

# NIHONBASHI

## FINAL REPORT

GEORGIA INSTITUTE OF TECHNOLOGY  
MAY, 2023





# Tokyo Smart City Studio at Nihonbashi, Tokyo

## International Urban Design Studio - Spring 2023

Eco-Urban Lab - School of City and Regional Planning & School of Architecture  
College of Design - Georgia Institute of Technology

In Collaboration With:

Department of Urban Engineering, the University of Tokyo  
Mitsui Fudosan - the University of Tokyo Laboratory  
Graduate School of System Design and Management, Keio University

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Cover Photo: By @wen\_xiao via Unsplash

This proposal is the output of the urban design studio of the graduate school educational program, and does not reflect the intentions of local stakeholders.

# Table of Contents

<b>Introduction</b>	<b>6</b>
<b>Mission Statement</b>	<b>10</b>
<b>Studio Process</b>	<b>12</b>
<b>Historic Nihonbashi</b>	<b>16</b>
<b>The Site: Nihonbashi District Two</b>	<b>22</b>
<b>Key Performance Indicators (KPI)</b>	<b>32</b>
<b>Design Scenarios</b>	<b>42</b>
(1) Human Scale	
(2) High Density	
(3) Business as Usual	
<b>Final KPI and Planning Support System</b>	<b>74</b>
<b>References</b>	<b>82</b>





Kidaishoran: A painting that shows a bird's-eye view of Nihonbashi street, today's Chuo-dori of Tokyo in 1805.

# Introduction

# Tokyo Smart City Studio: Georgia Tech 2017-2023

Professor Perry Yang



The Tokyo Smart City Studio explores a method of data-driven urban design, and how digital urban technologies enable architects and planners to comprehend cities, urban spaces and architecture from data visualization, mapping, modeling, performance evaluation to architecture and urban form making. The project aims to design a smart urban district that is carbon neutral, climate resilient and post-covid-19 conscious.

The Tokyo smart city project is an international collaboration between Georgia Tech's Eco Urban Lab of the School of City & Regional Planning and the School of Architecture, the Department of Urban Engineering of the University of Tokyo, and the Graduate School of System Design and Management of Keio University, a studio collaborative teaching from 2017 to 2023 over seven years. This collaborations between three studios in the U.S. and Japan have been exploring smart city design test beds in different urban settings around Tokyo's metropolitan area, from 2017 in Urawa Misono, one of Tokyo's Summer Olympics sites, 2018 and 2019 in Kyojima of Sumida, an inner city neighborhood, 2020 and 2021 in Shinagawa, a waterfront development around the high-speed rail terminal for a new Shinkansen maglev system connecting Tokyo and Osaka, and 2022 and 2023 in Nihonbashi, a historical origin of modern urban development of Tokyo and Japan from Edo period of the early 19th century.

The Tokyo studio in 2022 - 2023 was organized in sequence over one academic year: The University of Tokyo and Keio University conducted the Nihonbashi studio in Fall 2022 to develop planning strategies and scenarios of future urban development toward 2050 for carbon neutrality. Based on the scenarios projected by the Tokyo planning team, Georgia Tech's studio continued the project in Spring 2023 to focus on urban design and how data-driven planning can be incorporated into a digital platform for moving complex decisions with stakeholders. The Georgia Tech Studio envisions patterns, models and mechanism of future city development in Nihonbashi. Four approaches were taken this year:

**(1) Data-Driven Planning** investigates urban data of the Nihonbashi and Tokyo central city area to visualize patterns and trends in social demographics, built form, mobility, visual quality and urban climate of the area. A policy framework of key performance indicators (KPI) for ecological urbanism was applied to measuring and benchmarking quality and performance of existing urban environment and future planning scenarios.

**(2) A Human-Scale Design Proposition** was suggested to regenerate the area to be a vibrant, intimate and culturally sensible urban environment that refers to the historical landscape of Nihonbashi from Edo-period. Facing population decline and aging society of Japan, a lower density development and compact urban form of the proposal suggest a possible future urban living in central Tokyo.

**(3) A High-Density Development Proposition** was taken assuming that Nihonbashi needs its new vision to redefine its centrality in Tokyo. Through collaborating with Keio University on urban air mobility research, a new hub of vertiports was proposed along Nihonbashi waterfront to connect the area to Narita and Haneda international airports. This high-density green mosaics design would shape new urban skylines of Nihonbashi, a nexus of future urban air mobility and current public transit ground transportation to accommodate new mixed uses and mixed generational communities for both local residents and global entrepreneurs.

**(4) A Business-As-Usual Proposition** was chosen to examine existing urban social fabric of Nihonbashi, which requires incremental process of regeneration to achieve its goals of carbon neutrality by 2050. A performance-based planning tool Solar Envelope suggests how an urban neighborhood achieve its low carbon development through optimizing solar renewable energy and redesign high performance building through revitalization. A public realm of central park is designed that contains an urban data center to coordinate a long-term process of neighborhood regeneration and to incorporate smart technologies and systems integrations.

The Studio this year combined efforts from interdisciplinary and cross-cultural studio team of the U.S. and Japan to integrate data-driven planning and urban system design that lead to the following questions for lessons learned:

- **What urban design interventions would enhance carbon neutrality and climate resilience for post-covid urban development?** The studio proposed models of new urban form and systems design and tested their performance in carbon neutrality and climate resilience. Through tackling key variables such as density, building and land use functions, mobility network systems and urban climate, architects and planners design urban form alternatives, regeneration models and infrastructural systems at the level of neighborhood and communities. We argue that defining a designable and actionable systems through the community-level design is critical to the global carbon agenda and climate challenges, in which architects and planners will play critical roles.
- **How would data analytics inform planning that is defined in specific urban, social and institutional contexts?** While data-driven planning techniques enable planners to capture and manage enormous amount of data and conduct data visualization and spatial analytics, there are needs to fill the gap between data analytics, problem formations and strategic planning. It is critical to facilitate further processes for stakeholders and community engagement to contextualize problems and key issues.
- **What generate future urban form?** Finally, we again raise this classic question that has been central in architecture and planning studio education. While planners project scenarios of future urban changes based on social demographics and urban spatial information, architects and urban designers envision new architecture and urban systems through propositions. The studio facilitates joint processes between a planning decision making based on data-driven and modeling method, and an urban design form making for systems integration that rely on synthetic and creative thinking.

A handwritten signature consisting of stylized, cursive initials and a surname.

May 04, 2023



# Mission Statement



## Mission Statement

**The 3C's:  
carbon neutrality,  
climate resiliency,  
& post-Covid-19 conscious**

**Our studio's mission is to enhance the Nihonbashi neighborhood through:**

1. Celebrating the progress and history of the neighborhood
2. Engaging stakeholders across social, cultural, and geographic distances
3. Ensuring that future development supports climate resiliency and livable and people-focused communities
4. Adding open spaces that support synergy between blue and green systems
5. Designing streetscapes and transit that makes movement enjoyable and accessible
6. Helping the neighborhood become more resilient to shocks such as Covid-19 or natural disasters
7. Anticipating trends and needs of population changes with land use
8. Harnessing smart technologies to enhance quality of life and economic opportunity, as well as our designs and processes
9. Catalyzing Tokyo's pursuit of carbon neutrality by using Nihonbashi as an example.

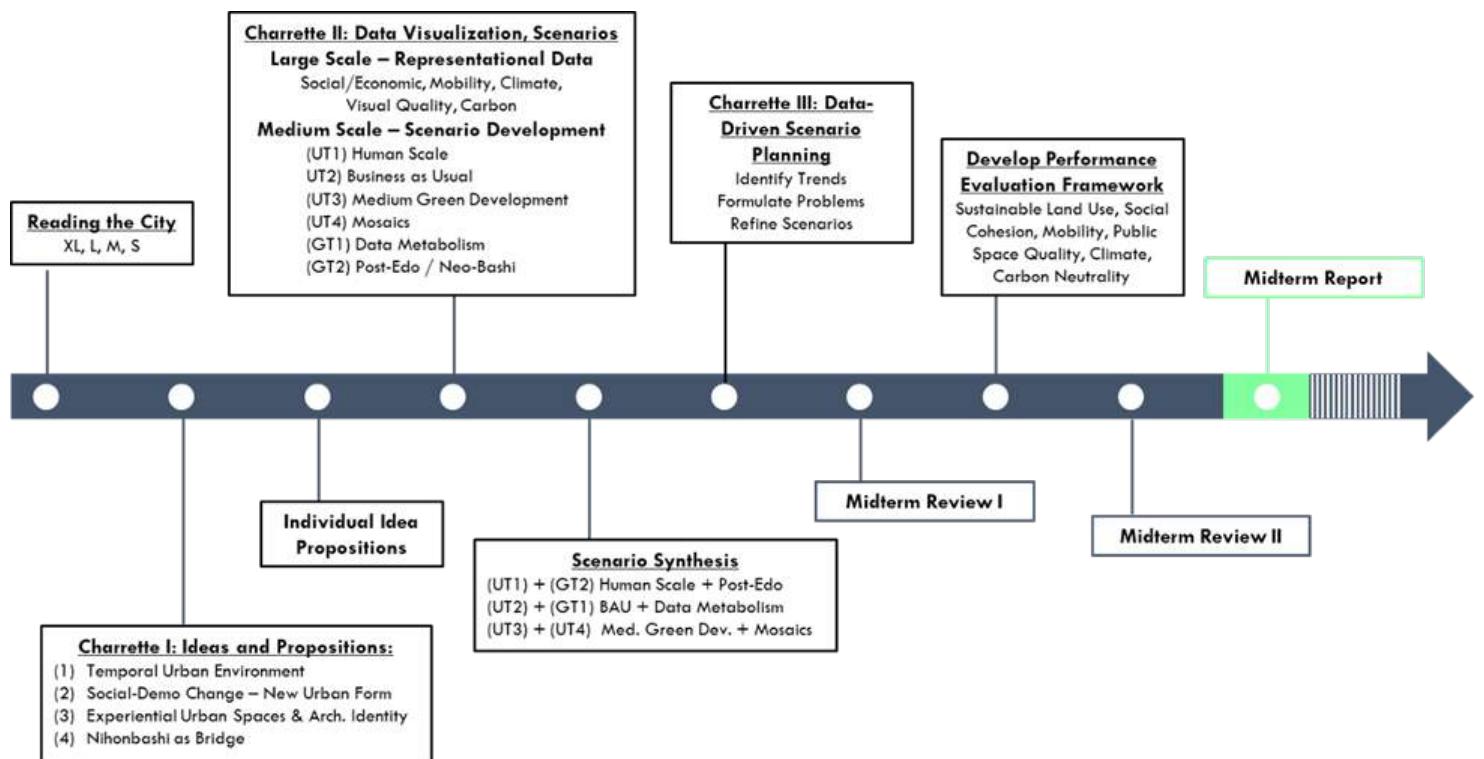
# Studio Process

The Spring 2023 Studio investigates Nihonbashi (meaning "Japan Bridge"), a business district in Chuo-ku, and focuses specifically on District Two, a 5-hectare area on the eastern side of the Nihonbashi River. In the Edo Period (1603-1868), Nihonbashi was the bustling mercantile center of Tokyo, but it has since lost much of its original vibrancy. Alongside other projects that aim to revitalize Nihonbashi and establish a direction for its future, this studio proposes three design scenarios for Nihonbashi's District Two to demonstrate how a low-carbon, smart community can be designed, evaluated, and implemented.

Since January 2023, Georgia Tech students have completed weekly workshop sessions, three design charettes, and two midterm reviews. From March 19-26, there was a week-long workshop in Tokyo with students from Georgia Tech and University of Tokyo. Students will work together to refine their design concepts and then presented to Mitsui Fudosan during a stakeholder meeting on Saturday, March 25. Upon their return from Tokyo, Georgia Tech students conducted a final review with an audience in Atlanta.

Students in the Georgia Tech studio are separated into two teams, a data-driven planning team and a design scenario team. The data-driven team provides data and insights to the design team, with a goal of informing their work and helping them predict the impact of their designs on the urban form, function, and experience of Nihonbashi's District Two. The design scenario team is split into three groups, each of which has created a unique design scenario for District Two.

- (1) Human Scale,
- (2) Urban Regeneration
- (3) High Density Green Mosaic



The three Georgia Tech design scenario team refined their initial concepts and incorporated insights from the data-driven planning team, such as demographic projections, economic trends, and mobility patterns. To evaluate the three design scenarios, the data-driven planning team developed a performance evaluation framework to measure and rate the designs according to several key performance indicators. The framework is based upon six key thematic goals that are critical for designing a low-carbon, smart community:

- (1) Sustainable Land Use
- (2) Social Cohesion
- (3) Mobility
- (4) Public Space Quality
- (5) Climate
- (6) Carbon Neutrality.

Using this framework, the data-driven planning team and the design scenario teams worked together in a co-design process to incorporate site observations from the Tokyo visit, as well as feedback from partners and stakeholders.

### プランニング案の比較 | Plan Alternatives



**Design Scenarios:** Four Proposals Developed by the University of Tokyo Students (2022)



**Design Scenarios:** Three Proposals Developed by the Georgia Institute of Technology Students (2023)



# Historic Nihonbashi

# History of Nihonbashi

Maggie Nicholson (Spring 2022 Studio)

Historic Nihonbashi was once swirling with water. The ancient flows of several rivers along its low, alluvial plains resulted in a canny water management strategy involving canals and bridges. These traditional water systems supported a lively exchange of goods and ideas, local and national transport, Edo Castle's security strategy, and local cultural identity. Nihonbashi's fish, produce, craft, and textile markets centered on its canal network, while its infamous Nihonbashi bridge (or "Bridge of Japan") was instrumental in cultivating Japan's national road network and postal service. The original wooden bridge was constructed with the establishment of the Tokugawa or Edo shogunate, Japan's final period of traditionalism. With the Nihonbashi Bridge as Japan's zero-mile post - the first or last station of the Tokaido - the ward naturally evolved as Tokyo's mercantile district with the constant ebb and flow of travelers.



"Nihonbashi After the Snow" (Nihonbashi Yukibare), by Hiroshige Ando. Part of the "One Hundred Famous Views of Edo"



Nihonbashi in Edo (Edo Nihonbashi) from the series "Thirty-six Views of Mount Fuji" by Katsushika Hokusai (ca. 1830 - 1832)



The Nihonbashi Bridge circa 1872. Courtesy of the Kammerhof Museum.

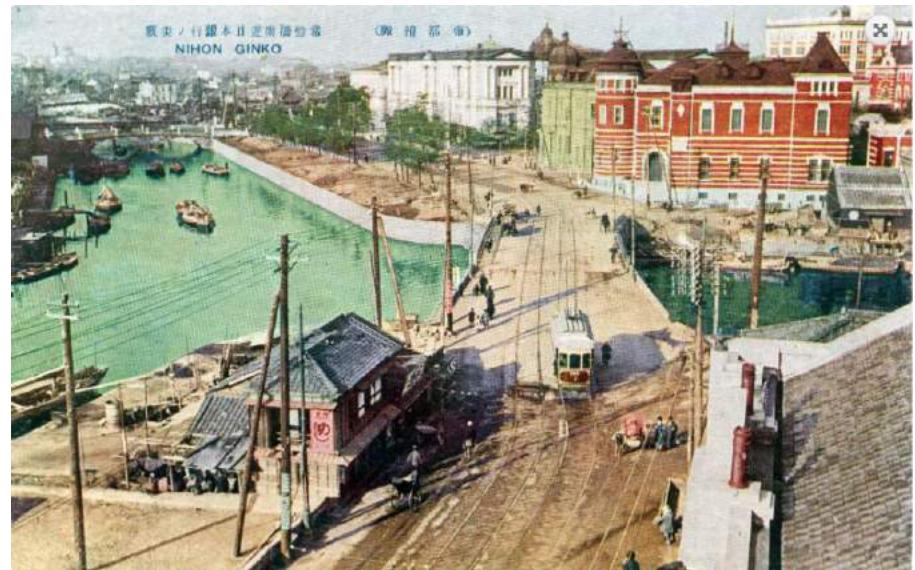
After the 1868 Meiji Restoration, the government renamed Edo (meaning "bay entrance") as Tokyo ("eastern capital") and relocated the emperor here from the historic capital of Kyoto. As Tokyo westernized through the late 1800s, European visitors compared the new capital to their own continent's great water city - Venice. Just as Venice exudes European cultural prowess, Nihonbashi's canal waterfront was the collective manifestation of Japanese intellectual, social, and artistic achievement built upon the island nation's customs, traditions, and way of life forever surrounded by and immersed with water.

The increasing prominence of Nihonbashi within Tokyo and within Japan solidified the ward as a national finance center. The Tokyo Stock Exchange, established in 1878, was constructed on its current Nihonbashi site in 1931. The Bank of Japan is the central bank of the nation and united the country under a common currency, the yen, in 1871. Its neobaroque facility was constructed atop the site of a gold mint on the northern shore of the Nihonbashi River in 1896.

However, one of the most prominent commercial endeavors to emerge from Nihonbashi started as Mitsui's Echigoya textile shop, opened in 1673 by Mitsui Takatoshi (1622-1694). By 1904, the shop had expanded business enough to rebrand as Japan's first department store, Mitsukoshi. Expanding further still, the Mitsui Company began investing in real estate holdings in 1914 targeting Nihonbashi specifically. Today, Mitsui is considered one of Japan's premier corporate holdings companies and one of the top 2,000 largest public companies in the world.



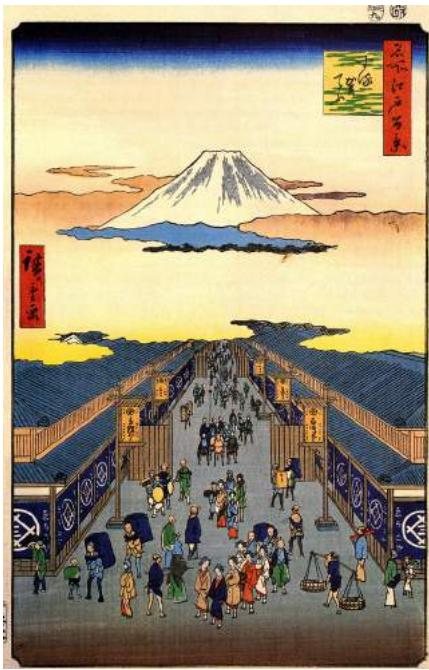
View across the Nihonbashi river canal towards the Bank of Japan circa 1910 (oldtokyo.com)



Looking across Ikkokubashi towards the Bank of Japan (center white structure) and Tokiwabashi (left), circa 1915 (oldtokyo.com)



Streetcar passing over the Yoroibashi (Armor Bridge constructed of iron in 1872) with the Tokyo Stock Exchange building to the right, circa 1910 (oldtokyo.com)



Left: Hiroshige's ukiyo-e print with Mount Fuji (background) and Echigoya (left foreground) as landmarks. Mitsukoshi's main store in Nihonbashi circa 2000s

Top: Mitsukoshi's main store in Nihonbashi circa 2000s

Nihonbashi's developmental history is consistently progressive, but not without setbacks. While Nihonbashi Bridge survived fires, the Great Kanto Earthquake of 1923, and the bombing of Tokyo during World War II, surrounding blocks experienced colossal destruction in all scenarios. Whereas Tokyo's wards historically fashioned a mosaic city - a patchwork of neighborhood locales shaped by their unique terrains and histories, reconstruction following these atrocities embraced increasingly more western styles of building. For Nihonbashi, the successive phases of occidental influence caused deeper and deeper ruptures with the ward's traditional water-based development. As land inheritance tax structures evolved after WWII, large parcels were subdivided for landholders to maintain affordability and new parcel typologies, such as flagpole lots, became common during selloffs.

The bridge met its ultimate demise when the elevated Metropolitan Expressway was constructed over the course of the Nihonbashi River in preparation for the 1964 Tokyo Olympics. This act was the final rupture of the ward and its residents from the historic lifeblood waterfront; the expressway megastructure sent Nihonbashi into a cultural and environmental decline with waterway economics nullified.

As greater Tokyo Bay continued to industrialize, water surface area lessened and water quality worsened. Nowadays, Tokyo is less a "water city" and more a city next to water, disconnected from its best asset. Natural coastlines and historic vistas are unrecognizable given landfill practices, sprawling industrial sites, and towering skyscrapers. Traveling up the few remaining Tokyo canals or upstream tributaries evokes romantic images of what life on the water must have been like - little traffic, quietness, brief encounters with natural greenspace and wildlife.

The Olympic legacy of elevated highways is a blessing in disguise. To avoid the cost and hassle of purchasing privately owned land parcels, Japanese transportation officials built their vehicle networks directly above rivers and canals. This allowed Nihonbashi's block structure to remain mostly intact. In 2017, Tokyo's Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) set plans in motion to remove the Nihonbashi flyover following the 2020 Olympic Games, relocating the expressway as a tunnel road under the Nihonbashi River. Moving highway environmental concerns below ground seems moot by Tokyo sustainability goals compared to a complete removal, but daylighting the river provides positive outcomes, nonetheless. These include an increase in water transit fleets, improved water flow and quality, mitigation of urban heat islands, restored natural vistas, and increased access to recreational green and blue spaces.

Nihonbashi Bridge after the Great Kanto Earthquake of 1923. Nihonbashi Bridge following the 1945 Bombing of Tokyo (ca. 1946)



Nihonbashi Bridge following the 1945 Bombing of Tokyo (ca. 1946)





# The Site: Nihonbashi District Two

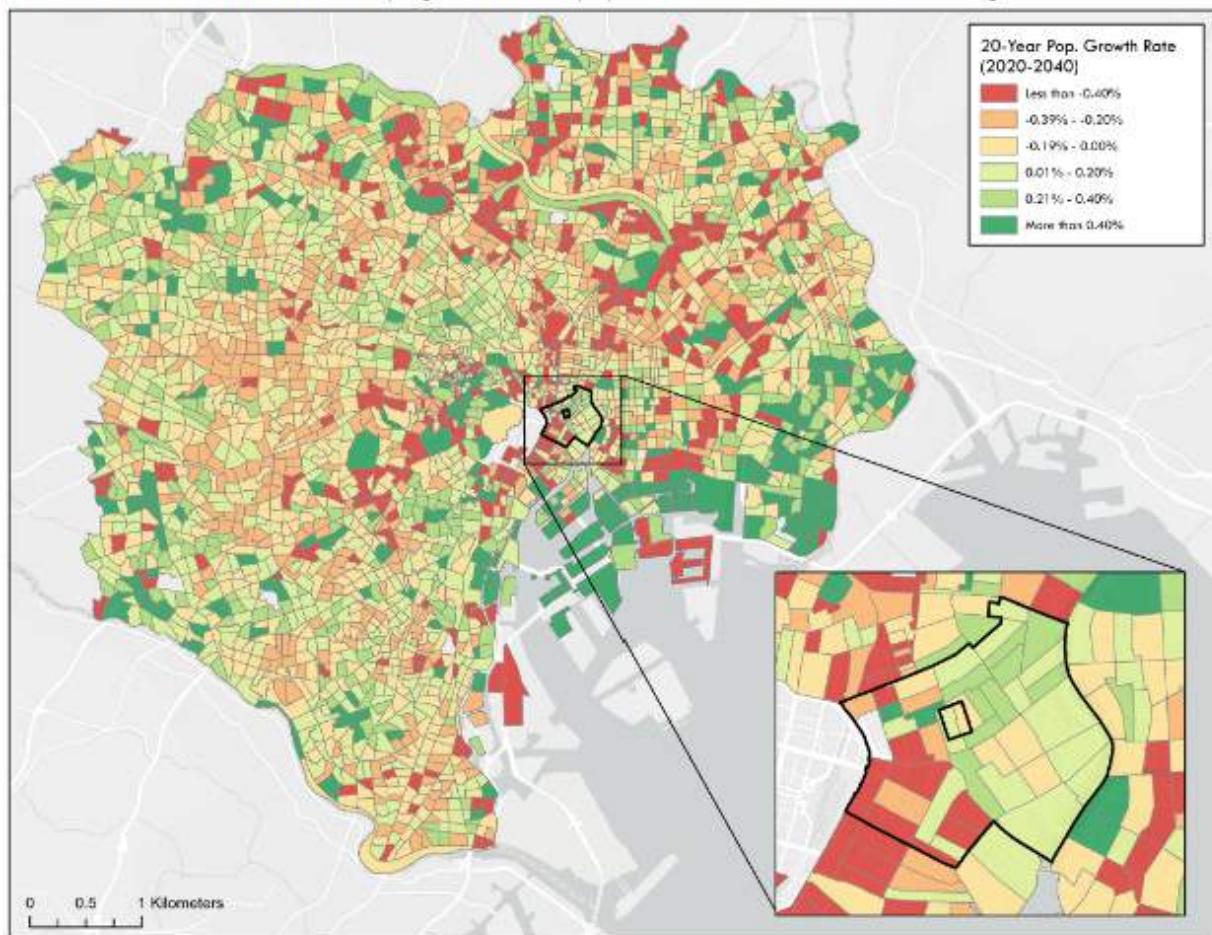


# Current Condition Analysis

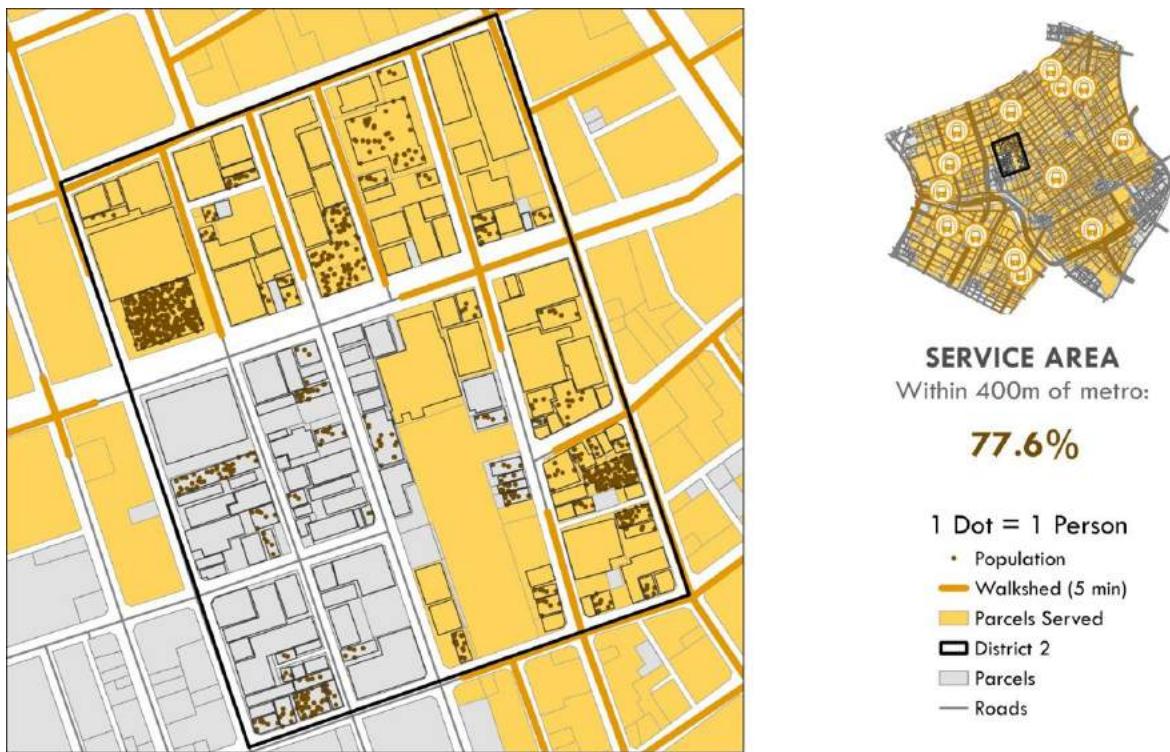
Aaron Beattie, Yasamin Khorashahi, Cooper Brock, Umar Farooq, Heather Mase, Yuxiang Zhao

Nihonbashi and District 2 are experiencing many unique, contradicting sociodemographic trends across the Tokyo Metropolitan area. Japan's population decline is well-documented, and some features of this trend have made their way into the central city and of Nihonbashi. However, as populations shift across the built environment, most high activity areas are centered around the suburbs and Central Tokyo, of which Nihonbashi is located. Another unique quality of the study area is the drastic changes in daytime and nighttime populations. Chuo Ward, of which Nihonbashi and District 2 are located, has a day to night population ratio of 3.74, or 4 employees for every resident. These demographic trends make design recommendations based on sociodemographic data difficult, especially when one factors in potential immigration policies that could be implemented to alleviate the pressures of the current population decline.

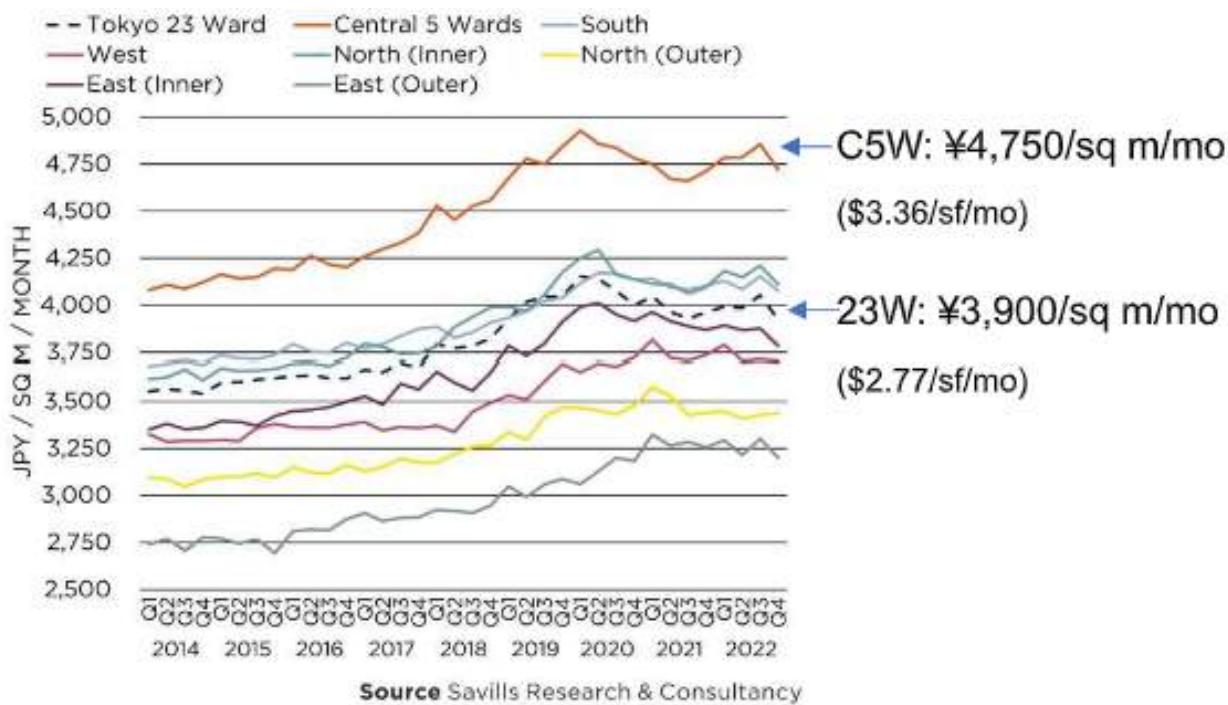
Within Tokyo's 23 Wards, the highest population growth is projected near **Tokyo Bay** and the outerlying suburbs. **Western Nihonbashi** is projected to see population decline over the next 20 years.



While Nihonbashi is experiencing some stable population increase, large-scale commercial and office projects have continued to sprout up along the western and southern parts of the district. The COVID-19 Pandemic had major impacts on office work culture and office rental rates. In Nihonbashi however, these effects were less severe with a shorter recovery period than many other areas across Tokyo, indicating the area will continue to be a desirable and high activity area moving forward. As for residential rental rates, Chuo Ward has experienced much higher rates with younger age brackets living near major business hubs of the central business district, in which Nihonbashi is in proximity.



With the major shifts in population across a 24-hour period, a robust transportation system is required to reliably such vast numbers. Based on personal trip data, external trips into Nihonbashi are done by train, and internal Nihonbashi trips are performed 93.6% by walking or biking. These environmentally friendly transportation options support the final goal of a net-zero development, and further recommendations should work to enhance existing travel behavior. 84% of all parcels within Nihonbashi fall within a 5-minute walk from metro stations, yet the designated study area of District only has 65% of parcels within a 5-minute walk. Systems such as bike shares could be implemented in inaccessible areas to further increase connectivity and reduce travel times to train stations.

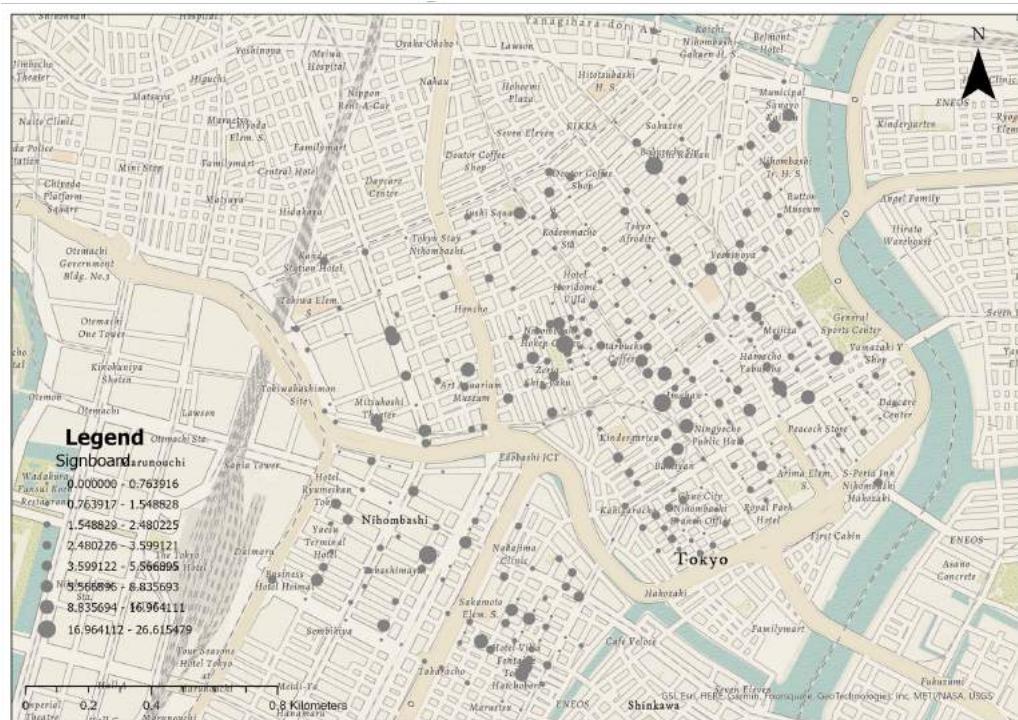


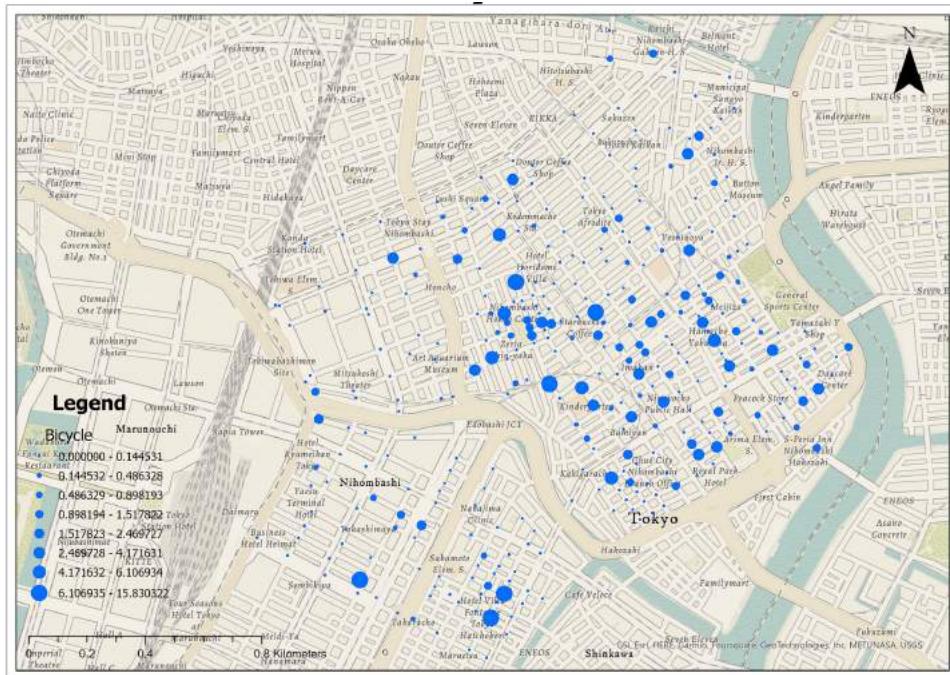
# Urban Visual Quality

Three additional analyses were conducted on the current conditions of the site. First, Google Streetview API was utilized to assess the visual quality of the urban street grid. The Streetview camera was set up from multiple angles at different intersections to assess the streetscape. For the intersection, four camera positions get the image of four views, for the general road, set two camera positions. Notable features of the streetscape were signboards, bicycles, and urban greenery.

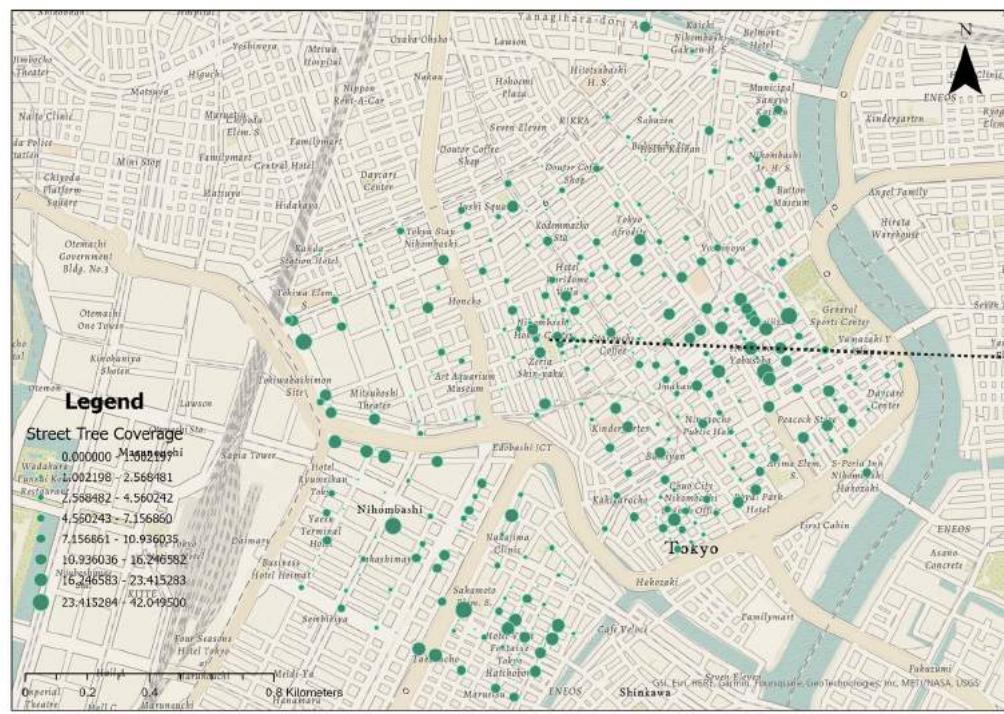


## Signboard





**Bicycle**



**Green Vegetation**

**District 2**

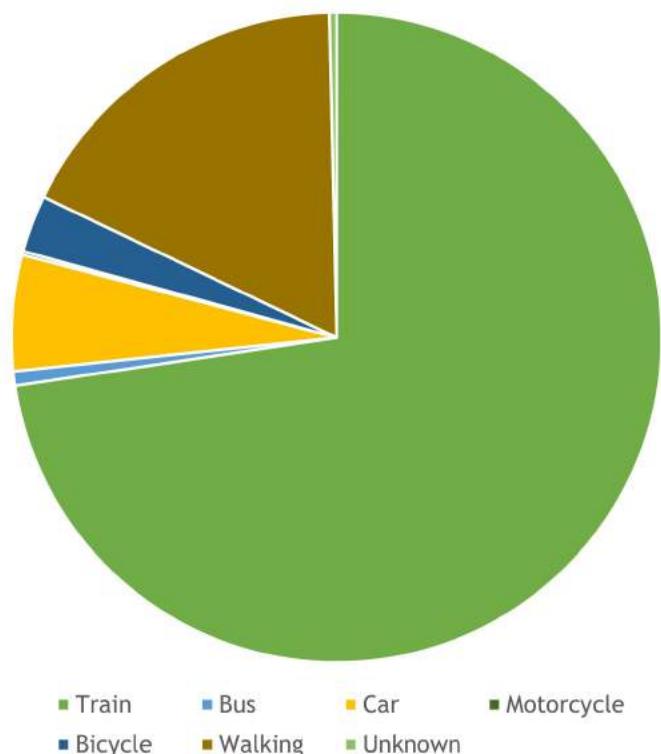


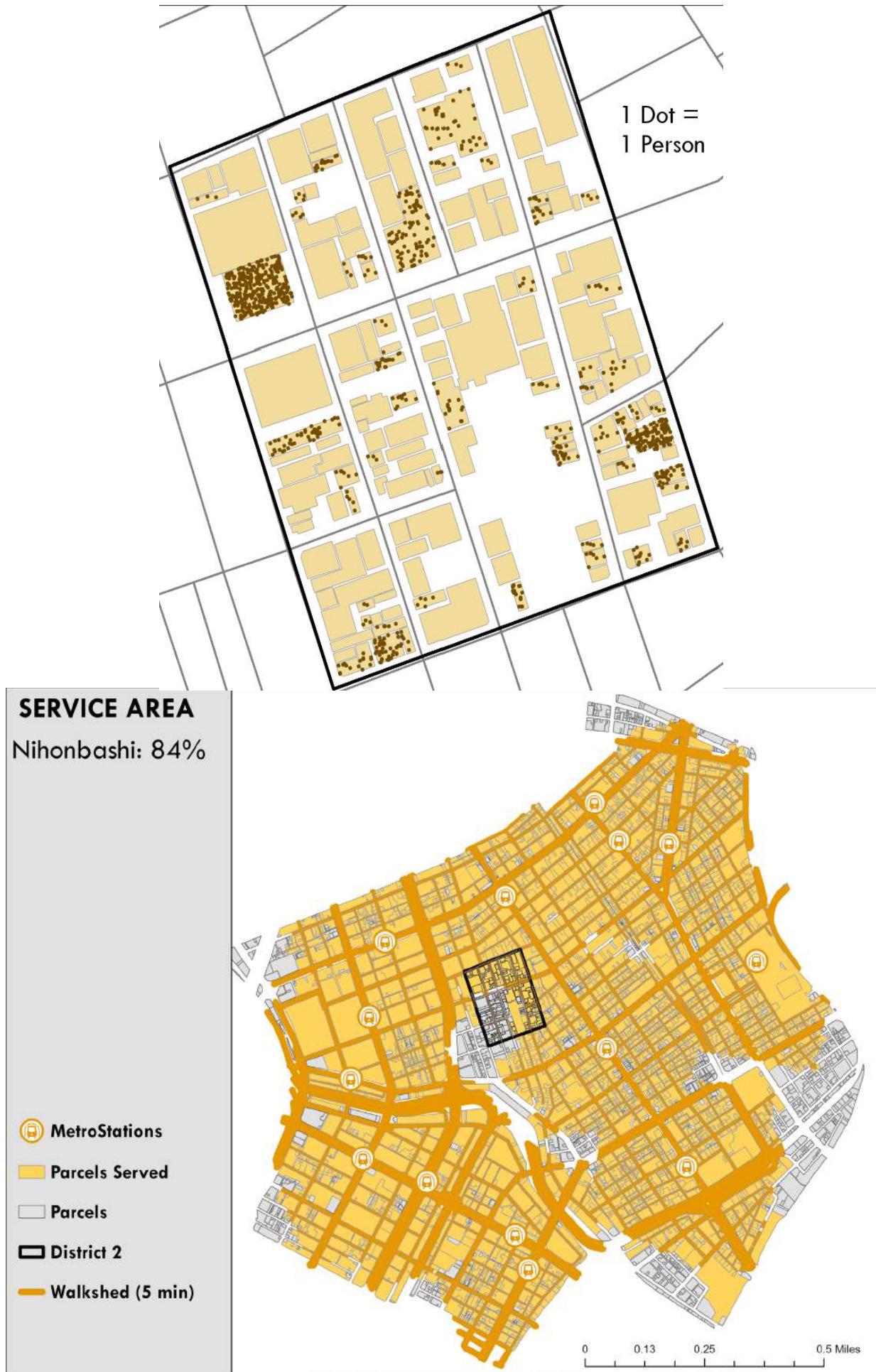
The whole street evaluated by using image data between two points separated by 30m.

## Urban Transportation

Urban transportation was assessed by comparing the frequency of different transit across the Nihonbashi neighborhood, and by calculating the existing 5-minute transit walkshed. First, all train and bus routes through the neighborhood were mapped to understand the transit accessibility in the neighborhood. Then, the breakdown of the different transportation modes utilized - the "mode split" - was visualized. Finally, a network analysis was done on District 2 and the entire Nihonbashi neighborhood to understand which parcels did not have immediate (or near immediate) access to public transportation.

External Nihonbashi Mode Split





## Urban Heat

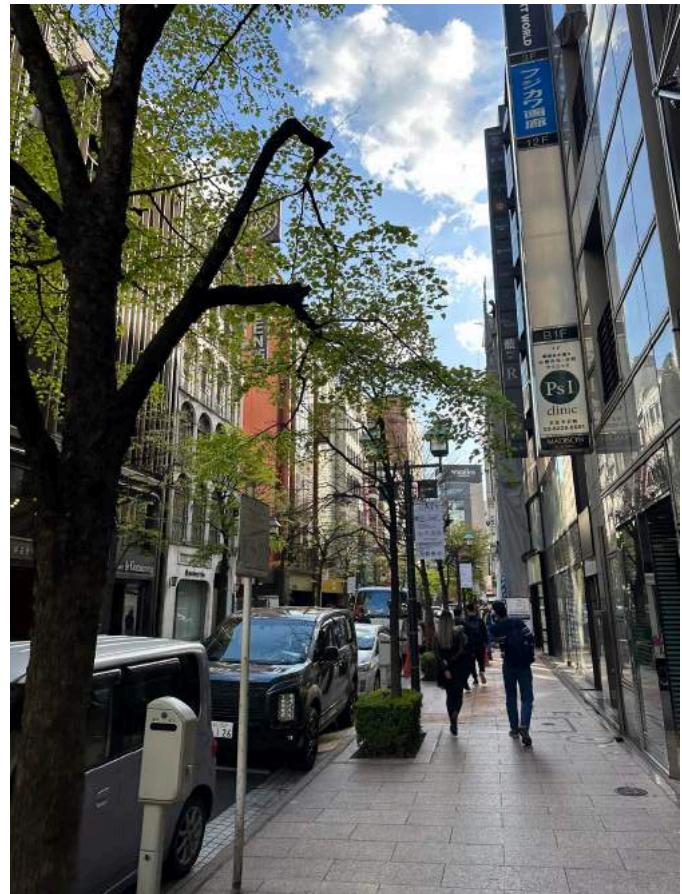
Japan's geographic character creates a need for comprehensive nationwide disaster resilience planning. Along with the Zero Emissions Tokyo Strategy for climate resilience which aims to put Tokyo at net zero emissions by 2050, the Tokyo Metropolitan Government has also convened a "Tokyo Resilience Project" in December of 2022, which puts forth a comprehensive guideline for strategies to reduce Tokyo's susceptibility to climate disasters. In February 2023, a pamphlet outlining priority measures for disaster resilience was released. General themes for intervention measures include Protecting Lives from Torrential Rain, Preparing for Rising Sea Levels, and Creating a Resilient City against Earthquakes. While these scenarios seem unrelated to urban heat, the Tokyo Resilience Project specifically cites raising global temperatures as a direct cause of storm and flooding related emergencies.

Japanese summers are infamous for being hot and muggy, particularly in the months of July and August. Observation of Tokyo residents and conversations about their attitudes towards heat and summertime temperatures reveal that residents feel that summertime heat is a major issue. Summertime heat, particularly extreme heat (as was experienced in June 2022, where temperatures were consistently above 90 degrees for several weeks), creates a major issue for Japan's aging population. Automobile use is limited and expensive in Tokyo, so residents primarily walk or use public transportation to get from place to place. Being outdoors during the summertime for extended periods of time means that vulnerable populations are vulnerable to heat related illnesses, such as heat stroke, fainting, fatigue, and exhaustion.

Public and private space in Tokyo reveal more information towards general behaviors about urban heat and climate resilience in the city. Limited real estate in the central city creates high demand for land and high real estate prices. Japanese parks and green spaces differ from western parks and green spaces. In cities such as Atlanta, green spaces and parks serve a dual purpose of an aesthetic break from the built environment, as well as provide utility for sidewalk and street shading. Japanese trees seem to be much more ornamental, as streets in Tokyo had cherry blossom and willow trees lining them, if any.

Field observation of District 2 reveals that the district has a more visible elderly population than the rest of Nihonbashi neighborhood and surrounding areas of Marunouchi and Ginza. This prominent elderly population may be explained by the large hospital and elderly facility adjacent to District 2's Horidome Park.

Nihonbashi's District 2, despite being near heavily commercial parts of the city with its proximity to the major roadway, is a relatively cool portion of the entire Nihonbashi neighborhood, as is revealed through surface temperature assessment of satellite imagery. The average summertime temperature in the Nihonbashi neighborhood is about 22 degrees Celsius (using June 2022 estimates from the national Japanese weather service). It is estimated that 13% of District 2 residents are elderly (above 65), and 6% are under age 5. While this proportion may seem high, it is important to note that the overall population of the district is estimated to be only about 700 residents, which means about 130 heat-vulnerable residents based on demographic measures.



Street trees near Tokyo Station

Exposure	Sensitivity	
AVG temp in the month of June 2022 was 21.975 degrees Celsius	Current <5: 39 65+: 95 living alone: 9	Human-Scale <5: 33 65+: 81 living alone: 7
	Business as Usual <5: 11 65+: 122 living alone: 50	High Density <5: 83 65+: 203 living alone: 18
Adaptive Capacity		
<p>Japan's hot and humid summers</p> <p>Street trees and Japanese attitudes about trees</p> <p>Building materials, use, and facade</p>		

Based on this assessment, I present three recommendations to reduce urban heat:

**1. Utilize the built environment.** Rather than trying to make tree planting a primary mode of urban heat mitigation, buildings and streetscapes should be designed with materials and in ways that reduce urban heat and provide shading to pedestrians.

**2. Urban greening other than trees.** As planting street trees is not a common practice in Tokyo, other forms of urban greening, such as green roofs or green walls should be used to increase shading and evapotranspiration to reduce urban heat.

**3. Integrate urban heat.** Existing climate resilience plans from the Tokyo Metropolitan government do not emphasize urban heat as a climate hazard the same that it does with earthquakes and flooding. The government should include urban heat in its official climate and hazard mitigation plans to bring urban heat mitigation to the forefront of climate policy issues in the city.



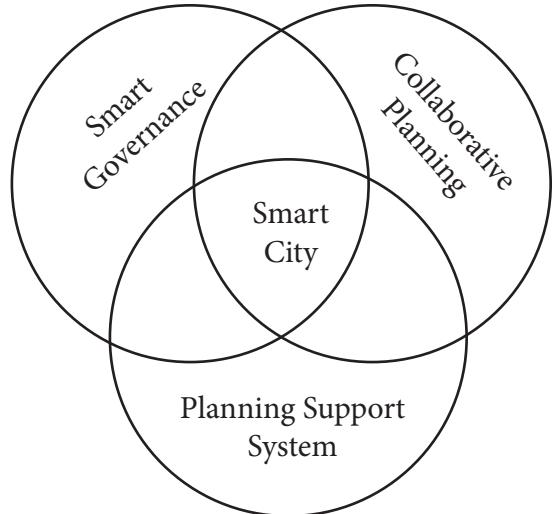
# Key Performance Indicators (KPI)

The background features a subtle, light blue-grey wavy pattern that covers the entire slide, creating a sense of depth and movement.

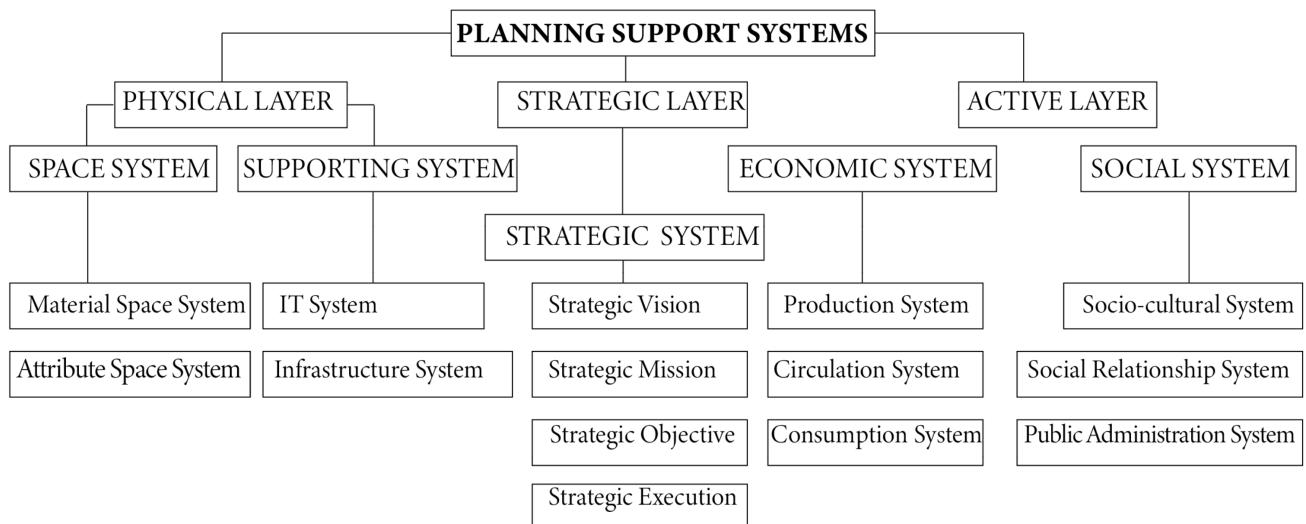
With the increasing interest in smart cities, planning support systems (PSS) offer the potential to harness the power of data and modeling for envisioning the future of urban areas. Importantly, a planning support systems does not stand alone; it works in tandem with smart governance and collaborative planning to form an essential triad. People are at the heart of this "Smart City Triad", as collaborative planning involves participation and consensus, and an essential aspect of smart governance is open data exchange, transparency, and inclusion.

Conceptually, the PSS comprises of three layers: a physical layer, a strategic layer, and an active layer. Each of these layers is evolved from a system or combination of systems interacting in a way to form a distinctive ecosystem. The physical layer of a planning support system is made of space system and supporting system that together form the objective environment of the PSS. in simpler terms, the physical layer is the "overall environment" of the area, which is the accommodation place for people to carry out various activities, has certain physical characteristics, and is reflected in the area as an intelligent flow space.

The strategic layer of planning support system is a strategic system which comprises of strategic vision, mission, objective, and execution to form an organizational management for the PSS. Lastly, the active layer of planning support system comprises of two broad subgroups of economic and social system. The economic system could be further categorized into production system, circulation system, consumption system and innovation system. The social system is further categorized as social relationship system public administration system and socio-cultural system.



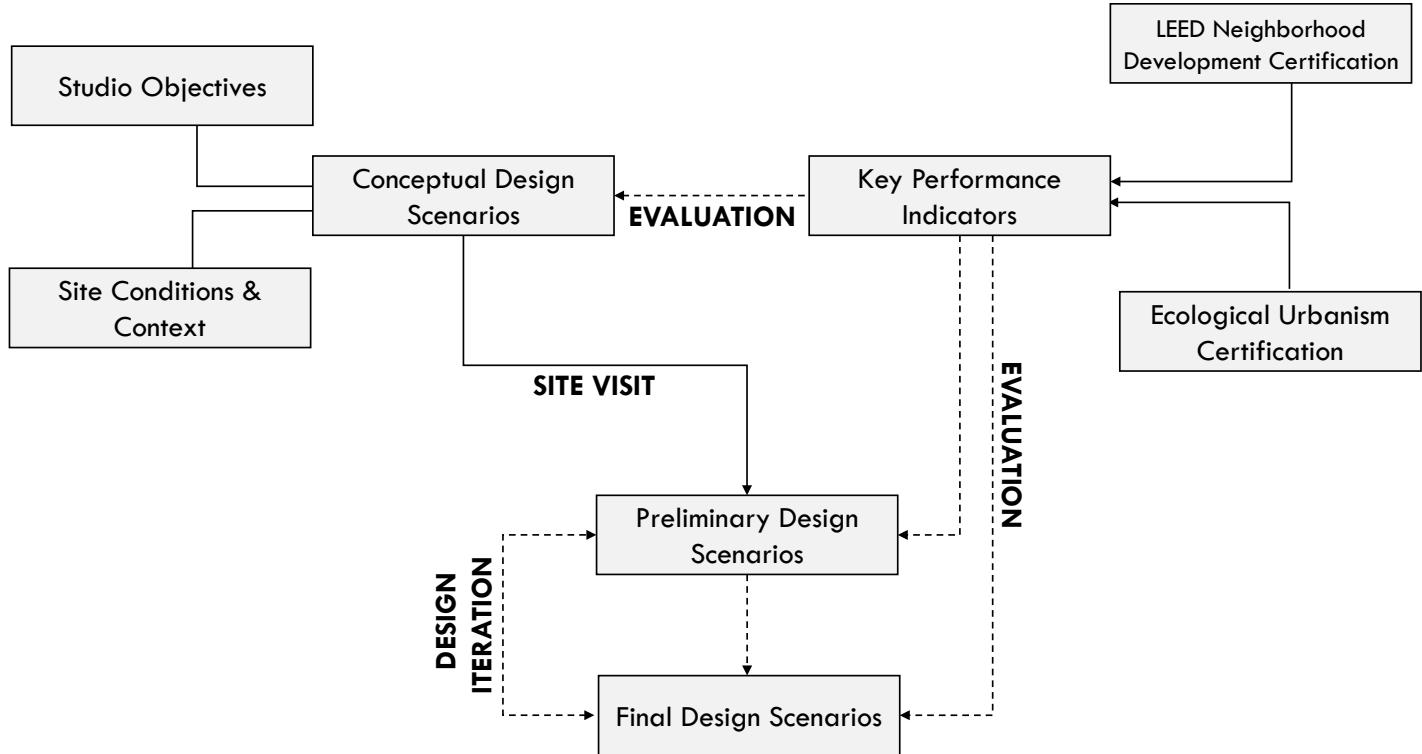
### Conceptual Components of a Planning Support System



With the conceptual components of a planning support system as a foundation, our studio team developed a unique planning support system that would support our team throughout the planning and design process. Specifically, we developed a planning support system that could be used to accomplish the following tasks:

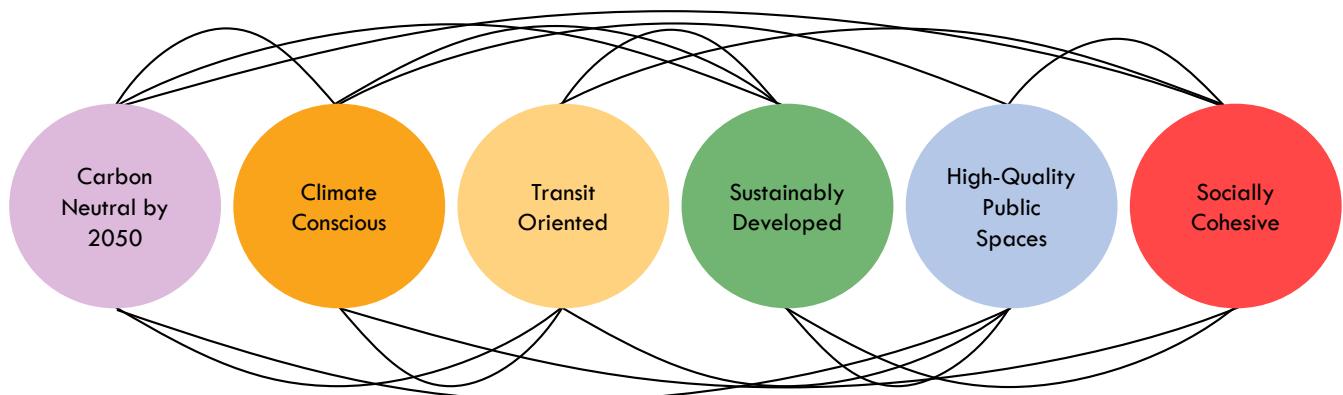
- Encourage a continuous and iterative planning and design process
- Measure and evaluate performance of designs
- Communicate final design scenarios to stakeholders

## Continuous and Iterative Process



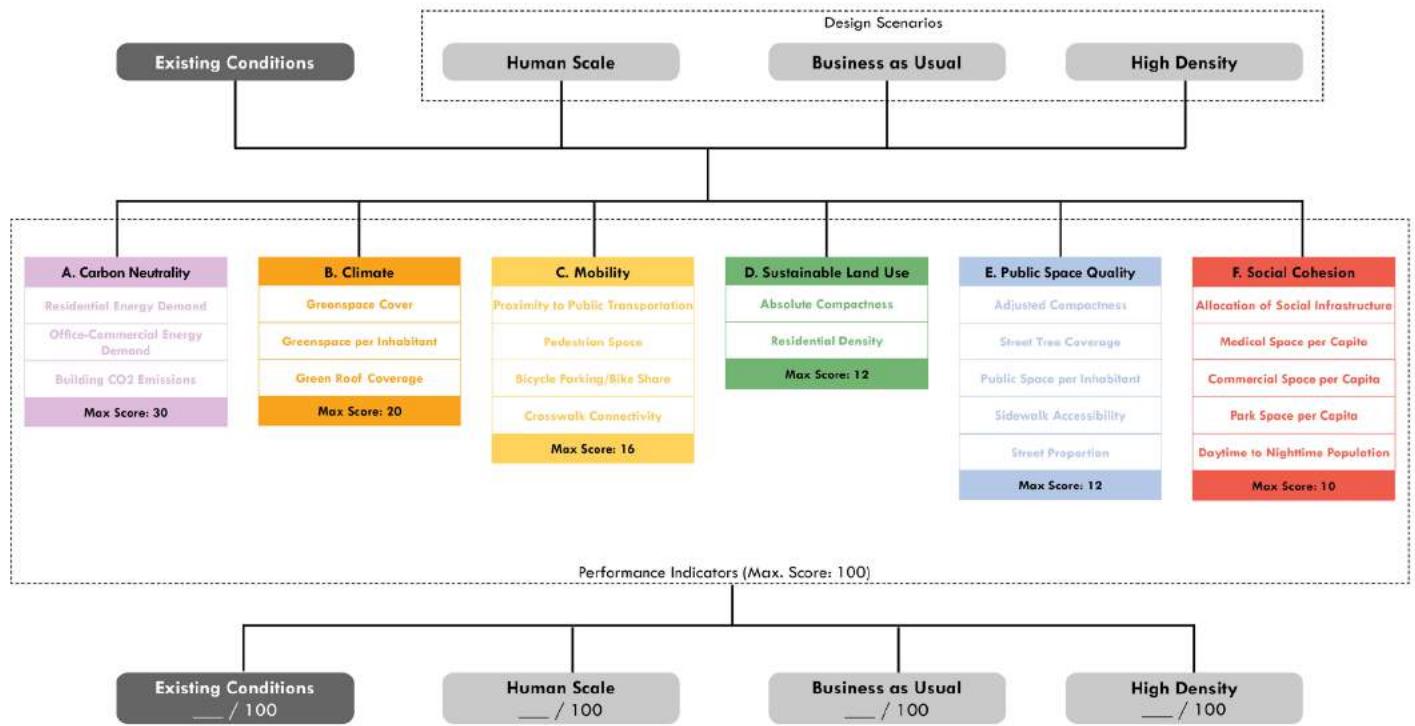
To ensure alignment among the goals for each design scenario, we established six performance goals/objectives for Nihonbashi's District Two (see figure below). The most important performance goal for all scenarios is achieving carbon neutrality by 2050. The other goals support carbon neutrality and provide essential co-benefits for one another.

## Performance Goals



To evaluate the three different design scenarios, and to compare them to existing conditions of District Two, we used a framework of Key Performance Indicators (KPIs), which we adapted from the LEED Neighborhood Design Certification and the Ecological Urbanism Certification (Salvador Rueda). The six KPI categories are aligned to our performance goals and are made up of several indicators that allow us to measure and quantitatively evaluate the performance of existing conditions and the three design scenarios. Each category is assigned a weight based on our studio's overall priorities, and the overall score is measured out of 100.

## Key Performance Indicators Evaluation Framework



Indicators for carbon neutrality and climate account for 50% of the total points, with a slightly greater weight given to carbon neutrality. Within each of the six categories, we also weighted the maximum number of possible points per indicator based on their relevance to the overall performance goal. For each KPI, we set a minimum and desirable objective using the Ecological Urbanism Certification as a baseline. However, we adjusted the objectives for certain indicators to better align with the environment in Tokyo. If a design (or existing conditions) met the minimum objective, it was allocated half of the maximum points and if it met the desirable objective, it was allocated the full maximum points. For values between below the minimum objective or between the minimum and desirable objectives, points earned were scaled to a proportion of the possible points.

In the following pages, we summarize the final KPI rubrics and radar graphs for existing conditions and the three design scenarios to show where points were earned. The radar graphs represent a percentage of the maximum possible points for each category.

# KPI Calculations

Key performance indicators were calculated using the following formulas. Minimum values are baseline for the designs receiving points. Desirable values are maximum points. Examples are included with several of the KPIs.

## Climate

Performance Indicator	Calculation + Units	Minimum	Desirable
Greenspace Cover	$\frac{\text{greenspace surface area}}{\text{total surface area}}$	50%	100%
Greenspace per Inhabitant	$\frac{\text{greenspace surface area (m}^2\text{)}}{\text{total population}}$	>10m <sup>2</sup> /inhabitant	>15m <sup>2</sup> /inhabitant
Green Roof Coverage	$\frac{\text{total green roof surface area}}{\text{total roof surface area}}$	>10%	>60%





**GREENSPACE**  
Greenspace Cover  
**6.6%**

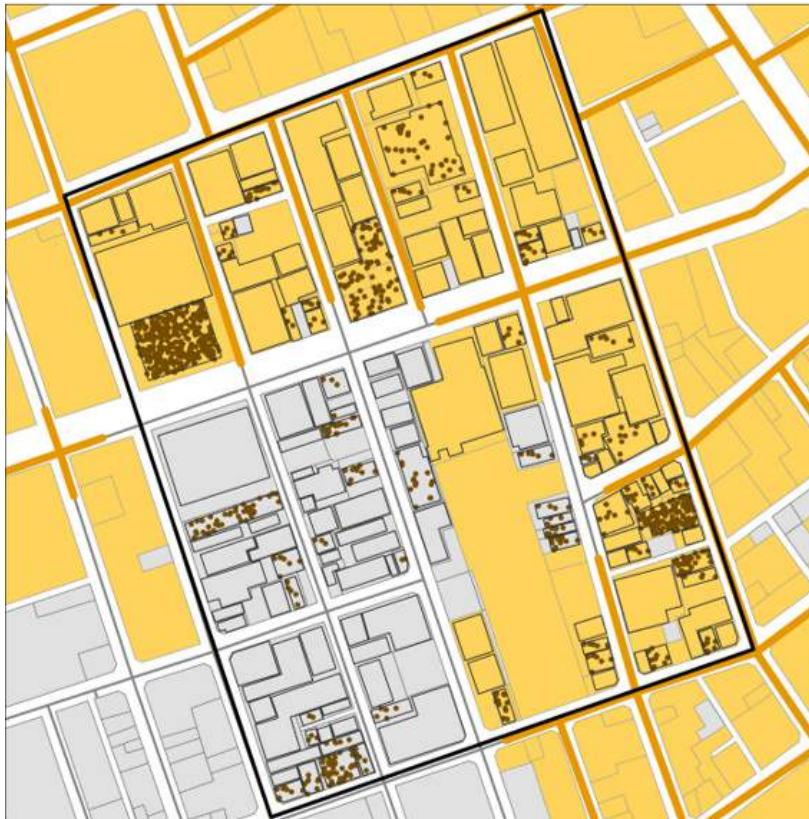
**Greenspace per Inhabitant**  
**4.98 meters squared**

**Green Roof Cover**  
**0%**

 **Greenspace**

# Mobility

Performance Indicator	Calculation + Units	Minimum	Desirable
Proximity to Public Transportation	$\frac{\text{pop. within 400m from transit stop}}{\text{total population}}$	>60%	100%
Pedestrian Space	$\frac{\text{road surface reserved for pedestrians (m}^2\text{)}}{\text{total road surface (m}^2\text{)}}$	<60%	<75%
Bike Parking/Bike Share	residential: 2/100m <sup>2</sup> commercial: 1/100m <sup>2</sup> public facilities: 3/100m <sup>2</sup>	compliance	compliance + designated parking
Crosswalk Connectivity	$\frac{\text{total existing sidewalks}}{\text{total of all possible sidewalks}}$	<80%	100%



**SERVICE AREA**  
Within 400m of metro:

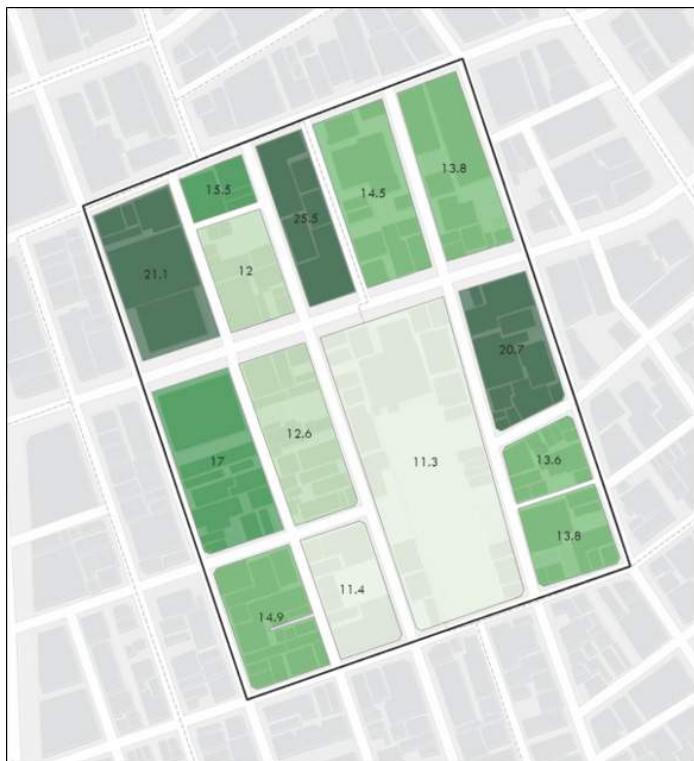
**77.6%**

1 Dot = 1 Person

- Population
- Walkshed (5 min)
- Parcels Served
- District 2
- Parcels
- Roads

# Sustainable Land Used

Performance Indicator	Equation + Units	Minimum	Desirable
Absolute Compactness	$\frac{\text{Built volume}}{\text{total area}}$	>10m for min. 50% total land area	>10m for min. 75% total land area
Residential Density	$\frac{\text{Number of residential units}}{\text{total land area (ha)}}$	80 units/ha	100 units/ha



## ABSOLUTE COMPACTNESS PER BLOCK

Measure of building intensity & proximity of uses

**>10m for 100% of District Two**



# Public Space Quality

Performance Indicator	Calculation + Units	Minimum	Desirable
Corrected Compactness	$\frac{\text{Built volume}}{\text{total area greenspace, pedestrian space}}$	10-50m for min. 50% total land area	10-50m for min. 75% total land area
Public Space per Inhabitant	$\frac{\text{total area greenspace, pedestrian space}}{\text{total population}}$	10m <sup>2</sup> /inhabitant	15m <sup>2</sup> /inhabitant
Sidewalk Accessibility	$\frac{\text{linear meters of sidewalk} > 2.5 \text{ or } 3.7\text{m}}{\text{total linear meters of sidewalk}}$	>90%	100%
Street Proportion	$\frac{\text{Meters of road w/ building-street ratio} < 2 \text{ or } 1}{\text{total road length}}$	>50% sufficient	>50% ideal
Street Tree Coverage	$\frac{\text{total of street trees}}{\text{total road length (km)}}$	50	70

# Social Cohesion

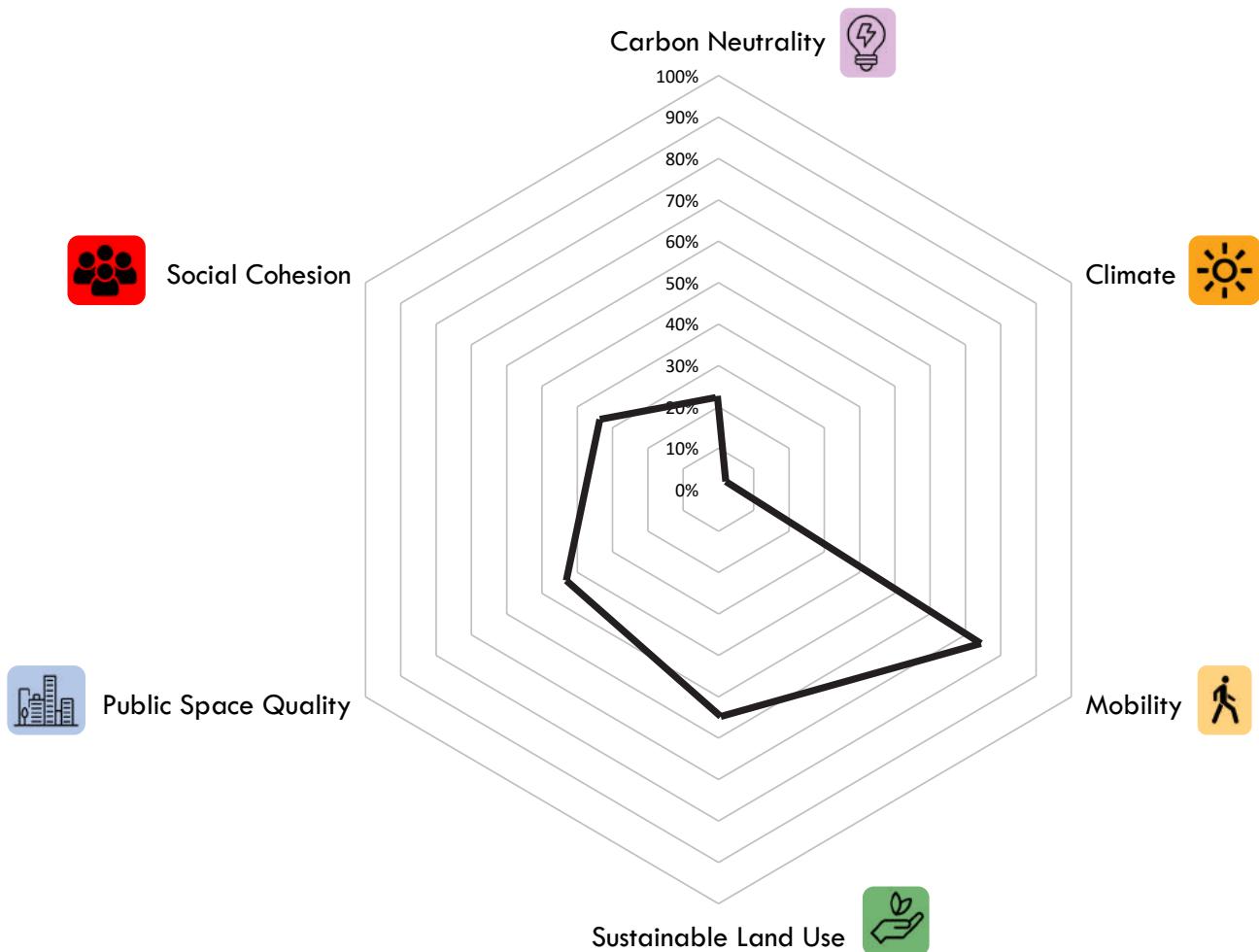
Performance Indicator	Calculation + Units	Minimum	Desirable
Allocation of Social Infrastructure	$\frac{\text{total floor area of social infrastructure}^*}{\text{total floor area}}$	>10%	>15%
Medical Space per Capita	$\frac{\text{area of medical (m}^2\text{)}}{\text{parcel population}}$	<0.6	<1
Commercial Space per Capita	$\frac{\text{area of commercial (m}^2\text{)}}{\text{parcel population}}$	>0.001	>0.003
Park Space per Capita	$\frac{\text{area of park (m}^2\text{)}}{\text{parcel population}}$	>2	>2.5
Daytime to Nighttime Population	$\frac{\text{number of employees}^{**}}{\text{number of residents}^{***}}$	<6	<1.2

\*Cultural, library, education, sports, or health facility \*\*total office floor area/20 \*\*\*total residential floor area/25

Adapted from 2014, M. Taleai<sup>a</sup>, R. Sliuzas<sup>b</sup>, J. Flacke<sup>b</sup>

## Performance Evaluation: Existing Conditions

Indicator	Minimum Objective	Desirable Objective	Actual	Points Earned	Max. Points
	Residential Energy Demand <80 kWh/m²	<65 kWh/m²	170.98 kWh/m²	0.5	/ 10
	Office-Commercial Energy Demand <125 kWh/m²	<110 kWh/m²	122.51 kWh/m²	5.8	/ 10
	Building CO2 Emissions <30 kg CO2/m²	<20 kg CO2/m²	63.37 kg CO2/m²	0.5	/ 10
	Greenspace Cover 50%	100%	6.60%	0.1	/ 6
	Greenspace per Inhabitant >10 m²/inhabitant	>15 m²/inhabitant	4.98 m²/inhabitant	0.5	/ 6
	Green Roof Coverage >10%	>60%	0.00	0.0	/ 8
	Proximity to Public Transportation >80%	>100%	64.99%	4.3	/ 6
	Pedestrian Space >60%	>75%	75.27%	2.0	/ 2
	Bicycle Parking Compliance	Compliance + Designated Bicycle Parking	Compliant	5.0	/ 6
	Crosswalk Connectivity >80%	100%	59.00%	0.7	/ 2
	Absolute Compactness >10 m for min. 50% total land area	>10 m for min. 75% total land area	11.15 m	6.0	/ 6
	Residential Density >80 units/ha	>100 units/ha	61.33 units/ha	0.8	/ 6
	Corrected Compactness 10-50m for min. 50% total land area	10-50m for min. 75% total land area	43.68 m. 25%	1.6	/ 4
	Street Tree Coverage 50 trees/km	70 trees/km	38.00 trees/km	0.8	/ 2
	Public Space per Inhabitant 10 m²/inhabitant	15 m²/inhabitant	3.50 m²/inhabitant	0.4	/ 2
	Sidewalk Accessibility >90% sufficient	>90% ideal	100%	2.0	/ 2
	Street Proportion >50% sufficient	>50% ideal	43% sufficient	0.5	/ 2
	Allocation of Social Infrastructure >10%	>15%	0.00%	0.0	/ 1
	Medical Space per Capita >0.6 m²	>1 m²	0.17 m²	0.3	/ 1
	Commercial Space per Capita >0.001 m²	>0.003	0.05 m²	2.0	/ 2
	Park Space per Capita >2 m²	>2.5 m²	0.63 m²	0.3	/ 2
	Daytime to Nighttime Population Ratio <6.0	<1.2	7.48	0.8	/ 4
	<b>Total Score:</b> <b>34.8</b>				





# Design Scenarios



Human Scale



High Density



Business as Usual

# Human Scale

Steven Aceto, Ethan Knight-Scott, Dillon Lejeune, Yizhou Lin

The Georgia Tech Urban Design Studio's first redevelopment proposal implements a human-scale urban pattern which aims to regenerate the residential and transient pedestrian experience of the Nihonbashi region while maintaining economic vibrance, reducing the neighborhood's carbon impact, and underlining the region's unique historical context. The human-scale form will manifest through a variety of unique micro and macro-level form-based strategies with an end objective of an urban township built for human comfort and prosperity. The guiding form-based tactic is a reduction of building heights paired with an increase in neighborhood walked connectivity. This low-rise residential proposal reflects future projections of reduced developmental demand within Tokyo, which is also reflected in University of Tokyo's Human Scale Proposal, UT-1.

Human scale planning principles guide this proposal with the aim of developing community social capital and networks while strengthening local economic and environmental resilience. In the creation of more public greenspace and reducing driven commutes, as well as creating more flood-resistant infrastructure, environmental impacts associated with climate change can be minimized. A walkable interconnected district emerges from the GT-1 Human-Scale proposal in a process that reflects Fumihiko Maki's Group Form Theory, which defines urban systems' bottom-up processes and patterns for incremental growth and development. The hyper-connected final "Group Form" morphology maximizes the social and economic interface, and is achieved through the constant evolution of a flexible, modular urban framework adaptable to changing demographics and needs of the neighborhood. In our proposal, discrete and isolated individual buildings are exchanged for a more cohesive urban fabric that integrates multi-building blocks into interconnected townships, establishing a more granular urban divisional structure that enables human-scale interactions, economic activity, and pseudo-private public spaces and networks that offer a variety of unique experiences and programs.

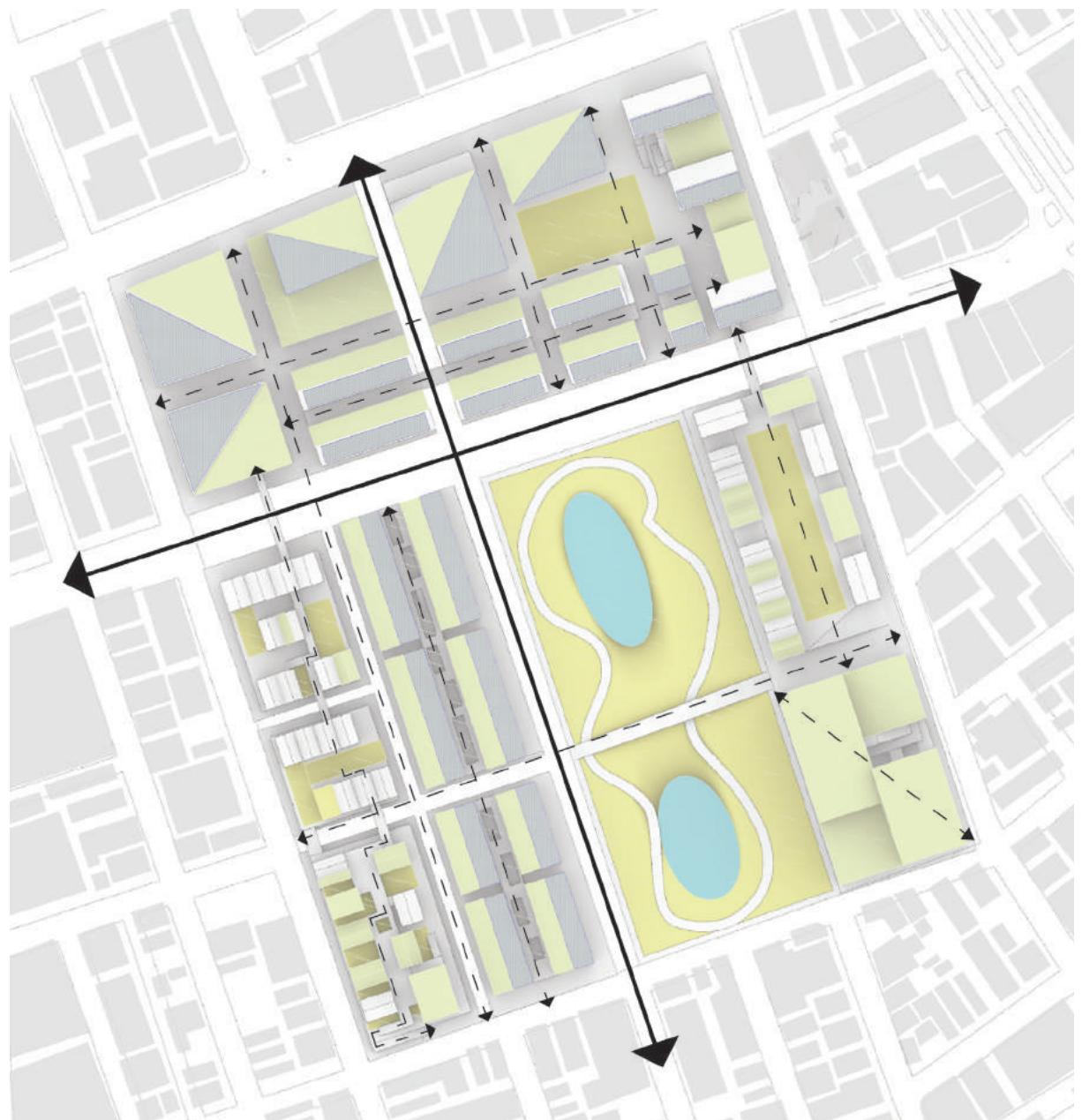


NIHONBASHI STREET AT THE INTERSECTION OF HONSHIROGANE-CHŌ STREET (CA. 1805). SOURCE: MUSEUM OF EAST ASIAN ART,

One guiding project was IKEA's Urban Village Project, which produces small, interconnected districts that employ multi-use flexible spaces to meet the unique needs of particular localities. This project also features grade-separated pedestrian spaces, protecting pedestrian activity from motorized transportation and strengthening the network hierarchy. This flexible design harkens back to the Edo-period typology which features two distinct building forms that reflect the unique historical characteristics of Japan; the machiya "shophouses" and nagaya "rowhouses."

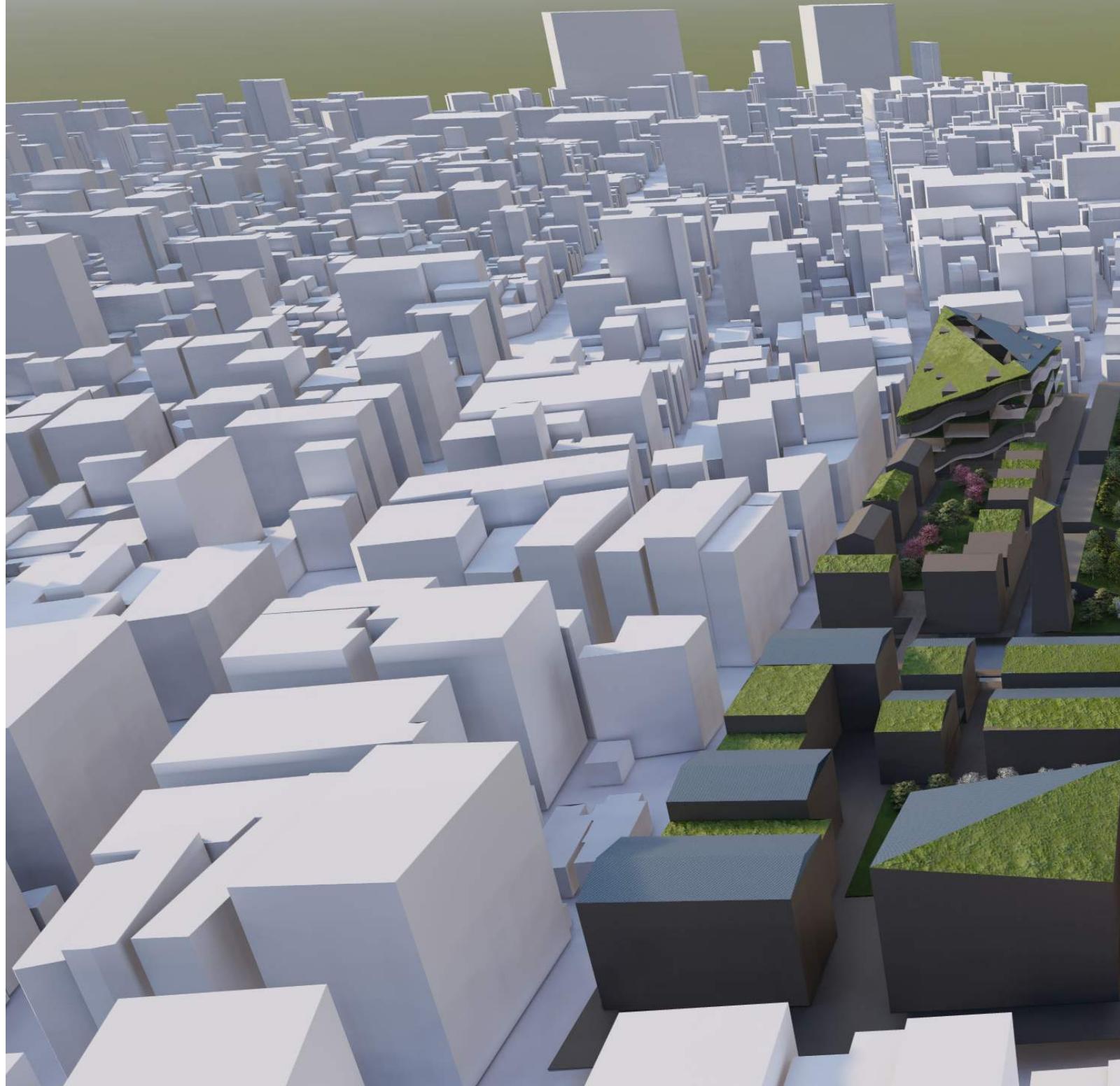
The iconic machiya form establishes a linear spectrum spanning from the hyper-public market streets of Edo Tokyo to the idyllic internal residential shared gardens, helping support a diverse public programming experience that benefits both visitors and residents. The community-focused nagaya structures represent a system that prioritizes neighborhood benefits over privatized amenities.

Services such as libraries, schools, hospitals, and public spaces will be prioritized in order to improve neighbor-level cohesion and generate social capital and networks. These services will be integrated through the usage of "smart city" infrastructure, which would employ utility usage analysis, renewable energy microgrids, green roofs, and transportation microanalysis to both influence maintenance and community programming as well as inform future neighborhood development. This redevelopment scenario implements a human-scale urban framework through the integration of flexible structures, interconnected with improved pedestrian networks, to best meet the needs of future Nihonbashi. Through the regeneration of the pedestrian experience, maintenance of economic vibrance, reduction the neighborhood's carbon impact, and emphasis of the region's unique historical context, the human-scale form will manifest with an end objective of an urban township built for human comfort and prosperity.



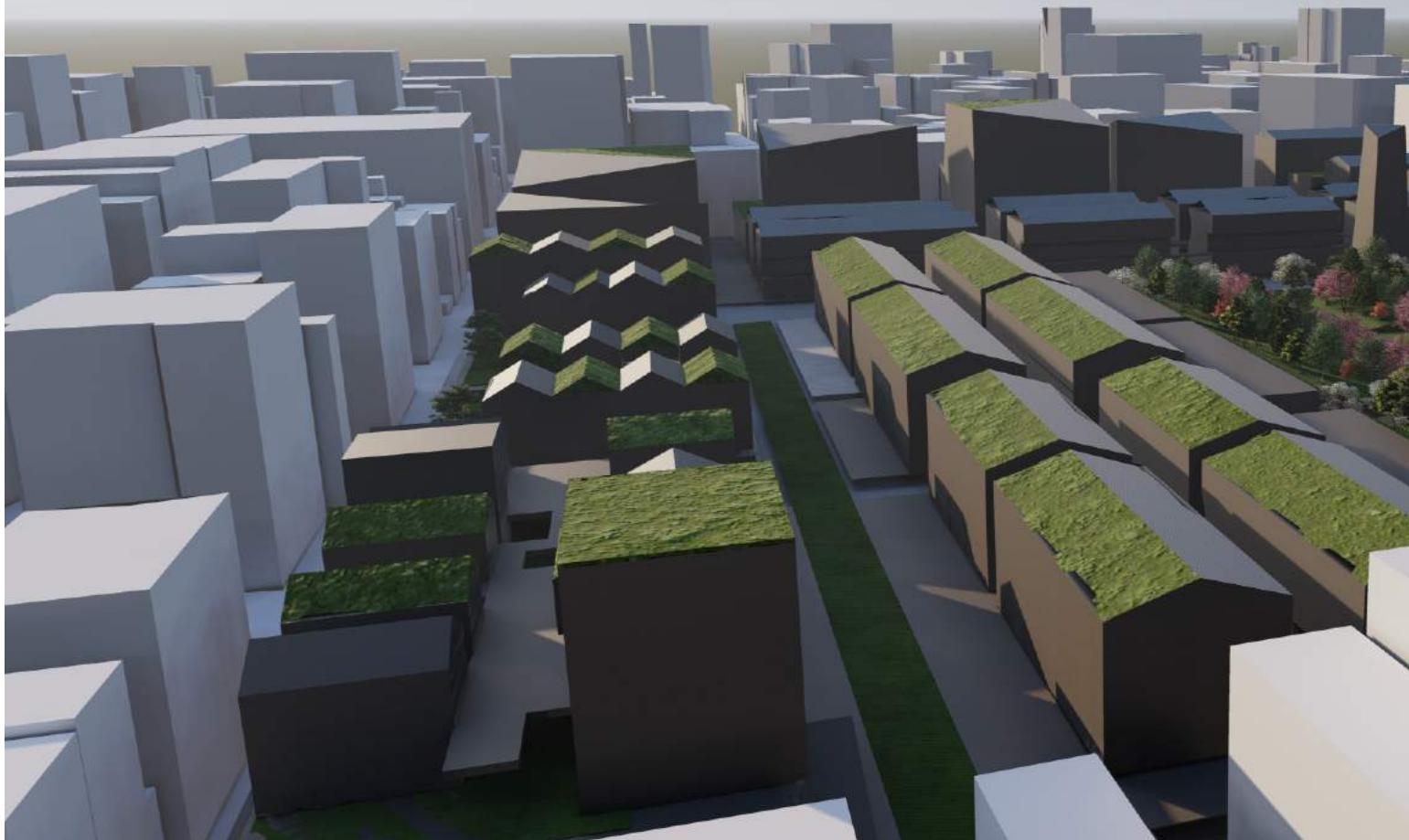
Circulation  
Diagram

Aerial render showing the park variation with a canal and "neo" bashi. The roofs were inspired by traditional Japanese textile patterns as a means to alternate between green roofs and solar paneled roofs. The machiya utilize an arrow pattern, or yagasuir (矢絣). The multi-family housing utilizes a checkered pattern, or ichimatsu (市松). And the taller buildings, such as the offices, hospital, and retail/hotel utilize the scale pattern, or uroko (鱗).

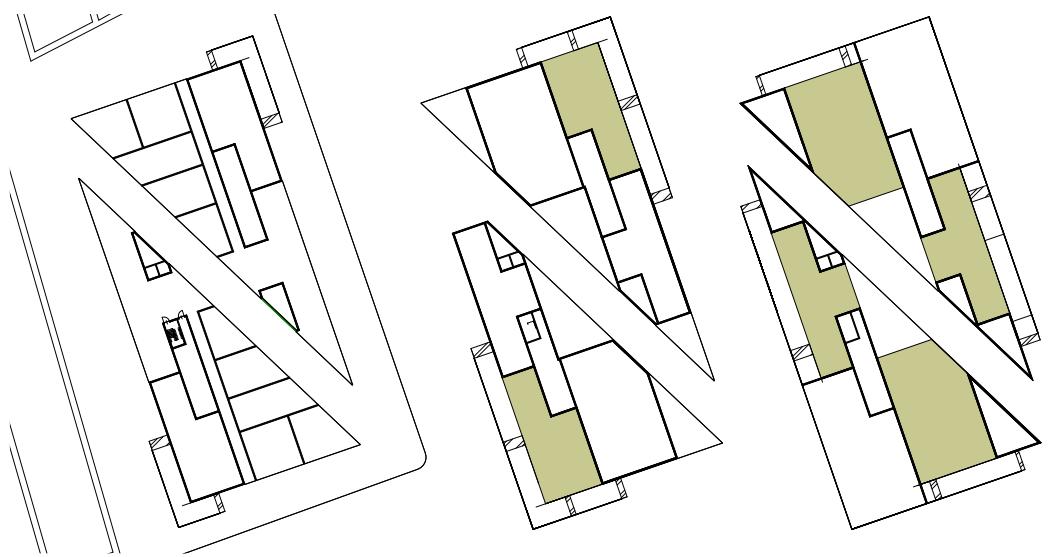


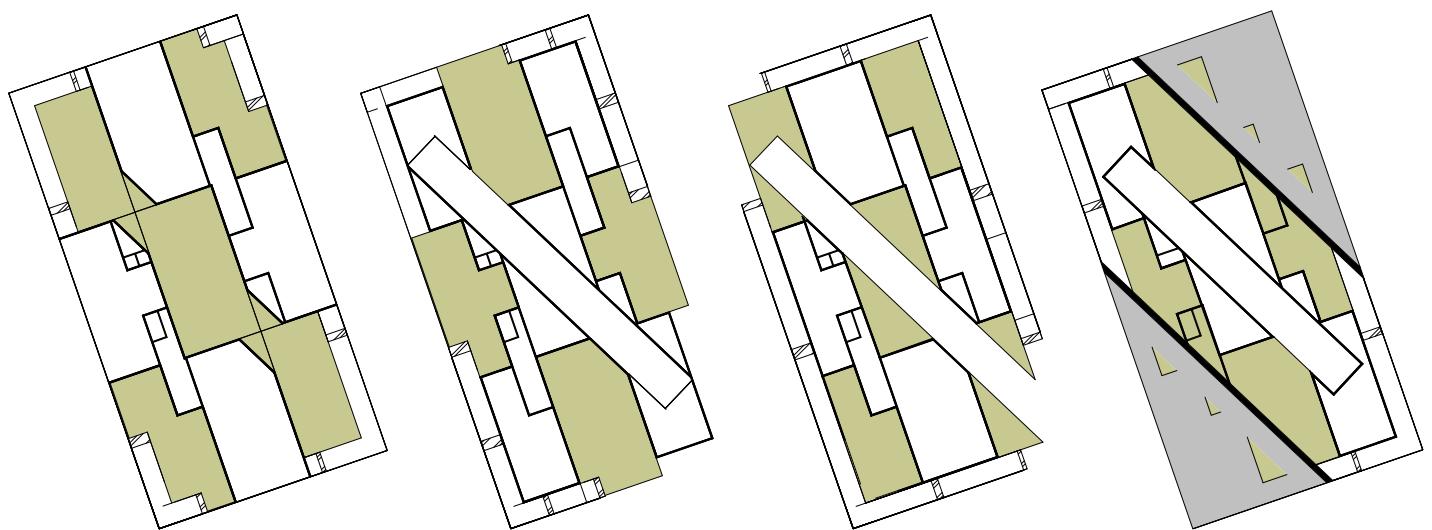
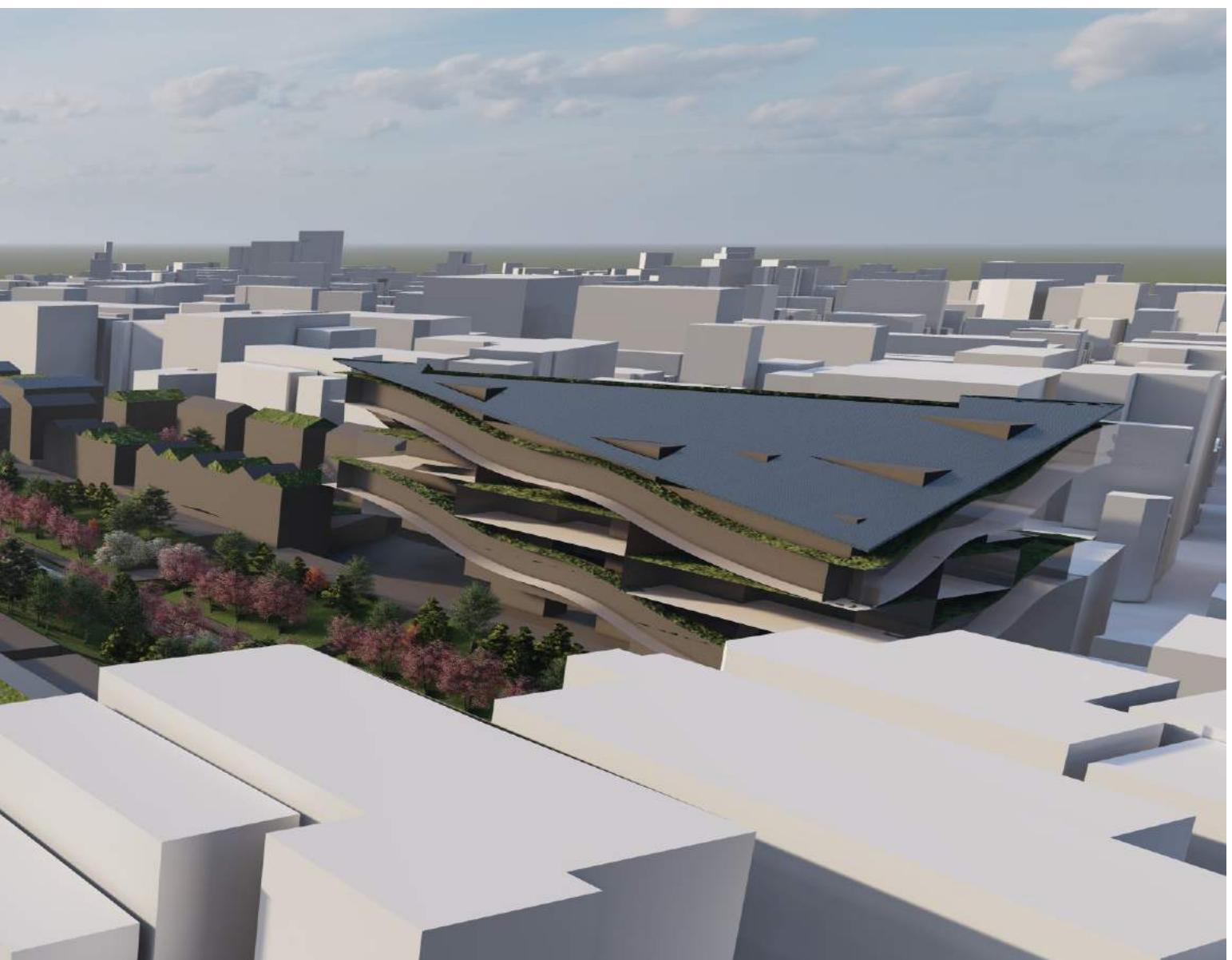


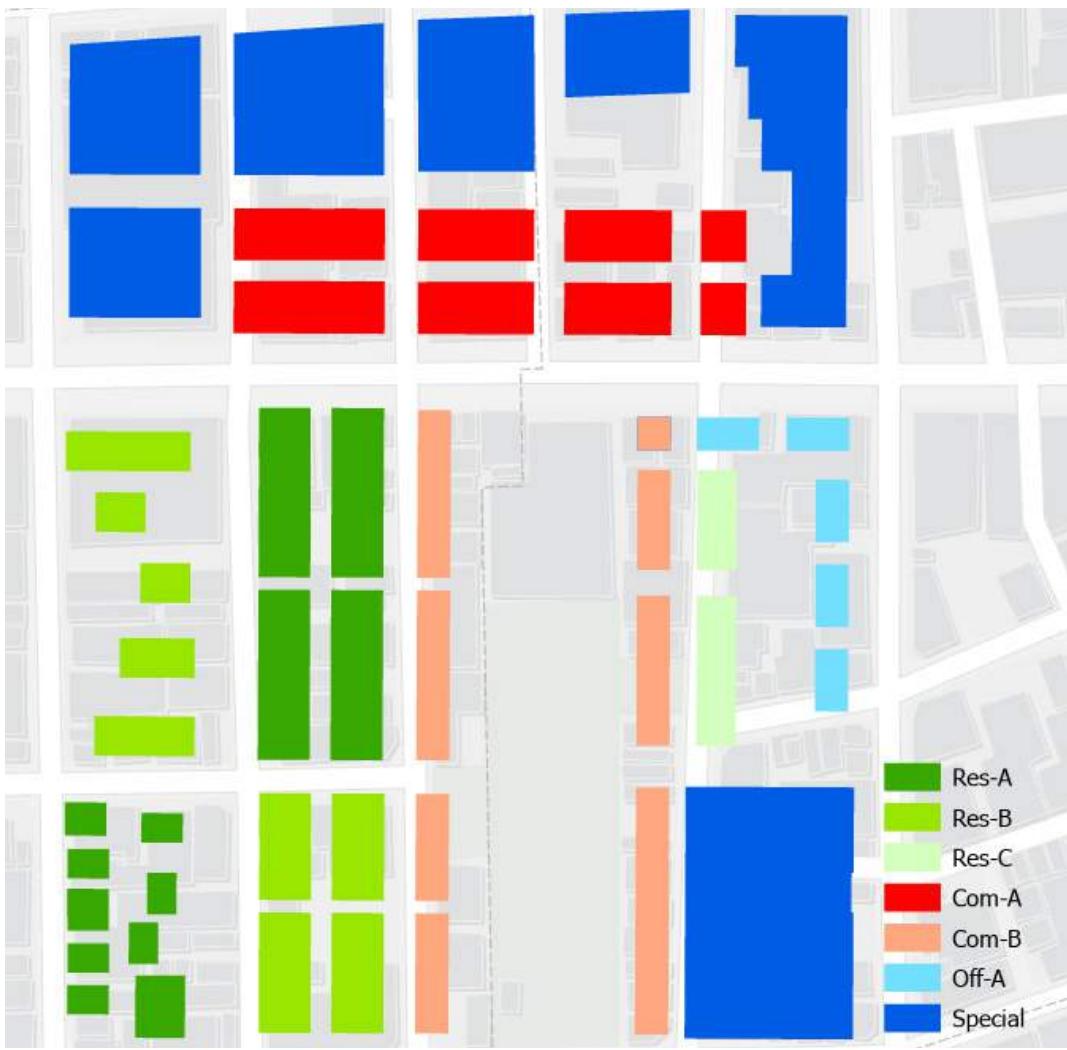
## Retail & Hotel Development



The intention behind the building is to give a through pass from the corner of our site which is near a metro station. This brings pedestrians to the center of the site where the park is. The design has a circulation ramp that joins the solids and voids in the form of program space versus terraces. The first 3 floors are retail which will include shops and restaurants. This is capped with what becomes the courtyard for the hotel, floors 4-7.







**Typology Map**

The Key Performance indicators have been integrated into the design as follows:

#### **Sustainable land use**

Through the usage of mixed-use flexible spaces connected with green pedestrian networks, this design aims to use land sustainably while improving neighborhood economic and environmental resilience. Additionally, green infrastructure such as the central park and transient green spaces will aim to improve air quality and reduce flooding potentials while offering diverse public spaces for programming.

#### **Mobility**

With the dissolving of motorized streets into secondary pedestrian-only networks, we improve the district's overall mobility while not overly restricting motor access to structures. This will also help with the design's social engagement and improve possibilities of the designed landscape.

#### **Social cohesion**

Through the usage of communal spaces and encouraging social mixing, we aim to improve social capital. Additionally, the usage of smaller, more granular commercial and residential spaces allows for a stronger interface between private and private networks, furthering the social cohesion potential of the design.

#### **Public space quality**

The design's green infrastructure, including a large central park and multiple smaller community-sized public spaces, will help in a variety of economic, social, and environmental factors. These spaces will draw outside visitors to the space to spur economic development and social activity, and the addition of green elements will help improve air quality and reduce susceptibility to flooding.

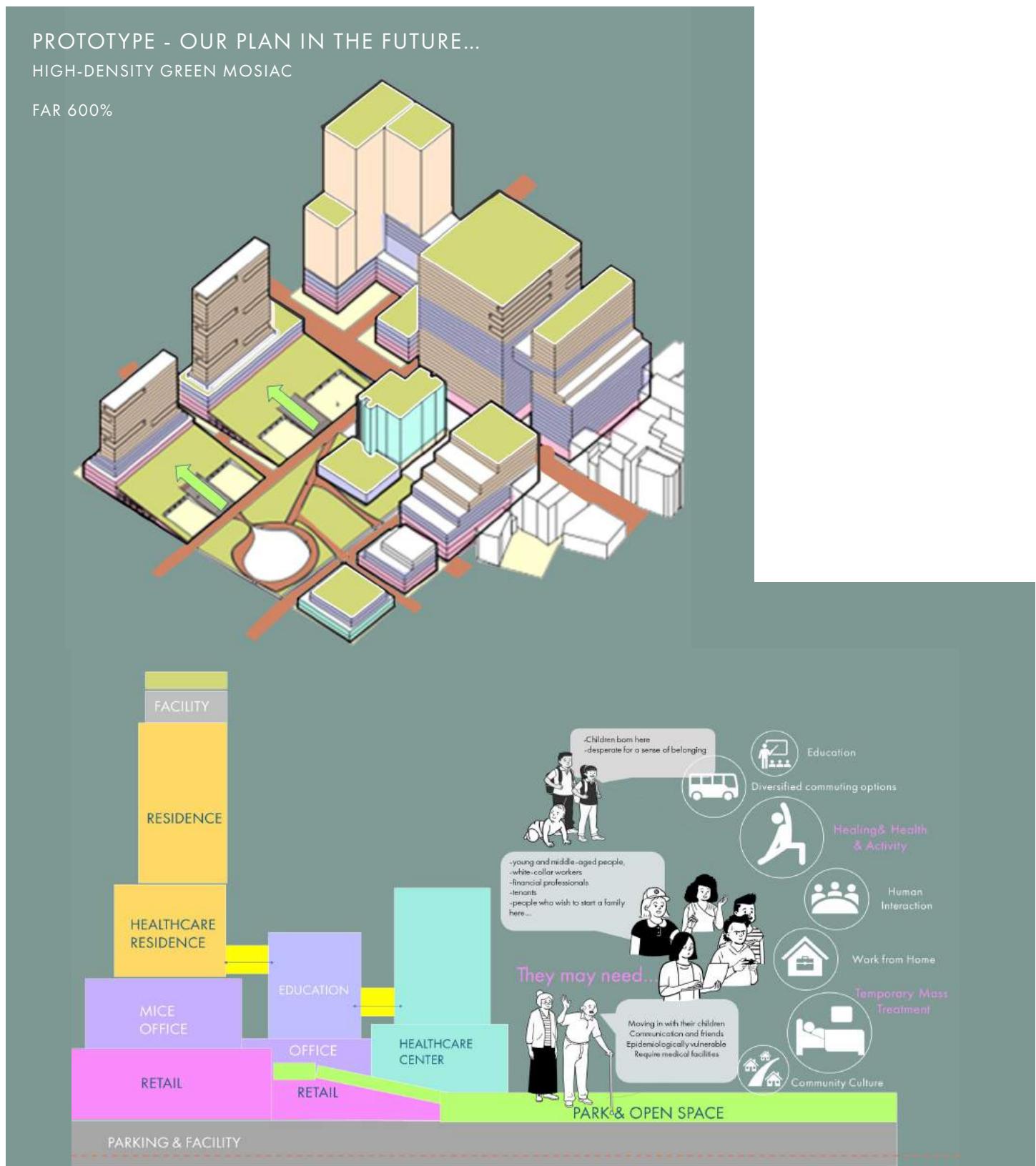
In this constantly evolving design, specific typologies will be continuously adapted to best fit the needs of the community. The design anticipates changes and a dynamic social scene, and through the usage of data monitoring is able to best create future spatial organization to meet the needs of both the present and future residents and workers.



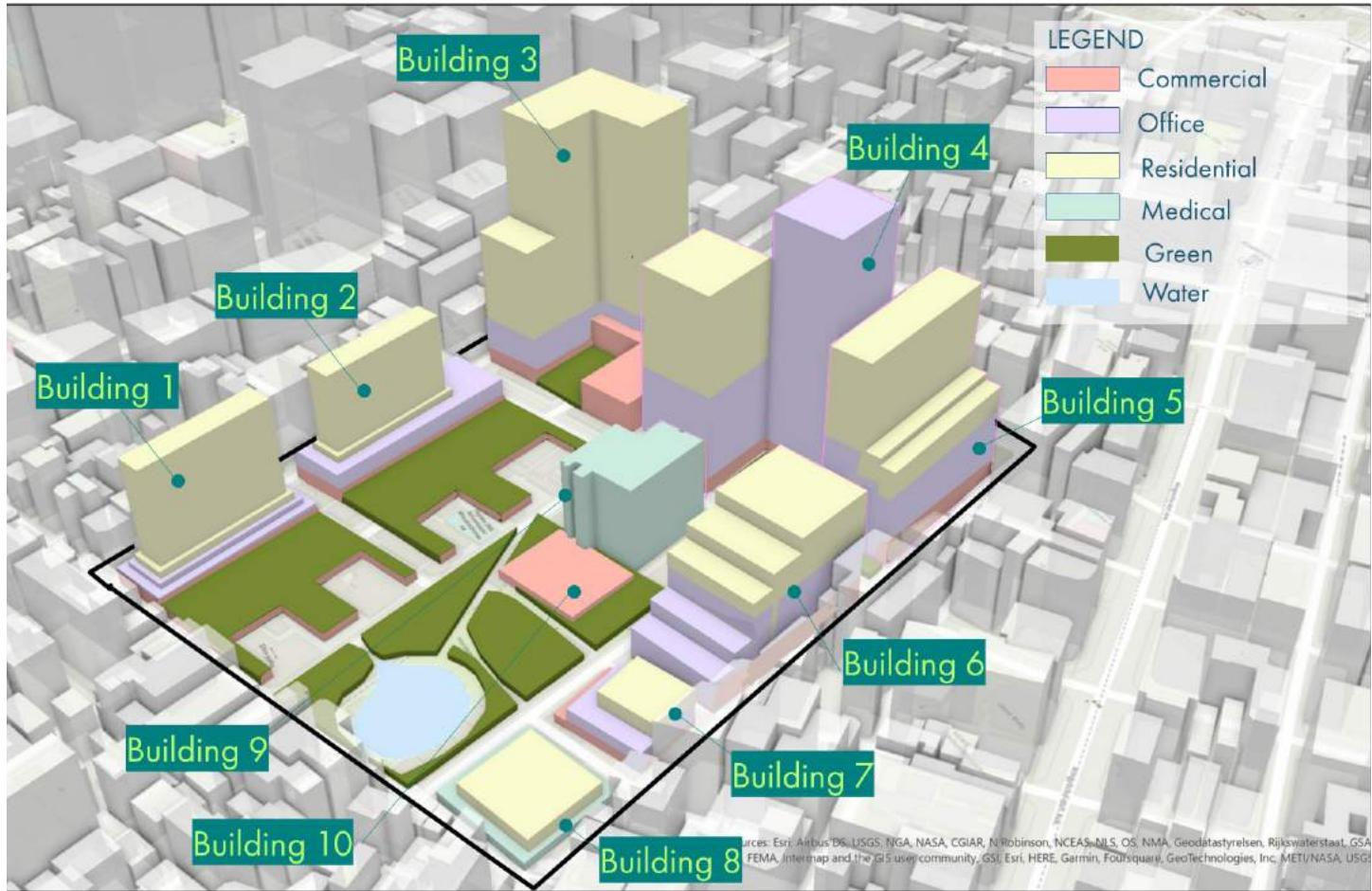
# High Density

Yining (Annie) Chen, Jayita Shetty, Yan (Lucy) Xie

The construction of Tokyo's Yamanote Line, which connects major city centers, has had a significant impact on the city's development. Two maps, based on location data extracted from Twitter API, show the most popular venues in the central area during a typical weekday in March. Larger dots indicate places with a higher percentage of check-ins. The Yamanote Line, has the highest concentration of popular venues. This presents great potential for Nihonbashi's future development.



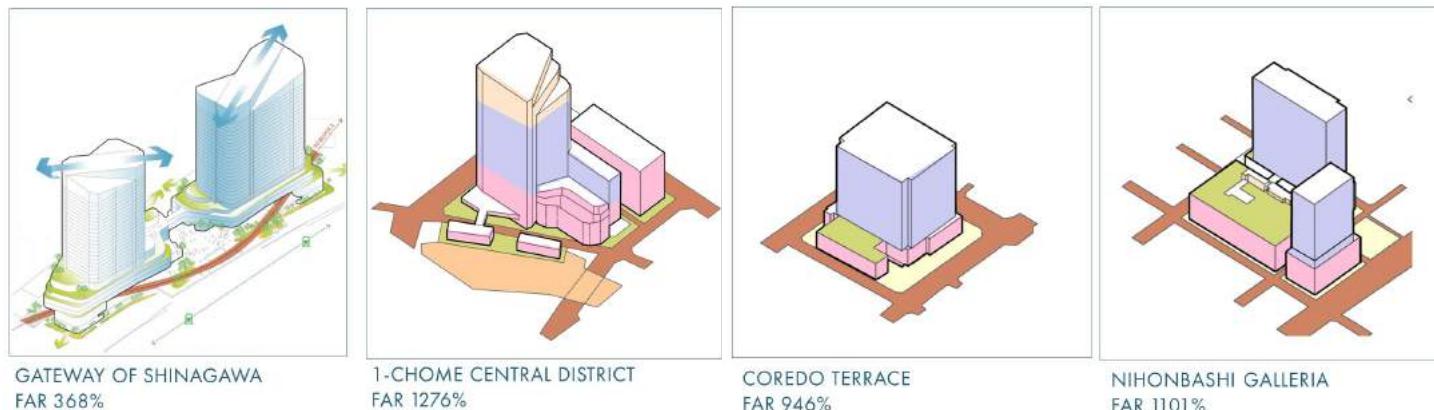
## SCENARIO FOR NIHONBASHI SITE2: HIGH DENSITY GREEN



### HIGH DENSITY GREEN

PROTOTYPE :

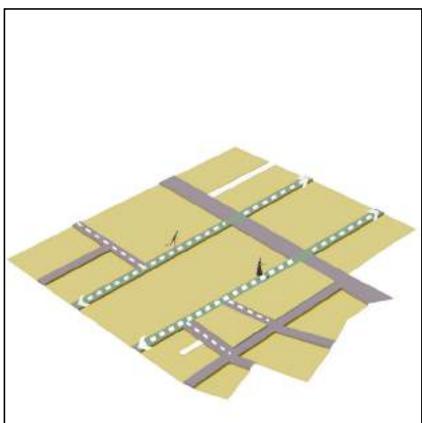
Less surface greenery, using green roofs or underground parks



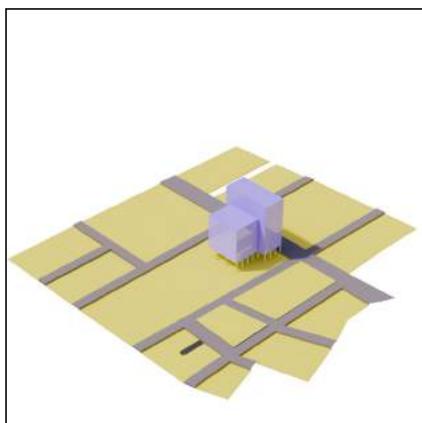
Nihonbashi is conveniently located within a 15-minute walk from Tokyo Station, with the current transportation infrastructure and the potential for future developments such as water traffic and the Flying Car system, Nihonbashi will be easily accessible by various modes of transportation, providing access to customers from the Central Wards of Tokyo, as well as international tourists. Despite the current population decrease, Nihonbashi still has significant potential to attract people from other areas, making it a suitable location for high-density development in the future.



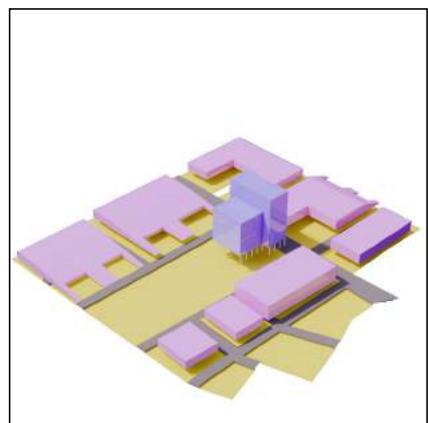
## SITE AND DESIGN DEVELOPMENT



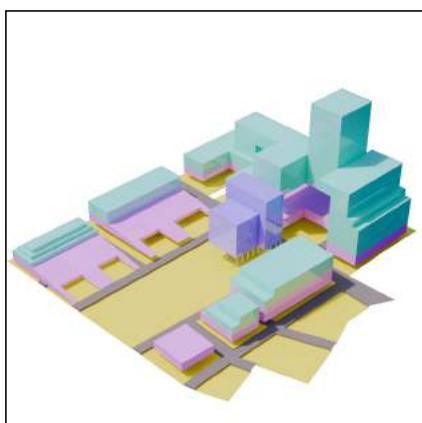
Merging plots and  
segregating vehicular and  
pedestrian streets



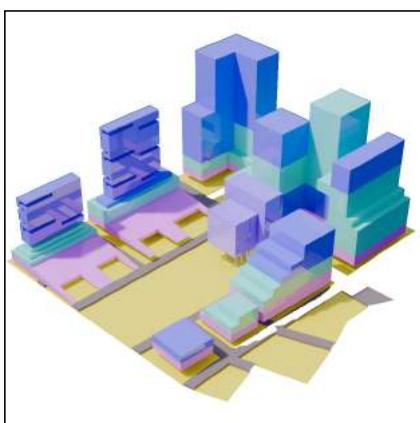
Redesigning the existing  
Amenities



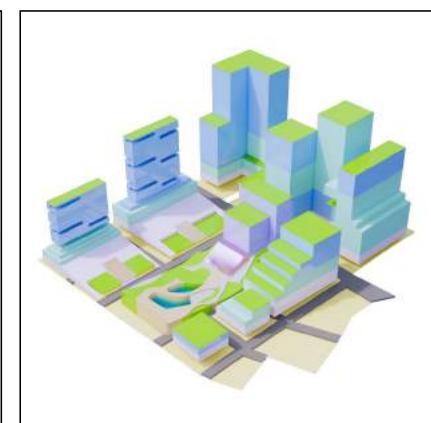
Commercial zones  
connected with the green area  
on ground level



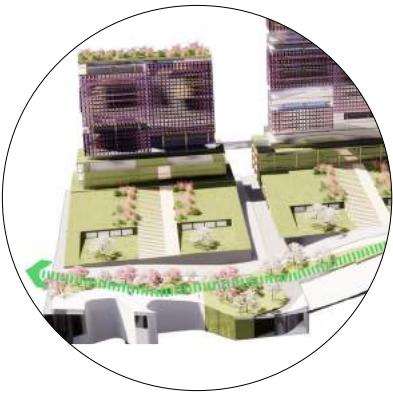
Offices spaces connected  
with common podium



Residential floors connected with  
green corridors



Retention park at the center of the  
development



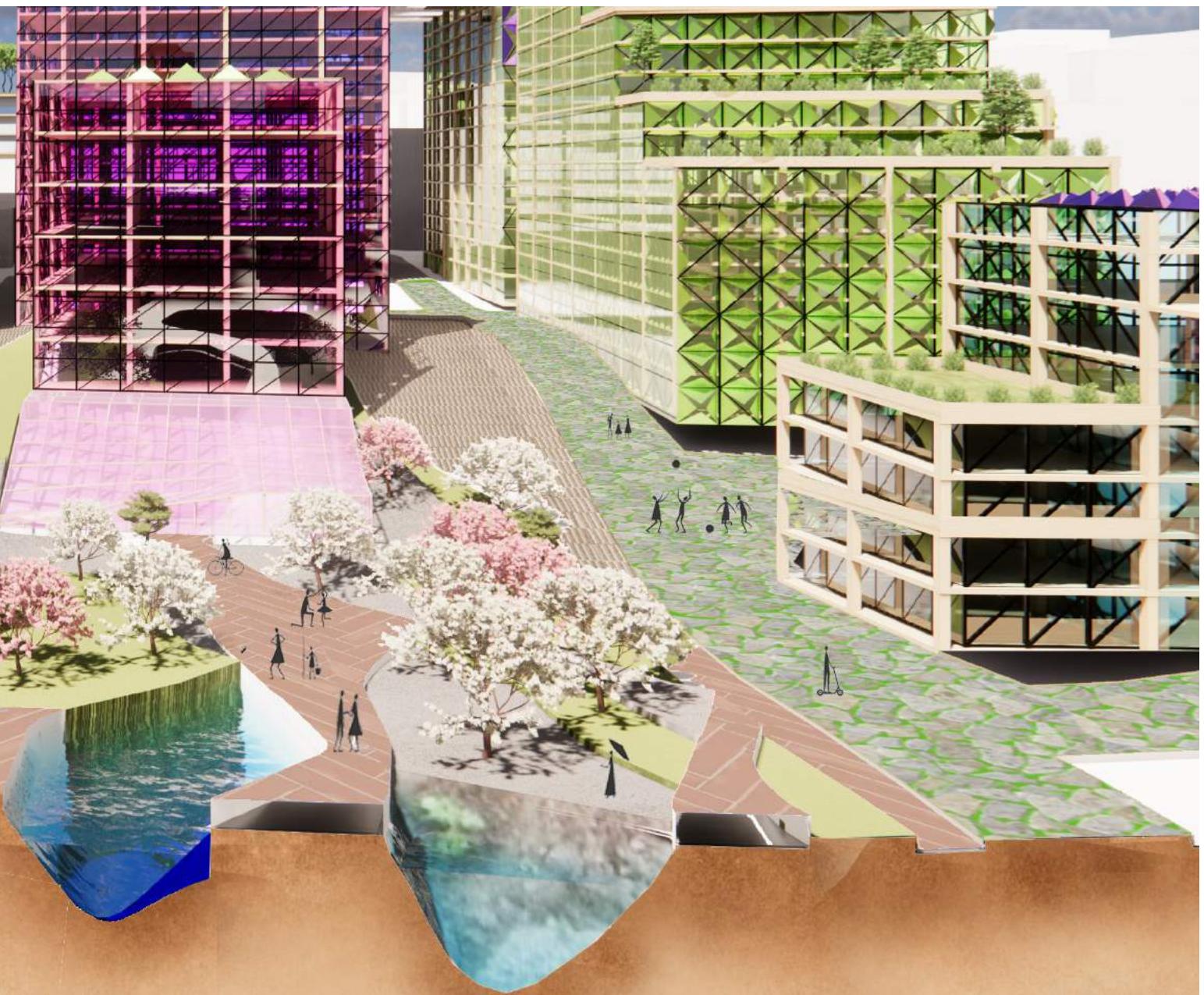
EXISTING TOPOGRAPHY  
RETAINED FOR WATER  
RETENTION



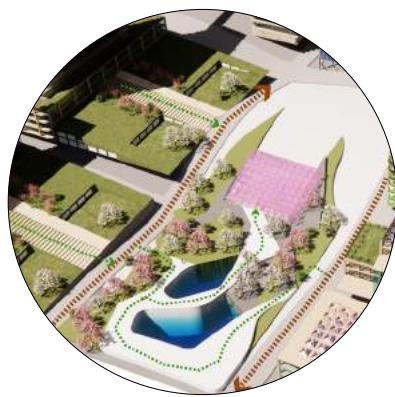
WATER RETENTION POND  
TO HOLD AND DISTRIBUTE  
WATER  
Max Capacity - 33,14,865  
gal. (approx)



CULTURAL CENTER  
APPROACHED FROM THE  
PARK



GREEN SLOPES  
CONNECTING THE PARK  
AND THE BUILDINGS



PARK CIRCULATION



## SITE ISOMETRIC

Previous FAR: 304%

Previous Employer Number: 5259

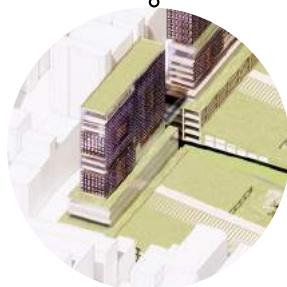
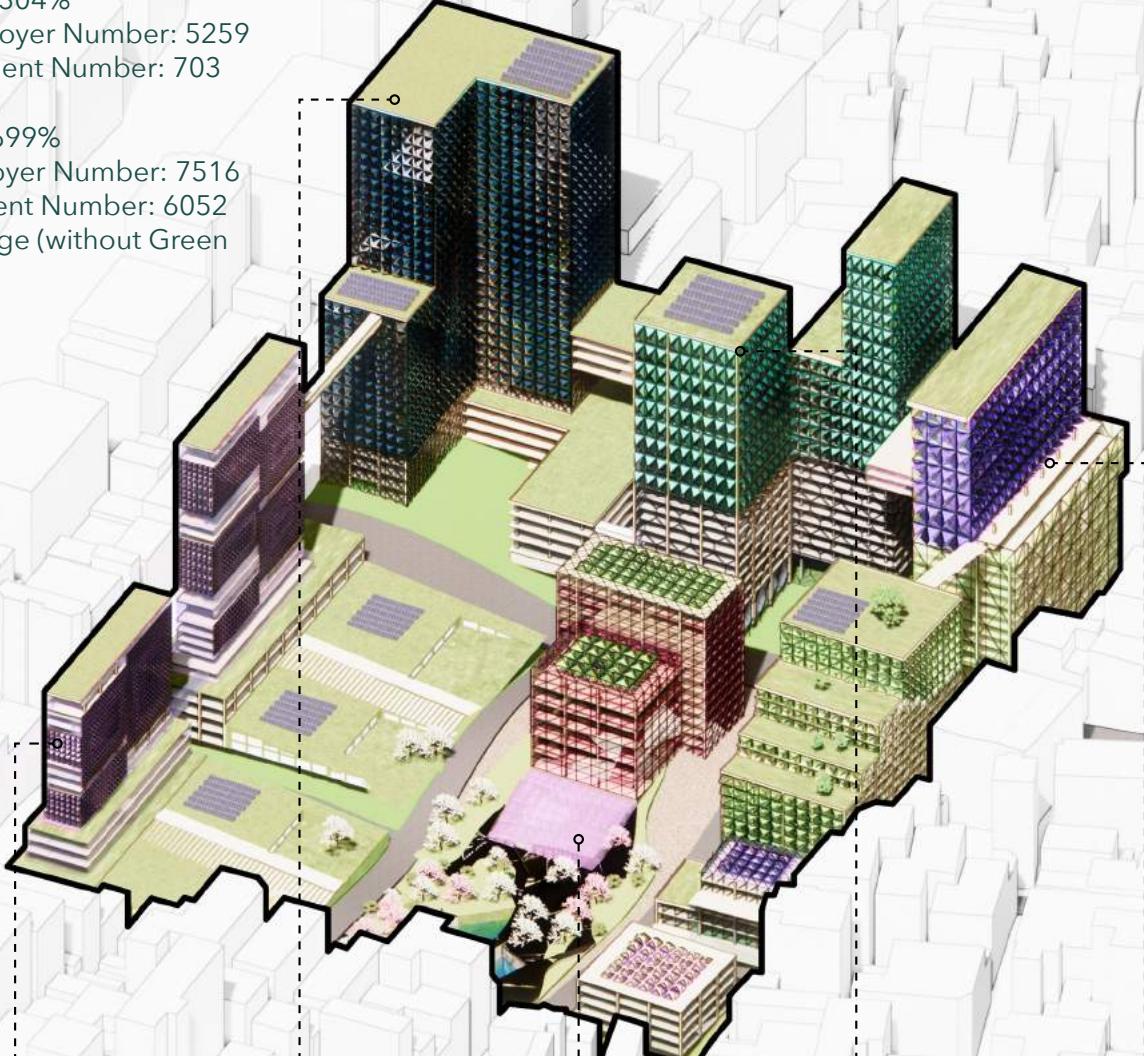
Previous Resident Number: 703

Current FAR: 699%

Current Employer Number: 7516

Current Resident Number: 6052

Green Coverage (without Green Roof): 87%



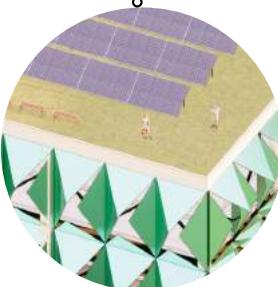
MULTI-FUNCTIONAL COMPLEXES



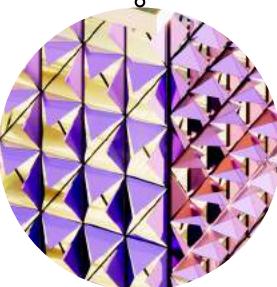
VERTICAL PARKING PORT



CENTRAL RETENTION GARDEN



GREEN ROOF



SOLAR PANELS



# Business As Usual

Emily Dean, Miles Rawlins, Siddharth Sivakumar, Perui Yan

The purpose of this proposal is to achieve carbon neutrality and neighborhood vitality in a manner that is as non-intrusive as possible.

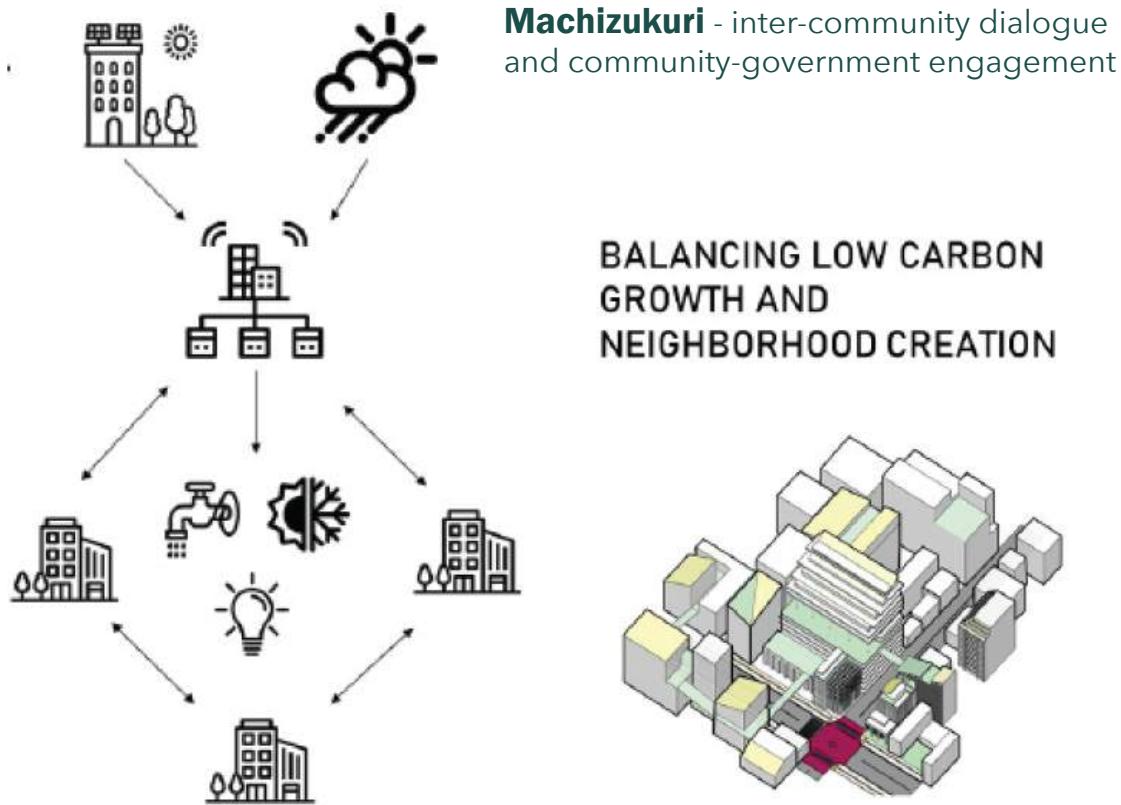
We do not want wholesale demolition and reconstruction. We want to identify the unique characteristics of Nihonbashi and preserve and enhance them with iterative redevelopment based on the principles of sustainable, smart-city systems. The physical elements of our proposal should provide the information necessary for community members to make informed decisions about the future of their homes.

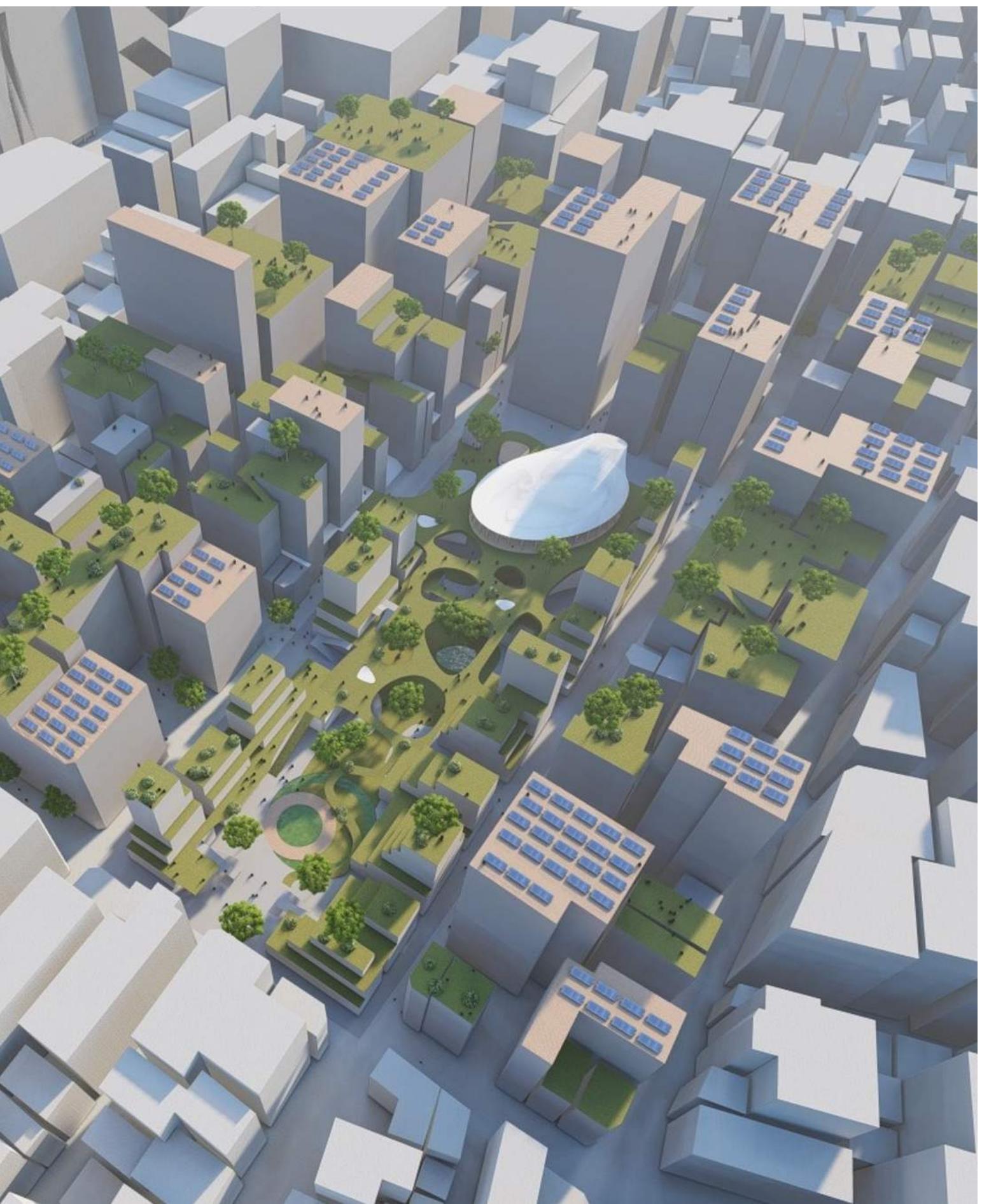
We propose that District 2 become a "living urban district", in which buildings mimic the interactions of plants with the use of emerging smart utility technologies. The central component of the proposal is a data center within the district's central park. Information on the production and consumption of electricity, heating/cooling, and water can be monitored and stored by the central data hub. The data itself will be in a secure site below ground, but a publicly accessible display will allow residents to see how their specific buildings and/or their district is performing in Tokyo's effort to reach carbon neutrality. Such data will allow for an "evolutionary" system of development in which data collected from buildings will highlight best practices and inform how the physical environment should change due to changing climate stimuli.

## A Living Urban District

To achieve the goal of carbon neutrality, we took inspiration from the processes that exist in forests. Trees exchange information and resources. Why not buildings?

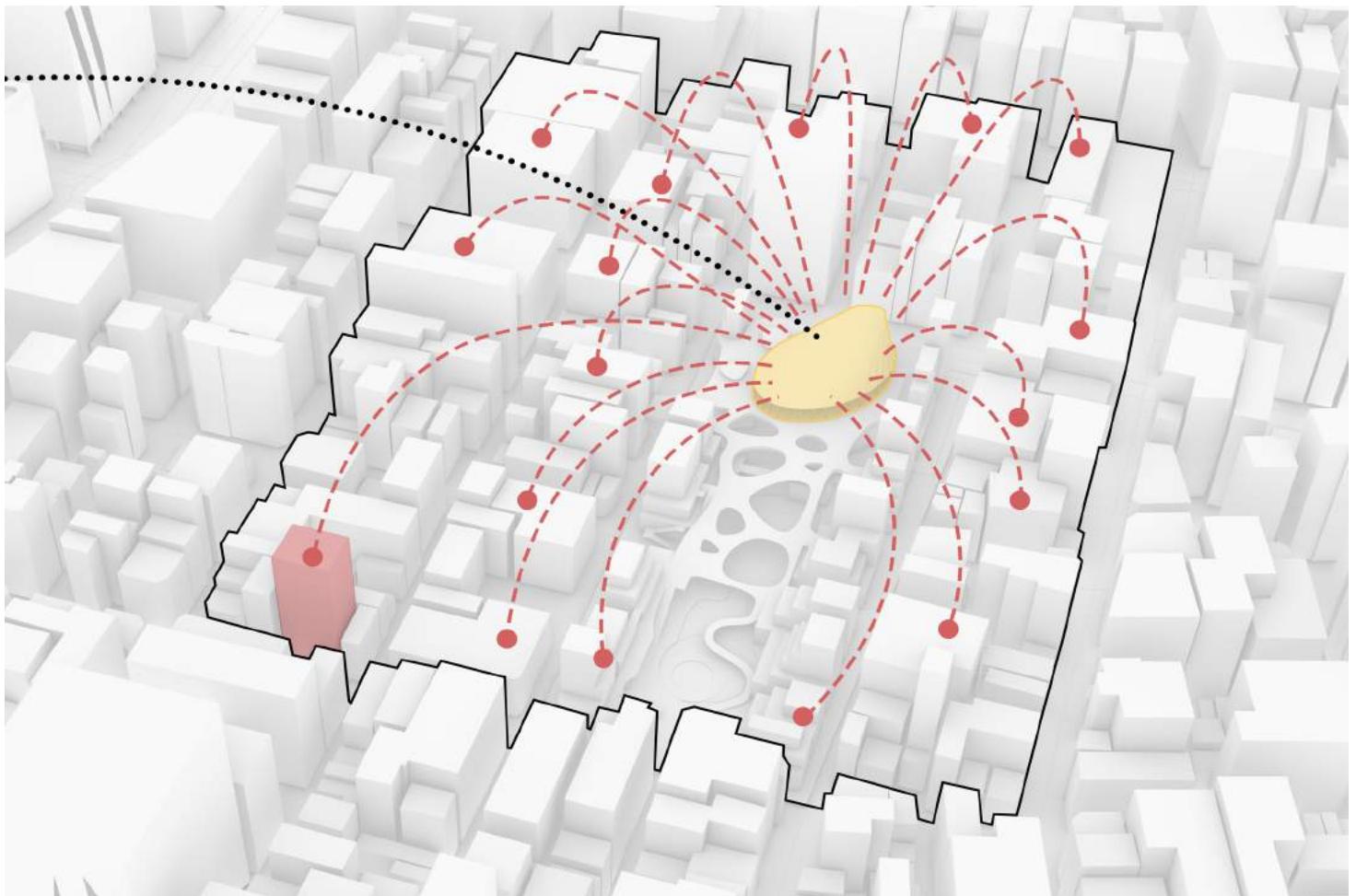
To facilitate the transfer of data within the district, a central data-center will be required. In addition to the utilitarian processes such a facility would provide, data could be presented publicly to provide district residents with information on their home's environmental performance.







To the right is a theoretical image of how neighborhood connectivity could be achieved. Buildings across the district would constantly share data with a central hub. If any one building is suddenly unable to access its own solar panels, other buildings can have their excess energy redirected to that building. The same process would apply to temperature and water. Additional data would include building use and material.





The smart systems proposed for District 2 are intended to be implemented in a manner that allows the system to be scaled up across Tokyo. We believe the district scale is a good starting point for managing local data and individual districts can be combined into regional centers to allow Tokyo a greater understanding of how each part is functioning

Smart systems would not just be limited to District 2 buildings. An entire network would need to be established in order to understand conditions at the street level. Sensors along roads and sidewalks will monitor air pollution, noise, and activity in order to get a sense of how the district is performing outside of big data. It is vital that any data collected be securely and responsibly used and democratized completely. It may be that such a system could only be managed by the city government.

To facilitate the transfer of data within the district, a central data-center will be required to publicly present data that provides district residents with information on their home's environmental performance.



Above the data center, a conference center pavilion would be placed as a space for conferences and community meetings to take place within the business district. The form of the structure was inspired by Japan's revered Fuji Mountain, a special landmark well known by the Japanese people, with a traditional Japanese Engawa porch around the perimeter. In terms of material, the translucent skin of the pavilion roof enclosure will be constructed out of ETFE (ethylene-tetrafluoroethylene) and a steel frame to make a mesh-tensioned architecture.



Ethylene tetrafluoroethylene (ETFE)  
Plastic Derivative Membrane Roof



CLT Timber Frame  
Engawa Porch



PRESERVE - MAINTAIN - REGENERATE

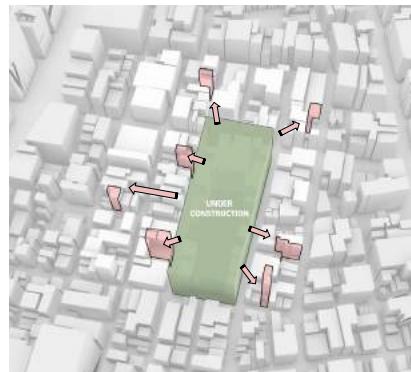




## NIHONBASHI REDEVELOPMENT FRAMEWORK



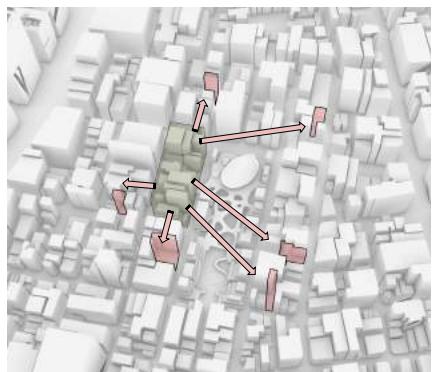
REPURPOSE:  
LEVERAGE EXISTING SURFACE PARKING FOR TEMPORARY



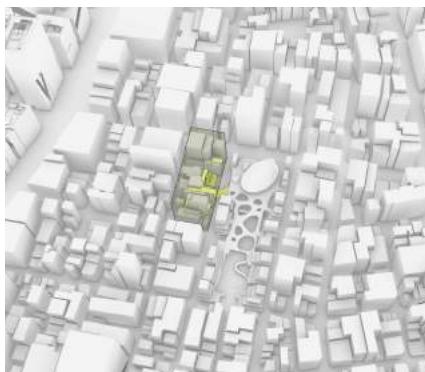
RELOCATE:  
POPULATION DISTRIBUTED UPON CENTRAL PARK



REINTRODUCE:  
POPULATION RETURNS UPON CONSTRUCTION



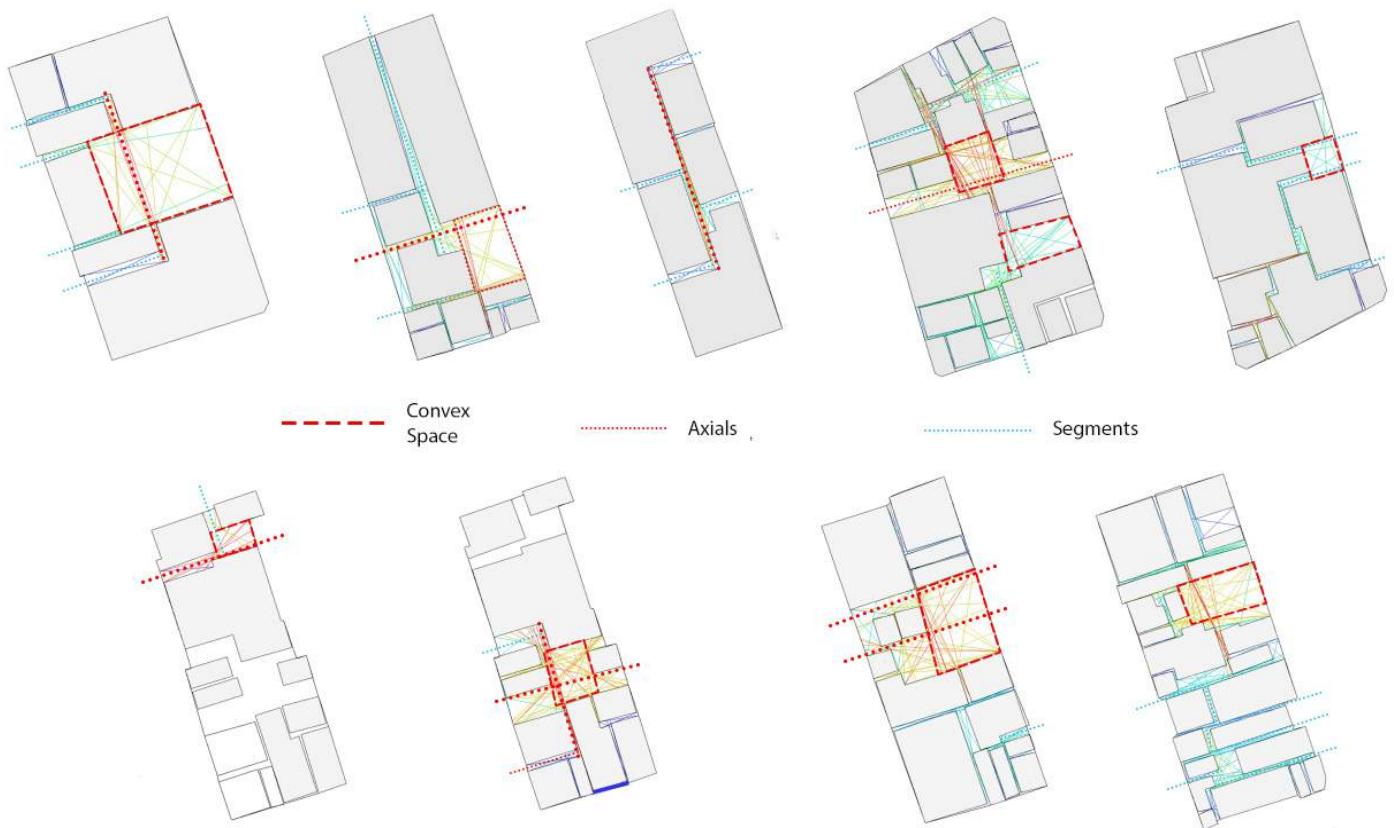
REUSE & EXPAND:  
REUSE TEMP. STRUCTURES DURING NEW CONSTRUCTION



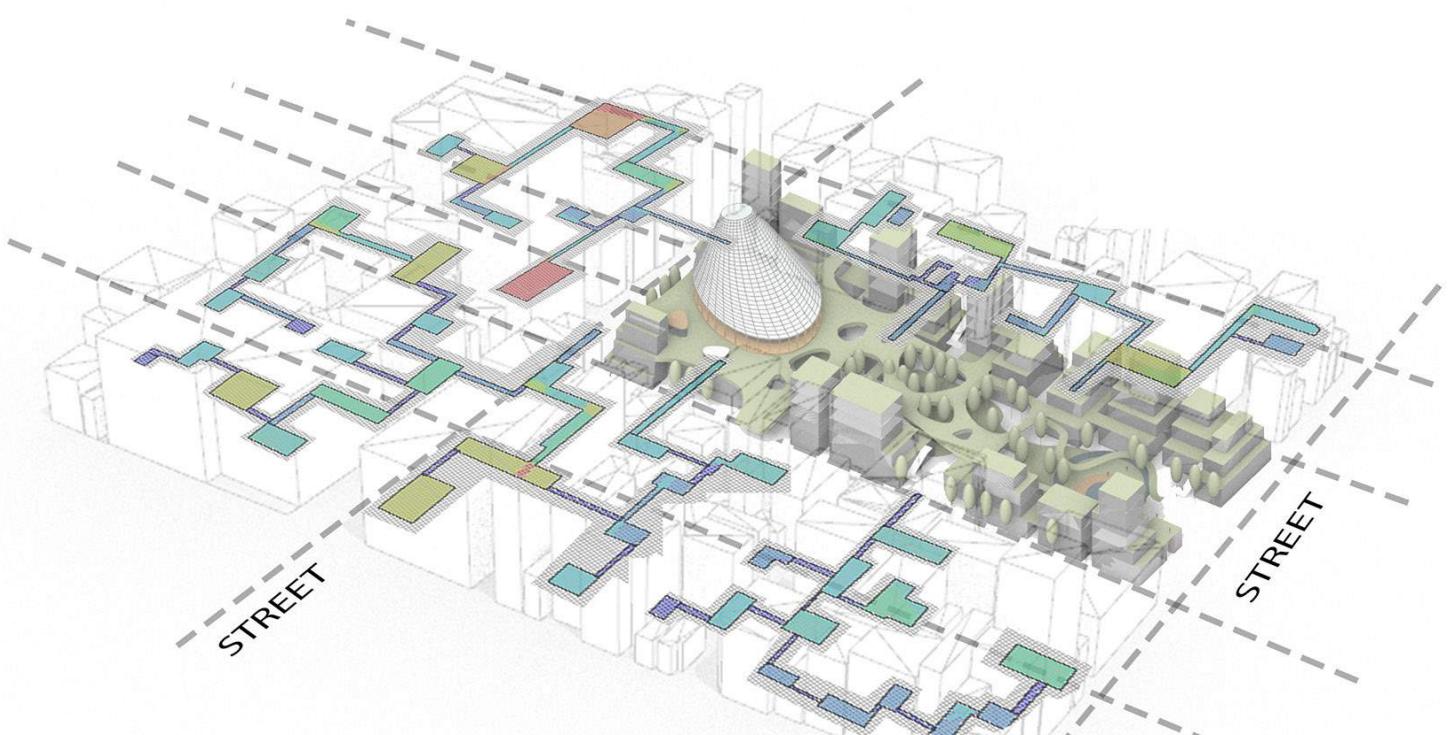
INTEGRATE:  
DEVELOP PATHWAY CONNECTION FROM CENTRAL PARK

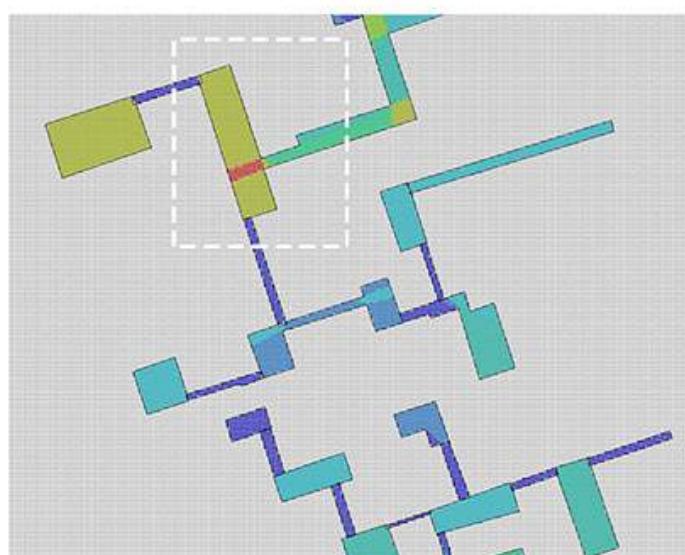
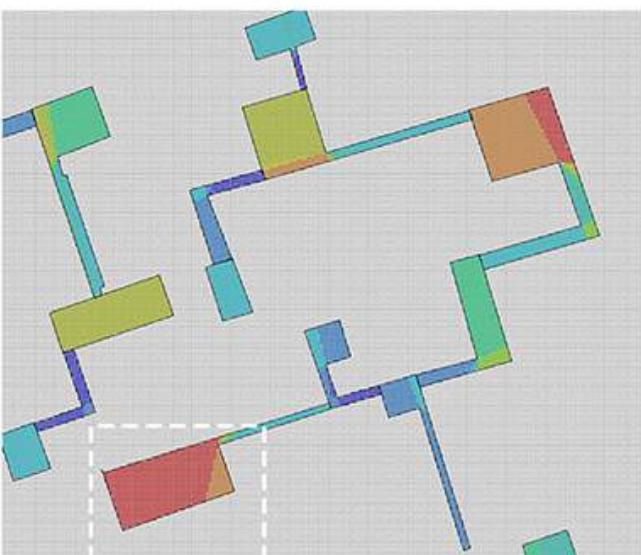
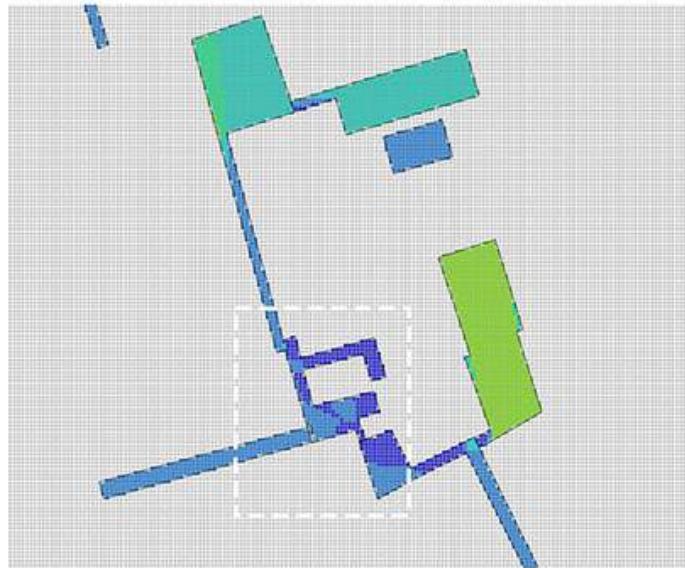
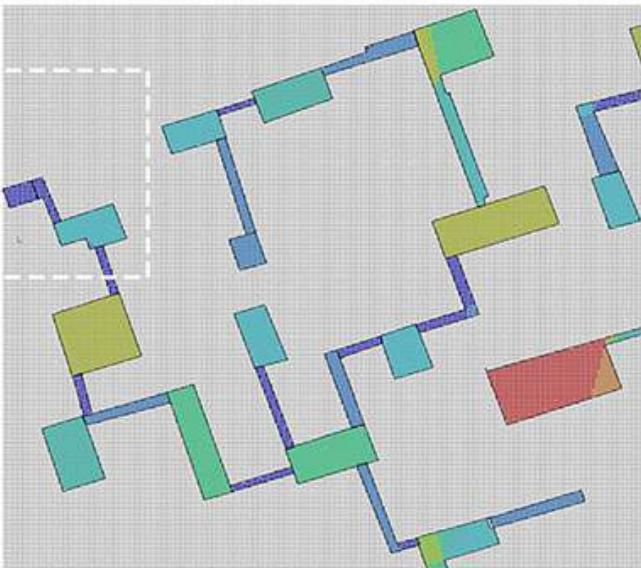


REPEAT:  
INCREMENTAL REDEVELOPMENT PHASE COMPLETED



Unlike streets, interstitial spaces have no researched hierarchy. The space syntax method allows us to create a new definition for these spaces for further use. Used district densifies. Space syntax analysis can be used to identify best uses for each part of the district network. Street frontage increases from 2800 to 4000 meters in this network increasing opportunities for retail within each building.





**Low Visibility  
Low Connectivity**

Private Access  
Private Volume  
Low Occupancy

**High Visibility  
Low Connectivity**

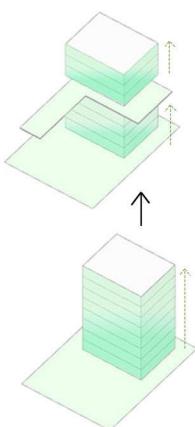
Private Access  
High Occupancy  
Public Volume

**Low Visibility  
High Connectivity**

Public Access  
Private Volume  
Low Occupancy

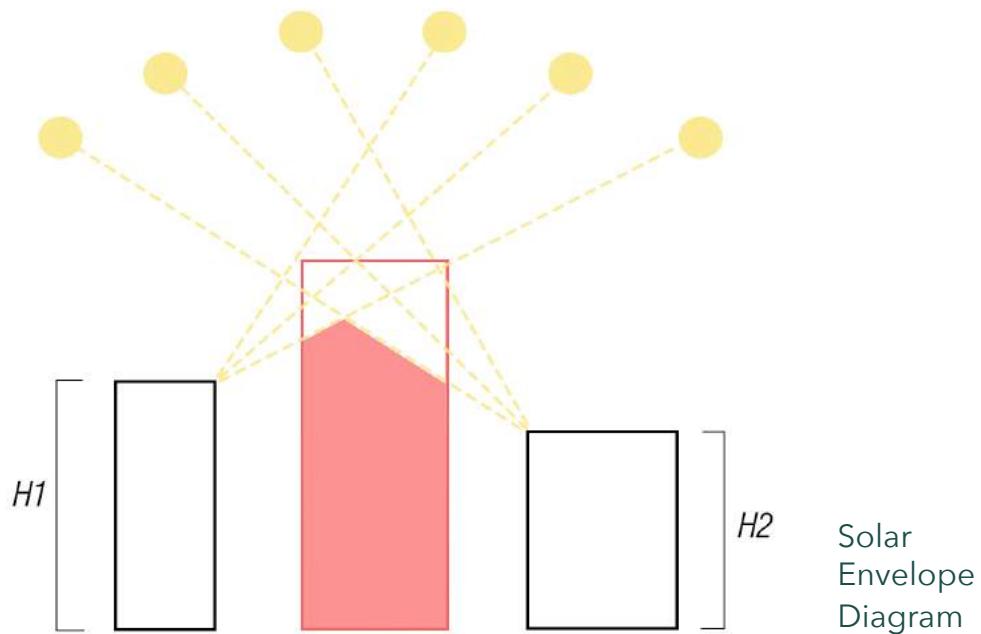
**High Visibility  
High Connectivity**

Public Access  
Public Volume  
High Occupancy



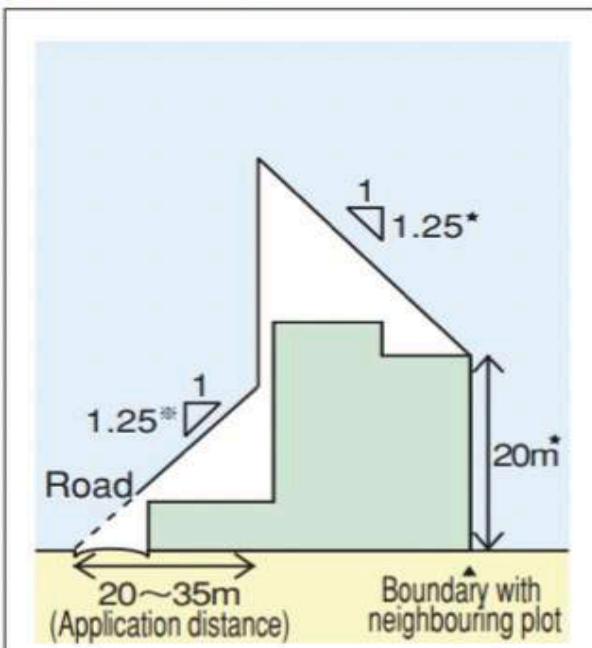
The creation of multi-level networks is necessary to increase public space provision as the district densifies. Space syntax analysis can be used to identify best uses for each part of the district network.

## SOLAR ENVELOPE ANALYSIS



[Slant Plane Restriction]

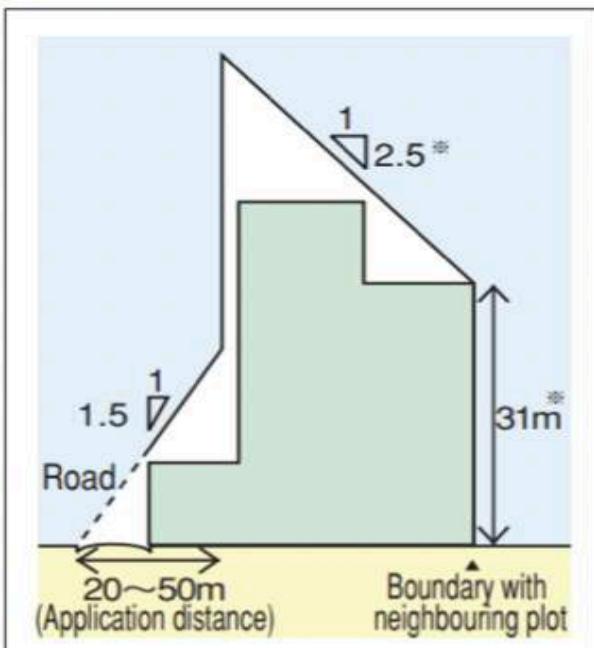
● Residential Land Use Zone



※ can be increased to 1.5 if designated as such by the local government building authority with the approval of the City Planning Council.

★ can be increased to 2.5 and 31 m respectively if designated as such by the local government building authority with the approval of the City Planning Council.

● Other Zones

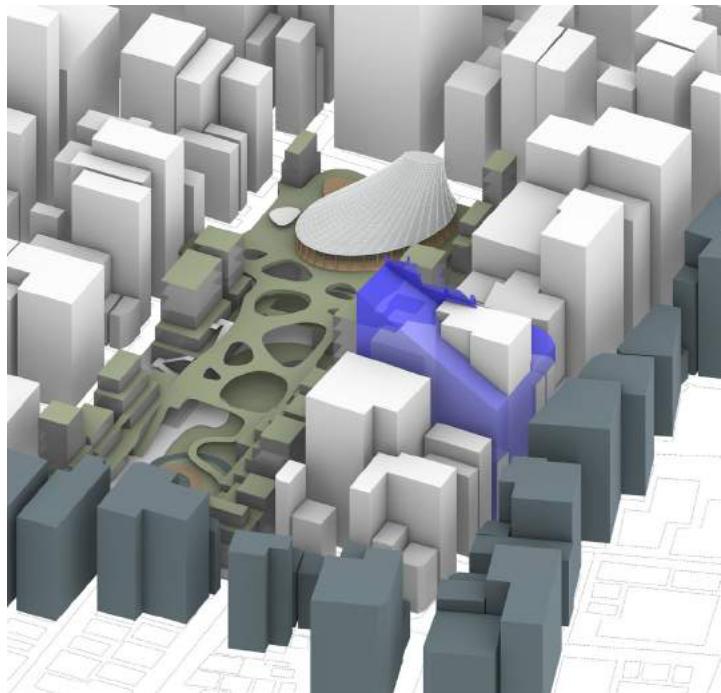


※ can be exempt from restriction in areas designated by the local government building authority with the approval of the City Planning Council.

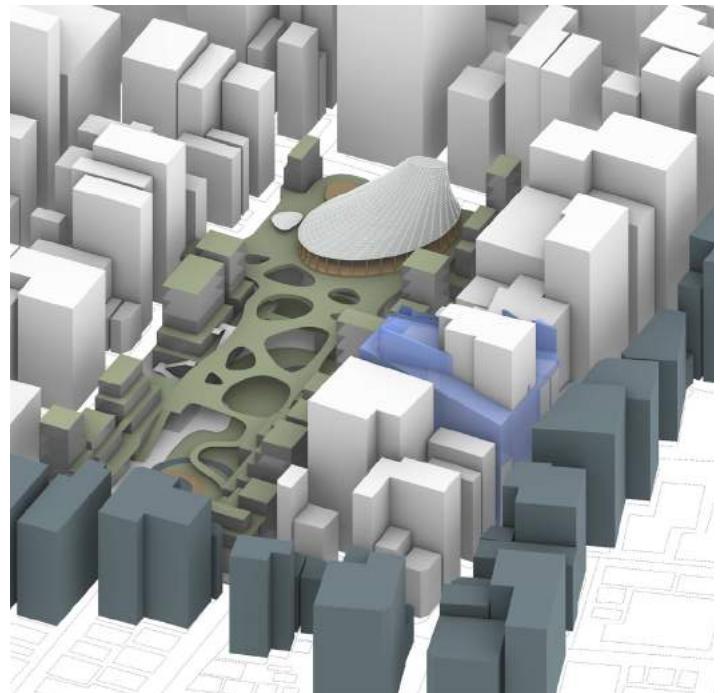


Previous regulations on building heights based on the width of roads determined when buildings would need to set back. This regulation was eventually removed, though a similar regulation could bring back building roof step backs to help maximize solar energy production.

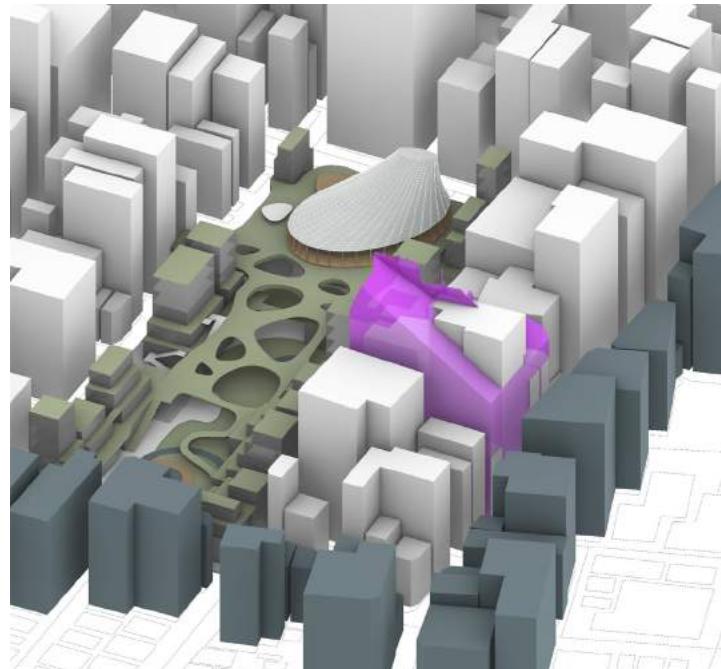
## SEASONAL SOLAR ENVELOPE SIMULATION



AUTUMN



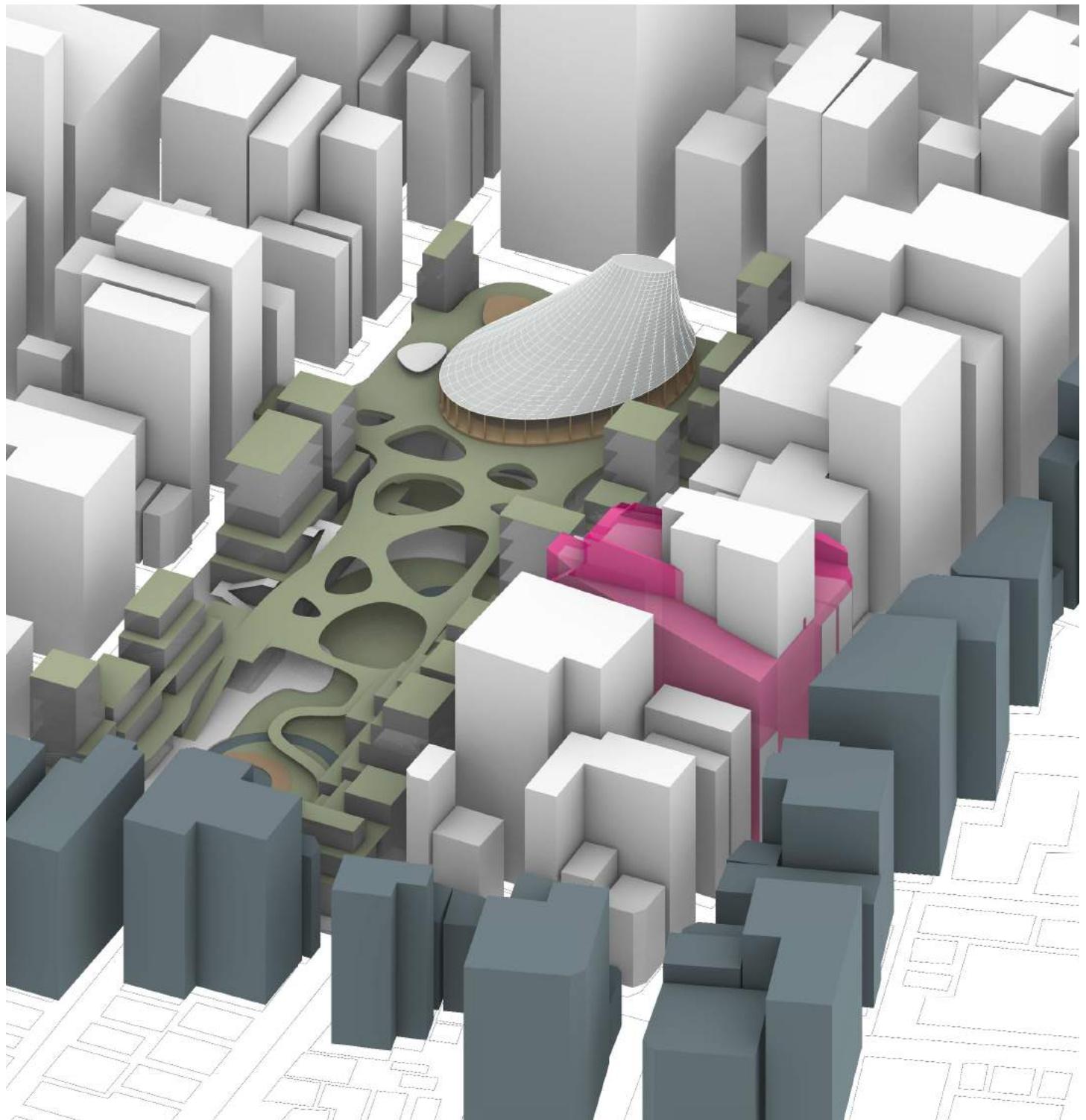
WINTER



SPRING



SUMMER



ANNUAL

# Final KPI and Planning Support System

To streamline our iterative scenario planning process and to support data-driven decision making for Tokyo stakeholders, we created an interactive dashboard in ArcGIS Online. This dashboard makes it easier to synthesize and comprehend a large amount of spatial and non-spatial data. It allows users to select a scenario and then see a few of the KPIs, summary metrics, building footprints, renderings, and a breakdown of building uses for each. Overall, it provides a clear method for summarizing our KPI results and visualizing the differences in performance between design scenarios and existing conditions.

### Scenario Selector (Drop-Down Menu)

Upon selection, each section of the dashboard updates with the respective KPI values, building footprints, and rendering

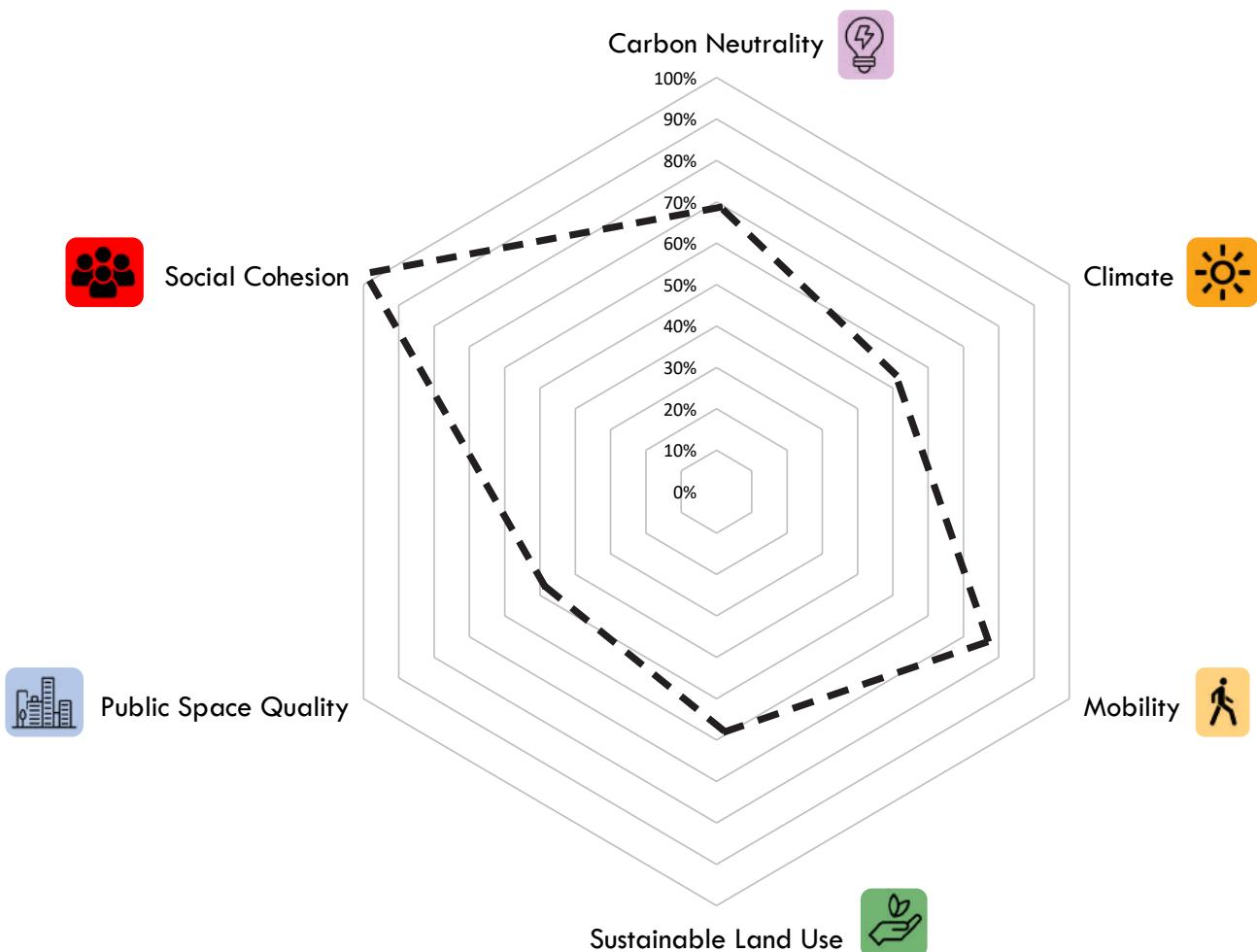


Future development of the dashboard may include the following features:

- Inclusion of all KPIs with an option to filter KPIs by category
- Gauge view (minimum to desirable objective) and value view for each KPI
- Radar graph summaries with pop-ups
- Performance evaluation rubric and final score
- Interactive 3D visualization of building plans show main use
- Nihonbashi background data - demographics, economy, climate, etc.
- Additional renderings (or street view for existing condition) to visualize scenarios

# Performance Evaluation: Human Scale

Indicator	Minimum Objective	Desirable Objective	Actual	Points Earned	Max. Points
Energy Efficiency	Residential Energy Demand <80 kWh/m <sup>2</sup>	<65 kWh/m <sup>2</sup>	66.22 kWh/m <sup>2</sup>	6.0	/ 10
	Office-Commercial Energy Demand <125 kWh/m <sup>2</sup>	<110 kWh/m <sup>2</sup>	101.15 kWh/m <sup>2</sup>	10.0	/ 10
	Building CO <sub>2</sub> Emissions <30 kg CO <sub>2</sub> /m <sup>2</sup>	<20 kg CO <sub>2</sub> /m <sup>2</sup>	54 CO <sub>2</sub> /m <sup>2</sup>	0.6	/ 10
Green Spaces	Greenspace Cover 50%	100%	45.96%	0.9	/ 6
	Greenspace per Inhabitant >10 m <sup>2</sup> /inhabitant	>15 m <sup>2</sup> /inhabitant	9.89 m <sup>2</sup> /inhabitant	1.0	/ 6
	Green Roof Coverage >10%	>60%	72.7%	8.0	/ 8
Walkability	Proximity to Public Transportation >80%	>100%	65.4%	3.4	/ 6
	Pedestrian Space >60%	>75%	268.4%	2.0	/ 2
	Bicycle Parking Compliance	Compliance + Designated Bicycle Parking	Compliant	6.0	/ 6
Urban Design	Crosswalk Connectivity >80%	100%	35.71%	0.4	/ 2
	Absolute Compactness >10 m for min. 50% total land area	>10 m for min. 75% total land area	4.62 m	0.9	/ 6
	Residential Density >80 units/ha	>100 units/ha	132 units/ha	6.0	/ 6
Infrastructure	Corrected Compactness 10-50m for min. 50% total land area	10-50m for min. 75% total land area	12.85 m. 27.94%	1.6	/ 4
	Street Tree Coverage 50 trees/km	70 trees/km	38 trees/km	0.8	/ 2
	Public Space per Inhabitant 10 m <sup>2</sup> /inhabitant	15 m <sup>2</sup> /inhabitant	0.76 m <sup>2</sup> /inhabitant	0.1	/ 2
Community	Sidewalk Accessibility >90% sufficient	>90% ideal	100%	2.0	/ 2
	Street Proportion >50% sufficient	>50% ideal	43% sufficient	0.8	/ 2
	Allocation of Social Infrastructure >10%	>15%	14.3%	0.9	/ 1
Social Cohesion	Medical Space per Capita >0.6 m <sup>2</sup>	>1 m <sup>2</sup>	3.92 m <sup>2</sup>	1.0	/ 1
	Commercial Space per Capita >0.001 m <sup>2</sup>	>0.003	7.64 m <sup>2</sup>	2.0	/ 2
	Park Space per Capita >2 m <sup>2</sup>	>2.5 m <sup>2</sup>	7.33 m <sup>2</sup>	2.0	/ 2
	Daytime to Nighttime Population Ratio <6.0	<1.2	0.24	4.0	/ 4
			Total Score: 64.0	/ 100	



# Key Performance Indicators: Nihonbashi District Two

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Select a Scenario  
Human Scale



### Building CO2 Emissions (kg CO2/m<sup>2</sup>)

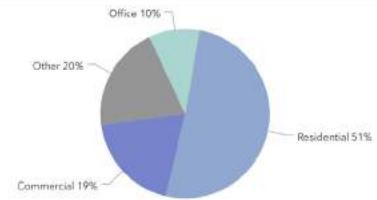


**Floor Area Ratio**  
 **1.40**

**Residential Density**  
 **132**  
units/hectare

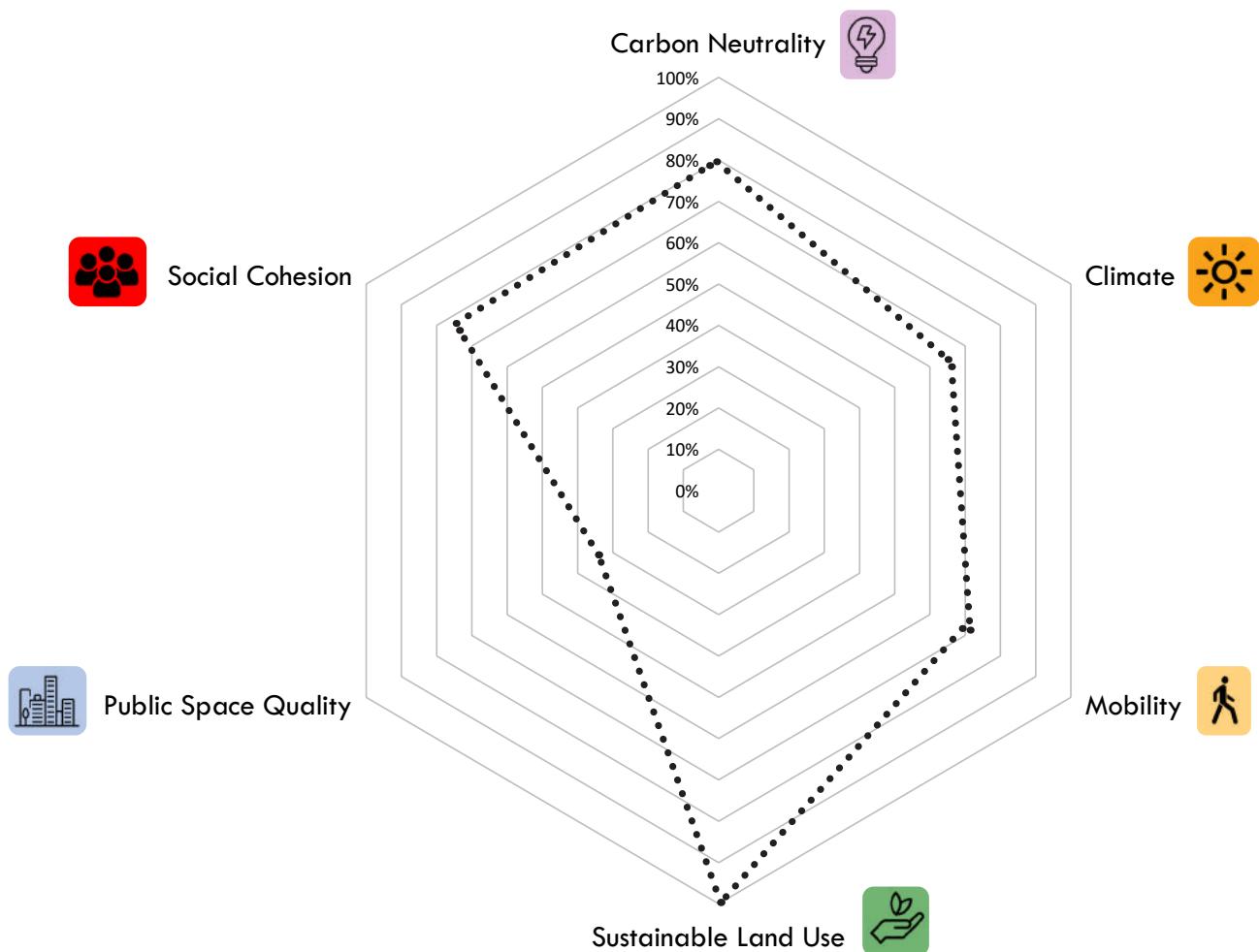
**Residents**  
 **1,514**

**Employees**  
 **360**



# Performance Evaluation: High Density

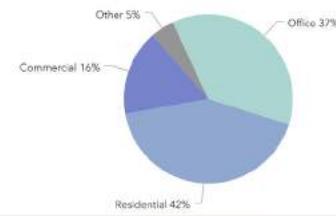
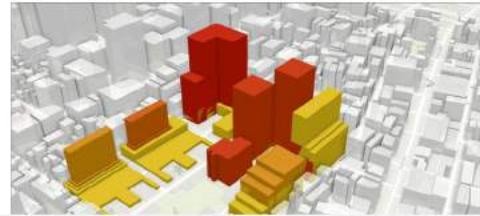
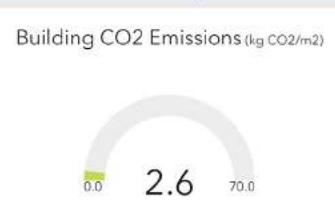
Indicator	Minimum Objective	Desirable Objective	Actual	Points Earned	Max. Points
Energy Efficiency	Residential Energy Demand <80 kWh/m <sup>2</sup>	<65 kWh/m <sup>2</sup>	79.54 kWh/m <sup>2</sup>	6.0	/ 10
	Office-Commercial Energy Demand <125 kWh/m <sup>2</sup>	<110 kWh/m <sup>2</sup>	61.83 kWh/m <sup>2</sup>	10.0	/ 10
	Building CO <sub>2</sub> Emissions <30 kg CO <sub>2</sub> /m <sup>2</sup>	<20 kg CO <sub>2</sub> /m <sup>2</sup>	27.30 kg CO <sub>2</sub> /m <sup>2</sup>	8.3	/ 10
Sustainable Land Use	Greenspace Cover 50%	100%	87%	5.2	/ 6
	Greenspace per Inhabitant >10 m <sup>2</sup> /inhabitant	>15 m <sup>2</sup> /inhabitant	4 m <sup>2</sup> /inhabitant	0.4	/ 6
	Green Roof Coverage >10%	>60%	97%	8.0	/ 8
Mobility	Proximity to Public Transportation >80%	>100%	65.4%	3.4	/ 6
	Pedestrian Space >60%	>75%	30.09%	0.5	/ 2
	Bicycle Parking Compliance	Compliance + Designated Bicycle Parking	Compliant	6.0	/ 6
Public Space Quality	Crosswalk Connectivity >80%	100%	40.00%	0.5	/ 2
	Absolute Compactness >10 m for min. 50% total land area	>10 m for min. 75% total land area	20.05 m	6.0	/ 6
	Residential Density >80 units/ha	>100 units/ha	470.33 units/ha	6.0	/ 6
Climate	Corrected Compactness 10-50m for min. 50% total land area	10-50m for min. 75% total land area	77.76 m. 25.78%	1.8	/ 4
	Street Tree Coverage 50 trees/km	70 trees/km	0.21 trees/km	0.0	/ 2
	Public Space per Inhabitant 10 m <sup>2</sup> /inhabitant	15 m <sup>2</sup> /inhabitant	0.41 m <sup>2</sup> /inhabitant	0.0	/ 2
Social Cohesion	Sidewalk Accessibility >90% sufficient	>90% ideal	100%	2.0	/ 2
	Street Proportion >50% sufficient	>50% ideal	29% sufficient	0.4	/ 2
	Allocation of Social Infrastructure >10%	>15%	3.77%	0.4	/ 1
Community Health	Medical Space per Capita >0.6 m <sup>2</sup>	>1 m <sup>2</sup>	4.64 m <sup>2</sup>	1.0	/ 1
	Commercial Space per Capita >0.001 m <sup>2</sup>	>0.003	0.05 m <sup>2</sup>	2.0	/ 2
	Park Space per Capita >2 m <sup>2</sup>	>2.5 m <sup>2</sup>	0.43 m <sup>2</sup>	0.2	/ 2
	Daytime to Nighttime Population Ratio <6.0	<1.2	1.09	4.0	/ 4
				<b>Total Score: 72.1</b>	/ 100



## Key Performance Indicators: Nihonbashi District Two

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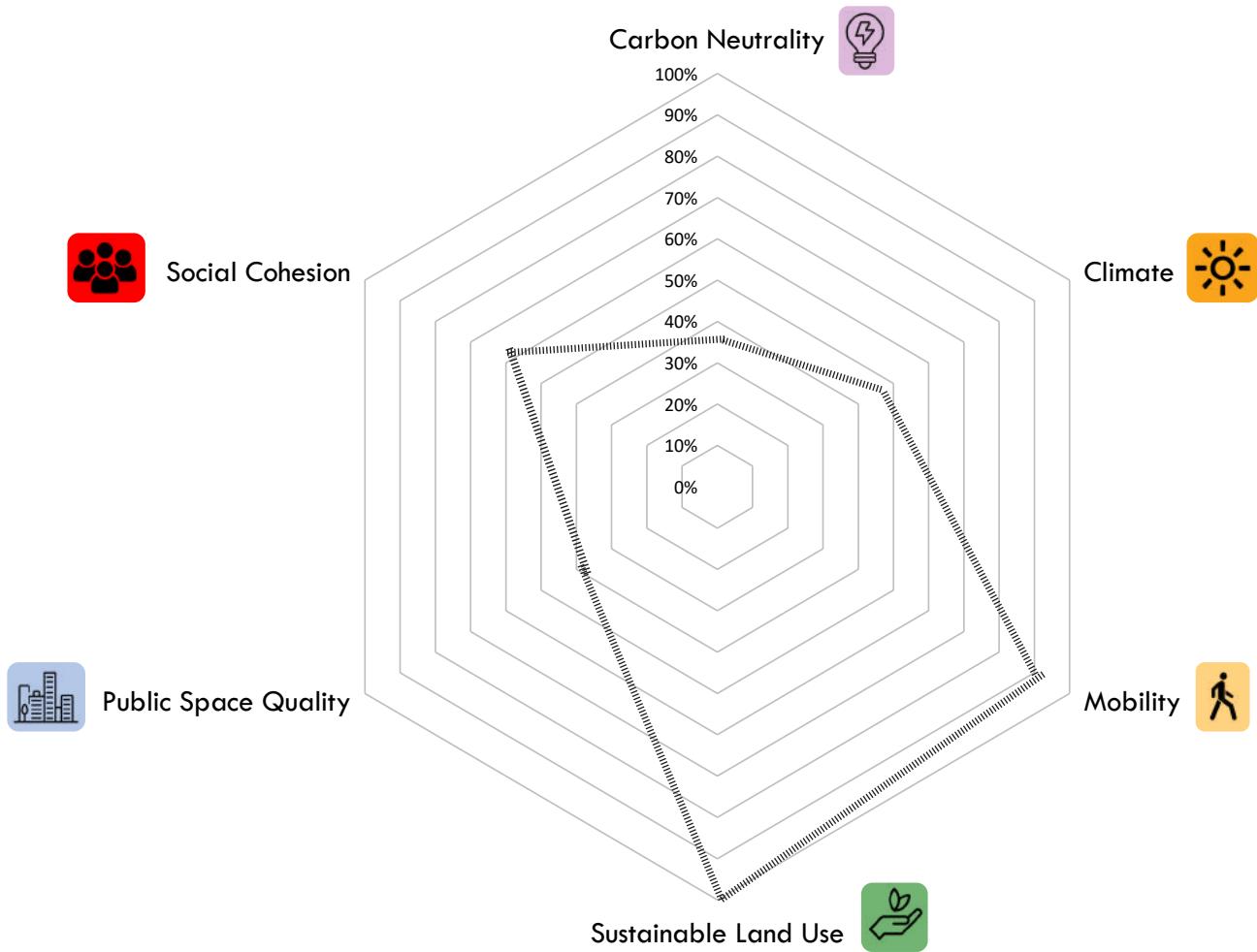
Select a Scenario  
High Density



# Performance Evaluation: Business as Usual

Indicator	Minimum Objective	Desirable Objective	Actual	Points Earned	Max. Points
Energy Efficiency	<80 kWh/m <sup>2</sup>	<65 kWh/m <sup>2</sup>	66.22 kWh/m <sup>2</sup>	9.6	/ 10
	<125 kWh/m <sup>2</sup>	<110 kWh/m <sup>2</sup>	101.15 kWh/m <sup>2</sup>	10.0	/ 10
	<30 kg CO <sub>2</sub> /m <sup>2</sup>	<20 kg CO <sub>2</sub> /m <sup>2</sup>	30.79 kg CO <sub>2</sub> /m <sup>2</sup>	1.0	/ 10
Sustainable Land Use	50%	100%	39.29%	0.8	/ 6
	>10 m <sup>2</sup> /inhabitant	>15 m <sup>2</sup> /inhabitant	4.44 m <sup>2</sup> /inhabitant	0.4	/ 6
	>10%	>60%	58.6%	7.9	/ 8
Mobility	>80%	>100%	77.60%	4.3	/ 6
	>60%	>75%	147.42%	2.0	/ 2
	Compliance	Compliance + Designated Bicycle Parking	Compliant	6.0	/ 6
Public Space Quality	>80%	100%	100.00%	2.0	/ 2
	>10 m for min. 50% total land area	>10 m for min. 75% total land area	14.22 m	6.0	/ 6
	>80 units/ha	>100 units/ha	112.93 units/ha	6.0	/ 6
Climate	10-50 m for min. 50% total land area	10-50 m for min. 75% total land area	25.42 m, 55.9%	2.2	/ 4
	50 trees/km	70 trees/km	50.00 trees/km	1.0	/ 2
	10 m <sup>2</sup> /inhabitant	15 m <sup>2</sup> /inhabitant	0.96 m <sup>2</sup> /inhabitant	0.1	/ 2
Social Cohesion	>90% sufficient	>90% ideal	100%	2.0	/ 2
	>50% sufficient	>50% ideal	35% sufficient	0.4	/ 2
	>10%	>15%	42.68%	1.0	/ 1
Healthcare	>0.6 m <sup>2</sup>	>1 m <sup>2</sup>	0.17 m <sup>2</sup>	0.3	/ 1
	>0.001 m <sup>2</sup>	>0.003	3.97 m <sup>2</sup>	2.0	/ 2
	>2 m <sup>2</sup>	>2.5 m <sup>2</sup>	0.78 m <sup>2</sup>	0.4	/ 2
Daytime to Nighttime Population Ratio	<6.0	<1.2	5.59	2.2	/ 4

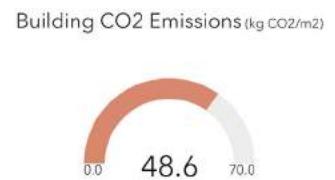
Total Score: **64.9** / 100



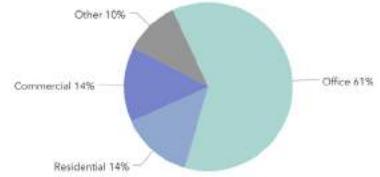
## Key Performance Indicators: Nihonbashi District Two

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Select a Scenario  
Business as Usual



<b>Floor Area Ratio</b> <b>4.44</b>	<b>Residential Density</b> <b>112.9</b> units/hectare	<b>Residents</b> <b>1,295</b>	<b>Employees</b> <b>7,238</b>
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## 2023 International Urban Design Workshop, Tokyo

Eco-Urban Lab, School of City & Regional Planning and School of Architecture  
College of Design  
Georgia Institute of Technology

Urban Land Use Unit, Department of Urban Engineering, School of Engineering  
The University of Tokyo