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Winthrop Center: A Bet on the World's Largest Passive House

Kathy MacNeil (MSRED 88') went into the real estate business working as a project manager for a general contractor. After graduating from the MIT Center for Real Estate with a Master in Science of Real Estate Development in 1988, she worked at a local Boston condo and office development firm, Macomber Development Associates (MDA), doing construction management, financial pro forma analysis, negotiating contracts and leases, and permitting. In 1998, MDA merged with Millennium Partners (MP), a New York-based luxury condo developer. MP brought in luxury condo premium branding and equity, while MDA provided Boston area development expertise and resources. As one of the founding partners of the MP Boston office, MacNeil has led the construction of every MP building in Boston for over past 20 years. She is one of the few female developers in Boston who is willing to take risks to create places and shape Boston's skyline. In 2022, MacNeil is leading the construction of the $1.3 billion mixed-use Winthrop Center in downtown Boston that at construction peak had a crew of about 400 workers on-site every day.

Millennium Partners and its Business Model

Millennium Partners (MP) was founded in 1991 by Christopher Jeffries, Philip Aarons, and Philip Lovett. In their first deal, a four-building development adjacent to Lincoln Center in Manhattan, they pioneered the prototype of a new concept in mixed-use, urban living and entertainment centers. Over the years, MP set their sights on key gateway cities across the United States, focusing on developing luxury condominiums, five-star hotels, a sports club facility, and retail as part of landmark mixed-use developments. Recognizing the value and services that a leading hotel brand can bring to condominium development, MP chose two prestigious hotel operators, the Ritz-Carlton Hotel Company LLC and Four Seasons Hotels & Resorts, to be its partners in development and operation. With these projects, MP created a new investment vehicle to provide equity capital. The resulting financial structure included a consortium of German financial institutions, such as ERGO, Provinzial Wuerttembergische, AXA Colonia Immobilien AG, Energie Baden Württemberg AG, as well as Goldman Sachs' Whitehall Fund and George Soros' Quantum Realty Fund.

As the business matured, the MP brand started to have some cachet and no longer needed the hotel component. The hotel portfolio had its risks and rewards that did not necessarily follow the "get in and get out" model for condominiums. After bringing five-star service for luxury residences with the acclaimed hotel brands Ritz-Carlton and Four Seasons, MP applied its core values and key learnings to the creation of residential-only buildings. In the making of One Charles Street Condominiums in Boston (completed in 2004), MP started to develop and sell condominiums without a hotel brand.

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Since the 2000s, with a strong brand premium and a global base of buyers, MP has grown its build-and-sell luxury high-rise condominiums business in New York City, Boston, San Francisco, Washington DC, and Miami. Their product strategies inform the decisions on unit mix, design, finishes, amenities, and importantly, residential property operation and services to ensure that the maximum intrinsic development value of the site is realized. MP also owns and operates a portfolio worth over $4 billion in commercial real estate in the US as of 2020, all of which are part of their mixed-use condominium developments.

Between 1998 and 2016, MacNeil and her team at MP Boston have developed and sold over 1,300 luxury condominium homes in four major mixed-use developments in downtown Boston: 10 St. James Street (1998), where they leased all the offices prior to completing construction; the Ritz Tower on Avery Street (completed in 2001); One Charles Street Condominiums (completed in 2004), and Millennium Place (completed in 2013), where 256 condos were sold in 18 months. Their fourth major development in downtown Boston is the $700 million, 975,000 sq. ft. speculative 60-story Millennium Tower with adjacent office building, which was acquired in 2013 (See Exhibit 1 for the MP's four major developments in Boston.) Millennium Tower, the high rise (680') has 442 luxury condo units with lower floor retail, Pabu restaurant, Old Navy, and Primark. It broke the record in the nation's condo sales by both speed and price per square foot outside of Manhattan. Fortuitous timing and perfect execution made it one of MP's most profitable investments. The exceptional return on Millennium Tower provided a solid foundation for MP Boston to take on the $1.3 billion Winthrop Center, which was the biggest real estate development in Boston as of 2020. The nature of this project dovetailed with MP's core competencies.

115 Winthrop Square Request for Proposal

The 115 Winthrop Square (aka 115 Federal Street) site is located in the heart of the Boston financial district. The site parcel is approximately 47,738 square feet, and was formerly an above-grade parking structure. It was owned by the City of Boston. The City of Boston has requested the Boston Redevelopment Authority's (BRA"s) assistance in issuing a Request for Proposal (RFP) for development of the property. In 2015, BRA issued an RFP proposal with a detailed set of requirements and criteria. The City of Boston received competitive bids from six well-established developers: MP, Accordia Partners, HYM Investment Group, Lendlease, TransNational Properties, and Trinity Financial. MP won the RFP bid in November 2016, with a purchase price offer of $160 million, among which $102 million went to the land purchase with $58 million payable over time from residential sales proceeds.[1] The unbeatable price coupled with MP Boston's proven record of delivering four successful major developments in the Boston CBD made it an easy decision for the City.

MP's proposed development plan is a 1.9 million gross square foot mixed-use development. It features a 691-foot-tall residential tower with 321 residential units (approximately 510,000 sellable square feet) atop a commercial podium base that consists of approximately 800,000 rentable square feet of office space, 23,000 square feet of office amenity space, and 32,000 square feet of residential amenity space (Exhibit 2).[2]

In September 2018, after obtaining the permits and almost three years from original interest with the back and forth on shadow law issues, the design, going through the City of Boston permitting process, known as Article 80, and the Massachusetts Environmental Policy Act (MEPA) review, MP closed on the land using its own equity. In October 2018, it broke ground without any pre-leasing of the office space or

[1] See all six bid submissions, including MPs' on 115 Winthrop Square at: http://www.bostonplans.org/work-with-us/procurement/rfp-listing-page?id=78.

[2] The data are from the most recent development plan as of November 2021. The development plan has evolved from its 2016 RFP to the first set of permits in August 2018 and then a revised permit in 2021.

pre-sales of the residences, the same conditions under which it commenced construction on Millennium Tower. The development was scheduled to be completed for office occupancy in three-and-a-half years. After groundbreaking, MP immediately began the pre-leasing process, engaging CBRE as the exclusive commercial broker. The strategy was to obtain a construction loan later based on the assumption that a better rate and more favorable terms would be achieved after securing anchor tenants. See Exhibit 3 for the capital structure.

Evolution of Sustainability in Boston (2000-2021)

In 2000, the United States Green Building Council (USGBC) established the Leadership in Energy and Environmental Design (LEED) rating system. The LEED green building campaign did a good job of promoting the rating system to corporate America. Corporate tenants' demands, together with the regulatory push of building codes, drove the LEED rating system adoption by developers. Developers began paying attention to green building ideas and "sustainability" issues. They started hiring consultants to understand "green" buildings; and wanted to highlight "green" amenities, although it is always a balancing between the costs and benefits. In 2007, the City of Boston adopted Article 37 into the zoning code, which requires all projects to achieve at minimum the rating that the building is LEED certified. It became the first city in the US to mandate a green building rating system (LEED) through municipal zoning requirements. Most cities only mandate LEED for public buildings. Other municipalities utilize LEED as incentives, such as property tax credit, exemption, density bonus, expedited permitting process, grants, and permit fee reductions. Asset managers and investors, on the other hand, always trade off greenness with financial return goals with fiduciary responsibilities.

In Massachusetts, after the 2008 recession, a suite of environmental efforts became legislated, including vehicle fuel standards, funds to promote jobs in clean energy, a fund to restore marine habitats, and the promotion of clean biofuels. To top off these initiatives was the Global Warming Solutions Act (GWSA) of 2008, which requires the Commonwealth to establish economy-wide greenhouse gas (GHG) emissions reduction targets, including a 25% reduction from all sectors of the economy below the 1990 baseline emission level by 2020, and at least an 80% reduction by 2050. Politicians, the electorate, and the business community agree that climate change is real. Boston is introducing stringent policies, taxes, and regulations to further climate goals. In 2011, the City of Boston instituted the E+ Green Building initiative, which is designed to demonstrate the feasibility of LEED Platinum certified housing. In 2013, Boston enacted the Building Energy Reporting and Disclosure Ordinance (BERDO), requiring large buildings to report their annual energy and water use to the City. Boston's updated 2019 Climate Action Plan contains GHG emission targets for existing large buildings, and a transition to zero net carbon for new construction. It requires large- and medium-sized buildings to report their annual energy and water use.

In 2000, when MP Boston developed its first project, the Ritz-Carlton Hotel & Tower, MacNeil did not recall any conversation about sustainability. As the city zoning evolved and climate change became a political issue, One Charles Street, Millennium Place, and Millennium Tower were all LEED certifiable as mandated by municipal zoning code Article 37. When Winthrop Center was initiated in 2016, the focus on sustainability became the centerpiece of the project.

MP's RFP: Sustainability Paradigm

In MP's Letter of Interest to the City of Boston on April 2016, MP's founder and chairman Chris Jeffries wrote: "The project will be a market leader in sustainability and resiliency and be designed to meet the more extreme climatic conditions anticipated in the future. We will explore a host of measures in the

initial design process, from chilled beams in the office areas to heat exchangers between uses, a high-performance façade, variable refrigerant flow, displacement ventilation systems, greywater systems, thoughtful daylighting, operable windows, smart metering, master switches, and more."

Richard Baumert, principal partner at MP Boston, had a vision for the Winthrop Center to be a next generation building. Baumert was inspired by a trip to the Edge building in Amsterdam, a 40,000-square-meter Amsterdam headquarters for the consulting firm Deloitte, deemed in 2015 as the "greenest" in the world. The Edge achieved a Building Research Establishment Environmental Assessment Methodology (BREEAM) new construction certification of Outstanding and a score of over 98 out of 100 points. BREEAM is an approach for assessing and rating the sustainability of buildings that takes into consideration criteria such as energy and water use, transport links, materials used and waste management processes. Baumert said: "With 800,000 square feet of office space, we need every competitive advantage we could possibly find. How are we going to market this building effectively to bring in prospective tenants? Doing something that no one's ever done before is a start. We were introduced by Handel Architect who had experience in doing the passive house. We want this building to be better than others. We started looking at all these different examples around the world, including the Edge building in Amsterdam."

MP's RFP submission stated: "Our goal is to set a new bar for market-rate, commercial building sustainable design performance. Buildings have a 50-100+ year immediate and long-term impact on the environment. The most important component to get right from the outset is a robust exterior envelope. Meeting LEED Platinum will address many of the other important environmental impacts like water usage, recycling and renewable materials, and building operating procedures. But setting a very high standard for low energy consumption will have the largest impact over time. It is anticipated that, if successful in meeting these standards, the energy use reduction compared to a comparable commercial office building will be approximately 50-70%."

Besides achieving LEED Platinum certification as desired by the City, MP's RFP submission targeted a significant portion of the project to meet Passive House standards (Exhibit 4). Passive House is a designation that started in Europe that has a similar intent as LEED certification, but with a much more focused attention on extreme reduction in energy consumption, greenhouse gas emissions, and the health and wellness of its occupants. It is the most rigorous protocol for energy use reduction in the world.

Designing to Passive House standards will drastically reduce Winthrop Center's greenhouse gas (GHG) emissions, making the building well-positioned to help the City of Boston meet its stringent GHG emissions reductions targets. Passive building principles can be applied to all building typologies — from single-family homes to multifamily apartment buildings, offices, and skyscrapers. However, Passive House had not been tried in the large-scale office typology. When certified, the Winthrop Center is slated to be the largest Passive House office building in the world.

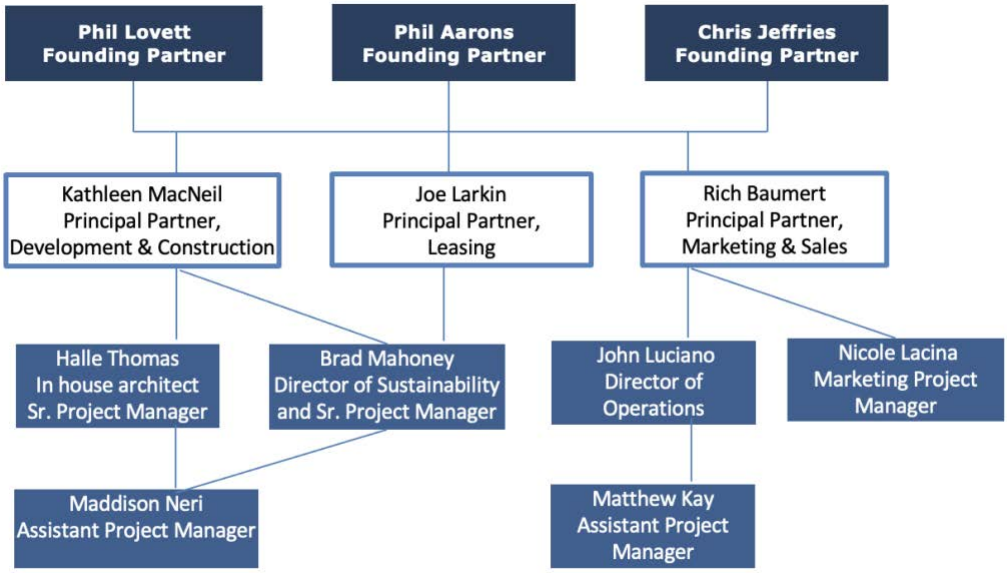
The idea of Passive House was brought to MP by their architect Handel Architects. Handel Architects has designed the House at Cornell Tech — a 26-story, 250,000 square feet, 352-unit residential high rise that houses about 530 graduate students, faculty, and staff (see Exhibit 5). In 2016, the House was the largest and tallest residential building in the world built to Passive House standards. MacNeil said: "The success and learning from the House at Cornel Tech took some risk away from our Passive House proposal for the Winthrop Center design. But there was still uncertainty to get it delivered and certified. Also, we will have to educate potential tenants as no tenants today would show up and say 'I want to be in a passive house building'."

Blake Middleton, a partner at Handel Architects, said: "Passive House is a high level of building energy performance. It has never been done on this scale (Winthrop Center) before. In a few years, all

buildings may have this level of performance, but this is the first one."

MP wants to be successful at developing for the future at a time when the future has not yet arrived. The secret is delivering a product that might be a little bit ahead of the curve but would create the market. To bring such a sustainable vision from an idea to a reality, the MP Boston team (see Figure 1) considered making a bold move to drive the market. Creating the market is a very different play than reacting to what the market currently wants.

Figure 1: Winthrop Center Development Team at Millennium Partners



The Boston Office Market

The downtown Boston office market encompasses more than 500 buildings totaling 85 million square feet, with more than 52 million SF of that classified as Class A in three major submarkets: CBD, Back Bay, and Seaport. As of 2019, the average asking rents surpass $70 PSF gross. 2018 had a record of over 2.39 million SF of total net absorption.

As of 2019, there were six projects totaling 3.7 million SF under construction including Winthrop Center, of which 57% of the total SF had been leased prior to the start of construction. Another 2 million SF has been permitted but has not yet commenced construction (Exhibit 6a). The benefits of new construction include highly efficient floor plates, higher-quality amenities, state-of-the-art infrastructure, sustainable features, and higher ceilings. Both growing and established companies are willing to pay premium rents for new construction based on the more efficient floor plates, ability to chart growth, and higher-quality amenities. The recent new construction additions to the CBD submarket (One Post Office Square, One Congress Street, and Winthrop Center) have resulted in 16.8% asking rent growth year-over-year. Exhibit 6b is a sampling of recently completed leasing deals in 2019. Most leases typically start negotiations 12-18 months prior to signing and may not fully capture the rent growth over the past 12 months. Exhibit 6c is a sampling of landlord issued proposals in 2019. The Boston office market demand

can be attributed to the diversity of industries due to the regenerative nature of the Boston area economy, that finds its roots in the region's world class universities and skilled workforce. Once dominated by financial institutions, insurance companies, and law firms, Boston now hosts several technology and life sciences companies, including Amazon, Aptiv, Draftkings, Rapid7, Parametric Technologies, Alexion Pharmaceuticals, and Foundation Medicine. All signed leases in 2018-2019 for a total of approximately 1.8 million SF. State Street Corporation, Bank of America, Acadian Asset Management, Boston Private Bank, Ameriprise, Loomis Sayles, Eaton Vance, GMO, and Fidelity Investments have recently signed leases or are touring the market for approximately 2.8 million SF. Exhibit 6d shows recent or anticipated capital market deals to be completed in the Boston market.

The Boston Condominium Market

Winthrop Center will be one of the two tallest residential buildings in Boston. Its residential apartments range from 900 – 5,000 square feet including penthouses, over 27 residential floors (see Exhibit 7 for unit mix). The project has been planned to appeal to each of the residential market segments: primary homes, secondary homes, and investments. As of 2019, there are four comparable developments, one in Back Bay and the others in the Seaport, which are in active sales or near initial closing (see Exhibit 8). One Dalton Street is the most relevant, comparable to Winthrop Center. It is in the Back Bay. Its first residential floor is floor 21 sitting above a Four Seasons hotel. The thirty-seven residential floors rise to over 700 feet. It was expected to average approximately $3,000 PSF upon completion of sales. With the pace of sales in these four luxury buildings, it is anticipated that One Dalton Street and Pier 4 will be substantially sold out and Echelon 1 and 2 will have 50-100 units remaining to sell when Winthrop Center commences sales in the spring of 2022. Winthrop Center's primary competition will be future developments. Two developments are currently being built but have not yet commenced sales and three more are approved but have not started construction. At the government center, a full block development consisting of One Congress, a 1,000,000 square foot office building and an adjacent 480-foot-tall residential tower with 368 rental apartments and 55 condominiums on the top floors, is currently under construction. The sales program is expected to begin shortly at a sales price reported to be $2,500 per square foot on average. Raffles, a high-end hotel and condo project in the Back Bay, is under construction and will also compete with Winthrop Center.

The MP Boston marketing team thinks there are several factors that would give Winthrop Center an advantage over its competitors. First is its location in the CBD, which is a desirable residential location that can compete with the Back Bay, South End, and Seaport. Of equal importance are the panoramic views of the city skyline. Extraordinary views are generally acknowledged to be the most sought-after attribute of a luxury residence. The unobstructed views south and west toward the Common, Public Garden, or Charles River, and north and east to the harbor and center city skyline, will give this development a unique advantage. Secondly, associated with the quality is the reputation of MP Boston as one of the pre-eminent developers of luxury residences. Finally, the twenty-sixth floor club would contain amenities for the private use of the residents. The La Vie program and its 32,000 square feet will include such features such as resident dining, fitness dining, owners lounge, library, game room, swimming pool, and outdoor terrace. The Club with its associated social La Vie program will set the project apart from its competitors.

Design Development: From RFP to Construction

After MP won the RFP bid in 2016, MP Boston worked through the design development to get the final permit. During the design development stage, key sustainability decisions needed to be made and the scope be finalized so that the construction budget would be locked and the construction loan be secured. Once design development concluded and the project was under construction, changes would be costly and

disruptive, potentially delaying delivery and affecting returns.

MacNeil and her team needed to prioritize the sustainability features of the Winthrop Center, and decide which costs to add or deduct. To design a significant portion of the project to meet various sustainability criteria, they needed to plan carefully. Building a Passive House required more financial investment with uncertainty. Cost pressures were mounting as the development team kept discovering that the building's costs were higher than expected.

Brad Mahoney, Director of Sustainable Development of MP Boston said: "The nature of the project is a competitive RFP to the City. The challenge in putting the RFP together was making a lot of decisions about the project ahead of time. Usually, developers don't want to spend too much money on design when you don't know if you have the project. In the RFP, we had the idea of sustainability, diversity and equity — setting benchmarks for diversity not only in the construction trades but also for minority business enterprises and women business enterprises in design and operations of the building. The design teams as well as operations, try to benchmark Passive House to set us apart, in addition to the purchase price. At the RFP stage, we didn't exactly know where the passive house would be applied. Would it be in the residential? Would it be only in the office? In the following design development stage (2016-2018), we had a lot of different iterations about what the building would look like, what the sustainability standard for different programs would be. There's a lot of work on the pro forma behind the scenes."

Sustainable Building Standards: Passive House and LEED

Originating in Germany, Passive House is a rigorous performance-based sustainability and comfort standard that results in significant energy reductions and healthier interior environments. The Passive House Institute (PHI), based in Darmstadt, Germany, offers its certification to structures that pass a stringent on-site "pressure test." A passive building is designed and built-in accordance with building science principles. A passive building comprises a set of design principles used to attain a quantifiable and rigorous level of energy efficiency within a specific quantifiable comfort level. "Optimize your gains and losses based on climate" summarizes the approach (Exhibit 9). The basic theory behind a Passive House building is straightforward. A Passive House has a heavily insulated, tightly sealed building envelope, combined with energy-efficient mechanical equipment, which dramatically reduce the energy needed for heating, cooling, and ventilation. Both solar heat gain and internal heat loss must be minimized, while maximizing the reach of natural light into the deep office floor plates. As the Passive House envelope, the curtainwall design employs a robust, triple glazed insulated glass window unit coupled with glass spandrel panels to obtain an average R-value of 7.35 BTU/hr/ft²/°F. To reduce energy loss, all connections between the exterior wall and the interior structure are thermally broken to minimize heat loss through thermal bridging, and all panel joints are gasketed and sealed to prevent air leakage. The highly insulated spandrel glass panels are designed with a unique fritted pattern that ties aesthetically to the brick and terracotta of neighboring buildings. Passive design strategy carefully models and balances a comprehensive set of factors including heat emissions from appliances and occupants to keep the building at comfortable and consistent indoor temperatures throughout the heating and cooling seasons.

- As a result, the Passive House office program will reduce energy use by approximately 50%-70% compared to the average Boston office building (per City of Boston BERDO data). In addition to energy efficiency, Passive House buildings offer long-term benefits, including:
- Passive house design reduces the size of the HVAC equipment while allowing for more fresh air and superior indoor air quality.

- Superinsulation and airtight construction provide thermal and acoustical comfort even in extreme weather.
- A comprehensive systems approach to modeling, design, and construction produces resilient and durable buildings.
- Passive building principles offer the path to net zero and net positive buildings by minimizing the load that renewables are required to provide.

The LEED rating system complements the Passive House standard by addressing environmental impacts like water usage, recycling, materials use and sourcing, and building operating procedures. LEED is one of the many widely adopted rating systems that focused only on operating process and management practices, not on performance outcomes until its 2019 v4 launch (Exhibit 10). The USGBC published the LEED Green Building Rating System (Version 2) in 2000. It was not until 2019 that version 4 of LEED emphasizes performance monitoring, fully integrated design, social equity, and human health factors. Version 4 is designed to up the ante with a more flexible, performance-based approach that calls for measurable results throughout a building's life cycle. Thirty percent of LEED credit points are based on energy, while Passive House is 100% focused on energy. Passive House helps to get a bulk of points in LEED Platinum certification and became the main driver for achieving LEED Platinum. In other words, if the office or residential part can achieve the Passive House standard, there is no question it would attain LEED Platinum certification as well.

Pro Forma

MacNeil worked with Suffolk Construction, the manager of the construction, on the project pro forma and budget with construction costs, which is the largest component of the development budget for the Winthrop Center (see Exhibit 11 for the project pro forma).

The cost premium for a Passive House is between 3%-10% based on the literature. MacNeil and her team believed that their premium would be towards the low end since MP Boston has always designed and budgeted a premium façade design. The rough estimate of Passive House and LEED Platinum was about $14 per square foot (see Exhibit 12). The soft cost such as extra design iteration with architects was not so black and white. It was tricky to budget with interim design, because it was evolving. Over her real estate construction career, MacNeil has learned to embrace flexibility and agility. She said: "We were fully engaged in the permitting process with design changes to address stakeholders' comments. You learn something new and find a better way to be able to give the government and the community what they want. If you're not fully engaged with a willingness to bring your engineer and your architect on. You're going to be behind. Some people try not to pay the architect a lot of money until after they get their permits because nothing's guaranteed. You have to put that investment in, especially now that the permitting has gotten more analytical on the sustainability side. You have to know what mechanical system you're going to use in order to complete that greenhouse gas analysis. Therefore, you have your design a little further along than you might like, which means you have to spend more money on your design. To me, that's good money spent. Because when you finally finish the permitting, you're ahead in the design process. By the time we finished permitting, we had a good set of documents. We knew what we were going to build. It saves us time by doing it in parallel."

On the one hand, the cost premium of Passive House and LEED Platinum seemed insensitive to the scope of the whole project. Should they aim for Passive House and LEED Platinum for both the offices and residential component? On the other hand, quantifying the benefits was much tougher than quantifying the

costs. High energy efficiency investment is usually reflected in lower operating costs with energy savings. However, MacNeil's pro forma underwrote the office building as a triple net lease, which means the benefits of energy savings could not be captured by the developer. MP believed that it was going to get higher rents in the long term, as the value of carbon reduction just entered the discussion in the jurisdiction. They planned to hold onto the office building for the foreseeable future.

To deliver for the future requires the vision to understand where the global community is going and projecting ahead. The bet was not just a matter of if the market would react positively, but also a matter of when.

Delivery

To meet the high bar for Passive House energy performance, the exterior envelope must meet rigorous design standards and quality control during installation. The three aspects of the Passive House building — the envelope, the ventilation system, and the heating and cooling system — were the trickiest to design and construct properly. MacNeil said: "Views sell offices. The market wants big beautiful windows. But it has to be a Passive House. Managing this trade off involves a lot of back and forth on the design. How can we get big, beautiful windows and still be a Passive House? Insulation levels of walls of Passive House are generally in the range of R-40 to R-60 for walls. This is in conflict with maximizing views. The designers have to figure out how to achieve the value and still have a view. On the north and south sides of the Winthrop site the views were compromised due to neighboring building. It made sense to insert more solid walls on these elevations, in order to get the overall R-value of the wall to the level that a passive house requires. Views also sell condos. The ability to do a Passive House in the residential portion was much more challenging."

The Passive House threshold for vision glass is in the 40% to 50% range. Window specifications are also demanding. A common specification is for U=0.15 (0.8 W/m2 K) or less for windows. To approach these targets, windows need to have non-conductive frames (vinyl, wood, or fiberglass) and triple glazing, low-e coatings, and gas. It is very difficult to find commercially-available operable windows that can achieve these specifications, and imported Passive House-certified windows reportedly cost about twice as much ($90-$100 per square foot) as much more readily available triple glazed fiberglass windows (R6 at $50/sf).

Brad Mahoney said: "Handel Architect's project in the House at Cornell Tech was 250,000 square feet. To scale it to 800,000 square feet was already a big risk with design and construction challenges and uncertainty, not to mention the full 1.8 million square foot building. It would be a chunk too big to bite off. For any team that has never done this before. There was inherent fear of the unknown. The biggest fear mongering in the industry came from the construction management. They would ask "Why do we have to try something new and take the risk?"

MacNeil opted for a guaranteed maximum price (GMP) contract with the construction firm. The contractor was compensated for actual costs incurred plus a fixed fee, limited to a maximum price. The contractor would be responsible for cost overruns greater than the guaranteed maximum price, unless the GMP increased by a formal change order. Savings resulting from unexpectedly low costs would be returned to the client. The developer carried less risk in a GMP contract as contractors are responsible for cost overruns. When done well, there is also less risk of paying for inadequate supplies or work because the schedule of value details the jobs the contractor must complete and the materials to be used. It also mitigates accounting challenges, as changes are minimal. GMP contracts would increase contractors' financial risk as they would be on the hook if costs exceed the maximum price allowed.

In addition to cost risk, there is also performance risk. What if the curtain wall does not perform well? What if they are not able to find a curtain wall vendor that is able to partner at this scale? Mahoney said: "The construction team wants business as usual, more than anyone else in the industry. We all depend on them. It's a lot of finding the right team and the right people to engage in innovation. This is intangible, tough to quantify and to put in a pro forma. But it is very essential when you're trying something new."

Electrification

Passive House buildings present a great opportunity to reduce the use of natural gas lines and go all electric, due in part to Passive House requiring extremely low heating and cooling demands. This, coupled with the cost savings of not having to install a gas line, makes Passive House buildings great candidates for a simple transition to an all-electric building. All-electric buildings are the easiest path towards a net zero-carbon built environment, when electric usage is offset with renewables. By avoiding natural gas and pairing all-electric energy with Passive House specifications, buildings can achieve even better energy efficiency, lower energy bills, higher indoor air quality, less risk of fire, higher comfort levels, and better performance. Heat pumps can be up to 250% more efficient (and up to 500% more efficient in some water heating applications) relative to the combustion of natural gas. However, designing and building an all-electric building has economic, architectural, and behavioral challenges.

From an economic standpoint, heat pumps for heating/cooling and water heating, LED lighting, and induction ranges can potentially add a premium to the already constrained budget, although this may be tempered with the cost savings of the improved energy efficiency over time. As a mixed-use building, gas emissions are from boilers serving both the residential units above and the offices below. What does this look like from a space perspective? Should they do it just for the residential units and not for the offices, when real estate is at a premium? How about locating all of the heating and natural gas boilers on the same floor to service the space up and down? Will it take away both sellable and rentable square feet in the pro forma? Do they increase the number of transformers that provide the electricity? Would they spend more money on all electric boilers?

The team debated if the office should go with total electrification since the heating load is low with the Passive House specifications. Does that push to a different mechanical system for the offices and for the residential unit? Electrification requires a system called variable refrigerant flow (VRF). The team was concerned with all the big unknowns, as well as the risks associated with the new VRF technology across 800,000 square feet of offices as it might not work as efficiently in the winter in Boston.

The main behavioral change of going all-electric in residential units is letting go of the gas cooktop. This is likely the biggest hurdle to removing gas as people like cooking on a gas range.

MacNeil wondered: "We already have to sell the new concept of Passive House, which is an environmentally-friendly, high-performance building, to a very traditional market that only has LEED ingrained in their heads. Should we be careful with how many new things we are educating ourselves and clients on and selling?"

MacNeil, Mahoney, and the rest of the team have to hit big numbers to pay for such a high level of sustainability. They also have to deliver Winthrop Center on time and on budget. That is a very risky approach without any signed leases. The risk also involves the macro economy: Where are interest rates going to be? Where's regulation going? How are tenants going to use the office space? Are they going to care that the office space is sustainable?

Exhibit 1: MP Boston Projects (2000-2021)

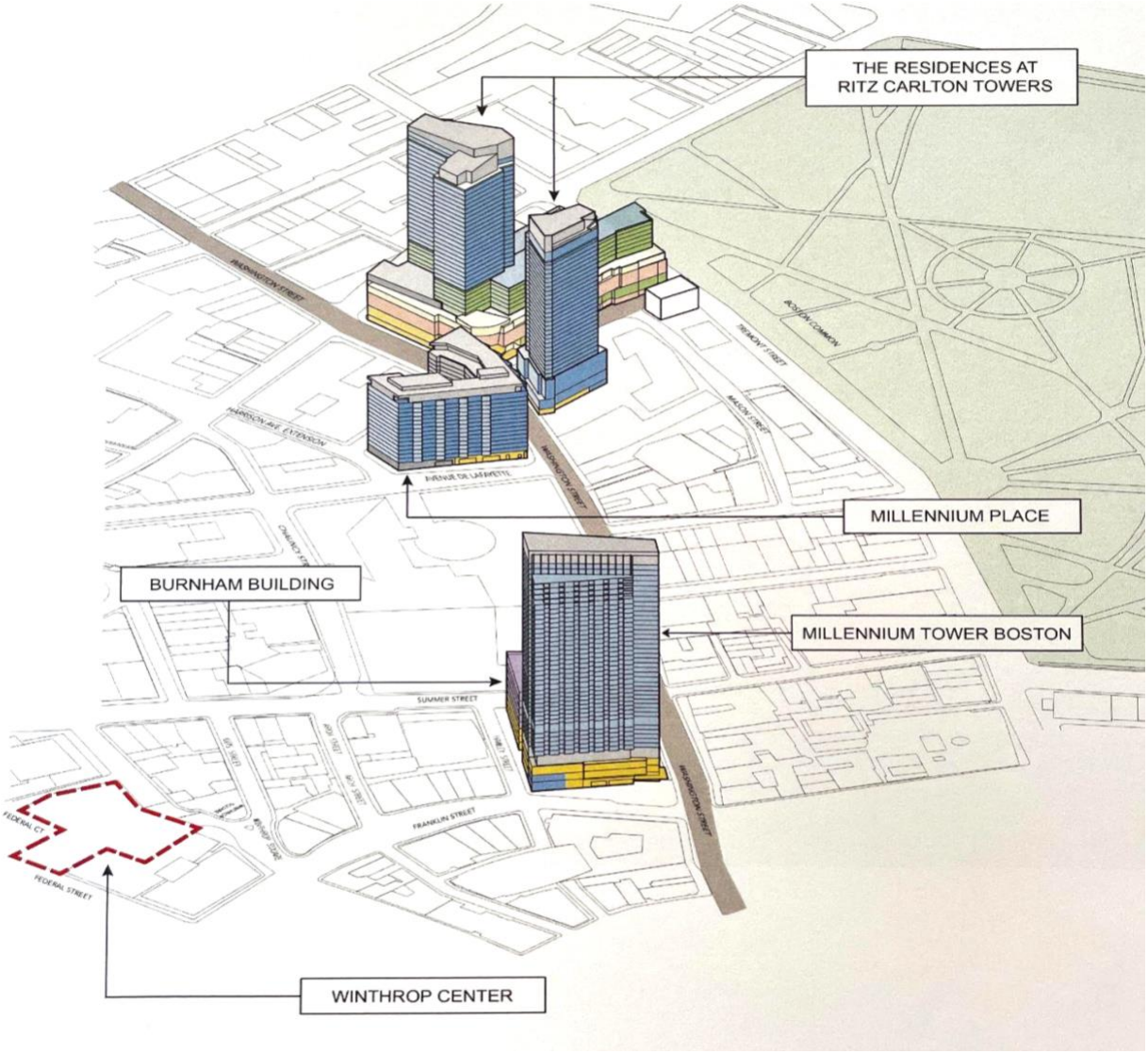


Exhibit 2: 2016 MP's RFP: Winthrop Center Program

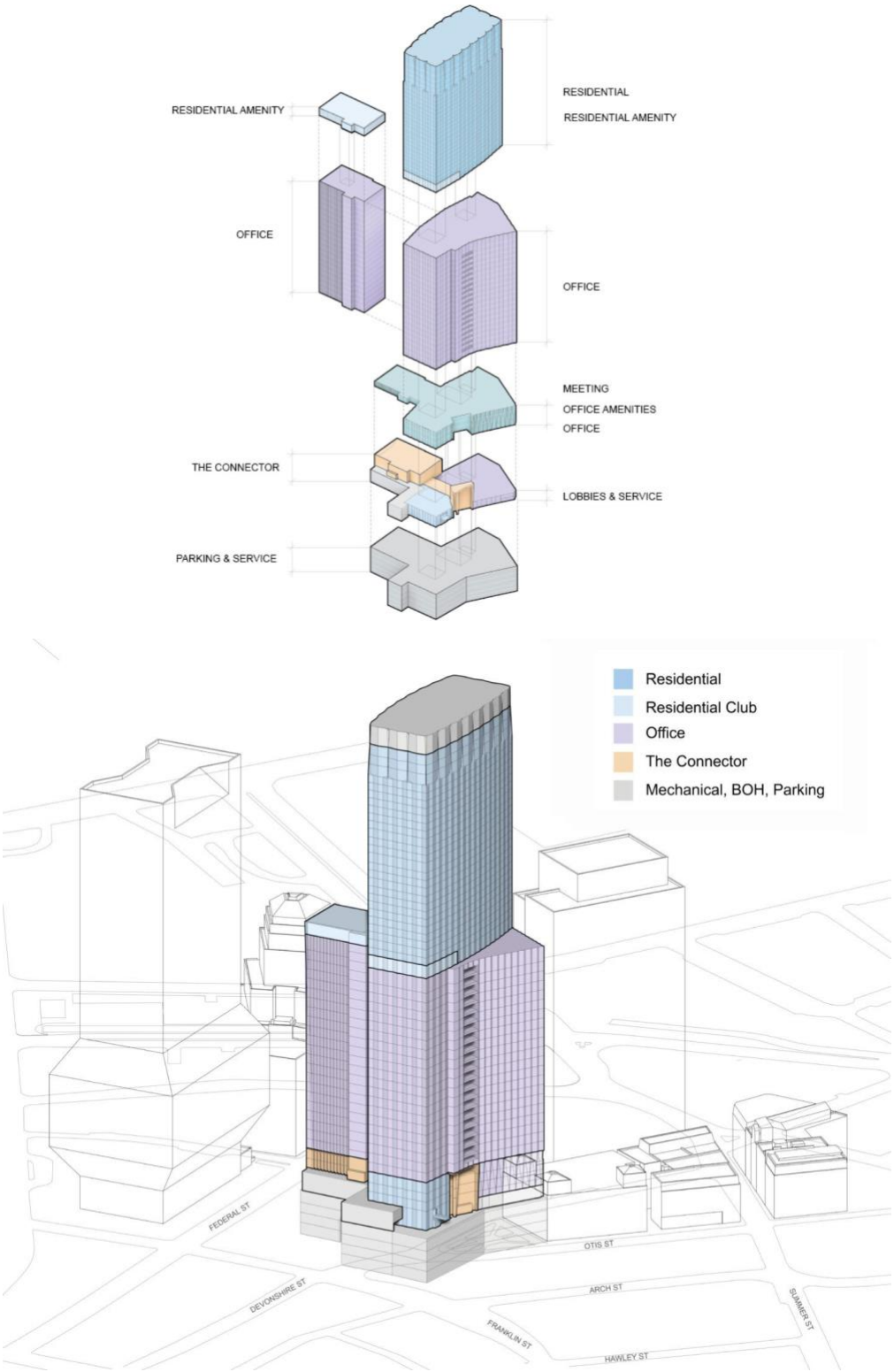
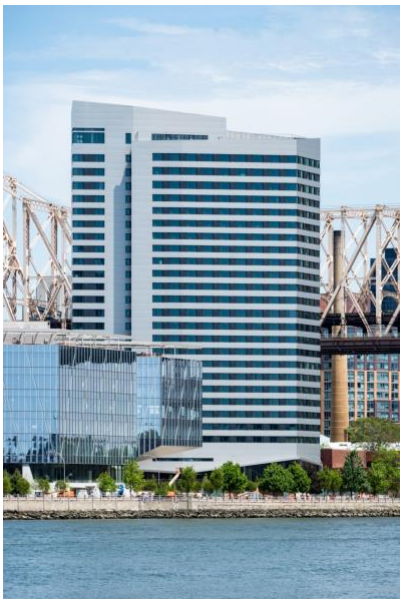


Exhibit 3: Winthrop Center Development Source

CATEGORY	AMOUNT
CONSTRUCTION LOAN	$700,000,000
MEZZANINE LOAN	$75,000,000
EQUITY	$525,000,000
TOTAL SOURCES	$1,300,000,000

Exhibit 4: 2016 Millennium Partner's submission to RFP

Exhibit 5: The House at Cornel Tech



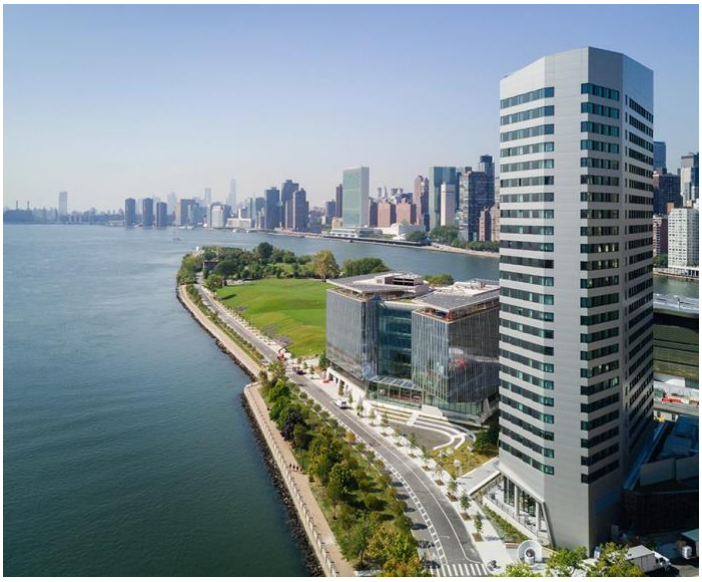


Exhibit 6a: Boston Office Market: Major Projects

Year	Projects	SF	Pre-Leased SF
2021	The Hub on Causeway (Tower)	630,000	589,580
	One Pose Office Square (Addition)	250,000	0
	111 Harbor Way (AMZN)	430,000	430,000
	Total	**1,310,000**	1,019,580
2022	Winthrop Center	812,000	0
	Total	**812,000**	**0**
2023	One Congress Street	1,001,200	509,707
	400 Summer Street (Foundation)	580,000	580,000
	Total	**1,581,200**	**1,089,707**

Exhibit 6b: Boston Office Market: Sample Completed Leasing Deals (2020)

Tenant	Rapid7	State Street	WeWork	Verizon (Oath)	Confidential E-Commerce	Confidential Life Sciences
Sign Date	Aug-19	Jan-19	Feb-19	Aug-18	May-18	Q3 2019
Property	The Hub on Causeway (Tower)	One Congress Street	One Lincoln Street	The Hub on Causeway (Tower)	Block L4	Seaport Square
Submarket	North Station	North Station	CBD	North Station	Seaport	Seaport
Size (RSF)	67,214	510,000	250,000	438,827	430,000	500,000 +
Floor(s)	9-10	1-27	24-34	15-21	3-17	3 – 17
Term	8 Years, 6 Months	15 Years, 8 Months	15 Years, 5 Months	20 Years	15 Years, 6 Months	15 Years
Starting Rent (NNN)	$60.00	$52.00	$58.00	Yrs 1-5: $49.50 Yrs 6-10: $52.50 Yrs 11-15: $55.50 Yrs 16-20: $59.50	$56.00	High $80s
Annual Esc.	2.00%	$1.00	2.00%	(See Above)	$1.00	2.50 – 3.00%
TI	$67.00	$115.00	$100.00	$150.00	$100.00	$175.00 - $200.00
Free Rent	0 Months	8 Months	5 Months	9 Months Free on RE Taxes & OpEx	6 Months	0 Months
Net Effective Rent	$56.84	$49.15	$56.95	$46.75	$54.52	-

Exhibit 6c: Boston Office Market: Sample Landlord Issued Proposals (2020)

Tenant	Confidential Proposal	Confidential Proposal	Confidential Proposal	Confidential Proposal	Confidential Proposal
Sign Date	Proposal Dated 7.9.19	Proposal Dated 6.5.19	Proposal Date 5.20.19	Proposal Date 8.1.19	Proposal Date 2.26.19
Property	601 Congress Street	One Post Office Square	One Congress Street	Seaport Square	1001 Boylston Street
Submarket	Seaport	CBD	North Station	Seaport	Back Bay
Size (RSF)	299,460	80,835	87,709	425,000	300,000
Floor(s)	6-14	28-30	30-32	3 – 17	12-20
Term	16 Years	15 Years, 3 Months	15 Years	15 Years	15 Years
Starting Rent (NNN)	$59.75	$75.00	$70.00	Mid/High $80s	$69.50
Annual Esc.	2.50%	2.50%	2.50%	2.50 – 3.00%	2.50%
TI	$100.00	$115.00	$100.00	$100.00 - $120.00	$120.00
Free Rent	12 Months	3 Months	0 Months	0 Months	8 Months
Net Effective Rent	$60.71	$80.65	$77.02	-	$70.72

Exhibit 6d: Boston Office Market: Sample Landlord Issued Proposals (2020)

Address	SF	Sale Date	Sale Price	Price/SF	Cap Rate	Seller	Buyer
75 State Street	841,000	Pending	$630,000,000	$749.10	4.90%	Brookfield Office Properties	DivcoWest / Rockpoint Group
100 Summer Street	1,100,000	Pending	$913,000,000	$830.00	3.96%	Blackstone	Rockpoint Group
121 Seaport Boulevard	400,342	12/13/2018	$455,000,000	$1,136.53	4.50%	Skanska USA Building, Inc	American Realty Advisors & Norges Bank Investment Management
53 State Street	1,216,472	12/7/2018	$845,000,000	$694.63	5.00%	UBS Realty Investors	Allianz Real Estate of America & Beacon Capital Partners
200 State Street	304,478	11/5/2018	$222,000,000	$729.12	4.60%	GLL Real Estate Partners	Carr Properties
200 Pier Four Boulevard	372,372	8/23/2018	$450,000,000	$1,208.47	4.19%	Tishman Speyer	CommonWealth Partners
28 State Street	572,000	6/6/2018	$418,000,000	$730.77	4.98%	TA Realty / Rockefeller Group Investment Management / Mitsubishi Estate New York	Heitman Capital Management
253 Summer Street	201,000	11/30/2017	$140,000,000	$696.52	4.70%	Synergy Investments & Independencia Asset Management	Morgan Stanley Real Estate
100 Northern Avenue	516,000	3/22/2017	$447,000,000	$866.28	5.00%	Fallon Company & Barings Real Estate Advisors	RREEF
10 St. James Avenue & 75 Arlington Street	825,000	1/6/2017	$673,000,000	$815.76	4.25%	Liberty Mutual Insurance Company	Mori Trust Company

Exhibit 7: Winthrop Center Condo Unit Mix (2019)

Type	Number	Size Range	Percent
Studio plus den	15	720 SF	4.0
One bedroom	69	735 - 900SF	18.3
One bedroom plus den	56	1230 - 1370 SF	14.8
Two bedroom	135	1150 - 2487 SF	35.7
Two bedroom plus den	64	1475 - 3690 SF	16.9
Three bedroom	39	2045 - 5067 SF	10.3

Exhibit 8: Boston Luxury Condominium Market (2019)

Development	Number of Units	Percent Sold (Estimate)	Price Range (Estimate)
One Dalton	160	75%	$1750 - 4000 PSF
Pier Four	106	80%	$1225 - 4180 PSF
Echelon 1	255	50%	$1200 - 2400 PSF
Echelon 2	192	10%	$1100 - 2000 PSF

Exhibit 9: Passive House Principles

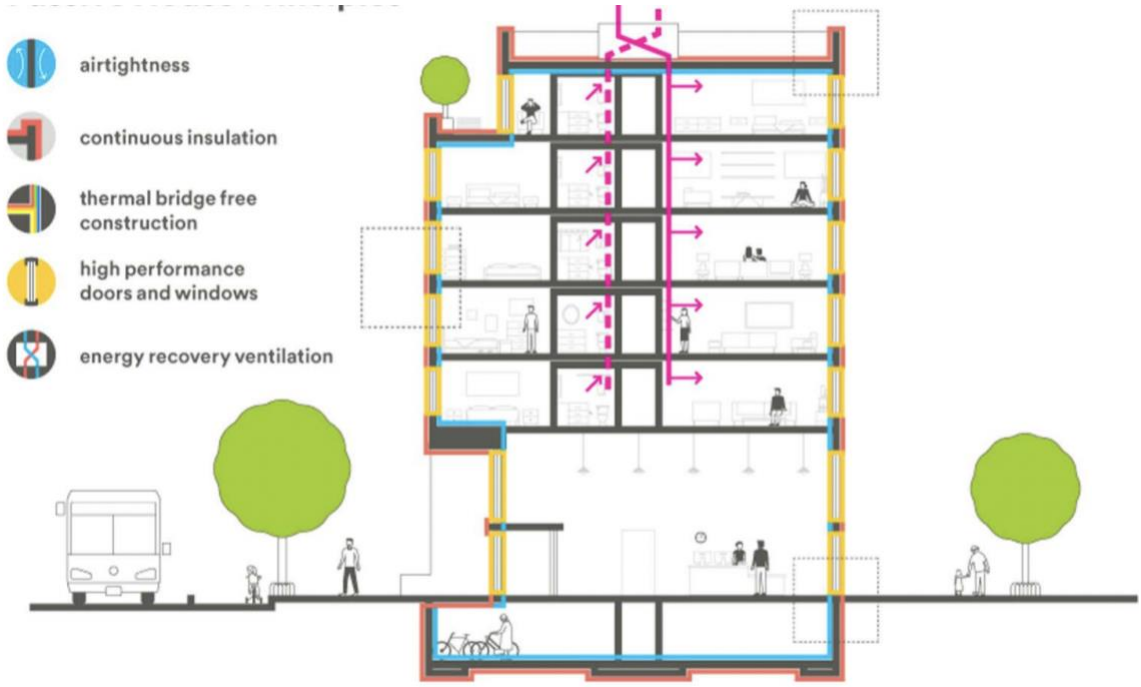


Exhibit 10: LEED-NC Criteria

Certification Level	V2.2	V2009	V4
Certified	26-32	40-49	40-49
Silver	33-38	50-59	50-59
Gold	39-51	60-79	60-79
Platinum	52-69	80 or above	80 or above

Credit Category	V2.2	V2009	V4
Location & Transportation			16
Sustainable Site	14	26	10
Water Efficiency	5	10	11
Energy & Atmosphere	17	35	33
Materials & Resources	13	14	13
Indoor Environmental Quality	15	15	16
Innovation & Design Process	5	6	6
Regional Priority		4	4
Integrative Process			1
Total Base Points	**69**	**100-110**	**110**

Table from Aydin Tabrizi, "LEED as a Green Rating System and the Importance of Moving to NZEB," 2021. License: CC BY.

Exhibit 11: Winthrop Center's Pro Forma

COMPONENTS		NET SQUARE FEET	$ RATE PER SF	INCOME
CONDOMINIUMS		500,821	$2,211	$1,107,315,231
OFFICE- Floor 2, 4-23 NET rent		812,000	$55	$44,660,000
OFFICE PARKING	150 spaces	-	-	$750,000
RESIDENTIAL PARKING	300			
RETAIL KIOSKS		-	-	$1,500,000
LONG BAR/MEZZ RESTAURANT		-	-	$1,500,000
CONFERENCE CENTER/PODS			-	
TOTAL AREA		1,312,821		$1,155,725,231

B. DEVELOPMENT USES

CATEGORY	COST	$/NSF
LAND COST	$102,000,000	$78
HARD COSTS	895,591,000	$682
SOFT AND OTHER COSTS	204,159,000	$156
CONSTRUCTION INTEREST	40,000,000	$30
OWNER CONTINGENCY	58,250,000	$44
TOTAL USES	$1,300,000,000	$990

COMPONENTS			RESIDUAL NET INCOME	NET CAPITALIZED VALUE
		NNN $/SF		
CONDOMINIUMS	Gross Sales	$2,211	$1,155,725,231	
	Less: City Payment:	($123)	(61,549,497)	
	Less: Selling Expenses @ 6.00%	($133)	(69,343,514)	
	Net Residential Sales	$1,955	$1,024,832,220	$1,024,832,220
		NNN $/SF		
OFFICE	Triple Net Rent	$55	$44,660,000	
	Expense Reimbursement	$20	16,240,000	
	Effective Gross Income	$75	60,900,000	
	Operating Expenses	($9)	(7,308,000)	
	Real Estate Taxes	($11)	(8,932,000)	
	Net Operating Income	$55	$44,660,000	
	Capitalized at:		4.25%	$1,050,823,529
PARKING (OFFICE & RESIDENTIAL)	Net Operating Income		$750,000	
	Capitalized at:		4.25%	$17,647,059
RETAIL/KIOSKS	Net Operating Income		$1,500,000	
	Capitalized at:		5.0%	$30,000,000
LONG BAR/MEZZ RESTAURANT	Net Operating Income		$1,500,000	
	Capitalized at:		5.0%	$30,000,000
CONFERENCE CENTER	Net Operating Income			
	Capitalized at:		5.0%	$0
				$2,153,302,809

PROJECT SUMMARY	
Net Capitalized Value	$2,153,302,809
Less Development Costs	(1,300,000,000)
Operating Surplus/(Deficits)	82,188,117
Value in Excess of Costs	935,490,926
Return on Cost	72.0%

Notes:
(1) Does not include residential parking, which is assumed to be for the private use of residents and is expected to breakeven. Schedule projects gross income for office, condominium and parking. It projects net operating income for Retail/Kiosks, Long Bar/Mezz Restaurant and Conference Center

Exhibit 12: Winthrop Center's Interim Design: Cost Estimates

High-Performance (Passive House)	Office Portion	Residential Portion
Passive House Curtain Wall	$ 6,500,000	5200000
Passive House Testing premium - carpentry	$ 225,000	180000
Passive House floor-by-floor testing prep	$ 425,000	340000
Passive House Testing	$ 250,000	200000
Passive House Energy Recovery Units	$ 500,000	400000
Aerosealing Vertical Ductwork (minimizing air leakage)	$ 250,000	200000
Efficient motors (pumping energy reduction)	$ 320,000	256000
Efficient design for Tenant - 4 delivery points of CHW/HHW/Fresh Air	$ 650,000	520000
SUBTOTAL	**$ 9,120,000**	**$ 7,296,000**
Healthy Buildings (WELL Gold)		
Enhanced Ventilation (More Fresh Air)	$ 550,000	
Cost Premium for Terraces over typical Core and Shell	$ 735,000	
Indoor Air Quality Sensors	$ 100,000	
Touchless Design	$ 175,000	
Additional WELL Requirements	$ 550,000	
Air and Filtration	$ 450,000	
SUBTOTAL	**$ 2,560,000**	
LEED Items (Platium for Office, Gold for Residential)		
Enhanced Comissioning	$ 225,000	$ 100,000
Metering	$ 200,000	$ 50,000
Stormwater Collection Treatment and Reuse	$ 475,000	
Digital App Features	$ 200,000	$ 50,000
Resource protection and materials	$ 225,000	
Parksmart Features	$ 75,000	
Miscellaneous	$ 300,000	$ 200,000
SUBTOTAL	**$ 1,700,000**	**$ 400,000**
Additional Items (for Office Portion)		
Mobility	$ 25,000	
Green Power	$ 35,000	
EV Charger Future	$ 95,000	
Integration of systems to enable high-performance, healthy building	$ 125,000	
High efficiency designs ERUs, etc	$ 375,000	
Certifications		
Certification - Passive House	$ 175,000	
Certification WELL	$ 135,000	
Certification LEED Office	$ 75,000	
Certification LEED Resi		$ 50,000
Certification Parksmart		$ 10,000
Soft Costs		
Soft Costs - Consultants	$ 1,250,000	
Soft Costs Performance Testing Passive Houe	$ 325,000	
Soft Costs Performance Testing WELL	$ 175,000	
Soft Costs Performance Testing LEED Resi (Blower Door)		$ 50,000
Energy Modeling Premiums	$ 200,000	$ 25,000
SUBTOTAL	**$ 1,950,000**	**$ 75,000**
TOTAL	**$ 16,370,000**	**$ 8,486,000**