annually based on market research. Sensitivity of NPV/IRR to these assumptions were assessed dynamically in the model.
- **Rate of grid decarbonization:** All markets where TS owns properties are in stated with codified Renewable Portfolio Standards (RPS) under state law. We assumed a straight-line reduction in grid electricity emissions intensity from now until the stated RPS target. We tested sensitivity of emissions reductions and NPV/IRR to these assumptions based on whether a given state achieves 25%, 50%, 75%, or 100% of its stated RPS target.

The next step was to design a framework for the model, which is shown below:

Exhibit 2. Designing the Tishman Speyer Net Zero Carbon Model



The foundation of the model is a series of databases. It stores all emissions factors, energy use data, financial performance data, and local regulation data for each building. This level is hidden from users of the tool but will be updated annually by the Sustainability team. Data from these databases is pulled into the Input level based on which property the user wants to perform the analysis on. This level also includes an interface for each building's chief engineer to input building-interventions and their associated costs, energy profile impacts, the earliest year the intervention could be launched, and the lifespan of the project. Lastly, the output level of the model provides several different outputs for stakeholders across the organization. These included:

- A report card on the building's current energy use and emissions
- Evaluation of available interventions, in terms of both impact on energy use and impact on financial performance of the asset
- A dynamic pro forma, with ability to see any intervention's impact on NOI in any year of launch

- Future emissions projections under different scenarios, including both recommended pathways and customized pathways designed by a user
- A dynamic 30-yr pro forma showing a decarbonization pathway's impact on entire Profit and Loss Statement

Exhibit 3. Outputs: Opportunities for Decarbonization

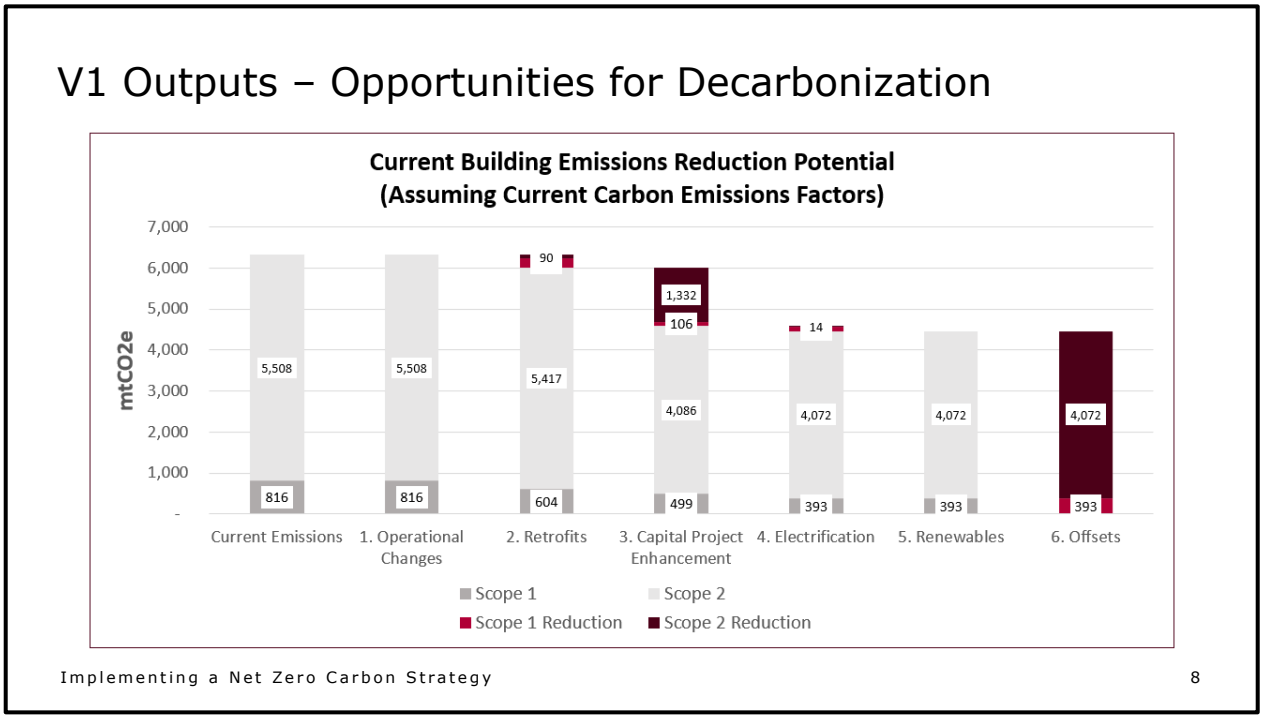
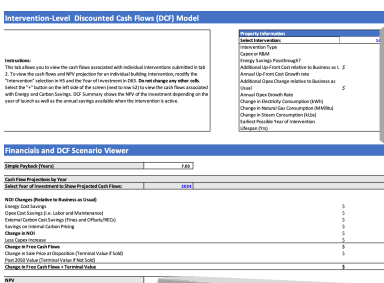


Exhibit 4. Outputs: Intervention Financial Metrics

V1 Outputs – Intervention Financial Metrics



Property Information	555 Washington Avenue
Select Intervention:	**14. DHW to Point of Use Electric**
Intervention Type	*Retrofit*
Capex or R&M	*Capex*
Energy Savings Passthrough?	*No*
Additional Up-Front Cost relative to BAU	*$ (450,000)*
Annual Up-Front Cost Growth rate	**1%**
Additional Opex Change relative to BAU	*$ (15,000)*
Annual Opex Growth Rate	**1%**
Change in Electricity Consumption (kWh)	*(261,809)*
Change in Natural Gas Consumption (MMBtu)	*-*
Change in Steam Consumption (kLbs)	*14*
Earliest Possible Year of Intervention	*2023*
Lifespan (Yrs)	*20*

NPV	**$158,450.47**
IRR	**10%**

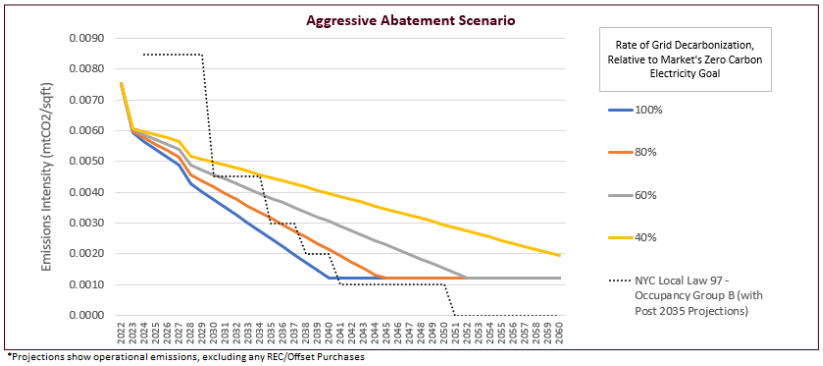
Exhibit 5. Outputs: Scenario Projections

V1 Outputs – Projections

Scenario Viewer

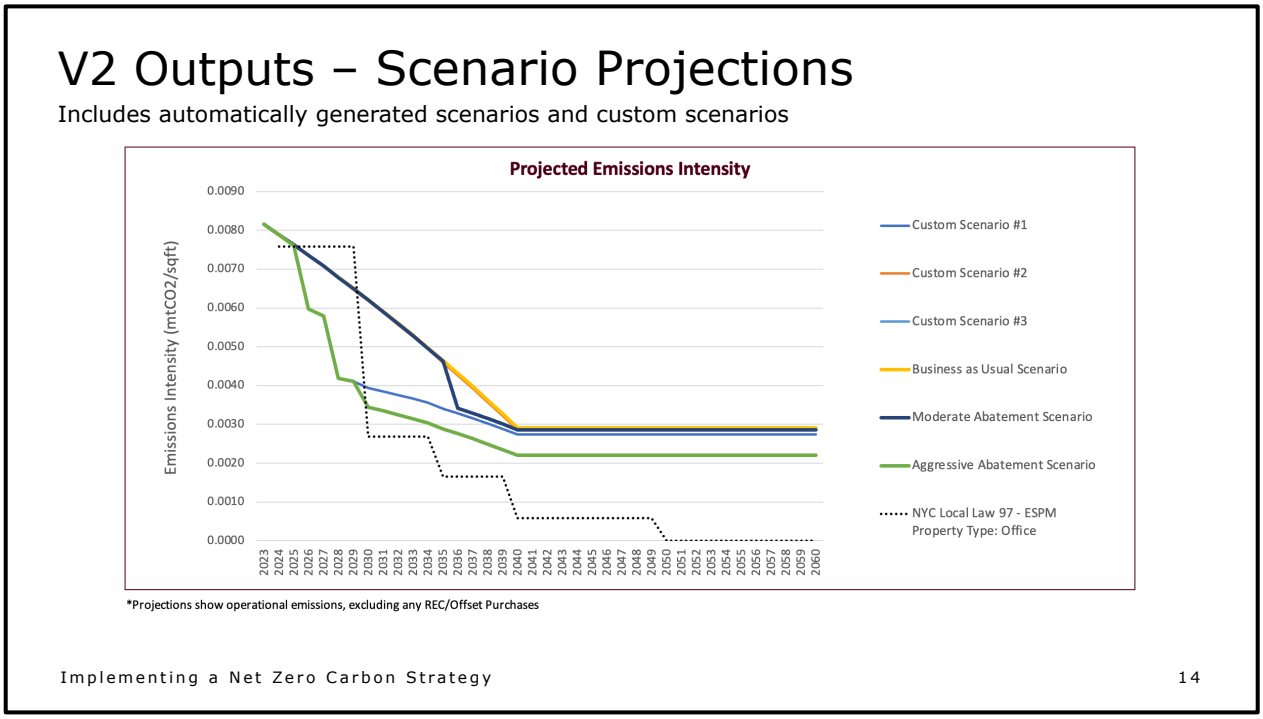
Toggle to View Each Scenario ->

Select a Scenario to View Its Projected Emissions Outcome:				
Aggressive Abatement Scenario	Heat Recovery Chiller	Variable Refrigerant Flow System	Air Source Heat Pump	Example Intervention 4
Year of Intervention (Empty if not Implemented)	2023	2028		
Required Capex	2,000,000	1,000,000	3,000,000	400,000,000,000
Change in Electricity Consumption (kWh)	(1,000,000)	(400,000)	(50,000)	(40,000)
Change in Natural Gas Consumption (MMBtu)	(1,000)	(1,000)	(2,000)	(4,000)
Change in Steam Consumption (kLbs)	(10,000.00)	(2,000.00)	-	(1,000.00)
Lifespan (Yrs)	30	No Lifespan	19	35



*Projections show operational emissions, excluding any REC/Offset Purchases

Exhibit 6. Outputs: Multiple Scenario Projections



After designing this framework, I began building the model. I met weekly with Tishman Speyer's Managing Director of Sustainability and Innovation, Head of US Engineering, and a Director of Asset Management to gather feedback and identify ways to improve the model's design.

Since the early fall, I have worked with the Tishman Speyer team to deploy the model across their US portfolio. This began with assisting in training Chief Engineers to identify building interventions and input them into the model. Next, I helped the sustainability team confirm the building-specific data housed within the databases in the model. We then sent the model to Asset Management, asking them to input their own custom scenarios to supplement the automatically generated scenarios, if they desired. The last step was to transfer all outputs of the model to a pdf file, which was then shared with engineers, asset managers, and sustainability team members. These files would then be sent to Investor Relations before being shared with external investors.

Results

Tishman Speyer has run its Net Zero Carbon Model on about 60% of its US portfolio by square footage. We have generated a handful of insightful findings thus far. One of the most important findings we have seen is that there are plenty of low-cost opportunities to make early progress on net zero goals. Energy efficiency interventions that have low up-front costs and result in significant energy savings are plentiful. The most common of these interventions are LED retrofits and retro commissioning. Deep energy retrofits such as building envelope upgrades and window retrofits have much higher up-front costs and are challenging to perform without disrupting tenants, but they do translate to significantly lower energy consumption and improved operating costs for buildings.

In the absence of carbon regulations, the return on investment for high-cost electrification projects is weak. Electrification of natural gas systems requires multi-million-dollar capex spending for the average building yet does not translate to reduced energy spend since electricity costs are increased significantly. However, regulations that tax buildings based on emissions help improve the ROI on these investments since electrification does shift the building's energy profile toward lower carbon fuels. As grids decarbonize, the GHG savings associated with electrification will only become more substantial. Analysis of electrification projects has also shown that electrification is much more feasible in warmer climates, where air source heat pumps are a more viable solution for meeting cooling demands.

Lastly, the process of launching the model has shown that a property's ability to meet their net zero targets is strongly dependent on rates of grid and steam decarbonization. For large real estate owners, it is critical to support energy providers in reaching their decarbonization targets in order for owners to meet their own goals.

Deployment of the model has also allowed the sustainability team to forecast emissions performance relative to local laws such as Local Law 97 in New York City, Building Energy Performance Standards (BEPS) in Washington D.C., and Building Emissions Reduction and

Disclosure (BERDO) in Boston. In all cases, Tishman Speyer's buildings will remain below legal emissions thresholds until 2030 even under a business-as-usual scenario. However, after 2030, significant investments need to be made to stay ahead of these regulations.

This project has also revealed a lot about the stakeholders involved in the decision-making process for net zero planning at Tishman Speyer. Asset managers need to see financial outcomes for interventions to understand tradeoffs between sustainability and other potential investments. For example, capex spending is limited, so a window retrofit that saves energy may mean that management must delay a much-needed lobby retrofit by a year. Secondly, we have seen a high level of engagement in this project from engineers. Chief Engineers have the knowledge sets to identify interventions and want to participate in net zero planning, however, the process of identifying and recommending interventions must be embedded in their day-to-day responsibilities in order to generate the most impact.

The Sustainability Team at Tishman Speyer has been trained to use the model and now has complete ownership of it. The Tishman Speyer hopes to update the *Net Zero Carbon Model* as needed and run the model on an annual basis. Continually improving the model and running it on a regular basis over the portfolio will ensure that all stakeholders know what is needed for the firm to reach net zero.